Republic of Indonesia

Data Collection and Confirmation Survey on Electrical Motorcycle Industry Development and Strengthening of Supply Chain in Indonesia

Final Report

July 2024

Japan International Cooperation Agency (JICA)

Oriental Consultants Global Co., Ltd.
Pacific Consultants Co., Ltd.
NRI Consulting & Solutions (Thailand) Co., Ltd.

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(JICA rate May 2024)
IDR 1 = JPY 0.009660
THB 1 = JPY 4.233400
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Abbreviations

Abbreviation	English / Indonesian
ACC	Adaptive Cruise Control
AISI	Asosiasi Industri Sepedamotor Indonesia
AISMOLI	Association of Indonesian Electric Motorcycle Manufacturers
AIST	National Institute of Advanced Industrial Science and Technology
ABS	Anti-lock braking system
AEML	Asosiasi Ekosistem Mobilitas Listrik
ASDIPI	Directorate of Access for Industrial Resources and International Promotion
ASEAN	Association of South‐East Asian Nations
B4T	Industrial Materials and Products Technology Center/ Balai Besar Bahan dan Barang Teknik
BAMS	Battery Asset Management Service
BAPPENAS	Ministry of National Development Planning / Badan Perencanaan Pembangunan Nasional
BEV	Battery Electric Vehicle
BLDC	Brushless Direct Current (motor)
BMS	Battery Manufacturing System
BPSDMI	Industrial Human Resources Development Agency / Badan Pengembangan Sumber Daya Manusia Industri
BRIN	National Research and Innovation Agency / Badan Riset dan Inovasi Nasional
BSKJI	Agency for Standardization and Industrial Services Policy
BSN	Industrial Certification Institute/ Badan Standardisasi Nasional
C/P	Counter Part
CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CAN	Controller Area Network
CASE	Connected, Autonomous / Automated, Shared, Electric
CBU	Complete Build Up
CKD	Complete Knock Down
COVID-19	Corona Virus Disease 2019
COP	Conference of the Parties
DB	Database
DCU	Domain Control Unit
DKI	Daerah Khusus Ibukota
E-Bike	Electric Bike
EBTKE	Direktorat Jenderal Energi Baru Terbarukan dan Konservasi Energi
ECU	Engine Control Unit
ECU	Electronic Control Unit
ELV	End-of-Life Vehicles
ENTEC	National Energy Technology Center.
ESDM	Ministry of Energy and Mineral Resources
EU	European Union

Abbreviation	English / Indonesian
EV	Electric Vehicle
FAME	Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles
FAMI	Federation of ASIAN Motorcycle Industries
GAIKINDO	The Association of Indonesia Automotive Industries
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIAMM	Association of Automobile and Motor Equipment Industries
IBC	Indonesia Battery Corporation
IBS	International Battery Summit
ICE	Internal Combustion Engine
IDR	Indonesia Rupiah
IIMS	Indonesia International Motor Show
IKFT	DG of Chemical, Pharmaceutical and Textile Industries
IKMA	DG of Small, Medium and Multifarious Industries
IKMLMEA	Directorate of Small and Medium Industry for Metal, Machine, Electronic and Transport Equipment
ILMATE	Directorate General of Metal, Machinery, Transportation Equipment & Electronic Industries
IMATAP	Directorate of Maritime, Transportation &Defense Equipment Industries
IMC	Indonesia Manufacturing Center
INPRES	Presidential Instruction
IOI	Indonesia Institute of Automotive Industry
IoT	Internet of Things
IP	Intellectual Property
ISO	International Organization for Standardization
JAMA	Japan Automobile Manufacturers Association
JASO	Japanese Automotive Standards Organization
JISC	Japanese Industrial Standards Committee
KLHK	Kementerian Lingkungan Hidup Dan Kehutanan
KPAII	DG of Industrial Resilience, Region and International Industrial Access
KUR	Kredit Usaha Rakyat
LCEV	Low Carbon Emission Vehicle
LIBTEC	Consortium for Lithium Ion Battery Technology and Evaluation Center
LVI	Independent Verification Agency / Lembaga Verifikasi Independen
MEMR	Minister of Energy and Mineral Resources Regulation
MIND ID	Mining Industry Indonesia
MOF	Ministry of Finance
MOI	Ministry of Industry
MTEC	National Metal and Materials Technology Center
NBRI	National Battery Research Institute
NEDO	New Energy and Industrial Technology Development Organization
NEMMP	National Electric Mobility Mission Plan

Abbreviation	English / Indonesian
NEVC	Office of the National Economic and Social Development Council
NIK	Nomor Induk Kependudukan
NITE	National Institute of Technology and Evaluation
NSDTA	National Science and Technology Development Agency
ODA	Official Development Assistance
OEM	Original Equipment Manufacture
OIE	Office of Industrial Economics
OJK	Otoritas Jasa Keuangan
OJT	On-the-Job Training
P4SI	Center for Formulation, Implementation and Enforcement of Industrial Standardization
PERIKLINDO	Perkumpulan Industri Kendaraan Listrik Indonesia
PIDI 4.0	Indonesia's Industry 4.0 Digital Center
PIKKO	Perusahaan Industri Kecil Komponen Otomotif
PLN	PT Perusahaan Listrik Negara
PMP	Peraturan Menteri Perindustrian
PP	Peraturan Presiden
PPPVI	Center for Industrial Vocational Education Development
PSBB	Pembatasan sosial Berskala Besar
R&D	Research and Development
R&D&D	Research and Design and Development
RIPIN	Rencana Induk Pembangunan Industri Nasional
RPJMN	Rencana Pembangunan Jangka Menengah Nasional
SBMC	Swappable Batteries Motorcycle Consortium
SKKNI	Standard Kompetensi Kerja Nasional Indonesia
SLA	Sealed Lead Acid (battery)
SME	Small & Medium Sized Enterprise
SMK	Sekolah Menungah Kejuruan
SNI	Standard National Indonesia
SOE	State-Owned Enterprises
SPBKLU	Stasiun Penukaran Baterai Kendaraan Listrik Umum
SPKLU	Stasiun Pengisian Kendaraan Listrik Umum
STMI	Sekolah Tinggi Manajemen Industri
STNK	Surat Tanda Nomor Kendaraan
TCO	Total Cost of Ownership
THB	Thai Baht
TISI	Thai Industrial Standard Institute
TKDN	Tingkat Komponen Dalam Negeri
TNKB	Tanda Nomor Kendaraan Bermotor
ToT	Training of Trainers

Abbreviation	English / Indonesian
TP	Technical Paper
UNFCCC	United Nations Framework Convention on Climate Change
UNR	United Nations Regulations
USD	United States dollar
VAMM	Vietnam Association of Motorcycle Manufacturers
VND	Vietnamese Dong
VOC	Volatile Organic Compounds

CHAPTER 1 SURVEY SUMMARY

1.1 Background and Purpose of the Survey

1.1.1 Background of the Survey

In Indonesia, the economy has been recovering steadily from the Corona disaster, and economic growth is expected to continue due to increased consumption by the growing middle-income class and the demographic bonus period. Indonesia is making national efforts to improve its infrastructure, investment environment, international competitiveness, and industrial and human resources development, and in the motorcycle industry, there is a strong desire to promote, produce, and export electric motorcycles.

Indonesia is the world's 3rd largest motorcycle sales market after India and China, and its production scale has remained at 5-6 million units/year despite the impact of the Corona disaster. Furthermore, according to Regulation No. 27 of 2020 of the Minister of Industry (currently updated by Regulation No. 6 of 2022 and its partial amendment No. 28 of 2023), the country has set a target of 1 million motorcycles sold per year and 12 million electric motorcycles sold in total by 2035, and aims to become a sales base for electric motorcycles in the country and a manufacturing base for key components such as batteries in Southeast Asia.

Indonesia's national plans for the promotion of the electric motorcycle industry are listed below.

Indonesia's national plan for the promotion of the electric motorcycle industry

1. Roadmap for the introduction of Industry 4.0 (Making Indonesia 4.0)
   - Electric vehicles and electric two-wheeled vehicles (collectively referred to as "EVs") are positioned as one of the seven areas of competitive advantage, and the National Medium-Term Development Plan (RPJMN) 2020-2024 also sets out this direction.
2. National industrial development plan (RIPIN) 2015-2035
   - EVs are positioned as the industry's top priority.
3. Presidential Decree No. 55 of 2019 / Minister of Industry Decree No. 27 of 2020 (currently revised to No. 6 of 2022)
   - Mainly stipulates measures to promote EVs.

1.1.2 Purpose of the survey

The purpose of this study is to understand the prospects and challenges for the spread of electric motorcycles in terms of demand and supply in order to realize stable development of electric motorcycles, and to examine the gradual shift to local production, standardization of battery standards, and the formation of a supply chain, taking into account domestic policies in Indonesia. Furthermore, the project aims to provide basic information to promote further investment by Japanese firms by examining measures to contribute to the development of the industry by taking advantage of Japan's strengths.

1.2 Survey Policy

1.2.1 Expectations of the Japanese and Indonesian Parties to the Survey

(1) Expectations on the Japanese side

Japanese side hopes to fully explain the Japanese battery safety standard (TP21003) to the Indonesian side through the ODA and hope that the Indonesian side will accept the standard adopted by the four major Japanese companies.

(2) Expectations on the Indonesian side

Indonesian side would like to standardize their own battery standards after fully examining the battery standards standardized by the four major Japanese manufacturers, Honda, Yamaha, Suzuki, Kawasaki. Furthermore, there is an expectation that by providing sufficient information to Japanese firms, they hope to increase investment and commitment from Japan related to electric two-wheeled vehicles.

1.3 Survey Contents and Process

1.3.1 Survey Contents

The inception report for this study, which was prepared in July 2023, was discussed with the Ministry of Industry (MOI) through a kick-off seminar held in Indonesia in the same month. Furthermore, JICA Survey Team discussed with the Japan Automobile Manufacturers Association (JAMA) and the Ministry of Economy, Trade and Industry (METI), in addition to the JICA headquarters, as the Japanese counterparts, and decided on the survey frame based on the agreement with these entities (see Figure 1-1).

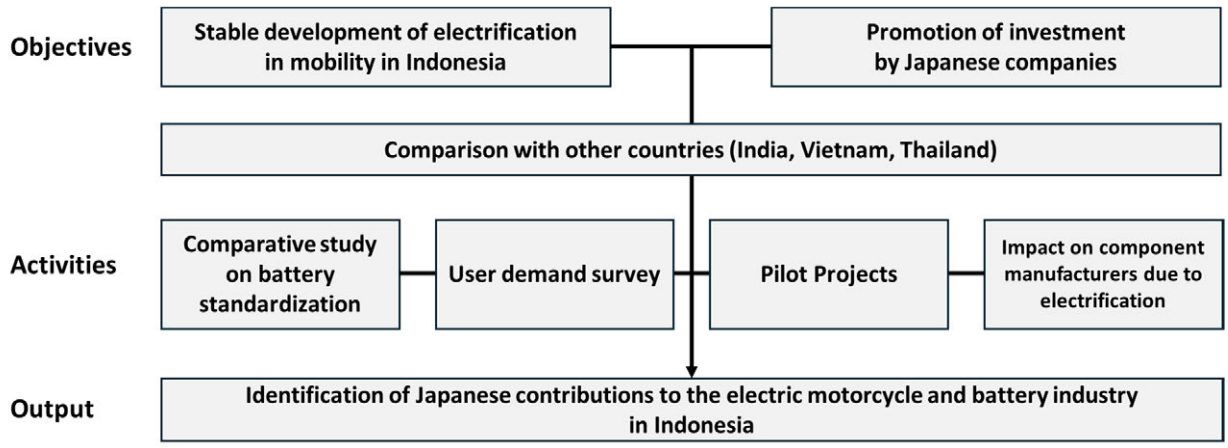


Figure 1-1 Objectives, Contents, and Outputs of this study

The following is a description of the survey according to the above figure.

(1) Comparative study on battery standardization

a. Identify the current status of electric motorcycle and battery-related business in Indonesia

- A total of about 25 organizations have been interviewed throughout the survey period, and minutes of the interviews will be kept.
- Outline market trends (users, auto loan insurers, and repair business) during the COVID-19 epidemic period.

b. Identify expectations of the Japanese companies

- During the period of the initial domestic work, set up a meeting to discuss with JAMA and the relevant departments of the four major manufacturing companies to explain the contents of this survey and to hear what they expect from this survey.
- Request for cooperation in conducting interviews with Indonesian local subsidiaries and related parts manufacturers of each company, and in accepting a Japanese invitation program to their factories and research centers in Japan.

c. Provide information of interest to the Indonesian side

- Battery safety inspections.
- Battery conformity evaluation.
- Battery recycles.
- Formation process of TP21003.

(2) User demand survey

- The demand survey will be conducted with the aim of clarifying the prospects for and challenges in the diffusion of electric two-wheeled vehicles from the users' perspective.
- Many Japanese OEMs and major parts suppliers do not have sufficient information on the diffusion potential of replaceable batteries and the use and preference of electric motorcycles by different users. This is one of the reasons why they are hesitant to invest in the electric motorcycle industry in Indonesia.
- The survey will be multi-pointed to determine user-specific characteristics.
- The survey items include objective usage of electric two-wheeled vehicles, key purchasing factors, subjective convenience and usage experience of users, and key issues from users' perspective for the popularization of electric two-wheeled vehicles.

(3) Pilot Projects

- The following contents are planned and implemented.
  - Kick-off seminar (report on survey results of case studies in other countries, explanation of inception report)
  - Invitation to Japan (training on support for battery standardization, recycling of electric bilaterals, human resource development related to batteries, and support for small and medium-sized enterprises (SMEs) facing business transformation due to electrification, etc.)
  - Local seminar (debriefing on the results)

(4) Impact on component manufacturers due to electrification

- Summarize the supply chain situation surrounding the electric motorcycle industry.
- Interviews with electric motorcycle assemblers were conducted by Japanese and local manufacturer, by vehicle type, and by rated output of electric motorcycles. In addition to relevant information services (e.g., MarkLines), the survey will be conducted with the Indonesian Association of Motorcycle Manufacturers (AISI).
- Understand how Japanese & Indonesian manufacturers perceive the impact of the electrification policy, and interview them about their thoughts on the standardization of TP21003 in Indonesia.

(5) Comparison with other countries

- An analysis of policy trends in Asian countries will be conducted and reported to the Indonesian side early in the study.

- Case studies will be conducted in three countries that could compete with Indonesia: India, Thailand, and Vietnam.
- The research team will be in charge of Thailand, and NRI India (see [Item 8]) will be in charge of India and Vietnam through re-commissioning. The latest information that cannot be covered by DB and statistics will be clarified through interviews in the field.
- The survey on advanced cases (Taiwan) regarding the development of battery exchange stations will be conducted by utilizing the information service provided by MarkLines and other companies.

(6) Identification of Japanese contributions to the electric motorcycle and battery industry in Indonesia

- The following information will summarize the results of the survey to date and conclusions from the field seminar in the upper section, including the following.
  - Measures related to national concerns (battery standardization, safety testing, recycling)
  - Measures that contribute to strengthening cooperation with Japanese motorcycle manufacturers and parts suppliers
  - Japanese government/private sector contributions to the promotion of Indonesian electric motorcycles (ODA/non-ODA)

1.3.2 Survey Process

This work shall begin in May 2023 and be completed by July 2024. The planned work process is shown in Figure 1-2 below.

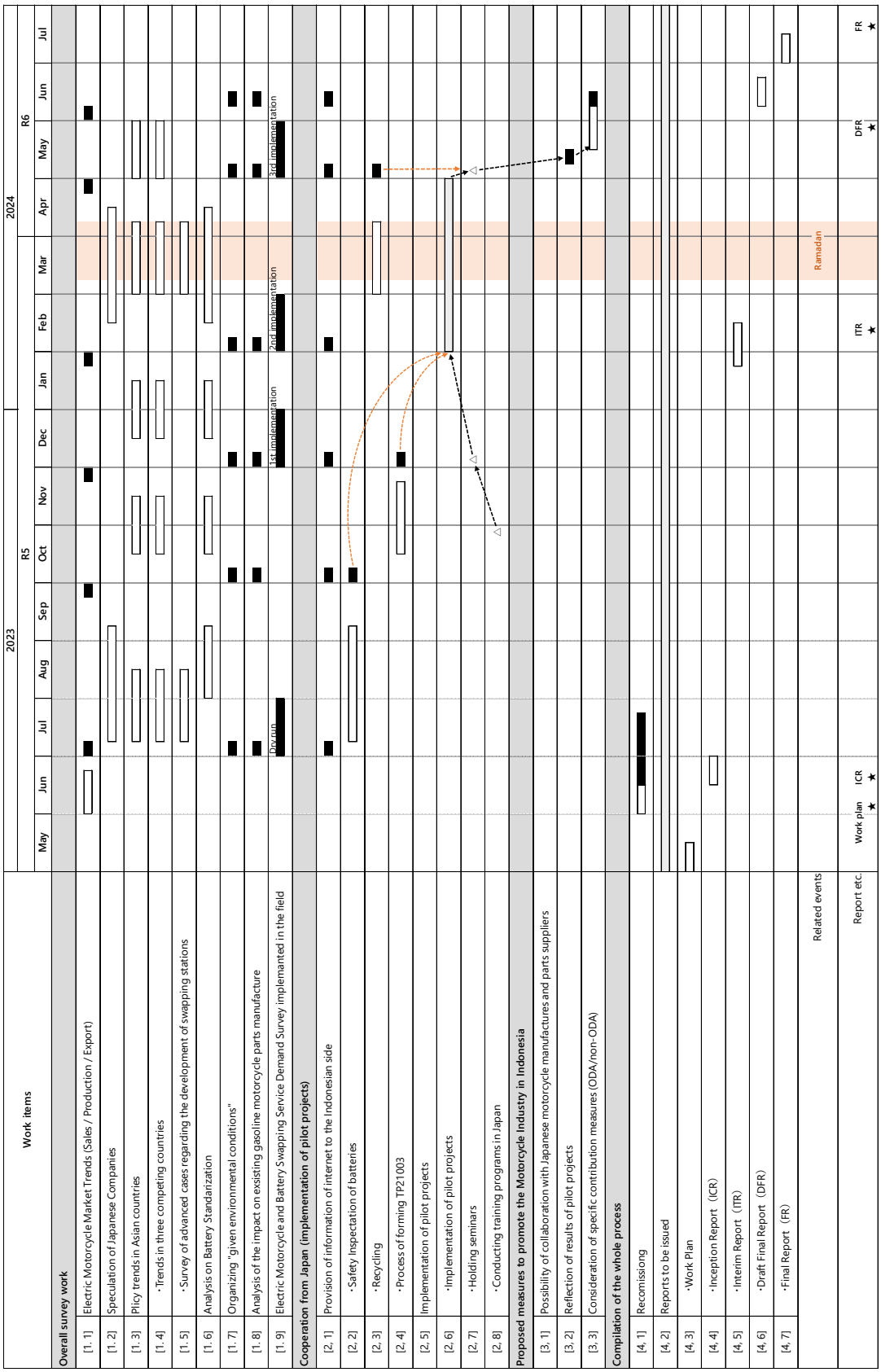


Figure 1-2 Survey process

1.4 Survey Team Members and Personnel Plan

The survey team members and personnel plan are shown in Figure 1-3 below.

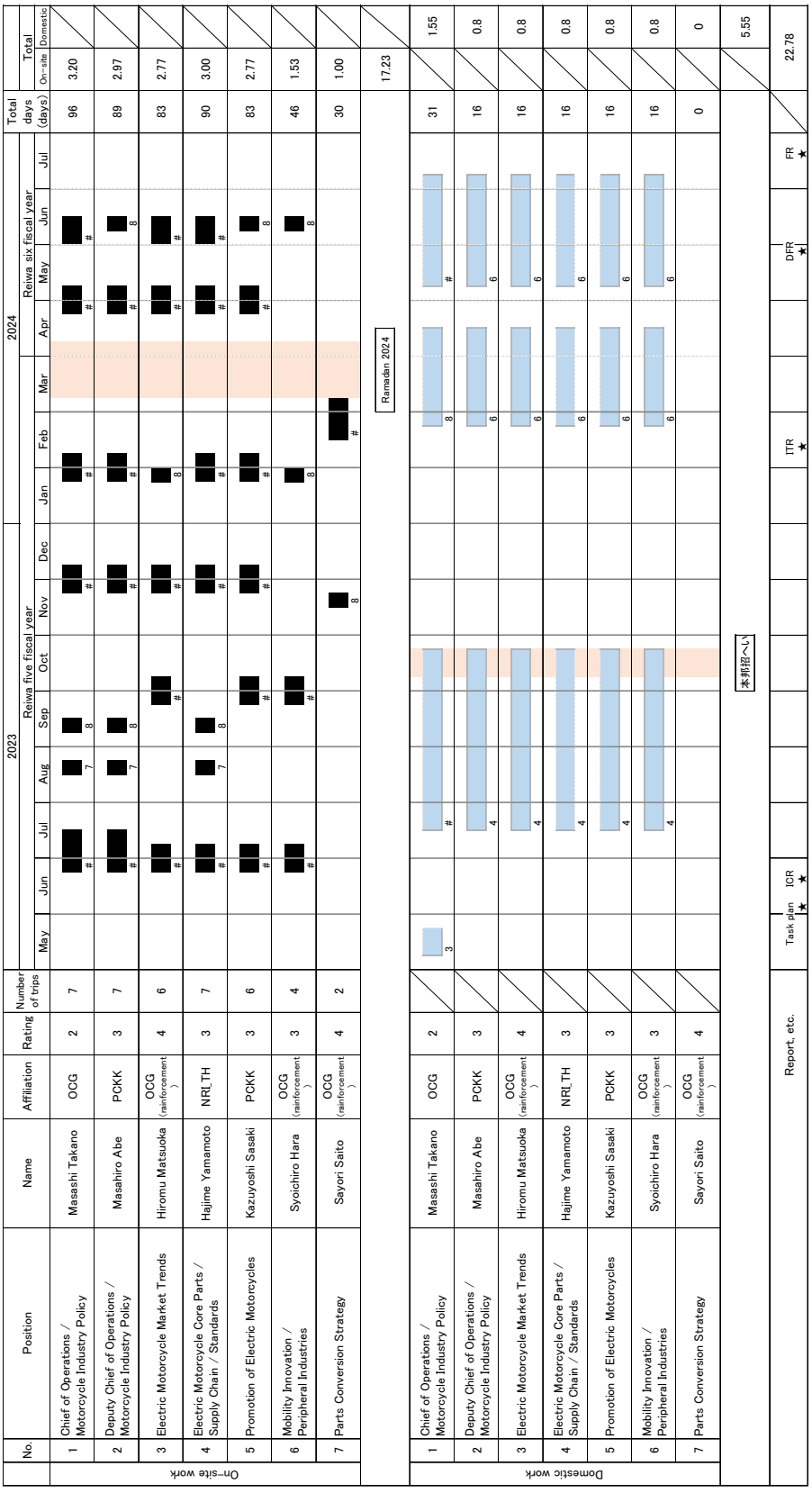
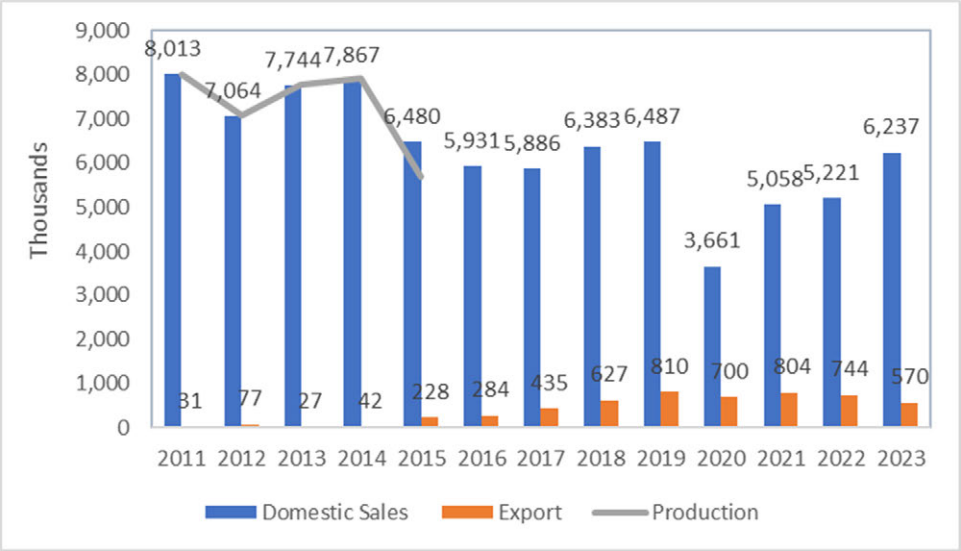


Figure 1-3 Survey team members and personnel plan

CHAPTER 2 TRENDS IN THE OVERALL MOTORCYCLE INDUSTRY IN INDONESIA

2.1 Market Trends (Sales / Production / Exports)

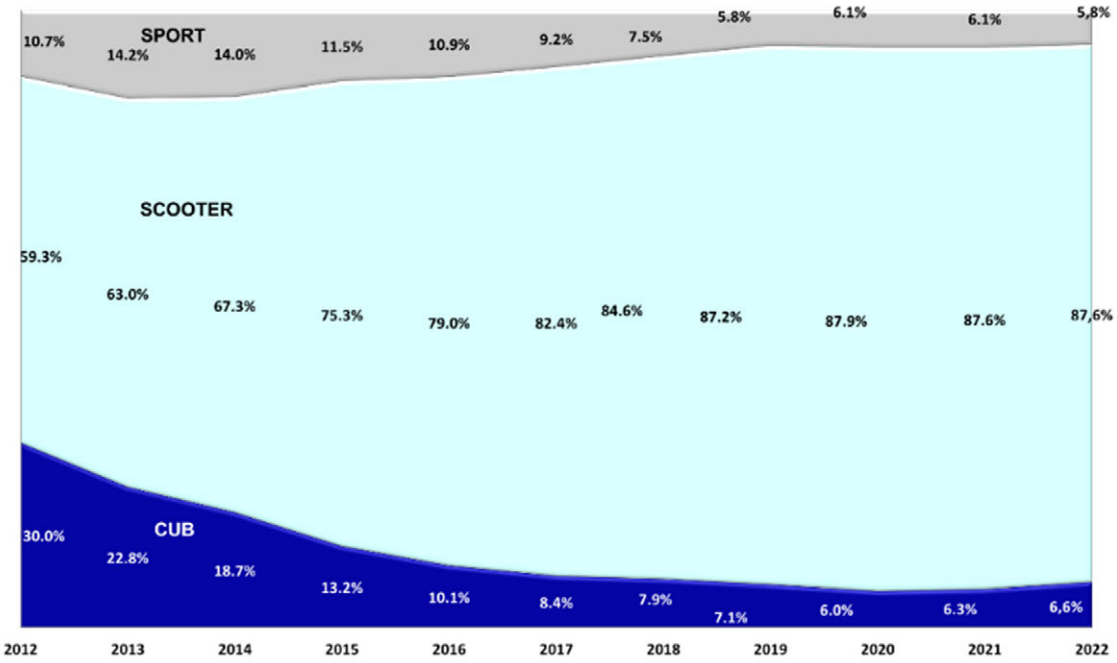
Indonesia's sales and export trends are shown in Figure 2-1 below. Motorcycle sales remained at 7-8 million units until 2014. After 2015, motorcycle sales declined due to stricter loans and remained 6-6 million. In 2020, due to the Corona disaster, sales declined significantly by 44% year-on-year to 6.24 million units. In 2023, sales reached 6.24 million units, 19% y/y, almost back to the pre-Corona disaster level.



Note: No public data for motorcycle production since 2016
Source: survey team from AISI and AAF

Figure 2-1 Motorcycle sales, production, and export trends (2011-2023)

As shown in Figure 2-2, in terms of segment sales, the share of scooters has increased rapidly since the early 2010s, reaching 88% in 2022. The share of cubs (under bone type) has declined from 30% in 2011 to 7%, but there is a certain persistent demand for these vehicles, as they are used as a means of transportation in rural areas.



Source: AISI

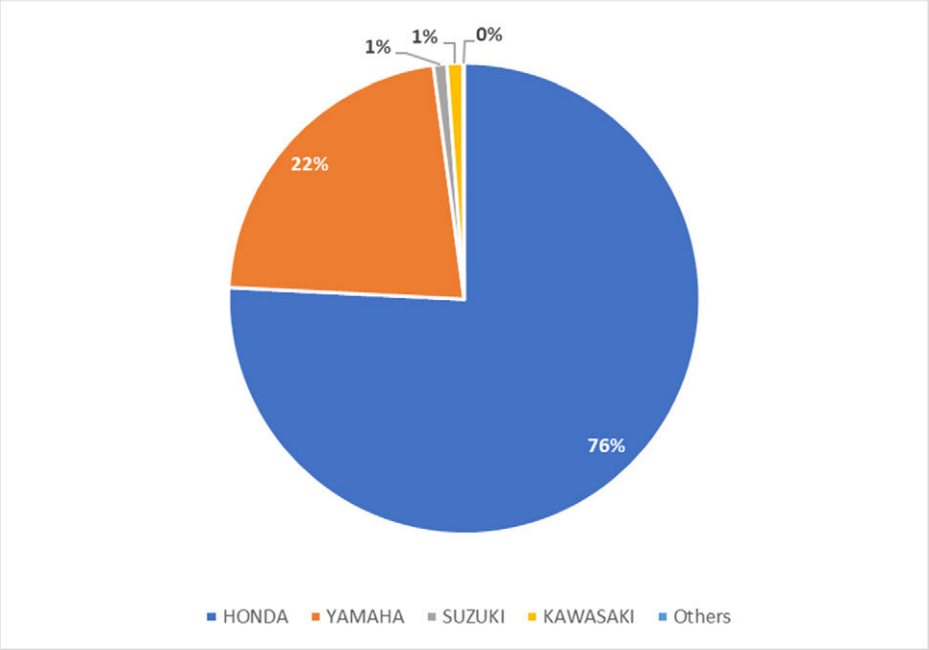
Figure 2-2 Motorcycle Sales and Export Trends (2012-2022)

Exports have increased markedly since the late 2010s, reaching a record peak of 810,000 in 2019. It is inferred that the decrease in domestic demand during this period due to the tightening of financial conditions was translated into exports. 2022-2023 will see a downward trend in exports, but this is inferred to be due to recovery of domestic sales due to a recovery in domestic demand, as opposed to the other way around.

2.2 Trends of Major Manufactures

According to AISI's statistics, Honda has by far the largest share by manufacturer in 2022 with 76%, followed by Yamaha with 22% (see Figure 2-3). When Suzuki and Kawasaki are added to the list, Japanese-affiliated companies will account for more than 99% of the market share. Electric motorcycle manufacturers are not included in the statistics because they are not members of AISI, but since electric motorcycles account for less than 0.5% of the total, the situation of Japanese dominance of the market remains unchanged even when electric motorcycles are included.

Honda, which has the largest market share, produces and sells its vehicles under Astra Honda Motor, a joint venture with Indonesia's largest conglomerate, Astra Group, with a total production capacity of 5 plants and 6 million vehicles. Last year, AHM produced 4.6 million vehicles, Honda's Indian base produced 4.2 million, and Honda's Vietnamese base produced 2.55 million, making AHM the Honda Group's largest production base in the world.



Source: Compiled from AISI and Marklines.

Figure 2-3 Indonesian motorcycle market share by brand (2022)

2.3 Impact of the COVID-19 epidemic

The new coronavirus epidemic caused a significant drop in motorcycle sales in Indonesia to 3.66 million units in 2020, down 44% from the previous year. It took three years for the motorcycle market to recover to pre-pandemic levels, and it is estimated that this was due to a decline in income and purchasing power among the general public, as well as a drop in demand for motorcycle taxis. In Indonesia's motorcycle market, demand for motorcycle taxis is high, especially in large cities, and since 2015, shopping and food delivery through online platforms such as Gojek, Grab, and Shoppee have increased rapidly, and by 2020, approximately 4 million Ojek (motorcycle taxi driver) drivers existed[1]. Large-Scale Social Restrictions (PSBB) implemented in March-April 2020 as a measure to prevent the epidemic of the new coronavirus increased demand for online delivery such as food delivery, while government measures to temporarily restrict the use of motorcycle cabs to transport passengers to work and shopping Demand for motorcycle cabs has declined significantly. According to one researcher's study[2], Ojek drivers' income decreased by 60% during this period. Even after the end of the infection, it took some time for the demand for motorcycle cabs to return as a result of changes in user behavior due to the widespread use of WFH and passengers' avoidance of motorcycle cabs and public transportation. After 2022, with the easing of behavioral restrictions and the recovery of the economy, demand for taxis and motorcycles largely returned to pre-infection social life and demand recovered. The return and recovery of demand for motorbike taxi has contributed to the rapid recovery in motorcycle sales.

2.4 Electrification Policy in Indonesia

2.4.1 Major Electrification Motorcycle Related Policies

The Indonesian government's policies related to electric two-wheelers include Presidential Regulation No. 55 of 2019 (partially amended by Presidential Regulation No. 79 of 2023), which establishes the basic policy for EVs as a high-level decree, under which ministries and agencies set specific measures

[1] Riani Rachmawati, Safitri, Luthfianti Zakia, Ayu Lupita and Alex De Ruyter "Urban gig workers in Indonesia during COVID-19" work organization, labour & globalization Volume 15, Number 1, 2021.

[2] Same as above

by law. The roadmap set a target of 3 million electric two-wheelers and three-wheelers, or 30% of the approximately 10 million motorcycles produced, by 2035. Subsequently, Regulation No. 6 of the Minister of Industry was issued in 2022, revising the previous Ministerial Decree of the Minister of Industry and changing the target value of electric motorcycles and tricycles for 2035 to 12 million units of cumulative sales.

Table 2-1 EV targets for motorcycles / three-wheelers and four-wheelers

Presidential Regulation No. 55 of 2019 ("PP 55/19")
• It prescribes various measures, including financial and non-financial non-financial incentives and the establishment of a national coordination team to accelerate the spread of electric vehicles, and under the policies of the Decree, specific measures and regulations will be issued by the Ministries of Industry, Finance, Transportation, Energy and Natural Resources, and other ministries and agencies. • For consumers, the policy will stipulate measures such as excise tax exemption (for four-wheeled vehicles), reduction of the cost of electricity for recharging, issuance of special license plates for electric vehicles, and reduction of interest rates. • For manufacturers, the government will set a target of gradually raising the domestic production rate to 80% by 2030 for automobiles and by 2026 for motorcycles, and will provide excise tax exemptions to manufacturers that have achieved the domestic production rate, as well as tax holiday benefits for investment in electric vehicle production. In addition, the government will also provide tax holiday benefits for investment in the production of electric vehicles.
Presidential Regulation No. 79 of 2023 ("PP 79/23")
• The date for achieving a 60% domestic production rate of BEVs (four-wheeled and two-wheeled) has been pushed back from 2024 to 2027. • By presenting an investment and production plan for BEVs (four-wheeled vehicles) by the end of 2025, imports of finished BEVs (four-wheeled vehicles) will be allowed until the end of 2025, and preferential measures such as 0% import tariffs will be granted. • A reference to subsidies for the purchase and conversion of electric motorcycles was added. • Reference to battery exchange stations (SPBKLU) was added.
Minister of Industry Regulation No. 27 of 2020 ("PMP 27/2020")
• Establish policies and strategies (BEV roadmap) for the development of the EV industry to achieve a minimum domestic production rate (TKDN). • The 2035 target is to have approximately 3 million electric motorcycles, or 30% of the approximately 10 million motorcycles produced. • Achieve a domestic ratio (TKDN) of 60% by 2025 and 80% after 2026. • The calculation method for the domestic production rate is defined, and the domestic production rate for motorcycle and three-wheeled vehicle parts is specified.
Minister of Industry Regulation No. 6 of 2022 ("PMP 6/2022")
• Revised the above Ministerial Ordinance of the Ministry of Industry to change the production target and the calculation method of the domestic production rate, etc. • Set a target of 12 million cumulative sales of electric motorcycles and tricycles by 2035. • The target for the domestic production rate remains unchanged, but the calculation method for each component is changed.
Minister of Industry Regulation No. 28 of 2023 ("PMP 28/2022")
• Partial revision of PMP 27/2020 following the enactment of PP 79/22. • The BEV roadmap was revised to match the backdating of the 60% domestic production rate of BEVs (four-wheeled and two-wheeled) from 2024 to 2026.

• By 2035, the company has set a target of 1 million electric motorcycles and tricycles sold annually, with a cumulative sales volume of 12 million units. • Changed the calculation method of BEV domestic production rate.
Regulation No. 13 of 2020 of the Minister of Energy and Mineral Resources ("MEMR 13/2020")
• Definition of services and operator requirements for public battery charging stations (SPKLU) and public battery switching stations (SPBKLU) • The direction of charging infrastructure development in Indonesia, PLN's mandate to initiate charging infrastructure development, business model options, and preferential electricity rates for charging. • Plug-in standards: charging connector standards and maximum voltage (480V), etc.
Presidential Instruction (INPRES) No. 7 of 2022
• Presidential Decree (INPRES) No. 7 of 2022 on the use of battery electric vehicles as service vehicles for central government agencies and local government operations and/or personal service vehicles.

As discussed below, as of May 2024, there are no laws regarding the handling (recycling, reuse, disposal, etc.) of electric two-wheeled vehicles and used batteries.

Table 2-2 shows the sales and production targets for autocycles and motorcycles for PMP27/2020 and PMP6/2022.

Table 2-2 Percentage of Motorcycles/Tricycles Produced Domestically by Component

Passenger/ Commercial vehicle (Unit:10000)			2025	2030	2035
PMP 27/2020	Production	Total	200	300	400
		LCEV ratio(10,000)	20%（40）	25%（75）	30%（120）
		EV ratio against LCEV (10,000)	20%（8）	20%（15）	20%（24）
	Domesitic sales		169	210	250
	Export		31	90	150
PMP 6/2022	EV production		40	60	100
2W/3W（Unit:10000）			2025	2030	2035
PMP 27/2020	Production	Total	880	980	1075
		EV ratio(10,000)	20%（176）	25%（245）	30%（322）
	Domesitic sales		770	840	900
	Export		110	140	175
PMP 6/2022	EV cumulative sales (population)		600	900	1200

Note: PMP6/2022 has a separate provision for a subsidy program for electric motorcycles (see next section 3.2).
Source: Prepared by the Survey Team from Ministerial Decree of the Ministry of Industry.

2.4.2 Compliance with the domestic production ratio (TKDN)

In Indonesia, as mentioned above, the domestic production ratio (TKDN) of industrial products is set as an obligation or target with the intention of promoting domestic industry, and the achievement of the TKDN is often a condition for purchase subsidies. As for electric motorcycles, as mentioned above, the TKDN is set by Presidential Decree, etc. The allocation of domestic production points by component of the domestic production ratio is shown in Table 2-3 (the system in which "domestic production points" are added by domestic production, and the domestic production ratio of the entire product is calculated). Under the May 2024 law, it is mandatory to achieve a domestic production ratio of 60% by the end of 2026 and 80% by the end of 2029, and domestic production of batteries with high points is particularly essential.

Table 2-3 Percentage of Motorcycles/Tricycles Produced Domestically by Component

Parts	Components	Localization point
Main frame or/and body parts	Frame, rear/front fender, food stand. etc.	10% (2020-23) 11%.(2024-)
Battery	Cell, module, BMS, cooling & thermal. Management. etc.	30% (2020-23) 35% (2024-)
Drive train	Gear, shaft, electrical wiring, controller/ ECU/ PCU., etc.	10% (%) (2020-23) 12% (2024-)
Supporting components	5 main parts (steering, suspension, brake, wheels, electrical instrument, universal components)	10% (%) (each main part 2% x 5 parts)
Research and Development (R&D)	Implementation level of R&D	10%
Assembly	Work force, equipment	30% (2020-29) 20% (2030-)

Source: Prepared by the Survey Team from the Ministerial Decree of the Ministry.

On December 8, 2023, Presidential Regulation No. 79 of 2023 (PP 79/2023), which amends Presidential Regulation No. 55 of 2019 (PP 55/2019) to promote EV conversion, went into effect. It mainly backtracks the BEV domestic production rate target and relaxes investment requirements for domestic production, and is seen as a policy revision based more on the domestic production status of batteries and other electric vehicle components (see Table 2-4). In interviews with AISI, AISMOLI, and other electric motorcycle-related industry associations, it was pointed out that this revision of domestic production targets has made it easier for Chinese electric vehicle manufacturers who want to start with CBU exports of electric vehicles to enter the market.

Table 2-4 Outline of Revision of President Regulations

	PP 55/2019	PP 79/2023
Domestic production rate of two-wheeled motorcycles (TKDN)	2019-2023,TKDN 40 % 2024-2025,TKDN 60 % After 2026, TKDN 80 %	2019-2026, TKDN 40 % 2027-2029, TKDN 60 % After 2030, TKDN 80 %
Domestic production rate of four-wheeled vehicles (TKDN)	2019-2021,TKDN 35 % 2022-2023,TKDN 40 % 2024-2029 TKDN 60 % After 2030, TKDN 80 %	2019-2021,TKDN 35 % 2022-2026,TKDN 40 % 2027-2029,TKDN 60 % After 2030, TKDN 80 %
Additional special provisions for CBU imports	Import duty and luxury tax incentives apply only to CKD production, and CBU imports are not eligible for these benefits (only four-wheeled vehicles are eligible).	For manufacturers that start mass production by the end of 2025, preferential measures equivalent to CKD will be applied to a certain number of CBU imports. (Only for four-wheeled vehicles)

Source: Prepared by the survey team from the Ministerial Decree of the Ministry of Industry.

2.4.3 Issues that should be solved in future

(1) Compliance with future domestic procurement rate regulations

Many electric motorcycle manufacturers in Indonesia currently purchase their batteries through "Indonesian domestic transactions" from domestic battery manufacturers who pack imported battery cells from China to produce finished products, or from importers who handle the finished batteries themselves. By interspersing Indonesian domestic transactions in this way, batteries are considered to

be procured domestically (100% domestic procurement rate), contributing to an increase in the overall domestic procurement rate of vehicles.

In order to further increase the domestic procurement rate in the future, it will be necessary to promote domestic procurement of components other than batteries, and it is essential for all manufacturers to strengthen their supply chains in Indonesia.

(2) Reduction of manufacturing costs

For the future spread of electric mobility, reducing manufacturing costs is an urgent task to keep selling prices down. In particular, the cost of battery procurement accounts for about 40% of the vehicle manufacturing cost. As mentioned above, many Indonesian electric motorcycle manufacturers procure batteries from domestic battery packing companies or importers, which adds a certain amount of transportation costs, customs duties, and transaction fees to the high cost. This is one of the reasons for the high cost.

Gesits' shareholders, such as Indonesia Battery Corporation, are promoting the domestic production of battery cells in Indonesia.

(3) Infrastructure Development

The battery swapping type electric motorcycle requires the development of battery swapping stations, which would require significant additional investment if they were to provide the same level of convenience as the network of gas stations and small service providers covering the whole of Indonesia as described above.

On the other hand, given that subsidized ICE fuel ”Pertalite” is constant at 10,000 Indonesian rupiah/liter, it is currently difficult to generate significant revenue from the operation of battery charging and swapping stations that compete with it.

In the future, it will be necessary to strengthen the supply chain for swapping station-related products, parts, and services, including reduction of procurement costs for swapping stations, stable supply of related electrical parts, etc., and inexpensive installation work, as well as to improve operations to ensure profitability.

(4) Providing after-sales service

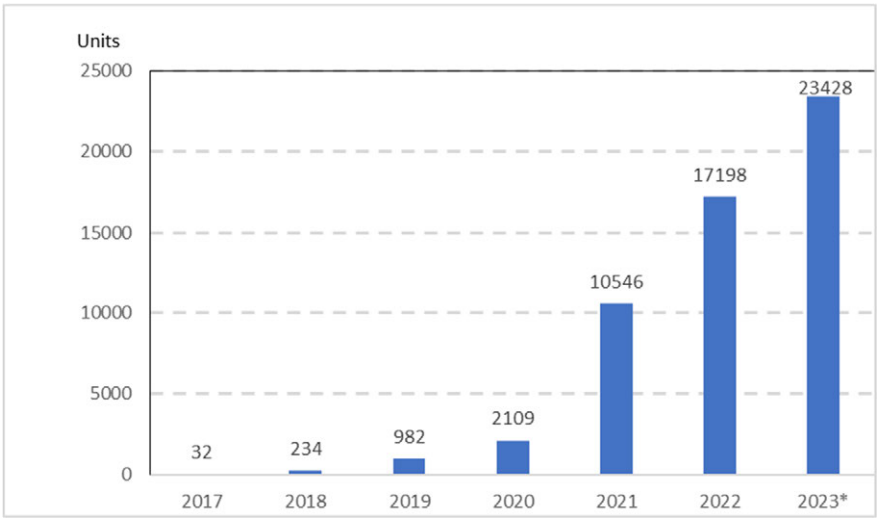
According to the interviews with Grab, the key factor they emphasized in procuring electric motorcycles for use in the ride-sharing service was the availability of after-sales service, such as repairs in the event of trouble. From this perspective, among the emerging electric motorcycle manufacturers, Viar is highly reliable because it originally manufactured and sold ICE three-wheelers and has workshops for repairs.

In Indonesia, motorcycles are "assets" for many users, and they tend to place great importance on after-sales service in order to maintain the value of their assets. Therefore, the availability of after-sales service, which is considered to influence the purchasing behavior of all motorcycle users, as well as Grab and Gojek, which provide ride-sharing services, is an important point for the future spread of electric mobility.

CHAPTER 3 TRENDS AND ISSUES IN THE ELECTRIC MOTORCYCLE INDUSTRY IN INDONESIA

3.1 Market Trends

The annual sales of electric motorcycles increased after Presidential Decree No. 55 of 2019, reaching 10,000 units in 2021 and 62,000 units in 2023 (see Figure 3-1). Factors contributing to the expansion of electric motorcycle sales in 2023 include (1) a subsidy policy of 7 million rupiah for electric motorcycles, which came into effect in April 2023, stimulating demand, (2) the entry of many electric motorcycle manufacturers in response to the subsidy policy, intensifying competition, and the introduction of low-priced models, (3) the introduction of new models (3) online platforms such as Grab and Gojek, as well as state-run companies, are shifting to electric motorcycles.



Source: AISI

Figure 3-1 Sales of Electric Motorcycles (As of December 2023, based on registrations)

The total number of electric motorcycles sold in the Indonesian market is not published, but there are two existing surveys about it: AISI's 2022 cumulative sales figures and a survey of owned electric motorcycle brands conducted by an Internet news site cited in Table 3-1 and Table 3-2 below. These two results don't fully represent the market situation and cannot be simply compared because they are different survey forms, but the following implications can be pointed out from the results;

- The lineup of popular electric motorcycle brands has changed dramatically over the past year. In the meantime, new policies such as subsidies were introduced, and Gesits, Volta, and Selis, which were among the first to be eligible for such subsidies, are gaining popularity with their low-priced models.

- In 2023, there are more than 60 electric motorcycle brands/manufacturers as far as the Ministry of Industry IMATAP is aware, compared to 43 brands in 2022. Therefore, it can be seen that the electric motorcycle market in Indonesia is a very competitive market as of 2023, with more than 17 new brands launching in one year and large fluctuations in popularity occurring as mentioned above.

Table 3-1 Cumulative Sales of Electric Motorcycles by Brands / Manufacturer (as of June 2022)

Electric Motorcycle Brands	Viar	Gesits	Volta	United	ECGO	Smoot	The Other 37 brands	Total
Cumulative Sales until June 2022	7,300	3,440	2,600	1,003	753	741	3,187	19,024
Market Share	38.4%	18.1%	13.7%	5.3%	4.0%	3.9%	16.8%	100%

Source: AISI

Table 3-2 Electric Motorcycle Ownership by Brands / Manufacturer (as of April 2023)

Electric Motorcycle Brands	Selis	Gesits	Uwinfly	Volta	Alva One	ECGO	NIU	Gogoro	Total
Owners	748	598	524	491	410	241	204	133	3,349
Share in Owners	22.33%	17.83%	15.62%	14.69%	12.27%	7.20%	6.09%	3.97%	100%

Source: AISI, REPUBLIKA[3]

3.2 Related Policies by the Indonesian Government

Subsidies for electric two-wheelers are available for both new and modified vehicles, with the Ministry of Industry administering the subsidy program for the former and the Ministry of Energy and Mineral Resources for the latter.

3.2.1 Subsidy program for new vehicles

The Ministry of Industry has issued Regulation No. 6 of 2023 of the Minister of Industry ("PMP 6/2023"), which began providing subsidies for electric two-wheeled vehicles in April 2023. Details are as follows.

[3] https://ekonomi.republika.co.id/berita/rtdqmh440/survei-republika-8-motor-listrik-terfavorit-selis-gesits-memimpin

Minister of Industry Regulation No. 6 of 2023 ("PMP 6/2023")
• Provision of government subsidy of 7 million rupiah per vehicle for the purchase of electric two-wheeled vehicles • Subsidies will be provided for up to 200,000 units in FY2023 and up to 600,000 units in FY2024. • Motorcycles eligible for subsidies must be registered in the SISIS Information System Supporting Information System (SISAPIRa) provided by the General Directorate of Metals, Machinery, Transport Equipment and Electronics (ILMATE) of the Ministry of Industry, and the TKDN value must be at least 40% to be eligible for information system registration. • Subsidies are offered to citizens of certain (income classes) (income requirements relaxed in the August 2023 amendment to the statute)

DG ILMATE, under the Ministry of Industry, commissioned PT Surveyor Indonesia to operate the online platform SISAPIRa (Government Support Information System for the Purchase of 2W-Electric Vehicles). However, until June 2023, only 600 people have been registered to purchase a new 2W-EV; in August 2023, MOI Regulation 6/2023 was amended to Minister of Industry Regulation No. 21 of 2023, expanding eligibility for the assistance program to all persons with a qualifying ID number (NIK) The new regulation was amended by the Minister of Industry Regulation No. 21 of 2023. To track government assistance programs, SISAPIRa has three statuses for dealers ().

1. Registration: Dealer registers buyer information (NIK)
2. Verification: The dealer verifies the customer's profile using NIK data from the Minister of the Interior and awaits issuance of the new STNK and TNKB. During the verification process, the dealer may request reimbursement of the subsidy/discount from the government.
3. Delivery: Subsidies are paid by the government to each dealer.

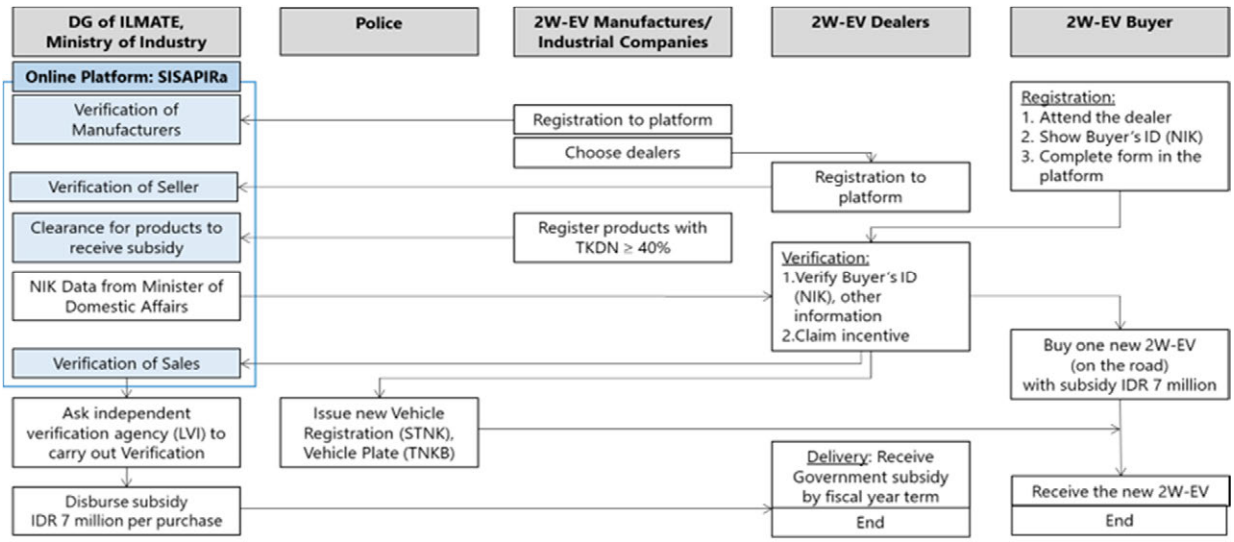


Figure 3-2 Government Assistance Scheme for the Purchase of Electric Motorcycles

After its introduction, the number of electric motorcycles eligible for subsidies reached 11,532 units in 2023, contributing to increased sales in the electric motorcycle market, but well below the government's target of 200,000 units (in 2023).

The first reason for falling short of the target was that the subsidy program initially had strict eligibility requirements, including income restrictions, which resulted in a lack of growth in applications. In light of this situation, the Indonesian government has relaxed the conditions so that after August 2023, the

income limit will be removed and any Indonesian citizen aged 17 or older with a resident registration number can purchase and apply for the subsidy. The second reason that prevented the achievement of the target was the limited number of finance companies offering financing services (installment payments) for the purchase of electric motorcycles for individuals. This is due to the difficulty in assessing the market value of used electric motorcycles, which is the basis for setting interest rates. The third reason is that for individual users who are eligible for subsidies, concerns about battery life and the relatively high price compared to ICE vehicles are not enough to dispel the points that discourage them from purchasing electric two-wheelers.

The first and second of the three reasons above have been improving since the start of the subsidy policy in 2023, and the latest information from January and February 2024 shows that the monthly sales volume has remained above 7,000 units and the number of subsidies has already exceeded 8,000 units, so sales and subsidy payments are expected to exceed those in 2023[4]. The number of subsidies is already over 8,000 units. Note that the number of subsidies eligible for 2024 has been significantly reduced to 31,600 units, and it can be said that the Ministry of Industry, which provides subsidies, has switched to setting more realistic targets.

3.2.2 Subsidies Program for Conversion from ICE to electric two-wheelers

The Ministry of Energy and Mineral Resources has issued Ministerial Decree No. 3 of 2023 of the Minister of Energy and Mineral Resources, implementing a subsidy program of 7 million rupiah (67,620 yen) for the conversion of 50,000 vehicles from ICE to electric two-wheelers. It stipulates that not only individuals (the subsidy for new vehicles is limited to individuals), but also community groups, government agencies, or nongovernmental organizations are eligible to receive assistance for the conversion of electric two-wheeled vehicles. The government and state-owned enterprises own many ICE motorcycles, and the measure is seen as a way to promote the use of electric motorcycles by encouraging the conversion of these ICE vehicles to electric vehicles.

Minister of Energy and Mineral Resources Regulation No. 3 of 2023 ("MEMR 3/2023")
• Provision of government subsidy of 7 million upiah (67,620 yen) per vehicle for the purchase of electric two-wheeled vehicles • The goal is to convert 50,000 motorcycles in 2023 and 150,000 in 2024. • Modifications may only be performed at modification workshops approved by the Land Transport Bureau of the Ministry of Transport.

To streamline the conversion application process and receive conversion subsidy, Directorate General of EBTKE under the Ministry of ESDM create an online platform[5]. EBTKE platform is useful for the motorcycle owner to register conversion application, conversion workshops to register their business and recognize by the public, and spare parts companies to supply spare parts for conversion and warranty.

EBTKE platform registration is also mandatory for the conversion workshop to receive the Government assistance/ conversion subsidy. The specific procedures for applying for subsidies are shown in Figure 3-3, and their complexity has been cited as one of the factors contributing to the low number of subsidy applications and payments (181 applications were approved in 2023). Other factors include the lack of after-sales service and other guarantees from the original ICE motorcycle manufacturer after the modification, and the limited number of modification workshops[6].

[4] https://otomotif.kompas.com/read/2024/03/18/070200715/motor-listrik-subsidi-laku-8.000-unit-pada-maret-2024

[5] https://ebtke.esdm.go.id/konversi/

[6] Conversions can only be performed at workshops accredited by the Directorate General of Land Transport of the Ministry of Transport; as of January 2024, the Ministry of Transport has accredited 29 modification workshops, mainly in Java and Bali. However, only 15 modification workshops are registered on the EBTKE platform, which is required to receive subsidies.

As specified in the 2023 Ministry of Transportation Regulation No. 39, modifications to electric motorcycles include the following

(1) Battery packs and battery management systems

(2) DC voltage reducer (DC-DC converter)

(3) Electric motors must be power regulated as follows

(i) 1 to 2kW for 110 cc or smaller types
(ii) Maximum 3 kW for 110 to 150 cc types
(iii) Maximum 4 kW for 150 to 200cc types
(iv) Minimum 4 kW for 200cc type

(4) Electric motor drive control system (controller, inverter, electronic control unit/ECU)

(5) Battery charging port

(6) Other necessary auxiliary equipment

These are the items that LVIs should check in order to receive government assistance for Conversion.

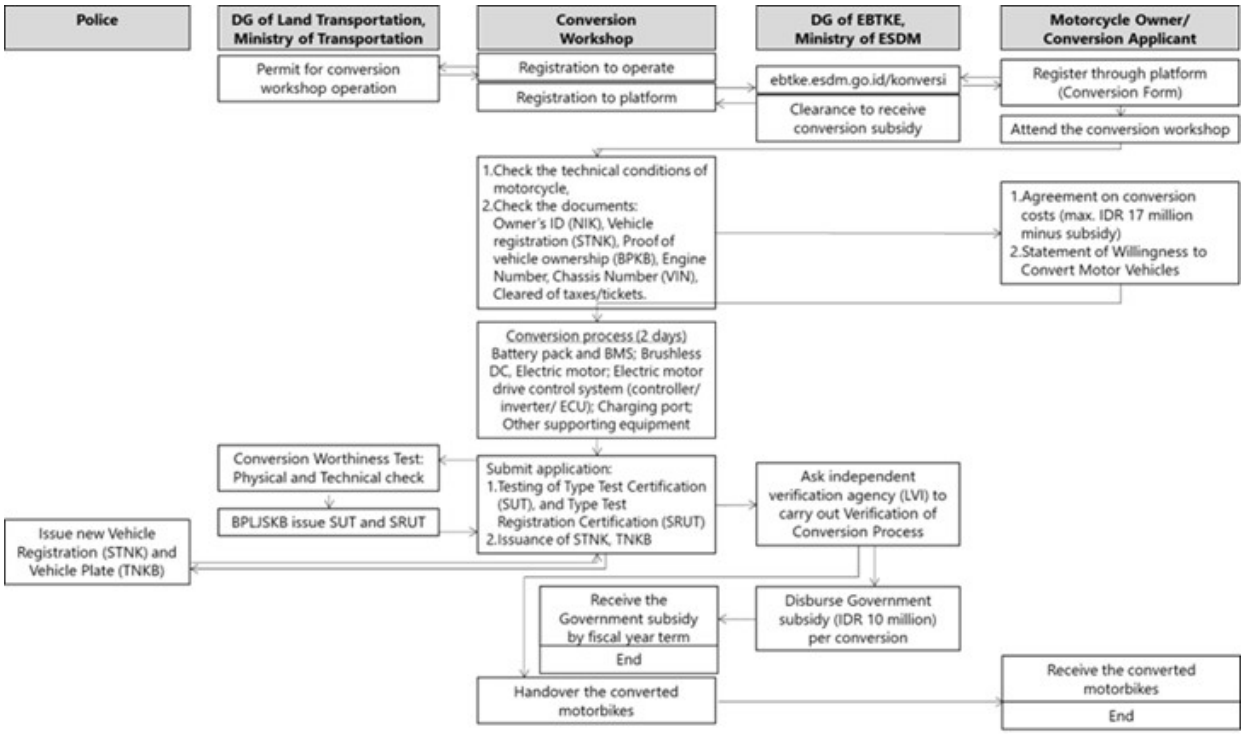


Figure 3-3 Government Support Scheme for Electric Motorcycle Conversion

As manufacturers and motorcycle models eligible for conversion as of 2023. Honda (50 types), Yamaha (47 types), Suzuki (10 types), Piaggio (8 types), SYM, Vespa, and TVS are included. The performance guidelines for converted bikes are as follows: (1) mileage: 50-60 km (fixed battery) or 25-30 km (replaceable battery); (2) maximum speed: 80 km/h (from ICE 100 km/h); (3) payload remains the same.

Conversion (from gasoline motorcycle to electric motorcycle) vehicles are covered by the following warranties: (1) 1-year BLDC motor warranty, (2) 2-year controller/inverter warranty, (3) 1,000 charge battery pack warranty, (4) 6-month or 10,000 km warranty except for major parts. The company will continue to provide a warranty for the following items.

At the end of December 2023, Minister of Energy and Mineral Resources Decree No. 13 of 2023 was issued, increasing the subsidy amount from Rp. 7 million to Rp. 10 million. A local magazine reported

that "as of August 16, 2023, only 112 subsidies for retrofitting had been granted and 5,399 applications for retrofitting were submitted during the same period, but 1,716 were cancelled due to cost constraints[7]," suggesting that the reason for the increase is that retrofitting of electric vehicles is well below the target of 50,000 units The reason for the increase is believed to be that the number of electric vehicles converted has fallen far short of the 50,000 target.

3.3 Major Electric Motorcycle Manufacturers

3.3.1 Trends of Major Electric Motorcycle Manufactures

According to statistics from the Ministry of Industry, there are 53 registered electric motorcycle manufacturers (the latest data indicate that the number has increased to 63). In addition, according to the Ministry of Industry[8], as of January 24, 2024, there are already 19 companies and 56 models of electric motorcycles that meet the 40% domestic production rate (TKDN) requirement and are eligible for government subsidy payments. The subsidy-approved companies, models, and prices are listed on the Ministry of Industry website and are outlined in the table below. Although no data is publicly available on the nationalities of the subsidy-approved motorcycle manufacturers and the companies that have invested in them, 15 companies are members of AISMOLI, mainly local and Chinese companies, and Honda (Astra Honda Motor) is the only Japanese brand.

[7] Tambahan Subsidi Konversi Motor Listrik Jadi Rp 10 Juta Per Unit Mendapat Apresiasi (kontan.co.id)

[8] https://kemenperin.go.id/artikel/24279/Diperluas,-Bantuan-Pembelian-Motor-Listrik-Berlaku-Satu-NIK-untuk-1-Unit

Table 3-3 Prices and Specifications of Major Brands

Brand	販売会社 (Company)	補助金対象 (TKDN)	AISMOLI 加盟企業	モデル名 (Models)	価格 (Mil IDR)	Specification (battery V/capacity/power)
Selis	Juara Bike	✓	✓	Agats, Emax, Go- plus	Agats : 9.59 - 159	Agats:60V/27Ah/ 2000W(SLA) 72V/20ah/ 2000W
Smoot	Smoot Motor Indonesia	✓	✓	Tempur, Zuzu	11.5-12.9	Zuzu:64V/21.5Ah/1500W Tempur 64V/21Ah/1500W
Polytron	Hartono Istana Teknologi	✓	✓	Fox	13.5	
Rakata	Artas Rakata Indonesia	✓	✓	S9, X5	13.5-15.1	
Alva	Electra Mobilitas	✓	✓	One, Cervo	29.49-35.75	One :60V/45Ah/ Max4KW Cervo:73.8V 24Gh Max9.8KW
Greentech	Greentech Global Engineering	✓		Scood, Aero, etc	5.3-9.7	
United	Terang Dunia Interusa	✓	✓	TX, MX	MX 8.8 TX 23.5-42.9	
Volta	Volta Indonesia Semesta	✓	✓	401, 402, 403	9.95-11.95	401:64V/21Ah/ Max1500W
Viar	Triangle Motorindo	✓	✓	New, NX, EV1	7.32-14.52	NX: 60V/223Ah/2000W New:60V/23.5Ah,/2000W
Gesits	Wika Industri Manufactur	✓	✓	G1, Raya	20.9-21.97	G1;72V/20Ah/Max4HP
Yadea	National Assembler	✓	✓	E8S, T9, G6	14.5-20.5	
Exotic	Roda Pasifik Mandiiri	✓	✓	Vito, Mizone, Sprinter	5.59-7.99	
Quest	Ide Inovatif Bangsa	✓		Atom	20.95	
Uwinfly	Uwinfly Indonesia Industries	✓	✓	N9, T3 Smart, , BW Smart, etc	5.99-15	72V/32Ah (SLA) /2000W
Jarvis	Jarvis Listas Mandiiri	✓	✓	Morgan	12.9	
Enine	Nenetology Indonesia	✓	✓	T1. T5	12.9-15	
Ecgo	Green City Traffic	✓		3 A/T. 5A/T	12.9-15.9	
Alessa	Alessa Motors Indonesia	✓	✓	Uno, Duo	10.9-12.9	
Honda	Astra Honda Motor	✓		EM1e:	33	50.26V/29.4Ah/Max1.7kW

Source: Compiled by the Survey Team from the Ministry of Industry's website SISAPIRa and the websites of the companies

The electric four-wheeled vehicle market can be divided into four price segments as follows. Note that all prices are expressed in terms of actual prices after discounting the subsidized amount of 700 rupiah (67,620 yen).

(1) Low-end segment (approx. 5-10 million rupiah (48,300-96,600 yen))

5-10 million rupiah (48,300-96,600 yen) segment sold by manufacturers such as Seltis, Unifly, and others. Many of these models use SLA (lead-acid) batteries, which are cheaper than electric motorcycles with lithium batteries. Two types of batteries are used: 60V and 72V. Electric motorcycle manufacturers supplying this segment also produce and sell electric bicycles that do not require license plate registration. Unwinfly, a Chinese-owned company that is a leading manufacturer in this segment, was the industry leader last year, selling 10,980 units. Yadea, also Chinese-owned and affiliated with the Indomobil Group, sold 8,018 units last year, ranking third in the industry. Both companies mainly use plug-in systems.

(2) Low to medium segment (approx. 10-15 million rupiah (96,600-144,900 yen))

It is currently the volume zone with the highest sales volume, priced between 10 and 15 million rupiahs (96,600-144,900 yen), and uses mainly battery swap system. The two leading brands are Smoot and Volta, which use 60-64V lithium-ion batteries. The former sold 10,935 units last year and the latter 5,074 units last year. The motor is an in-wheel type, and its maximum output is mainly 1.5Kw. Volta also sells a plug-in type.

Apart from these two companies, the third company that is increasing its sales after 2023 is Hartono Istana Teknologi, which is part of the Polytron Group, a major local consumer electronics brand, and is in third place. It uses a plug-in 72V lithium-ion battery.

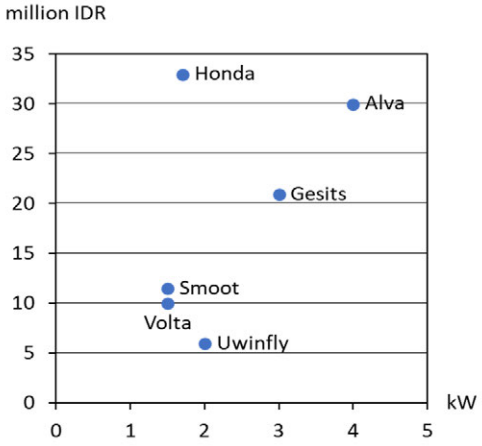
(3) Intermediate segment (approx. 20-30 million rupiah (193,200-289,800 yen))

The main manufacturer in this segment is Gestis, a subsidiary of the state-owned IBC. The company has adopted a unique standard with a plug-in charging type, a 72 V battery, a center type motor, and a maximum output of 3 kW. 2,238 units were sold in 2023, placing it 9th in the industry.

(4) High-end segment (from approx. 30 million rupiah - (289,800- yen))

The leading brand in the high-end segment is the Alva brand from Electra Mobilitas, which starts at over 29 million rupiah. The charging type is plug-in, the battery is 72 V, and the motor system has a center maximum output of 3 kW, which is higher than other companies. Honda has been selling the high-priced 30 million rupiah swappable battery type EM1e: since last December, with Honda's removable Mobile Power Pack e: (MPP) battery, 48V standard (catalog value is 50V), side-type motor, and maximum output of 1.7 kW.

The major brands are plotted by price and maximum output in the figure below.



Note: Plotted by price (after subsidy discount) and maximum output for each brand
Source: Each brand's catalog

Figure 3-4 Price and maxixmum output of major brands

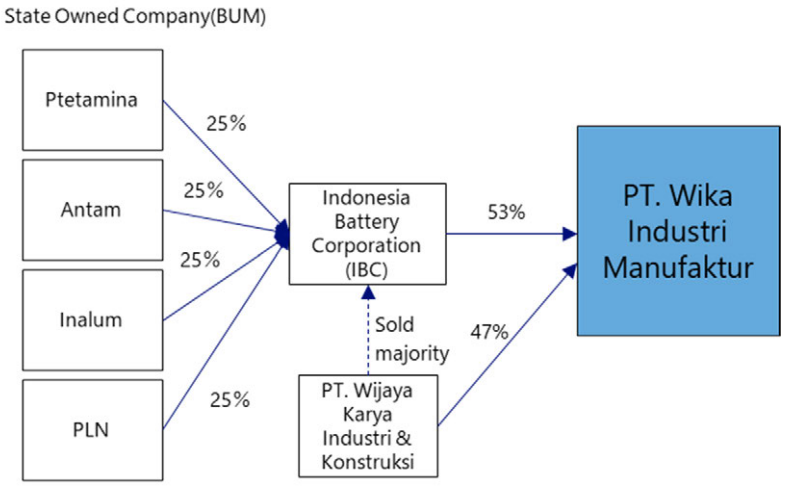
(5) State-owned company Wika Industri Manufaktur (Gesits)

The Gesits brand of electric motorcycles is manufactured by state-owned Wika Industri Manufaktur, which was acquired in December 2022 by the Indonesia Battery Corporation (IBC), a company in which four state-owned companies (state-owned electricity company PLN, state-owned oil company Pertamina, state-owned mineral resources development company Aneka Tambang, and MIND ID) have invested. Indonesia Battery Corporation (IBC), in which four state-owned companies (PLN, state-owned electricity company, Pertamina, state-owned oil company, Aneka Tambang, and MIND ID) have equity stakes, acquired 53% of Wika Industri Manufaktur's outstanding shares, positioning Gesits as a national company (see Figure 3-5). Production capacity is 25,000 units per year, with plans to expand to 50,000 units per year in the future.

Gesits currently produces plug-in electric motorcycles with 72V batteries, and in February 2022 agreed to collaborate with Electrum, a joint venture between Gojek and TBS Energi Utama, Pretamina, and Taiwan's Gogoro to develop an electric motorcycle ecosystem. Gesits is providing vehicles to Pretamina and Gojek (see Figure 3-6). However, increased sales by competitors have put the company in ninth place in the industry with 2,238 vehicles sold in 2023, down from second place in 2022.

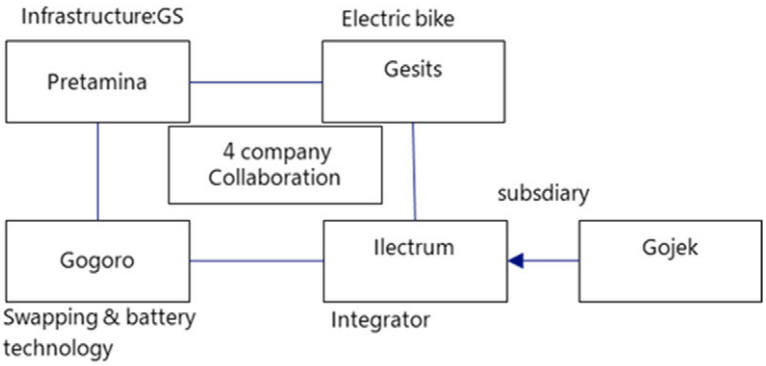
Traditionally, the company has focused on plug-in electric motorcycles, but in line with the growing popularity of battery-replaceable electric motorcycles, at the electric vehicle exhibition organized by Periklindo in April 2024, along with IBC's battery swap station, the company converted from a plug-in model to a battery The model with a battery swap station was exhibited (see Figure 3-7). The battery voltage and capacity of the battery-swappable electric motorcycle on display was 72 V and 25 A, which was modified from the 72 V and 20 A of the plug-in type in response to users' requests for longer distances. The company plans to install 100 battery replacement stations and produce 1,200 replacement batteries by 2024.

Gesits' replacement batteries are supplied by the Chinese-owned Renewable Energy Group. The company is a member of the Fulcrum Consortium, a consortium of state-owned enterprises (SOEs) in China. The consortium agreed in June 2023 to cooperate with Indonesian SOEs such as IBC in the development and standardization of the BAMS and other electric motorcycle ecosystems, and the supply of batteries to Gesits is seen as part of that cooperation.



Source: Prepared by the Survey Team from newspaper reports and other sources.

Figure 3-5 Relationship between Gesits and its manufacturing company Wika Industri Manufacture



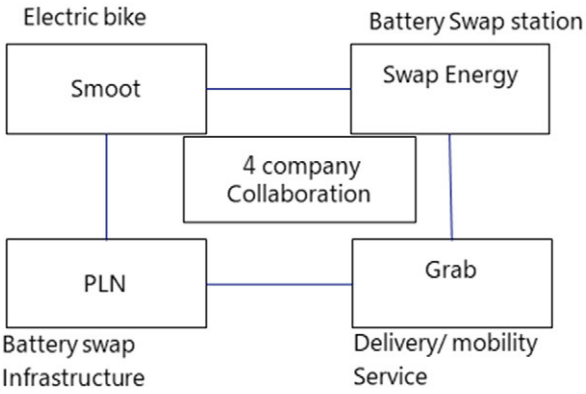
Source: Prepared by the Survey Team from newspaper reports and other sources.

Figure 3-6 Collaboration with Gesits, Ilectrum (Gojek), Pretamina, Gogoro

Figure 3-7 Gestis electric two-wheeler, battery, and battery swap station (Photo taken by the Survey Team at the electric vehicle motor show organized by Periklindo in April 2024)

(6) Smooth Motor (Smoot)

Smoot Motor produces electric two-wheelers under the Smoot brand, its flagship product, and was established in 2021 by SWAP Energy, a battery replacement service provider established in 2019 Smoot's electric two-wheelers are provided by SWAP Energy. In March 2022, Smoot/Swap Energy, Grab, and PLN will launch the In March 2022, Smoot/Swap Energy, Grab, and PLN agreed to collaborate to develop an ecosystem for electric two-wheeled vehicles, supplying vehicles primarily to Grab (see Figure 3-8). and the second largest sales volume in the industry. In addition, PT Santomo Green Power Management (SGPM), a subsidiary of Santomo Resources Corporation (Tokyo), has a business alliance with Smoot Motor, and SGPM will be responsible for Smoot's electric motorcycles in Sulawesi and east of Lombok, including Makassar City, South Sulawesi SGPM sells and rents vehicles and operates battery exchange stations in Sulawesi and east of Lombok, including Makassar City, South Sulawesi.



Source: Prepared by the Survey Team from newspaper reports and other sources.

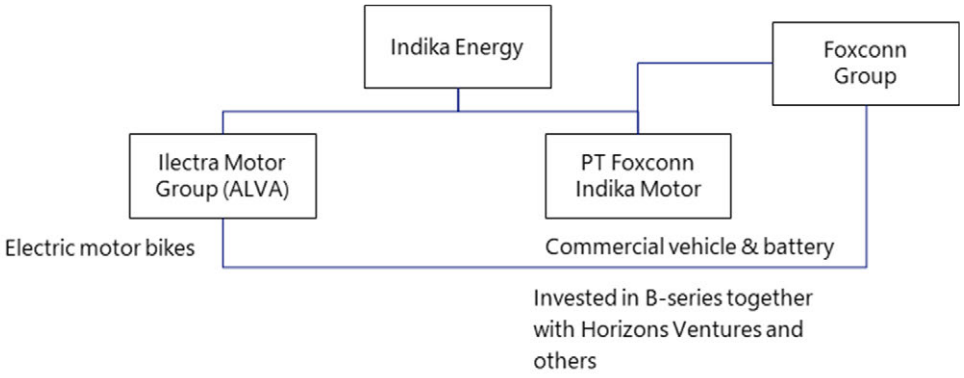
Figure 3-8 Collaboration with Smoot, Swap Energy, Grab, and PLN

(7) Volta indonesia Semesta (Volta)

Volta is a joint venture between digital service provider M Cash Integrasi and last-mile delivery startup SiCepat Ekspres and is manufactured at a manufacturing facility in Semarang, Central Java. SiCepat and M Cash are working together to add battery replacement stations. SiCepat and M Cash are cooperating to build more battery exchange stations, and have agreed to cooperate with PLN to build battery exchange stations. 500 stations are in operation in Java and Bali as of the end of 2022.

(8) Ilectra Motor Group (Alva)

Indika Energy is diversifying from the coal business and has established Ilectra Motor Group, a manufacturer of electric motorcycles in 2022. Co-financiers are Indonesian venture capital firm Alpha JWC Ventures and Hong Kong-based Horizons Ventures (Figure 3-9). The price is relatively high at 300,000-400,000 rupiah (2,898-3,864 yen), but the Italian design has been well received by motorcycle enthusiasts. Indika is building a manufacturing facility in Cikarang, West Java, with an annual production capacity of 100,000 units starting in late 2022. Sales in 2023 were 2,354 units, ranking 9th in the industry. Indika has also formed a joint venture with Taiwanese tech giant Foxconn[9] and has agreed to invest in commercial vehicle and battery production.



Source: Prepared by the Survey Team from newspaper reports and other sources.

Figure 3-9 Indika Energy Group's electric vehicle business

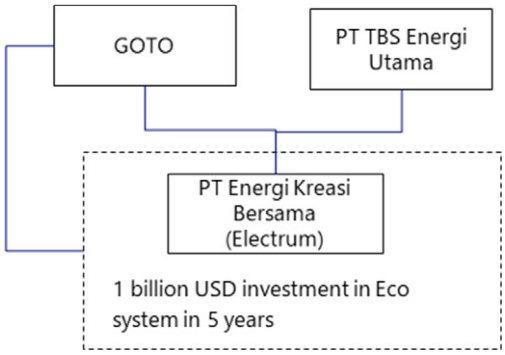
(9) Astra Honda Motor (Honda)

In November 2022, Astra Honda Motor announced plans to increase electric motorcycle sales in Indonesia to 1 million units per year by 2030 and to launch a combined seven models by 2030. Two of these models, the Honda EM1 e: and EM1 e: Plus, battery-replaceable electric motorcycles, were launched in December 2023. These two models are eligible for the battery replacement service provided by PT HPP Energy Indonesia (HPP), and customers can apply for the service on HPP's website after purchasing the electric motorcycles. The sales volume of these two models is undisclosed, but it can be inferred that the sales volume is small since there are very few vehicles seen running in the city compared to other electric motorcycle manufacturers.

(10) PT Energi Kreasi Bersama (Electrum)

Energi Kreasi Bersama is a joint venture between PT GoTo Gojek Tokopedia Tbk (GOTO) and energy company PT TBS Energi Utama Tbk (TOBA), which markets the Electrum electric motorcycle brand (Figure 3-10). The company is working with Pertamina to provide swapping station services at Pertamina's gas stations. The company will invest US$1 billion (about 156.7 billion yen) to start construction of a plant with an annual production capacity of 250,000 units in Cikarang, West Java, in June 2023, with operations scheduled to begin within 2024. Electrum plans to supply all of the electric motorcycles used by parent company GOTO's Gojek by 2030, with recent plans to sell 500,000 units by 2025. Meanwhile, GOTO and TOBA have announced plans to invest about $1 billion (approx. 156.7 billion yen) over five years starting in 2024 to support the development of Indonesia's electric vehicle ecosystem.

[9] Hon Hai Technology Group is well known in Japan. The world's largest electronics manufacturing service provider (EMS)



Source: Prepared by the Survey Team from newspaper reports and other sources

Figure 3-10 Electrum's Shareholder Composition

3.3.2 Trends in industry associations

In Indonesia, motorcycle-related industry associations include AISI (Association of Indonesian Motorcycle Industry) and AISMOLI (Association of Indonesian Electric Motorcycle Industry), and there is also PERIKLINDO (Electric Vehicle Industry Association), which has members of both electric motorcycles and automobiles.

Established in 1971, AISI is the oldest motorcycle-related industry association, with a total of five members: four Japanese motorcycle manufacturers (Honda, Yamaha, Kawasaki, and Suzuki) and one other company (Indian-affiliated TVS). AISI is a member of FAMI, the international motorcycle organization, and is the Indonesian counterpart of Japan's JAMA (Japan Motorcycle Manufacturers Association). is run by members who focus on internal combustion engine vehicles, and no startup electric motorcycle manufacturers are members.

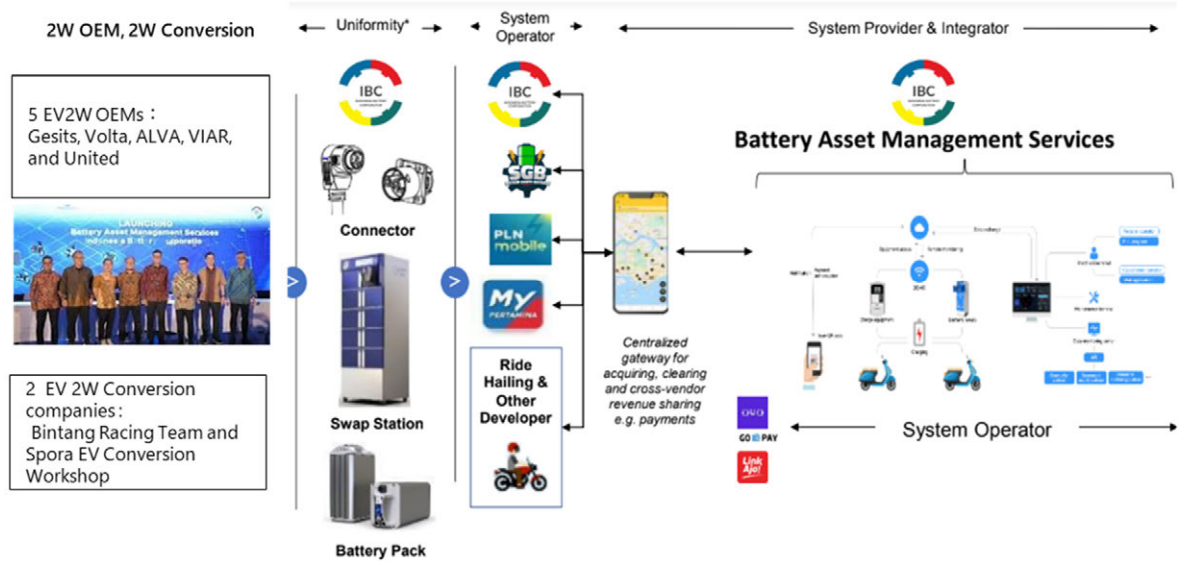
AISMOLI was established in January 2022 and has 26 members (as of July 2024), mainly emerging electric motorcycle manufacturers; with over 50 motorcycle manufacturers registered, this means that about half of them are members. Only 24 companies have their names published on the website, and major local companies such as Volta, Gesits, Smoot, and Alva are members (see Figure 3-11).

Figure 3-11 AISMOLI Member Companies

The Indonesian Electric Vehicle Association PERIKLINDO was established in April 2022 mainly by electric vehicle (four-wheel) manufacturers such as Wuling and DFSK, both Chinese companies, and MAB, a local bus manufacturer, but also by electric motorcycle manufacturers Smoot, Benelli, HTM, battery manufacturers, A wide range of related companies, including workshops, are members. The main activity is the Periklindo Electric Vehicle Show (PEVS) organized by PERLIKINDO every May, which is the largest electric vehicle motor show in Indonesia, attended by both association and non-association members. The association is headed by Mr. Moeldoko, Chief Advisor to the President, who has a strong influence on Indonesia's electric vehicle policy.

3.3.3 Trends in Industry AssociationsTrends and Future Issues for Unification of Standards and Criteria in the Industry

In July 2023, IBC, in cooperation with five electric motorcycle manufacturers and two internal combustion engine to electric motorcycle conversion service companies, agreed to establish Battery Asset Management Service (BAMS) system (see Figure 3-12). BAMS is a system management that integrates physical infrastructure, such as batteries and battery exchange stations, and digital systems in a unified manner. By standardizing the infrastructure, digital systems, and batteries of electric two-wheelers, BAMS will promote the development of the electric two-wheelers ecosystem and the spread of electric two-wheelers. IBC plans to supply the batteries procured by IBC to BAMS participating companies in the future, which is expected to reduce battery costs through mass production of batteries.



Source: Prepared from IBC data

Figure 3-12 BAMS: Battery Asset Management Service Overview

The cooperation of the five OEMs in the formation of BAMS is expected to spur a move to unify the standards for swappable batteries that IBC plans to supply (see Figure 3-13). On the other hand, Smoot/Swap Energi, the largest battery swap provider, and Electrum, in which leading mobility service provider Gesits has a stake, are not members of BAMS, and it remains to be seen how far BAMS will spread in the industry in the future.

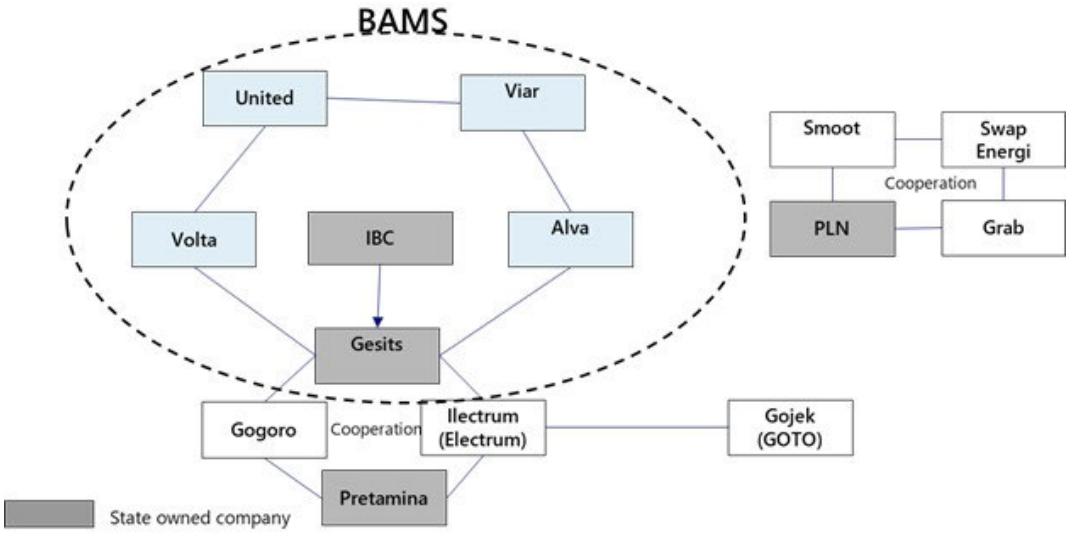


Figure 3-13 Relationship Diagram between BAMS and OEMs

While the unification of hardware, infrastructure, and system standards through BAMS is expected to lead to the development of a domestic ecosystem, it will be a challenge to determine how the companies will share the investment in future charging infrastructure development. In addition, since the battery standards and battery charging methods of each company are currently different, it will be a challenge to determine which standards will be aligned. For example, Gesits and Volta use 72V and 60V, respectively, and the former uses a top cable connection while the latter uses a bottom push connector.

Furthermore, BAMS does not include Indonesia's largest ICE motorcycle manufacturer, Astra Honda Motor, or the second largest, Yamaha, nor does it include Taiwan's Gogoro, the largest battery replacement service provider in the global market. The issue will be how to harmonize with international standards and norms, such as the Swappable Battery Motorcycle Consortium (SBMC), in which these manufacturers participate.

In other developments, in June 2023, the Asosiasi Ekosistem Mobilitas Listrik (AEML) was established, led by state-owned companies Pretamina and PLN, to bring together companies involved in the broad battery ecosystem, including electric motorcycle manufacturers, ridesharing, and charging infrastructure. (The AEML has 18 member companies in the battery ecosystem. The chairman of the Trustee Board of the association is Airlangga Hartanto (Minister of Economic Coordination), and the member of the Supervisory Board is Rachmat Kaimuddin (Deputy Minister of Maritime Investment Coordination), making it an organization established with the backing of high-level government officials. As shown in Table 3-4, AEML is characterized by the participation of a wide range of companies from upstream (mineral resource development) to downstream (ride-sharing, etc.). In addition, while BAMS is led by IBC, of which four state-owned companies are shareholders, AEML is led by state-owned infrastructure and energy companies and resource companies, as only PLN and Pertamina are members among IBC shareholders.

Table 3-4 AEML members

State-own Companies	PLN、Pertamina
Private Sectors	Mining industry: Adaro, TBS Toba Energi Utama
	Motorcycle Manufacturer: Alva, Smoot, Viar, Volta, Gesits, VKTR (Bus, Charging)
	Rideshare: Goto, Grab.
	Charging Stations: Oyika

3.4 User Trends and Issues

3.4.1 Characteristics of Users of Electric Two-Wheelers

(1) Business User

Business users refer to users who use electric motorcycles as a means of earning income, specifically drivers who provide taxi and/or delivery services through online vehicle dispatch apps such as Gojek and Grab (referred to here as "online taxi drivers").

As shown in Table 3-5, the daily mileage of business users is approximately 150-200 km. Many business users need to recharge or swappable batteries multiple times during the day, and they use electric motorcycles with swappable batteries to save recharging time. In most cases, the vehicles are rented or leased from Gojek or Grab.

Table 3-5 Characteristics of Business Users of Electric Motorcycles

Item	Contents
Purpose of Use	Revenue generation through the provision of taxi and delivery services via online vehicle dispatch apps
Distance traveled per day	Approx. 150-200 km
Types of Electric Motorcycles	In many cases, battery-swappable
Mode of Use	Often rented or leased

Source: Project team based on demand survey results

Based on the results of the demand survey discussed below, the major brands of electric motorcycles used by business users are Smoot and Volta. An overview of these brands of electric motorcycles is shown in Table 3-6.

Table 3-6 Major Electric Motorcycles used by Business Users

Brand	Smoot	Volta
Typical model	 Tempur	 401 Regular
Price	Rp 18,500,000 (178,710 yen)	Rp 16,950,000 (163,737 yen)
Driving range	60km/battery	60km/battery (*One additional battery can be added as an option)
Battery voltage and capacity	64V, 21.5Ah	64V, 21Ah
Motor power	1,500W (Max. 3,000W)	1,500W
Maximum speed	60km/h	60km/h
Dimensions (in mm)	1,925 x 870 x 1,140	1,920 x 680 x 1,100

*Prices are before the government subsidy is applied (as of May 2024).
Source: Project team based on information disclosed by each company

(2) Private User

Private users are defined as users who use electric motorcycles for personal use. In most cases, they use electric motorcycles for daily transportation, such as commuting to work, shopping, or taking their children to school.

As shown in Table 3-7, the average daily mileage of private users is about 15-70 km. Unlike business users, most private users do not need to recharge or swappable batteries during the day, so they use plug-in electric motorcycles that allow them to manage their own batteries. In most cases, they own electric motorcycles by themselves.

Table 3-7 Characteristics of Private Users of Electric Motorcycles

Item	Contents
Purpose of Use	Daily travel to and from work, shopping, taking children to school, etc.
Distance traveled per day	Approx. 15-70 km
Types of Electric Motorcycles	In many cases, plug-in type
Mode of Use	In many cases, use by self-ownership

Source: Project team based on demand survey results

Based on the results of the demand survey discussed below, Volta and Gesits are the major brands of electric motorcycles used by private users. Since an overview of Volta electric motorcycles has already been provided in the section on business users, Table 3-8 provides an overview of Gesits, Alva, and Polytron electric motorcycles.

Table 3-8 Major Electric Motorcycles used by (or interest) Private users

Brand	Gesits	Alva	Polytron
Typical Model	 G1	 one	 Fox R
Price	Rp 28,970,000 (279,850 yen)	Rp 36,490,000 (352,493 yen)	Rp 20,500,000 - 21,500,000 (198,030-207,690 yen) (*Battery not included)
Driving range	50km/battery	70km/battery	130 km
Battery voltage/ capacity	72V, 20Ah	60V, 45Ah	72V, 52Ah
Charging time	3 hours	4 hours	unknown
Motor power	2,000W (max. 5,000W)	4,000W	3,000W
Maximum speed	70km/h	90km/h	95km/h
Dimensions (mm)	1,947 x 674 x 1,135	1,960 x 755 x 1,200	unknown
Other Information	-	-	・ Battery is rented at 200,000 rupiah (1,932 yen) per month

Note: Prices are before government subsidies (as of May 2024).
Source: Project team based on information disclosed by each company

3.4.2 Characteristics of Swapping System provided by each company

(1) Overview of Battery Swapping Services

In Indonesia, battery swapping stations are referred to as SPBKLUs. According to an announcement by the Ministry of Energy and Mineral Resources (ESDM) in January 2024, there are 1,772 SPBKLUs throughout Indonesia, of which about 70% are concentrated in Western part of Java, namely in DKI Jakarta (555 SPBKLUs), West Java (367 SPBKLUs), and Banten (294 SPBKLUs).

There are also several types of battery swapping stations, as shown in Table 3-9. The most widespread type is SWAP[10], followed by VOLTA[11].

Table 3-9 List of Battery Swapping Stations in Indonesia

Type	Number of units	Remarks
SWAP	More than 1,500	Installed at gas stations, convenience stores, etc.
VOLTA	More than 300	Installed at convenience stores, SiCepat (last mile delivery service) locations, etc.
OYIKA	109	-
HPP Energy Indonesia	16	Installed at convenience stores, etc.

Source: Compiled by Project team from various sources.

(2) Overview of Each Company's Battery Swapping Service

Table 3-10 outlines the SWAP and VOLTA battery swapping services that are becoming increasingly popular in Indonesia.

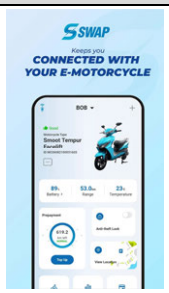
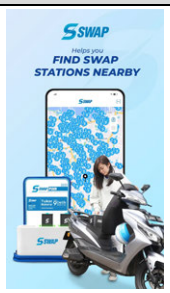
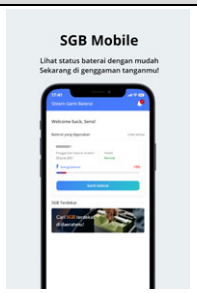
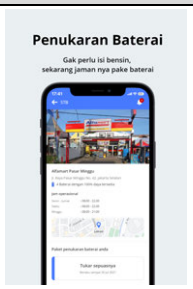
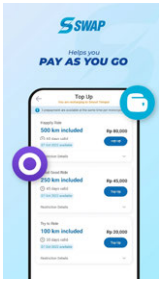
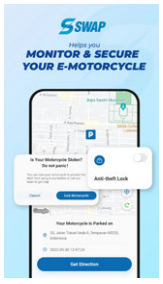
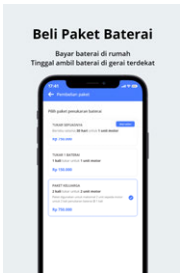
Both of these systems allow users to check the remaining battery level of their electric motorcycles and search for battery swapping stations via a mobile app. At the battery station, the user places the used battery in a designated space (in the case of SWAP) or reads a QR code (in the case of VOLTA), which opens a slot for the battery to be swapped. Battery swapping usually takes less than one minute.

Table 3-10 Overview of SWAP and VOLTA Battery Swapping Services

Item	SWAP	VOLTA
Battery swapping station	・ Two types are available: 3-slot type and 8-slot type  (3 slots)  (8 slots)	・ Number of slots varies by location 
Battery	・ Voltage/capacity: 64V 21Ah ・ Type: Lithium-ion iron phosphate battery ・ Size (mm): 177 x 140 x 338 ・ Weight: 11.5 kg ・ Motorcycle driving range: up to 60 km 	・ Voltage/capacity: 60V 23Ah ・ Type: Lithium-ion iron phosphate battery ・ Size (mm): 175 x 103 x 365 ・ Weight: 11kg ・ Motorcycle driving range: up to 60 km 
Mobile app Feature	・ Display of battery level and temperature ・ Locating and reserving a battery swapping station ・ top-up ・ Anti-theft lock	・ Display of remaining battery level ・ Locating battery swapping station ・ top-up

[10] Battery swapping station provided by Swap Energi Indonesia

[11] Battery swapping station provided by PT Volta Indonesia Semesta

Item	SWAP		VOLTA	
Mobile app Screen Image	 (Display of battery level and temperature)	 (Station location search and reservation)	 (Display of battery level)	 (Station location search)
	 (Top-up)	 (Anti-theft lock)	 (Top-up)	-
How to swap	[For 8-slot type] 1. Find station locations with the mobile app (reservations can also be made) 2. Go to the station and place the used battery in the designated space in front of the station. 3. The empty slot in the station will open and a used battery can be inserted there. 4. The slot containing the replacement battery will open and the battery can be taken from it.		1. Find station locations with the mobile app 2. Go to the station and read the QR code attached to the station surface 3. The empty slot in the station will open and a used battery can be inserted there. 4. The slot containing the replacement battery will open and the battery can be taken from it.	
Cost	160-200 rupiah (1.5-1.9 yen) per kilometer traveled		10,000 rupiah (97 yen) per exchange	
Eligible Electric Motorcycles brand	Smoot, Minerva Electron		Volta	
Other Information	・ The company plans to increase the number of 8-slot type stations in the future. ・ Home charger also sold as an accessory		-	

Source: Compiled by Project team based on publicly available information from each company and interviews with dealers.

3.4.3 Contents of Demand Survey and Its Result

(1) Overview of Demand Survey Implementation

A demand survey was conducted targeting users of electric motorcycle with the aim of clarifying future prospects and issues for the diffusion of electric motorcycles in Indonesia from the users' perspective.

(i) Discussion Points and Survey Items

This survey was conducted on the items listed in Table 3-11 with the aim of identifying objective

status of use of electric motorcycles, key purchasing factors, subjective convenience and usage experiences of users, and key issues from users' perspectives for the diffusion of electric motorcycles.

Table 3-11 Discussion Points and Survey Items

Discussion Points	Survey Item
Understanding the Actual (Objective) Use of Electric Motorcycles What are the current conditions of use of electric motorcycles and how do they differ from those of gasoline-powered motorcycles (increase/decrease in mileage, increase/decrease in maintenance, etc.)?	**Current usage** ・ Actual usage (daily mileage, frequency of battery swapping/charging, etc.) ・ Maintenance status (major replacement parts, maintenance locations, etc.) ・ Differences from gasoline-powered motorcycles (both in terms of use and maintenance) and why
Identification of Key Purchasing Factors What do users consider important when selecting and purchasing electric motorcycles?	**Key Purchasing Factors** ・ Motivation for Electric Motorcycle Use ・ Selection Criteria for Electric Motorcycles ・ Brands you consider most attractive and why
Understanding the subjective customer experience What do users think about the convenience and experience of using electric motorcycles (especially the advantages and disadvantages compared to gasoline-powered vehicles)?	**Convenience and User experience** ・ Advantages and disadvantages of electric motorcycles compared to gasoline-powered motorcycles ・ Satisfaction with batteries, battery swapping / charging, maintenance, and mobile apps
Identification of key issues for diffusion What do users consider important among the various challenges to the widespread use of electric motorcycles?	**Issues and Needs** ・ Problems you have experienced or concerns you have about electric motorcycles and batteries ・ Bottleneck Factors for the diffusion of Electric Motorcycles ・ Recommended measures

Source: Project team

(ii) Survey Target

In setting up the survey target population, users were classified from two perspectives: "user attributes" and "motorcycle type".

In terms of "user attributes," as described in (1) above, JICA Survey Team categorized users into two groups: "business users" and "private users. On the other hand, in terms of "motorcycle type," electric motorcycles were categorized into two types: "battery-swappable electric motorcycles" and "plug-in electric motorcycles," while "gasoline-powered motorcycles" and "electric bikes[12]" were also included.

(iii) Survey Methodology

This survey was conducted through a combination of offline interviews (one-on-one), online questionnaires, focus group discussions, and house visits. Since the main purpose of this survey was to identify issues from the user's perspective, the methodology was designed with a focus on obtaining qualitative information rather than statistical accuracy.

First, one-on-one offline interviews were conducted with visitors by waiting at battery swapping changing stations around town for business users of battery-swappable electric motorcycles and at gasoline-powered motorcycle users (both business and personal users) at gas stations around town for visitors.

[12] Electric bikes are battery-powered bikes and, unlike electric motorcycles, do not require vehicle registration. However, government regulations limit their speed to 25 km/h.

On the other hand, for private users of battery-swappable electric motorcycles and users of plug-in electric motorcycles (both business and personal users), an online survey was conducted because it was difficult to source survey participants using the above method.

Focus group discussions were then conducted with electric motorcycle users (both business and personal users) and electric bike users (personal users only) to gain a more detailed understanding of the actual usage and issues regarding electric motorcycles and electric bikes. In addition, house visits were conducted to personal users of electric motorcycles to understand the actual conditions and issues related to charging electric motorcycles at home.

For the details of survey target and methodology as well as survey schedule and locations, please refer to "Appendix 1: Demand Survey".

(2) Demand Survey Results

The following are the findings of the demand survey regarding the current use of electric motorcycles in Indonesia, as well as prospects for their widespread use and issues to be addressed. For details of the survey results, please refer to Appendix 1: Demand Survey.

(i) Although the use of battery-swappable electric motorcycles is increasing among business users, the frequency of battery swapping is high due to concerns about battery quality, etc.

- Business users are increasingly using electric motorcycles with swappable batteries that save recharging time. Business users travel 150-200 km per day, and swappable batteries on average 5 times per day (i.e., after traveling approximately 30-40 km).
- This is due to concerns about battery quality, such as the possibility that the remaining battery charge may suddenly drop and the motorcycle may stop midway through the trip. However, this behavior may in fact cause a negative cycle: more frequent recharging, battery degradation, reduced driving range, more frequent recharging, and so on.

(ii) Plug-in electric motorcycles are becoming popular among wealthy individuals and early adopters.

- Private users use motorcycles for daily use, such as commuting, and prefer plug-in models that allow them to manage their own batteries, since the mileage is short and there is little need to choose a battery-swappable model.
- The most important factors for persona; users when purchasing electric motorcycles are "mileage per battery" and "charging time". Recently, brands with long mileage such as Polytron (mileage per charging: 120~130km) have been well received.
- Charging is performed once a day for 2-3 hours at night (charging from 30~50% battery level to 100%) at home in many cases. During the house visit survey, no complaints of power outages occurring or other problems were heard. It seems that the 2,200W contracted power at home is enough to charge the electric motorcycles almost without any problems.
- Private users of electric motorcycles are currently the affluent and early adopters (sensitive to new things and trends), and they select brands based on price, functionality, performance, as well as appearance and reputation. The major issue in the future will be whether the adoption of electric motorcycles will expand not only to early adopters but also to the majority of the population.

(iii) Although electric motorcycles have been in use for only a short period of time and have not caused any major problems, problems may occur in the future due to battery quality deterioration.

- For both business and private users, the current usage period of electric motorcycles is

generally short, ranging from six months to one year. For business users, maintenance support is provided by Grab and Gojek, and for private users, no major maintenance problems have arisen because the motorcycles are still within the warranty period.

- In terms of use, many positive comments were heard, such as savings in running costs compared to gasoline-powered motorcycles, while no major complaints were expressed.
- However, as the period of use lengthens, problems associated with battery quality deterioration in particular (safety issues and economic issues such as lower resale prices of used electric motorcycles) may arise and become a bottleneck in the diffusion of electric motorcycles. In the survey, the expected resale price was not necessarily high (less than 60% of the purchase price after 5 years), and many respondents indicated that they wanted to use their electric motorcycles as long as possible (until it breaks down), so it appears that not many users expect to sell their used electric motorcycles in the future.

(iv) The amount of purchase subsidy from the Indonesian government is sufficient. Challenges to diffusion include: (1) expansion of swap/charging station infrastructure, (2) performance improvement, and (3) enhancement of maintenance and parts supply system.

- Many users answered that the Indonesian government's purchase subsidy (7 million rupiah) for electric motorcycles is sufficient, and price is not considered to be a major issue.
- The most frequently cited issues for diffusion are: (1) expansion of swap/charging station infrastructure (increase in the number of stations, even distribution, extension of operating hours, etc.), (2) performance improvement (increase in battery range, horsepower, etc.), (3) enhancement of maintenance and parts supply system (especially outside of Jakarta). The government should focus on addressing these issues.

(v) It is also important to educate citizens about the quality and safety of electric motorcycles. The release of Japanese-brand electric motorcycles could be a catalyst for changing the mindset of citizens.

- In addition to the above issues, many users of electric motorcycles said that the general public is not fully aware of electric motorcycles and that concerns about the quality and safety of electric motorcycles (e.g., that they might explode suddenly or break down in heavy rain or floods) could be a bottleneck in their diffusion. Many respondents said that they were concerned about the quality and safety of electric motorcycles.
- Therefore, in order to popularize electric motorcycles among the majority of the population, it is important to conduct educational activities to eliminate the above concerns. Many people also expressed hope for electric motorcycles of Japanese brands, and the release of an electric motorcycle under a Japanese brand that has already earned the trust of gasoline-powered motorcycles would provide an opportunity to change the mindset of the public.

(vi) Demand for converting gasoline-powered motorcycles to electric motorcycles has been strong among users who want to save money on gasoline while retaining their existing motorcycle bodies. However, there is a problem that they are no longer covered by dealer maintenance.

- The main motivation for converting gasoline-powered motorcycles to electric motorcycles is to save on gasoline while retaining the body of the existing motorcycle (mostly Japanese brands). Although the cost of conversion is about IDR15-20M (without subsidy), demand for conversion is growing steadily, especially among the younger generation.
- The number of users of government subsidies for conversion is still low. To receive

government subsidies, workshops need to be government certified, but due to the high cost of installing the equipment required for such certification (IDR 500M+), small workshops are providing conversion services without government certification and without subsidies.

- After conversion, the motorcycle is no longer eligible for dealer maintenance, and some users are concerned about this. The risk that a motorcycle that could be resold for a reasonable price without conversion will have its value significantly reduced due to conversion, and this could be a bottleneck to the widespread use of conversion in the future.

(3) Implications from the Survey Results

Based on the results of the above demand survey, the following implications can be drawn.

- Business users who mainly rent or purchase replacement battery-powered motorcycles from OJEK operators (Grab, Gojek, etc.) enjoy the economic benefits of simplified maintenance, but the limited number of battery swapping stations hinders ease of use. If the number of swapping stations can be set up in line with traffic demand and motorcycle supply, and if there are no problems for OJEK operators or swapping station operators to continue their business, the business use of battery-swappable electric motorcycles will have the potential to spread.
- Plug-in electric motorcycles are purchased mainly by private users, but their use period after purchase is short and is still covered by warranty. Therefore, no major problems have been reported during the survey.
- About half of the personal users surveyed owned a main gasoline-powered motorcycle and used an electric motorcycle as a second vehicle. Therefore, it cannot be said that electric motorcycles are replacing gasoline-powered motorcycles at present, but there is a good possibility that electric motorcycles with a longer mileage will spread in the future due to improved battery performance, and that they will replace gasoline-powered motorcycles.
- In addition, there is a risk that the value of these motorcycles will decline significantly in a few years' time compared to gasoline-powered motorcycles, which can be used continuously for a long period of time, due to battery quality deterioration, availability of battery swapping guarantees, and other sales conditions, and depending on market conditions a few years later, a decline in demand from private users may occur. Depending on market conditions over the next few years, there is a possibility that a decline in demand from private users may occur.
- JICA Survey Team have confirmed that there are a small number of private users of battery-swappable electric motorcycles and a certain number of business users of plug-in electric motorcycles.
- For private users of battery-swappable electric motorcycles, it is necessary to either use them for routine neighborhood transportation or to systematically replace the batteries by checking the replacement points in advance when going on long trips. It is believed that the generalization of this usage still needs to wait for the development of external conditions, such as the establishment of swapping stations, etc.
- Business users who use plug-in electric motorcycles are constrained by the charging time, so they charge at night, resulting in a daily mileage limitation. Business users can use plug-in electric motorcycles if they have a business model that allows them to conduct their business within these restrictions (e.g., delivery of food and goods to nearby areas).
- There is a certain demand for the conversion of gasoline-powered motorcycles to electric motorcycles among users who want to save money on gasoline while retaining their existing motorcycle bodies. However, there is the problem of the vehicle no longer being covered by dealer maintenance after conversion. Therefore, whether incentives (government subsidies, etc.) can be provided to compensate for the risk of a significant decrease in the value of the vehicle due to conversion is considered a challenge for future diffusion.

3.5 Status of Related Infrastructure and Issues

3.5.1 Gas Station

In Indonesia, the state-owned oil company Pertamina supplies fuel for mobility throughout the country, operating 7,868 gas stations as of the end of 2022. At the end of 2020, the number of locations was 5,518, indicating an increase of more than 2,000 locations in two years.

Source: https://www.pertamina.com/Id/news-room/news-release/optimalkan-suplai-energi-spbu-pertamina-di-wilayah-jawa-tengah-dan-di- yogyakarta-terapkan-digitalisasi-spbu

Figure 3-14 Plutamina-operated gas station

Pertamina also operates Pertashops, which are smaller than gas stations, in 6,152 locations nationwide as of the end of 2022, mainly in suburban and rural areas. The number of these pullout stores was 4,308 at the end of 2020, so the number increased by about 1,800 over the following two years until 2022.

Source: https://www.pertamina.com/id/news-room/news-release/energi-berkualitas-dari-layanan-pertashop-diminati-masyarakat-papua-barat

Figure 3-15 Plutamina Operated Plutashop

Non-Pertamina operated gas stations such as Shell (222 only in Java as of January 24, 2024) and BP (42 only in Java as of January 24, 2024) exist mainly in urban areas of Java.

There are also small fueling facilities called "Pertamini" (unrelated to Pertamina in terms of sales business) and small distributors who sell fuel in glass bottles or plastic bottles nationwide. Although there are many unauthorized and illegal businesses, they are an important means of supplying fuel in mountainous areas and islands where gas stations such as Pertamina do not operate.

Source: https://otomotif.tempo.co/read/1608918/pertamini-harus-daftar-mypertamina-untuk-kulakan-pertalite

Figure 3-16 Small Fueling System

Source: https://otomotif.kompas.com/image/2020/08/05/142100815/amankah-mobil-minum-bensin-eceran-?page=3

Figure 3-17 Sales of Gasoline on the Road

With these fuel-sharing networks stretching from urban areas to mountainous regions and islands, motorcycles and automobiles in Indonesia are able to travel everywhere without the possibility of not being able to refuel.

The rapid increase in the number of gas stations in Indonesia is due to the growing demand for fuel resulting from strong sales of motorcycles and automobiles in Indonesia.

According to the Association of Indonesian Motorcycle Industry (AISI), Indonesia's motorcycle sales volume, after a primary decline due to COVID-19, has gradually recovered and is expected to reach its pre-COVID-19 level of over 6 million units by 2023 (see Table 3-12).

Table 3-12 Motorcycle Sales and Exports (AISI)

Year	Domestic Sales	Number of units exported
2019	6,487,460	810,433
2020	3,660,616	700,392
2021	5,057,516	803,931
2022	5,221,470	743,551
2023	6,236,992	570,004

Source: Prepared by the Survey Team from information provided on the AISI website. (https://www.aisi.or.id/statistic/)

As for four-wheeled vehicles, although sales declined significantly in 2020, they have almost recovered to the pre-COVID-19 level of over 1 million units in 2022 (Table 3-13).

Table 3-13 Motorcycle sales and exports

Year	Domestic Sales	Number of units exported
2019	1,030,126	332,023
2020	532,027	232,175
2021	887,202	294,639
2022	1,013,582	473,602
2023	998,059	505,134

Source: Prepared by the Survey Team from information provided on the GAIKINDO website.
(https://www.gaikindo.or.id/indonesian-automobile-industry-data/)

3.5.2 Electric Power

By the end of 2022, Indonesia's total installed generation capacity amounted to 81 GW, of which 48.04 GW (60.7%) comes from the state-owned power company PT Perusahaan Listrik Negara (PLN), 20.18 GW (26.5%) from independent power producers, 5.64 GW (7.7%) from business license holders, 3.58 GW (5.1%) from private companies (factories, etc.), and the remaining 55 MW (0.01%) are governments.

Electricity demand in Indonesia has been increasing year by year. Indonesia's electricity demand increased by 5.69% from 2020 to 2021, with a total consumption of 310.06 TWh. From 2000 to 2021, Indonesia's electricity demand increased by 216.29% .

Although Indonesia has achieved an electrification rate of 99.78% , there are many areas on islands where electricity is supplied through the grid only for a few hours when diesel generators are in operation, and lighting and other equipment is used during the rest of the day using electricity stored by solar power generation.

3.5.3 Battery charging and exchanging stations

By the end of 2023, there will be 932 registered battery charging stations (SPKLU) and 1,772 registered battery exchanging stations (SPBKLU) throughout Indonesia. This is about 2.5 times the target (1,035 SPKLUs and SPBKLUs combined)of the Ministryof Energy and Mineral Resources (ESDM) of Indonesia. Below are the main operators and related information for SPKLU and SPBKLU.

Table 3-14 Major Battery Charging Stations in Indonesia

Service Providers	Charging station locations	Service Area
PLN	411	Major cities nationwide
Green Energy Station (Pertamina)	4	Jakarta, Tangerang
Astra Otopower	14	Jakarta metropolitan area, West Java, East Java

Source: Prepared by the Survey Team

Table 3-15 Major Battery Replacement Stations Installed in Indonesia

Service Providers	Exchange Station Locations	Service Area
SWAP ID/Smoot	Approx. 1,500	Major cities nationwide
SGB/Volta	131	Jakarta metropolitan area, Bandung, Semarang, Cirebon, Surakarta
Oyika	109	Jakarta metropolitan area
HPP Energy Indonesia/Astra Honda Motor	15	Jakarta

Source: Prepared by the Survey Team

3.6 Trends and Issues in Strengthening Production and Supply Chain in Japan

JICA Survey Team summarize the trends and issues related to the strengthening of the electric motorcycle production and supply chain of Astra Honda Motor (AHM), the Japanese motorcycle manufacturer with the largest market share in terms of sales volume in Indonesia.

3.6.1 Trends in Strengthening Production and Supply Chain in Indonesia

AHM published its electrification roadmap to 2030 in November 2022. A summary is as follows.

Roadmap for electrification by AHM

- Introduce a total of seven electric motorcycle models to the market by 2030 (two models in 2023, two models in 2024, and then three models by 2030)
- Two types of batteries are planned to be introduced: one that directly charges the vehicle's onboard batteries and another that replaces the batteries.
- 1 million electric motorcycles are planned to sell annually by 2030.
- AHM's electric motorcycles will be developed with the highest priority on quality and durability.
- Gradually increase the local procurement rate of electric motorcycle-related parts, including battery replacement infrastructure, and invest in the construction of a new production line in Indonesia.
- Strengthen relationships with local parts suppliers and others in Indonesia, and enhance human resource development for engaged employees.
- Develop a sales and after-sales service network as well as a manufacturing ecosystem for electric motorcycles.
- Note that AHM's roadmap to 2030 is in line with Honda Motor's goal of achieving carbon neutrality for Honda brand motorcycles worldwide by 2040.
- Honda Motor aims to launch more than 10 global models of electric motorcycles by 2025 and to reach 1 million electric motorcycles sold worldwide in the next five years (by 2027) and 3.5 million by 2030

As indicated in the roadmap above, AHM is launching the EM:1e and EM1e:PLUS (electric motorcycles) to the public in December 2023. A summary of the EM:1e and EM1e:PLUS is as follows;

A summary of the EM:1e and EM1e:PLUS

- It is manufactured in Indonesia (at the AHM factory in Pegangsaan, North Jakarta), utilizing the Indonesian domestic supply chain for parts, etc., and has achieved a domestic procurement rate (TKDN) of over 40%. Therefore, it is eligible for government subsidy (7 million Indonesian rupiah, about 70,000 yen) for the purchase of electric motorcycles, which enables it to purchase EM1e: for 33 million Indonesian rupiah (about 330,000 yen) and EM1e:PLUS for 33.5 million Indonesian

rupiah (about 335,000 yen).

- EM1e: and EM1e:PLUS can choose to charge the battery at an off-board charger or replace it at a battery swapping station.
- The MPP e: (battery) used in EM1e: and EM1e:PLUS has an IP65 rating and is resistant to dust and water from all directions. It has also acquired the international standard UNR136 for the MPP e:.
- AHM will build a comprehensive ecosystem, from high-quality production processes to the provision of dedicated after-sales service through Honda e:shop dealers.

In addition, AHM will exhibit the SC e: Concept equipped with two MPPe: at IIMS 2024 (Indonesia International Motor Show 2024) in February 2024, attracting much attention for its sales.

Thus, AHM, which has started production and sales of electric motorcycles to the general public in line with the 2030 roadmap, is strengthening cooperation with local parts suppliers to achieve a domestic procurement rate (TKDN) of 40%, and is also working to build a comprehensive ecosystem that leverages its sales and after-sales service network The company is also working to build a comprehensive ecosystem by leveraging its sales and after-sales service networks.

Yamaha Indonesia Motor Manufacturing, which has the second largest market share in Indonesia, has not yet decided on sales of electric motorcycles in Indonesia, and is currently assessing the timing of market development by gathering user feedback through test rides at major dealers[13]. However, as with AHM, the company plans to launch a new electric motorcycle in the 2030s. However, like AHM, the company exhibited a concept vehicle at IIMS2024 in February 2024, indicating that as a major manufacturer in the Indonesian market, it is essential to consider the trend toward electrification.

3.6.2 Issues in Strengthening Production and Supply Chain in Indonesia

As for issues to be addressed to strengthen domestic production and supply chain, it can be said that the issues to be addressed by all electric motorcycle manufacturers, including AHM, are to increase the ratio of domestic production, provide after-sales service, and improve infrastructure for charging and replacement of batteries, as shown in 2.4.3.

In order to improve the domestic production ratio, the Indonesian government is working together to promote the domestic production of batteries, i.e., to establish a domestic production system from the stage of cells or even earlier (upstream) materials, rather than importing cells from China and packing them in Indonesia or importing finished batteries, as is currently the case. The Indonesian government is working in unison to promote the establishment of a domestic production system. However, it is difficult for the Indonesian government, state-owned enterprises, and local private companies to develop such a system on their own, so all stages are being promoted mainly through cooperation (joint venture) with Chinese or Korean companies.

For example, the Morowali Industrial Park in Indonesia's Central Sulawesi Province was developed in 2013 with funding from China Development Bank, China Exim Bank, Industrial and Commercial Bank, and Chinese stainless steel giant Aoyama Holdings, which supplies nickel especially for electric vehicles. In addition, the company is assisting Indonesia with the infrastructure needed to process nickel (e.g., coal-fired power plants) in the context of China's "One Belt, One Road" initiative. This has increased Indonesia's nickel-related exports from USD 6 billion as of 2013 to approximately USD 30 billion in 2022 due to increased value added from refinin[14].

In addition, the country is promoting the attraction of EV battery manufacturers by establishing a materials production system, and European companies such as BASF and Eramet are considering investment, while South Korea's Hyundai Motor and LG, as PT Hyundai LG Indonesia (HLI) Green Power, a joint venture with IBC, will start production in 2024 The first phase of the project, around

[13] https://voi.id/ja/aktual-ja/337574

[14] https://www.internationalaffairs.org.au/australianoutlook/indonesias-nickel-supremacy-chinas-backing-and-australias-decline/

May, will start up a 10GWh-scale plant in Karawang, West Java, which will produce about 32.6 million battery cells for approximately 150,000 electric vehicles. The investment for the first phase is estimated at 1.1 billion USD, and the second phase, which is scheduled to be completed by 2025, will expand the production capacity to 20 GWh, with a total investment of 3.1 billion USD[15]. The plant will create approximately 1,000 jobs, and the second phase is expected to employ an additional 1,800 people.

This cooperation between IBC and Hyundai has spilled over into the production of electric motorcycles, with IBC and its subsidiary Gesits, utilizing the supply chain they have established, and Hyundai Kefico, which produces battery management systems, motors, and other components, announcing cooperation in the development and production of high-quality, inexpensive electric motorcycles[16].

In this way, the Indonesian government has formed partnerships with Chinese and Korean companies to build battery-related supply chains, and Chinese and Korean companies are developing their businesses within the supply chains established in these partnerships. On the other hand, Japanese firms are not expected to collaborate with local IBCs like the Chinese and Korean firms mentioned above by 2024, which will make it difficult for Japanese firms to stably procure electric motorcycles, batteries, and other products when they need to do so in Indonesia. The issue for Japanese motorcycle and battery manufacturers entering the Indonesian market will be how to establish their own local supply chains or how to utilize existing supply chains in cooperation with local firms.

3.7 Trends of Companies in Related Services

3.7.1 Gojek (ride-sharing service provider)

Gojek plans to replace the ICE motorcycles of Gojek drivers (approx. more than 2 million as of 2023) with electric motorcycles by 2030. Gojek has established PT Energi Kreasi Bersama (Electrum), a joint venture with PT TBS Energi Shoutam Tbk, a manufacturer of electric motorcycles, and has started construction of a plant in Cikarang, West Java, at the end of June 2023. The plant is expected to be completed in mid-2024 and to produce approximately 250,000 units per year.

3.7.2 Grab (ride-sharing service provider)

As mentioned above, Grab emphasizes after-sales services such as repairs, etc. As of July 2023, Viar had the largest number of electric motorcycles installed, approximately 6,000 (of which only a few hundred are battery swapping types in Medan), followed by SWAP ID with approximately 2,000 and Kymco (Taiwan) with approximately about 180 units. In November 2023, Grab adopted a new Viar model, the Viar N2, in Medan.

3.7.3 Pos Indonesia (Postal and delivery service)

Pos Indonesia is trialing 300 electric motorcycles and more than 10 electric vehicles for courier and logistics services in areas including Jakarta, Surabaya, Yogyakarta, and Bali in 2023.

3.7.4 Finance Service for Electric Motorcycles

As of May 2024, the following financing companies provide financing services for installment sales of electric motorcycles (see Table 3-16).

[15] https://www.just-auto.com/news/new-indonesia-battery-plant-starts-in-april/

[16] https://otomotif.kompas.com/read/2024/05/03/164339515/gesits-ibc-dan-hyundai-kefico-kolaborasi-bikin-motor-listrik-murah

Table 3-16 Major Companies Providing Finance Services for Electric Motorcycles in Indonesia

No.	Finance Company	Applicable Brands
1	Adira Finance	Any Brand
2	DSF	Smoot
3	BCA Multifinance	Polytron、United、W Moto、Smoot、Volta、Alva、Selis
4	PT BFI Finance Indonesia	Selis, Alva, Smoot, United, Volta, Sabar
5	PT BRI Multi Finance Indonesia	Volta
6	FIF Finance	Astra Honda Motor
7	WOM Finance	Volta、Gesits、Selis、Rakata、Alessa、Alva One、Davigo、Smoot
8	AEON Credit Service Indonesia	Any Brand

Source: Survey Team

In addition to these financing services for installment sales, some companies, such as PT Mitsubishi HC Capital's Indonesian subsidiary Arthasia Finance (AAF), are also engaged in leasing electric two-wheelers (Smoot) to corporate customers to support Indonesia's decarbonization efforts. business from October 2022, and is increasing the number of manufacturers it handles, including the provision of 150 Volta vehicles to AstraZeneca in October 2023.

According to the OJK (Indonesian Financial Supervisory Agency), several multi-finance and leasing companies offer financial services for electric vehicles/electric two-wheelers as mentioned above, but only 1~4% of the total amount of loans for ICE four-wheelers/two-wheelers. The following points have been cited as the reasons for this trend.

- The battery price factor is very important, making it difficult to estimate the collateral value of electric vehicles.
- Limited charging stations and service infrastructure.
- The used market is immature, and there are concerns that the sales value of electric four-wheelers/motorcycles will decline.

3.7.5 Conversion Workshop

In Indonesia, vehicle insurance policies for ICE motorcycles are sold by various insurance companies, all of which provide insurance coverage within the premium rates set by the OJK, but as of May 2024, no insurance premium rates specifically for electric motorcycles have been set. Based on the call for a separate insurance premium rate for electric motorcycles, which are generally more expensive than ICE motorcycles but also receive subsidies to promote their use, the OJK has been studying the possibility of a separate insurance premium rate for electric motorcycles.

By May 2024, the insurance companies selling insurance products as vehicle insurance for electric motorcycles include Asuransi Sinarmas, PT Solusiutama Tekno Broker Asuransi, Adira Insurance, Sompo Indonesiai, Zurich There are many insurance companies, both local and foreign, that sell insurance products for electric motorcycles, including Asuransi Sinarmas, PT Solusiutama Tekno Broker Asuransi, Adira Insurance, Sompo Indonesia, and Zurich Indonesia.

3.7.6 Conversion Workshop

The number of conversion workshops accredited by the Ministry of Energy and Mineral Resources remains at 15 as shown in Table 3-17 .While ESDM is promoting the increase of accredited workshops, a number of conversions are taking place at workshops that are not accredited, such as Motoriz (PT. SEMESTA MOTOR INDONESIA), which this project team visited. While ESDM is promoting an

increase in the number of accredited workshops, there are also many conversions at non-accredited workshops, such as Motoriz (PT. SEMESTA MOTOR INDONESIA), which this project team visited. Although conversions at non-accredited workshops do not receive subsidies, users can enjoy the benefits of electrification, such as reduced fuel costs and access to battery replacement services.

Table 3-17 Conversion Workshops accredited by ESDM

Workshops	City	Business Entities
VOLTO MECHANIX	KOTA DENPASAR	PT. PERCIK DAYA NUSANTARA
Elders Garage	KOTA ADM. JAKARTA SELATAN	PT Roda Elektrik Asia
PT Cogindo DayaBersama	KOTA CIREBON	PT Cogindo DayaBersama
PT.Mitrametal Perkasa	KAB. KARAWANG	PT.Mitrametal Perkasa
ELECTRIC WHEEL	KOTA DENPASAR	PT RODA ELEKTRIK GEMILANG
PT Ekolektrik Konversi Mandiri	KOTA SURAKARTA	PT Ekolektrik Konversi Mandiri
QUEST	KOTA BANDUNG	PT Ide Inovatif Bangsa
Bengkel Konversi SOI	KAB. BEKASI	PT. Saikono Otoparts Indonesia
PT Braja Elektrik Motor	KOTA SURABAYA	PT Braja Elektrik Motor
PT ELECTRIC VEHICLE TRIMOTORINDO	KAB. TANGERANG	PT ELECTRIC VEHICLE TRIMOTORINDO
PT TECO MULTIGUNA ELEKTRO	KAB. BOGOR	PT TECO MULTIGUNA ELEKTRO
SR ELECTRIC	KOTA MOJOKERTO	PT. SARANA MAKMUR SEJAHTERA
NAGARA	KOTA ADM. JAKARTA SELATAN	PT Nagara Sains Konversi
BRT Electric	KAB. BOGOR	PT. Tri Mentari Niaga
ATR	KOTA ADM. JAKARTA PUSAT	PT. BINTANG MAS LESTARI

Source: Made by Survey Team based on ESDM website.

However, as of the end of 2023, the number of subsidized conversions was only 181 units[17], far short of the target of 50,000 conversions. The target for 2024 is to convert an even greater 150,000 vehicles, and to achieve this goal, the company is using funds raised through corporate CSR activities to cover costs not covered by subsidies[18], and is promoting the training of mechanics who will be responsible for work at certified workshops and workshops[19].

3.8 Impact of Electrification Policy

3.8.1 Characteristics of Companies Affected by Electrification

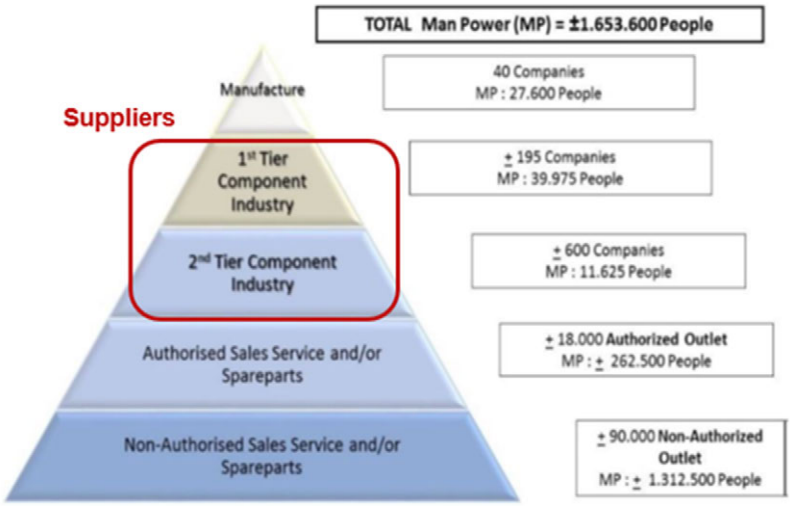
There are 1,550 auto parts suppliers in Indonesia, of which 500 are Tier 1 and 1,000 are Tier 2. Of the 210 member companies of GIAMM, about half are Japanese-affiliated or jointly owned with Japanese companies; the majority of Tier 2 and Tier 3 companies are local companies; and 135 companies are members of PIKKO, an SME parts industry association composed of Tier 2 and Tier 3 suppliers. The localization of components has progressed to some extent, as Tier 1 companies are mainly Japanese and Tier 2 companies are also increasing their local manufacturers. Many of the components imported at the Tier 1 and Tier 2 levels are centrally manufactured parts such as ECUs for electronic components, transmission-related gears, and ABS (Anti-lock braking system). On the other hand, little progress has been made in the localization of materials such as steel and plastics.

[17] https://lestari.kompas.com/read/2024/01/18/190000786/target-50.000-unit-baru-181-insentif-konversi-motor-listrik-pada-2023

[18] https://www.viva.co.id/otomotif/1711080-ikut-konversi-motor-listrik-gratis-ujung-ujungnya-disuruh-bayar?page=3

[19] https://voi.id/en/economy/377316

In the Indonesian motorcycle industry, production of parts for conventional internal combustion engines is expected to decline due to the trend toward electrification of motorcycles. In particular, engine-related parts such as engine blocks, engine heads, crankshafts, and intake and exhaust systems, as well as drive and transmission parts such as transmissions and fuel tanks, and steering system parts such as clutch levers will be affected. Many of the affected parts are critical safety parts, and Japanese suppliers will be responsible for the production of critical safety parts, which require high technology and durability. In addition, the Indonesian motorcycle industry has a workforce of approximately 50,000 people at Tier 1 and Tier 2 suppliers. Therefore, a decrease in production of parts for internal combustion engines at both Japanese and local suppliers of parts for motorcycles, including those for automobiles, is expected to have an impact on corporate sales as well as a significant decrease in employment, which could affect Indonesia as a whole, whose manufacturing industry accounts for approximately 20% of its nominal GDP. In order to understand the impact, the Survey Team conducted interviews and questionnaires with Japanese and local parts suppliers. (refer to Appendix 2 for the responses from each company.)



Source: GIAMM

Figure 3-18 verview of the Indonesian mmotorcycle industry

(1) Target of the survey

As of the end of April 2024, a cumulative total of 32 component suppliers (12 Japanese and 20 local) were interviewed online or in person.

(2) Result of the survey

Indonesia has set a goal of having approximately 3 million of its 15 million motorcycle sales/year be electric motorcycles by 2035. However, since the annual sales volume is only 20,000 units as of June 2023, and parts suppliers are still receiving many inquiries for parts for internal combustion engines, few companies are directly affected by the shift to electric vehicles, and both Japanese and local companies do not expect any major impact from the shift to EVs. Many companies, both Japanese and local, do not expect any major impact from EVs. On the other hand, many companies are concerned about the impact on their business as electric two-wheelers become more widespread, and this is especially true for local companies. Therefore, many companies are responding to the shift to EVs by developing new businesses and fields that utilize existing technologies. For example, Japanese companies are developing parts for motorcycles by utilizing their existing muffler vendor technology for four-wheeled vehicles and developing chains for industrial machinery from the manufacture of timing chains for motorcycles. Some local firms are taking advantage of the spread of electric motorcycles to shift from the traditional "copy to make" business model to a "product" business model, which is expanding into new fields such as electric motorcycle frames and electric vehicles. In terms of employment, many local suppliers are already working to reduce their workforce by investing in

production automation to improve productivity, and many companies point out that electrification will have little impact on employment. JICA Survey Team also interviewed companies about their policy expectations of the government and confirmed that both Japanese and local companies need governmental support for business matching and the deregulation of material imports to facilitate expansion into new businesses and sectors. Additionally, there are expectations for the government to formulate a concrete and realistic roadmap for the expansion of electric two-wheeled vehicles based on dialogue with industry and to lead the development and expansion of charging infrastructure. Furthermore, there were requests to improve the quality of curricula in collaboration with local universities and to promote matching with engineers to develop human resources, specifically mechanical engineers and production technology engineers, at manufacturing bases.

Considering the above, although many companies have not been significantly affected by electrification for the time being, both Japanese-affiliated and local companies are working on their own strategies to cope with electrification. Specifically, both companies are aiming for two types of business development: (1) development of new products and new businesses, and (2) process sophistication. Furthermore, some companies are aiming to achieve both (1) and (2) at the same time. Japanese companies are looking for government-led business matching opportunities, the development of recharging stations, and the relaxation or elimination of import restrictions, while local companies are looking for technical assistance and training in the manufacture of parts for electric motorcycles. The Indonesian government is considering support measures for the transition to electrification, including business matching, dispatching experts for technical support, and business and technology support centers, as well as EV human resource development for reskilling and upskilling, and export promotion and company attraction to ensure local suppliers' profitability. The following support measures are being considered.

3.8.2 Needs of Companies Affected by Electrification

The advance of electrification will have a major impact on many industries, including the motorcycle industry. Particularly for component suppliers, this change may present both direct business opportunities and risks, and companies are seeking ways to respond. Japanese-affiliated companies have identified the following needs.

- Business matching opportunities to facilitate expansion into new markets and other sectors.
- Assistance to develop charging infrastructure.
- Relaxation or elimination of import restrictions on materials to facilitate market introduction of new technologies and products.

The majority of the Japanese companies surveyed in this study expect little or no direct impact from electrification at this point in time. However, they are expanding into new fields and markets backed by their advanced technological capabilities and product development capacity while keeping an eye on market trends over the medium to long term, and they are trying to maintain their competitiveness through access to the global market from their Indonesian bases. To this end, the company is seeking opportunities for business matching and business meetings to develop strategic collaborative partners and customers that will complement and strengthen its technological capabilities. In addition, the spread of battery charging stations is essential for the popularization of electric motorcycles, and many Japanese suppliers are interested in the government's moves to develop charging infrastructure along with the popularization of electric motorcycles in the market. This includes a desire for government subsidies to promote the installation of battery charging stations within manufacturing facilities for employees who commute to their Indonesian bases by motorcycle. In addition, the Indonesian government has implemented a policy of prioritizing domestic products since 2018. As part of the policy to strengthen the competitiveness of the industry, import permits are required from the Ministry of Industry and the Ministry of Commerce for mandatory items of Indonesian National Standards (SNI) and for complementary materials (pass-through items), respectively, affecting Japanese companies in the region. Given this situation, some Japanese companies have expressed a desire to have import restrictions on materials eased or eliminated.

Local firms requested: 1) government promotion of domestic production, 2) preferential measures such

as low-interest loans to lower investment costs in new fields, and 3) support for promoting technological cooperation and joint ventures with Japanese firms, etc. Regarding 1), the government's promotion of domestic production would help strengthen competitiveness against overwhelmingly cost-competitive Chinese manufacturers due to the mass production effect. The reason for the high demand for low-interest loans is that interest rates in Indonesia are as high as 10% or more, placing a high interest burden on small and medium-sized enterprises (SMEs) and preventing them from investing in new fields. The reason for the high demand for low interest rate loans is that the interest rate in Indonesia is over 10%, which is a high interest rate burden for SMEs and prevents them from investing in new areas.

In order to meet the challenges and needs of these groups of companies, they will need to review their product development and strategies to respond to the market changes associated with electrification. In addition, government environmental policies and deregulation will be required, as well as targeted support for companies. On the other hand, while the spread of electric motorcycles is expanding, it has not yet reached a large scale, and based on the current situation, many companies do not expect any major impact over the next 5 to 10 years, so these measures are still being considered in stages.

CHAPTER 4 CASE STUDIES IN OTHER COUNTRIES

In this study, case studies were conducted in India, Vietnam, and Thailand, and it was thought that the results should be used as a reference for Indonesia's future determination of standards for swappable batteries. These three countries, like Indonesia, are currently in the process of determining their swappable battery standards, and all are aiming to become future Asian sales hub for electric motorcycles.

Since it was said that the standardization of swappable batteries in Indonesia would be implemented by the end of 2023, the JICA Survey Team immediately re-commissioned this survey (on India and Vietnam) after receiving the order for this survey from JICA[20]. As for Thailand, the JICA Survey Team directly conducted the survey by March 2024, since the interest of the Indonesian side was not as high as that of the other two countries.

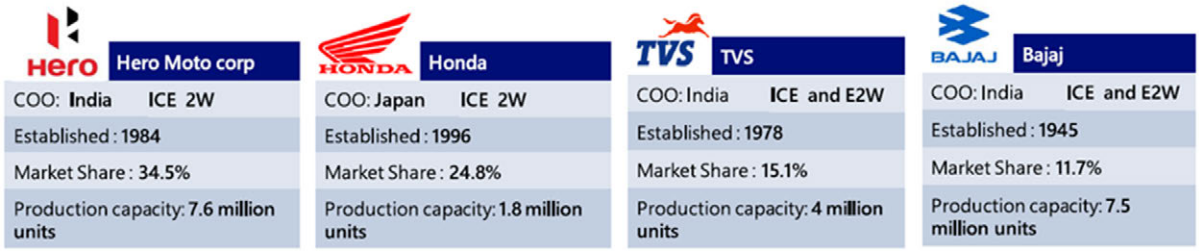
Mr. Ashim Sharma, a partner of NRI_India, was invited to the first workshop with the Ministry of Industry (July 2023) to report the results of the survey comparing the situation in India and Vietnam with that in Indonesia. After that, NBRI, which was an attendee of the above-mentioned workshop, was asked to report the results in front of an audience of over 200 people at the International Battery Summit (IBS), which was held in August 2023 (see Appendix 5).

The following is a summary of the analysis of the current status and issues in the three countries, with a particular focus on India and Vietnam, which were of particular interest to the Indonesian side[21].

4.1 India

India achieved a per capita GDP of US$2,600 in 2023 (2021: US$2,200), of which about 60% is household consumption. Since 70% of urban workers commute to work within a 10-km radius, demand for motorcycles is increasing, especially among middle- and lower-income groups.

As for motorcycles, it is still the world's second largest market, with a global share of 32%. Domestic sales of 20 million units+ until 2018 fell about 5% due to the Corona disaster, but there are signs of recovery from 2022 onward. Domestic production, mainly by Honda and the four major local brand companies, accounts for 85% of the total (Figure 4-1). In addition, a total of 3.5-4.5 million vehicles are exported annually to 140 countries[22].



Source: ACMA

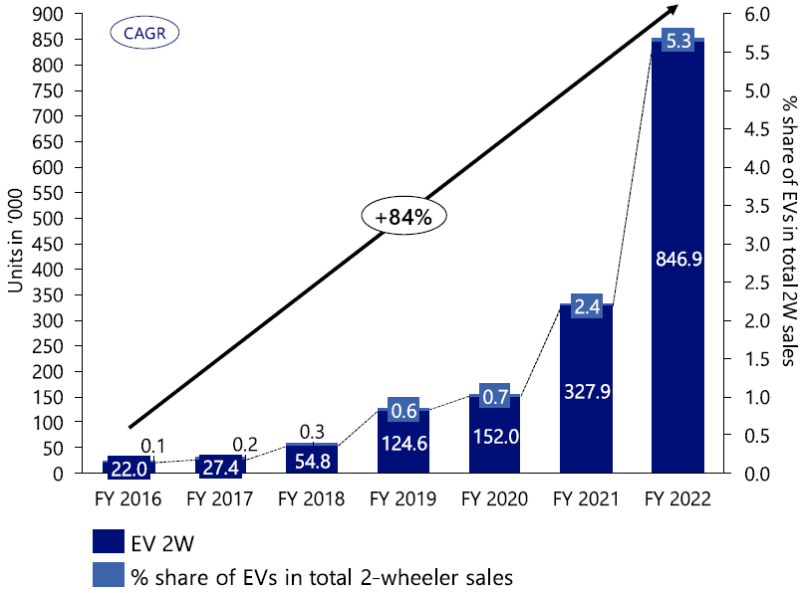
Figure 4-1 Top 4 Motorcycle Companies in India

[20] It was re-commissioned to Nomura Research Institute India Pvt. Ltd (referred as “NRI India” hereinafter)

[21] For a detailed comparative analysis of the three countries, see "Chapter 5: Presentation Materials at the International Battery Summit" of Appendix.

[22] Colombia, Nigeria, and the Philippines are the top three countries.

Regarding ICE vehicles, Japanese OEMs have made significant contributions to local firms through technology transfers, but local firms have been increasingly investing in promising start-ups companies based on their investment strategy for electric motorcycles in recent years.



Source: SIAM

Figure 4-2 Sales Trend of Electric Motorcycles in India

Sales of electric motorcycles surged 84% between 2016 and 2022, mainly in urban area, and the number of motorcycles sold as of 2022 was around 850,000 units.

In addition, the share of EVs in total motorcycle sales grew significantly to 5.3% of the total in FY2022 (up 120% from the previous year) (see Figure 4-2).

As shown on Figure 4-3 below, the development of the electric motorcycle ecosystem was examined from the five perspectives of "market," "government policies/regulation," "customers," "OEMs & supply chain," and "infrastructure.

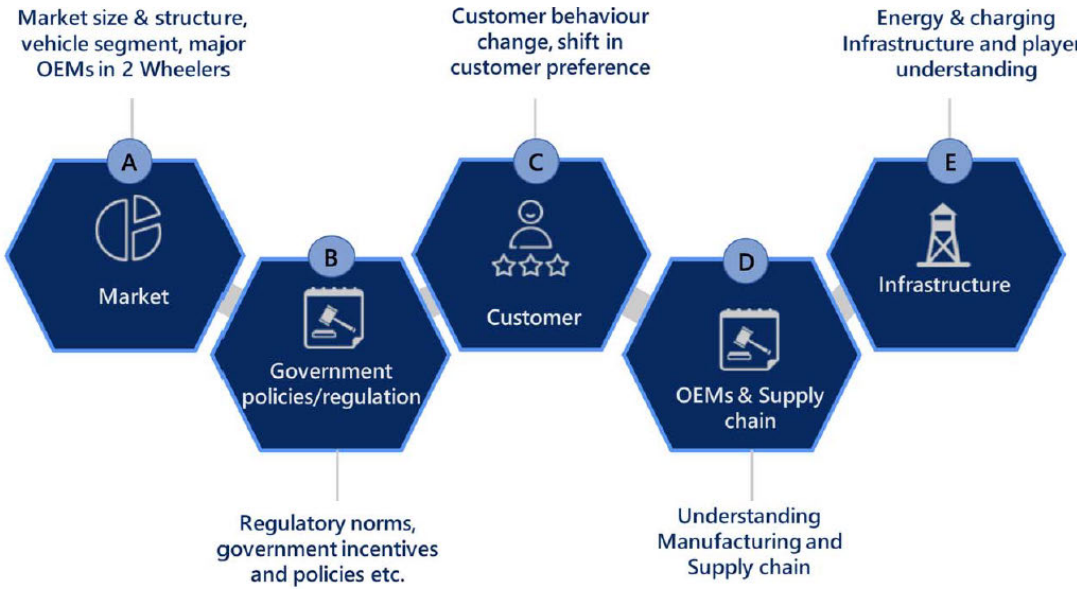


Figure 4-3 Five Important Perspectives for the Development of the EV Ecosystem in India

(1) Market

While the government has been promoting EVs since the FAME policy of 2015 (see succeeding section), the surge in sales in the metropolitan area can be attributed to major OEMs entering the market in earnest from 2018 onward. Currently, the electric two-wheeler market is dominated by local start-ups with capital from major OEMs and they are competing for market share.

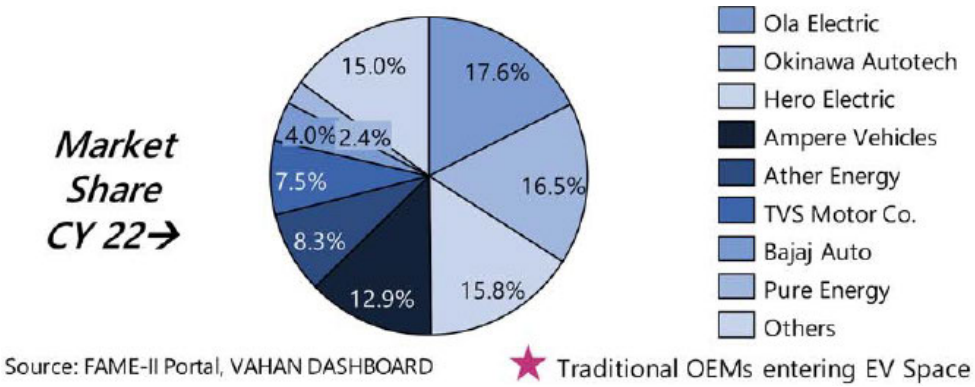


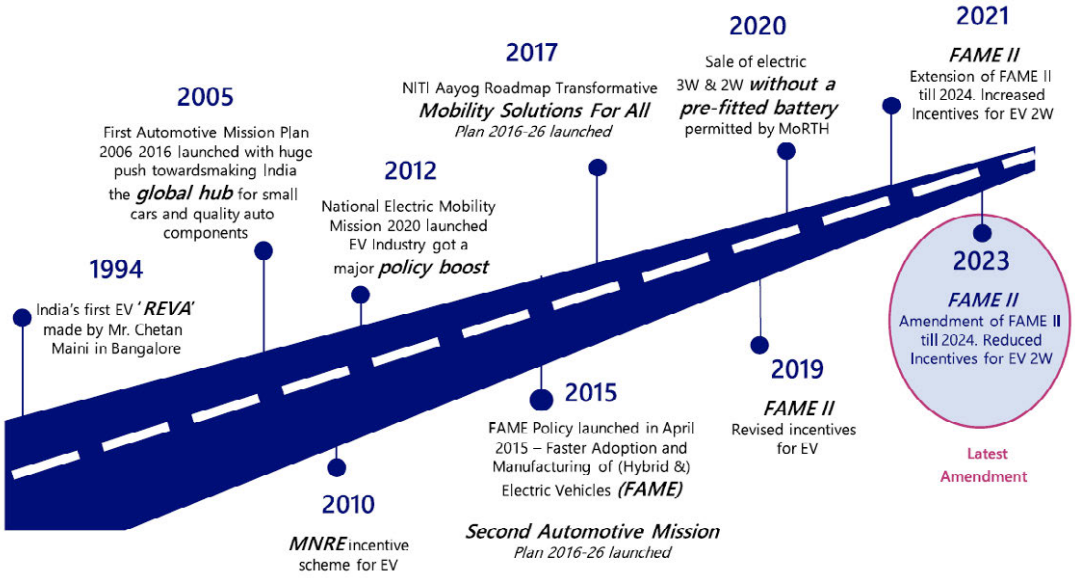
Figure 4-4 Sales Share of Electric Motorcycle by OEM

(2) Government policies / regulation

The Indian government is promoting EV-powered transportation to achieve reduction and sustainability goals on greenhouse gas emission. To this end, the government has a vision to electrify 30% of all private cars, 70% of commercial vehicles, and 80% of two-wheel & three-wheel vehicles.

- National Electric Mobility Mission Plan (NEMMP)
- Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME I&II)
- Phased Manufacturing Program（PMP)
- Production Linked Incentive Scheme (PLI)

Figure 4-5 shows the evolution of government policies aimed at promoting electrification of transportation equipment in India. Since the NEMMP came into effect in 2012, these policies have been directed at three points: a. increasing customer (demand), b. decreasing supply costs, and c. improving charging infrastructure.



Source: NITI AAYOG

Figure 4-5 India's policy evolution on transportation electrification

For example, in the most recent case, FAME II is offering subsidy at Rs15,000/kWh (28,169 yen/kWh) for two-wheeler with advanced batteries (non-lead) and Rs10,000/kWh (18,780 yen/kWh) for three- and four-wheelers, plus sales incentives for EVs with domestic components, in order to expand customer base. The PMP is also conducting a policy intervention focused on local production. In particular, it provides significant incentives for attracting companies with ACC (Adaptive Cruise Control: automatic driving) related technologies.

Local governments have also responded to these government guidelines with policies that have resonated with them, and are attracting more investment in the countryside. In addition, the Indian government has been proactive in announcing standards and regulations regarding electric vehicles to ensure safety in light of road conditions (see Table 4-1).

Table 4-1 Summary of Major Indian Electric Motorcycle Standards

Standard	Year*	Description	UNECE Ref.
AIS 038: Revision 2	2022	Electric Power Train Vehicles- Construction and Functional Safety Requirements, Specific Requirements and EV battery Testing Standards	UN ECE R100
AIS 156: Amendment 3	2022	Specific Requirements for L Category Electric Power Train Vehicles	UN ECE R136
AIS 048: Amendment 1	2016	Battery Operated Vehicles - Safety Requirements of Traction Batteries	N/A
AIS 039: Revision 1	2017	Electric Power Train Vehicles– Measurement of Electrical Energy Consumption	UN ECE R101
AIS 040: Revision 1	2017	Electric Power Train Vehicles - Method of Measuring the Range	UN ECE R101
AIS 041: Revision 1	2015	Electric Power Train Vehicles Measurement of Net Power and The Maximum 30 Minute Power	UN ECE R85
AIS 049: Revision 1	2016	Electric Power Train Vehicles - CMVR Type Approval for Electric Power Train Vehicles	N/A
AIS 131	2015	Type Approval Procedure for Electric and Hybrid Electric Vehicles introduced in market for Pilot / Demonstration Projects intended for Government Scheme	N/A
BIS Draft	2022	Electric Vehicle Battery Swap System – Part 4 Light Electric Vehicles – Section 1 Guidelines And Pack Dimensions	N/A

Represent regulations related to e2W Battery safety and usage

* The top three are battery safety standards

Source: AIS : Automotive Indian Standards, BIS

(3) Customer

In the Indian market, the preference for electric vehicles is believed as a combination of the social image of being environmentally friendly and the technical characteristics of lower Total Cost of Ownership (TCO).

The majority of electric motorcycle buyers are affluent, ride less than 50 km per day, and live within the metropolitan area. While range, power, and top speed remain the main criteria for purchasing electric motorcycles, customers are beginning to demand more high-tech features from the products (see Figure 4-6 below).

Customers consider driving range, features, and public charging facilities to be differentiating factors, while comfort, price, performance, and design are the purchase criteria at this stage.

HYGIENE

1) Digital Cluster *(functionality matters)*
2) Style & Design *(Imposing Scooter Styling)*
3) Strength & Durability
4) Multiple Ride Modes

GOOD-TO-HAVE

1) Tamper Alert
2) Voice Assistant with Speakers
3) Higher Tyre Size *(14 Inch has highest preference)*

DIFFERENTIATORS/DELIGHTERS

Performance

Power	Higher the better → **8 kW** is most attractive
Top Speed	Higher the better → **90 kmph** has the highest preference with high premium associated
Vehicle Range	Optimum at **120 km** | Delighter is **240 km**

Battery & Charging Capabilities

Battery Warranty	At least **5 Years**
Battery Life for Replacement	Optimum at **50000 km** with highest profitability associated
Charging Mode & Location	**Fast Charging** Capabilities | **Public** Charging Support

Features

Area for Storage	Higher the better → **40 Liters** is most attractive. Highest attractiveness among non-core features
Smartphone Connectivity	Easy connectivity with associated connected features
Tech Features	**Proximity Lock/Unlock | TPMS** (Tyre Pressure Monitoring System)

NOT CRITICAL

1) Ground Clearance	2) Remote Boot Lock/Unlock

Source: Buyer characteristics survey by NRI India (n=535)

Figure 4-6 Customer Preference for Electric Motorcycles

Furthermore, the last mile logistics services in India is growing rapidly with the entry of several start-ups and technology companies and growing investor interest. Some Indian third-party logistics (3PL) companies have started owning two-wheelers for home delivery and delivery within the metropolitan area.

According to an analysis by NRI India, the total cost of ownership (TCO) over a five-year period is analyzed to be less expensive for electric 2-wheelers compared to ICE 2-wheelers (see Table 4-4 below). Therefore, financing of a reasonable amount for the purchase of electric two-wheelers is considered to play an important role in lowering the purchase cost and promoting their widespread use.

The customer characteristics of electric motorcycle sales in India at this stage can be summarized as follows.

(Individual users)

- The preferential treatment (FAME2) has lowered the initial cost of purchase, leading some customers to prefer electric 2-wheelers. However, recent revisions have put a damper on the popularity of them.
- Most customers use these two-wheelers only within the city, not as their primary mode of transportation, due to concerns about range and charging infrastructure.
- Safety concerns from the recent fire accident are still on people's minds.

(Fleet customers)

- The rise of e-commerce and hyperlocal commerce is driving demand for last-one-mile delivery improves total cost of ownership (TCO).
- Therefore, an increasing number of fleet customers are adopting swappable battery models.

(4) OEM & Supply Chain

India has an established supply chain for procuring electric motorcycle parts (see Figure 4-7 below), and with the exception of battery raw materials and cells, all necessary parts are highly localized. However, due to lack of sufficient reserves of lithium, nickel, and cobalt, the country relies on imports for all battery raw materials.

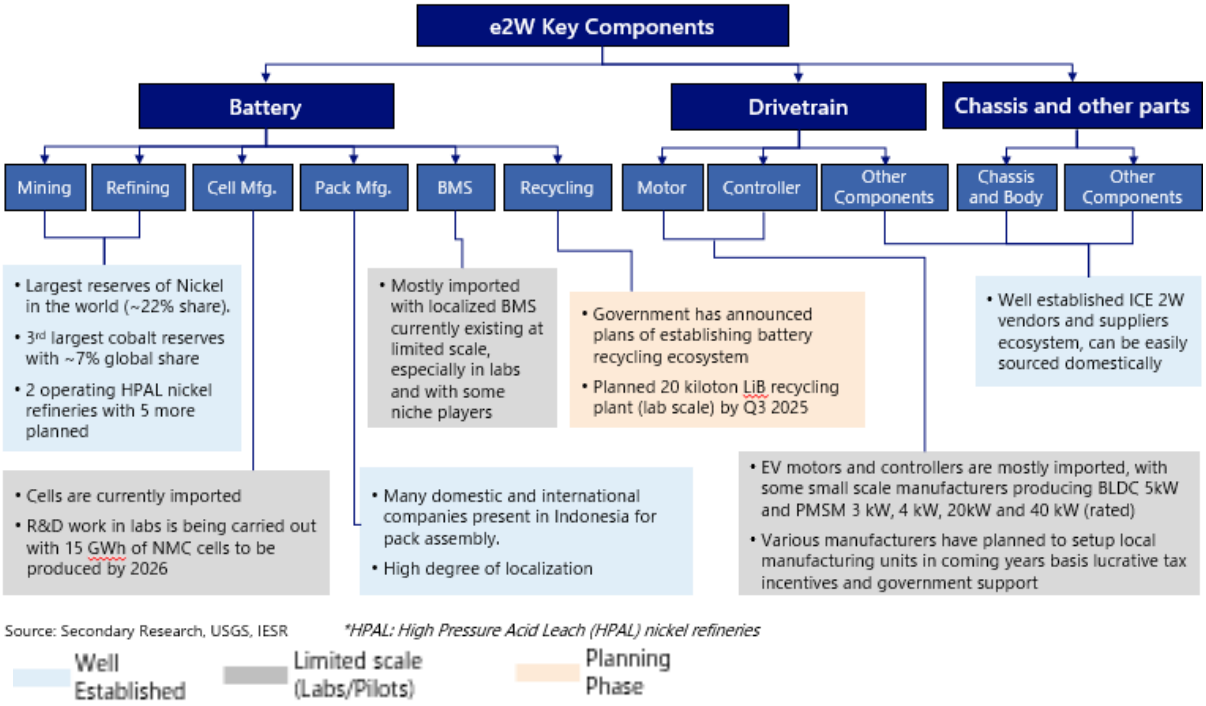


Figure 4-7 Ecosystem surrounding the electric motorcycle supply chain in Indonesia

India has been seeking strategic partnerships around the world to secure battery raw materials, and various companies, including Exide Industries, Tata Chemicals, Ola Electric, and Lucas TVS, have announced plans to build lithium-ion battery manufacturing plants in India. Lithium-ion battery manufacturing has been boosted by the launch of the production-linked incentive (PLI) scheme by the Indian government. Once the lithium-ion battery plant is established, India will be ready to manufacture and supply battery packs domestically.

Meanwhile, as shown in Table 4-2, various suppliers of drivetrains are providing domestically produced components for electric 2-wheelers.

Table 4-2 Major Drivetrain Manufacturers in India

Major Parts	Manufacturer
Electric Motor	Tata Auto Comp、SonaComstar、EMF innovations、Rotomotive Powerdrives、MAHLEelectric drives、Physics Motor Technologies etc.
Controller	SEG Automotives、Napino Auto and Electronics、C-electric automotive drives、Konmos technologies、Temsrax、Compage Automation etc.
Chassis and Body	Various ICE component manufacturers

Source: Survey Team

With the initial kick-start, India is poised to manufacture electric motorcycles with localized content in the future.

(5) Infrastructure

From a global perspective, there are various types of EV charging infrastructure depending on the connecting technology. In India, plug-in charging stations and swapping are the mainstream. Currently, the main charging solution deployed for commercial charging is fixed charging (private), but swapping is gaining attention as an option.

India currently has 1,742 charging stations, but will need 25,000 by 2025 and 46,000 by 2030. The Department of Heavy Industry (DHI) has already approved the development of 3,000 charging stations (1,600 of which are The Department of Heavy Industry (DHI). India lags behind major markets in terms of charging infrastructure, while China and the U.S. have EV charger ratios[23] of 6 and 19, respectively, India has 135.

As EV sales increase, the charging infrastructure is expected to become ubiquitous in step with the fossil fuel network. The government has established the following guidelines (see Table 4-3 below) for charging stations to support the growing charging infrastructure.

Table 4-3 Charger Guidelines for Public Charging Stations in India

Charger type	Sl.no	Charger connectors	Rated output voltage	No. of connector guns	Charging vehicle type
Fast charger	1	Combined charging system (CCS) – min 50 kW	200-750 V or higher	1CG	4W
	2	CHAdeMO- min 50 kW	200- 500 V or higher	1CG	4W
	3	Type 2 AC- min 22kW	380-415V	1CG	4W, 3W, 2W
Slow charger	1	Bharat DC-001- 15 kW	48 V	1CG	4W, 3W, 2W
	2	Bharat DC-001- 15 kW	72V or higher	1CG	4W
	3	Bharat AC-001- 15 kW	230V	3CH of 3.3 kW each	4W, 3W, 2W

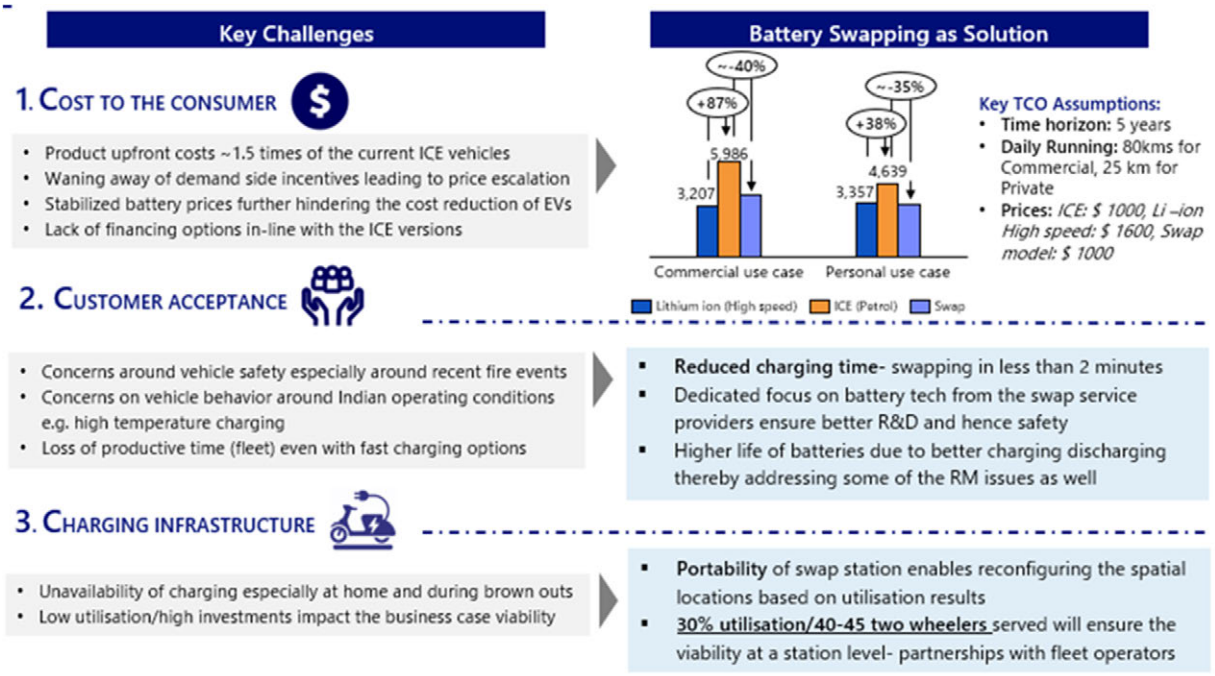
Source: AIS : Automotive Indian Standards, BIS

The Bureau of Indian Standards (BIS) is the nodal agency for defining standards for EV charging station. Current EV charging equipment, especially connector types, are in line with global trends where CHAdeMO and CCS are widely use. Charging stations for 2-wheel & 3-wheel EVs can be installed with chargers other than the specified type. BIS has published a draft battery replacement standard IS 17896 in 2022 with general guidance and safety requirements. Safety standards are already in place for both replacement and fixed batteries.

Some of the main concerns of the fixed charging model appear to be addressed by battery swapping services. For example, concerns about vehicle safety, particularly with regard to recent fire incidents, are thought to be better addressed by battery swapping service providers by focusing more on battery technology, which in turn will ensure better R&D and, ultimately, safety. At this stage, swapping's share of electric motorcycle charging in India is low (4-5% of the total number of vehicles covered), but is expected to grow with private sector investment and policy measures. Furthermore, with government mandates and policy frameworks that ensure safety and interoperability, battery swapping could facilitate EV promotion (see Table 4-4).

[23] A statistic that shows how many EVs are tied to a public charger

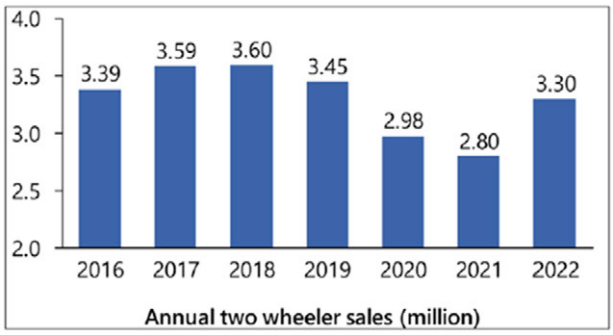
Table 4-4 Issues surrounding Battery Swapping Systems for Electric Motorcycles



Source: Survey Team & NRI India

4.2 Vietnam

Vietnam is the fourth largest motorcycle market in the world with 65 million motorcycles on the road. The motorcycle ownership rate is high at 670 motorcycles per 1,000 people, resulting in a mature and saturated motorcycle market. New sales are mainly replacement demand, and annual sales are very stable. A drop of about 14% was seen from 2019 to 2021 due to COVID-19, but sales recovered sharply in 2022 (Figure 4-8).



Source: VAMM

Figure 4-8 Motorcycle Sales in Vietnam

As for production, 91% of motorcycles sold in the country are manufactured by member manufacturers of the Vietnam Association of Motorcycle Manufacturers (VAMM). However, Japanese OEMs dominate the Vietnamese ICE motorcycle market, with Honda leading the way with a 72% share and nearly 90% in total.

The impact of COVID-19 in Vietnam was very minimal compared to other countries, with only a couple of sharp declines in quarterly sales trends. Sales recovered quickly in the following quarters and motorcycle sales continued their trend of rapid recovery. Production also showed a strong recovery, reaching pre-pandemic levels by 2022.

Below, the development of the electric motorcycle ecosystem was examined from the five perspectives of "market," "government policies/regulation," "customers," "OEMs & supply chain," and "infrastructure (see Figure 4-9 below).

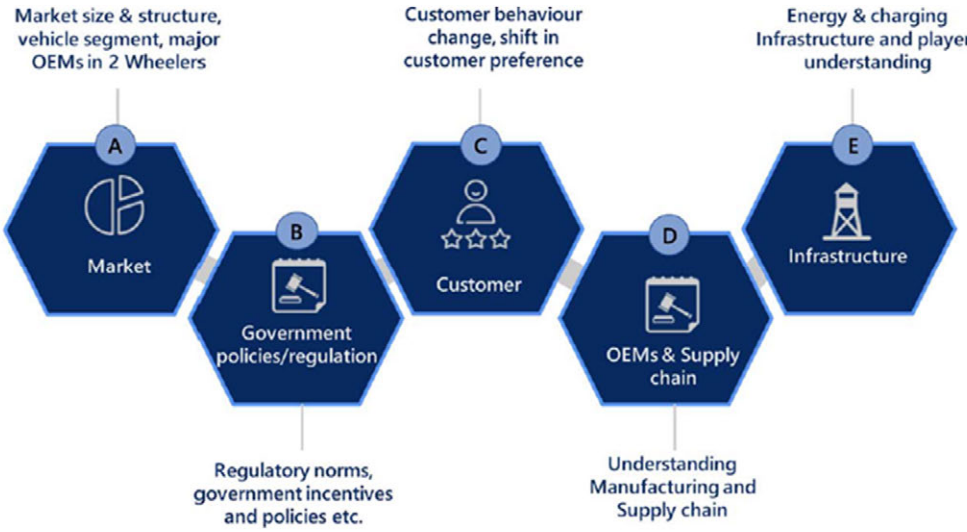
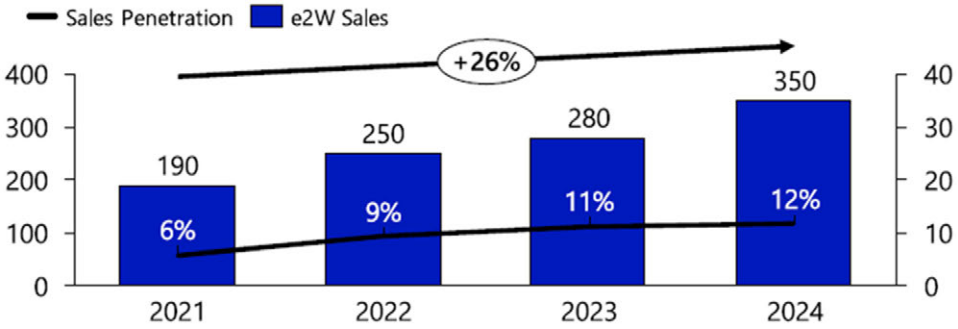


Figure 4-9 Five Important Perspectives for the Development of the EV Ecosystem in Vietnam

(1) Market

Sales of electric motorcycles in Vietnam have been growing rapidly in recent years and are expected to exceed 350,000 units by 2022.Especially since 2021, the penetration rate of electric motorcycles has exceeded 10%, and it is estimated that the share will reach 12% by 2024 (see Figure 4-10 below).



Source: VAMM

Figure 4-10 Electric Motorcycle Sales in Vietnam

As for the characteristics of electric motorcycles sold, low-speed (<50 km/h) and low-power (<4 kW) e-mopeds account for the majority of sales, with an 85% share. Therefore, the penetration rate of electric motorcycles (lithium-ion batteries) is estimated to be about 2%. Sales of electric motorcycles are dominated by domestic brands such as Vinfast and Pega (see Figure 4-11 below).

Source: NRI India

Figure 4-11 Major Sales Models (Electric Motorcycles)

(2) Government policies / regulation

The development of an electric 2-wheeler ecosystem is a promising approach for Vietnam to achieve its ambitious GHG reduction and sustainability goals. Namely, the transportation sector is a major source of GHG and air pollution in Vietnam, the former accounts for 18% of total GHG emissions.

Among them, motorcycles account for more than 90% of all vehicles in the country, more than 90% of CO and VOC (volatile organic carbon) emissions in the transportation sector, and 60% of suspended particulate matter emissions. However, although the Vietnamese government has announced the following plans to achieve its emission reduction targets, specific details and action plans are lacking. In addition, specific regulations, and conditions for implementing the targets are inconsistent, as they are set separately for both the provinces and the country.

a. Phasing out of fossil fuel powered vehicle

On July 22, 2022, the Deputy Prime Minister signed Decision No. 876/QD-TTg approving the Action Program on Green Energy Conversion and Reduction of Carbon and Methane Emissions in the Transport Sector. The gist of the program is as follows.

- By 2025, 100% of buses shall use electricity and green energy.
- By 2030, at least 50% of vehicles shall use electricity and green energy, and 100% of cabs shall be adapted to this.
- By 2040, stop producing, assembling, and importing cars and motorcycles that use fossil fuels.
- By 2050, build a complete green transportation network with net zero greenhouse gas emissions.

b. Motorbike ban in cities by 2030

To reduce traffic congestion and emissions, the Vietnamese government has requested that Hanoi and the four major cities of Ho Chi Minh City, Haiphong, Da Nang, and Can Tho plan to ban motorcycles after 2030.

- The request was made in a government resolution issued on April 6, 2022, on ensuring traffic safety and preventing traffic congestion between 2022 and 2025.
- In Hanoi, the ban shall apply to districts 1 and 2 downtown and three major roads: Truong Sa, Hoang Sa, and National Highway 5.
- After 2030, motorcycles shall be banned from all 30 districts in the city (including 18 suburban districts) and from other provinces.

As mentioned above, no detailed roadmap has been formulated to achieve the goal of introducing electric motorcycles. For example, as a demand-side policy, no specific policy has been formulated to create demand for electric motorcycles, and electric motorcycles are taxed at the same rate as ICE vehicles, with no preferential treatment for their purchase. No policy has been announced for the supply side to provide incentives for the manufacture of electric motorcycles and their components. Furthermore, no concrete plans have been announced for the development of recharging infrastructure,

nor any incentives or subsidies for the installation of recharging facilities or recharging stations.

In Vietnam, there are technical standards and regulations to ensure that electric motorcycles meet safety, performance, and environmental protection standards. However, there are also two types of standards, and no decision has been made as to which takes precedence (see Table 4-5).

Table 4-5 Technical Standards and Regulations for Safety, Performance, and Environmental Protection Standards for Electric motorcycles

	1. National Technical Regulations (QCVN)	2. Technical standards (TCVN)
Responsibility for Development	Technical regulations on 2W's including e2W's are developed and promulgated by the **Ministry of Transport (MOT).**	Technical standards are developed by the National Standard Technical Committee TCVN/TC22 on Road Transport Vehicles and promulgated by **the Ministry of Science and Technology (MOST)**
Scope/Coverage	Newly manufactured, assembled and imported motorcycles and mopeds must comply with QCVN 14:2015/BGTVT (National technical regulation on safety and environmental protection for motorcycles and mopeds)	**Covers wide range of aspects**: from standards for requirements and test methods on motorcycle chains to standards for measurement methods for gaseous exhaust emissions of motorcycles during inspection and maintenance.
Compliance	**Compliance is mandatory** for new vehicles, to ensure vehicle quality, safety, and environmental protection	Compliance with technical standards is **voluntary.** 2W that do not comply with technical standards are still allowed to be traded in the market.
e2W Scope	QCVN 90:2019/BGTVT16 and QCVN 91:2019/BGTVT17 stipulate the technical requirements, safety inspections and the quality of the electric motor and traction batteries	Key areas covered include rechargeable energy storage systems (RESS), test specifications and safety requirements for li-ion battery systems, cell testing and safety, vehicle safety specifications, vehicle operational safety, electrical safety, vehicle performance, and electricity consumption.

Source: NRI India

As mentioned above, electric motorcycles in Vietnam are currently subject to the same taxes and fees as ICE motorcycles as shown below, which increases the initial cost of an electric motorcycle compared to an ICE motorcycle (up about 37%[24]).

- Special consumption tax (SCT) of 20% is levied on motorcycles over 125 cc at the time of purchase.
- Liability insurance is levied annually (Mopeds: VND 55K/year, ICE 2-wheelers: VND 60K/year).

(3) Customer

As mentioned above, low-priced and low-speed E-Mopeds powered by lead-acid batteries are basically the mainstay of motorcycle sales in Vietnam. E-Moped has the following features.

(Positioning of E-Mopeds)

- Motorcycles with an output capacity of less than 4 kW do not require a license.
- E-Mopeds are low-cost and popular, especially among students and pupils over 16 years old.

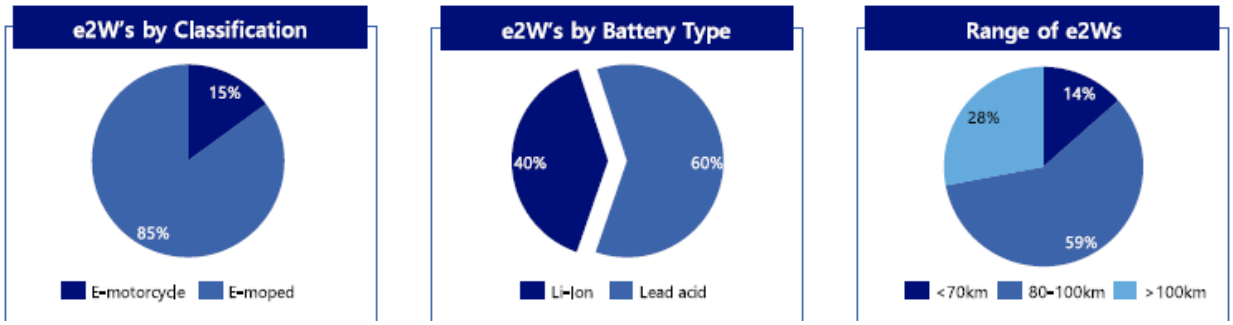
(Battery category)

- Lead-acid powered e-Mopeds have lower initial costs overall and lower TCO.
- Lithium-ion powered motorcycles are relatively new.

(Mileage)

- Most electric motorcycles on the market have a range of less than 100 km, mainly due to the low capacity of lead-acid batteries.
- Most people travel 20-30 km per day, and the range provided is adequate for most people.

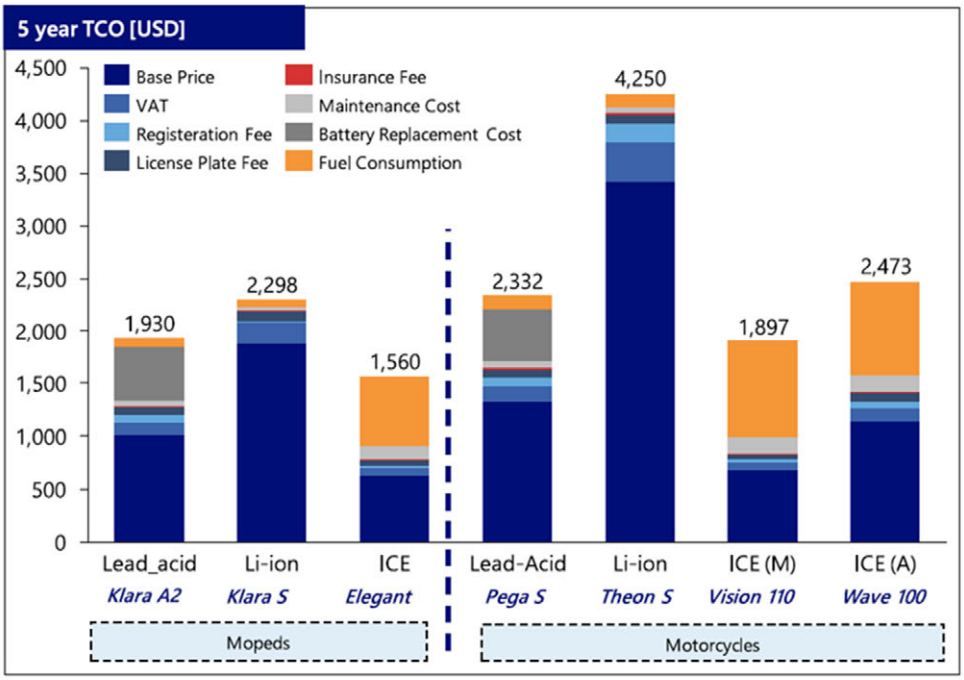
[24] Thermon5 model with lithium battery is calculated as a base model.



Source: NRI India

Figure 4-12 Characteristics of Electric Motorcycles on Sale

Calculations show that E-Mopeds have higher initial costs and TCO than ICE-Mopeds (see Figure 4-13 below). E-Mopeds powered by lithium-ion have the highest TCO, 19.0% higher than E-Mopeds powered by lead-acid batteries and 47.3% higher than ICE-Mopeds. Electric motorcycles equivalent to ICE 125cc or larger with lithium-ion batteries have the highest initial cost and TCO, 71.9% higher than automatic transmission models and 124% higher than manual transmission models.



Source: NRI India

Figure 4-13 Comparison of Total Cost of Ownership (TCO) of various electric motorcycles

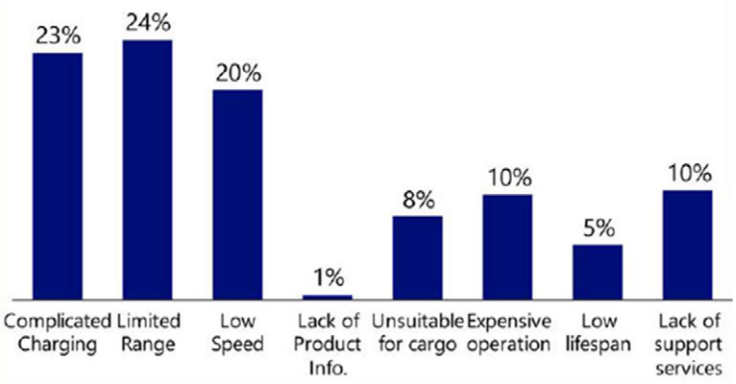
A lower tax burden would reduce the initial cost of EVs by 13-15% and reduce the 5-year TCO cost by the same amount. However, the TCO of electric motorcycles is still higher than that of ICE models; additional incentives beyond tax and registration fee waivers may be needed to make electric motorcycles more attractive to bridge the gap between ICE 2-wheelers and electric motorcycles.

The use of electric motorcycles for fleet operations such as ride hailing and logistics is starting to pick up pace as OEMs begin to work with fleet owners. For example, in May 2023, Gojek announced a collaboration with Dat Bike to enable Gojek driver partners in Vietnam to offer transportation, food delivery, and courier services through GoRide, GoFood, and GoSend, respectively. Also in April 2023, food delivery service company Baemin announced a partnership with Selex on a pilot project.

On the other hand, regarding the challenges of electric 2-wheelers from the perspective of "fleet

customers," they recognize limited driving range, low speed and acceleration, and the complexity of charging and battery replacement. According to the awareness survey of delivery personnel engaged in fleet operations in Vietnam shown in Figure 4-14, the main challenges for delivery drivers who want to switch to electric 2-wheelers are technological innovations related to driving performance and charging infrastructure.

- Increased mileage per charge
- Increased speed and acceleration
- Reduced battery charging time
- Charging efficiency/battery changing station services



Source: NDC Transport Initiative for Asia, Promoting sustainable transport in Vietnam : MDPI

Figure 4-14 Reasons why delivery people don't use electric 2-wheelers (N=810)

In addition, the high initial cost of electric motorcycles is a major barrier to their widespread adoption, and the Vietnamese government needs to provide fiscal and non-fiscal incentives to the demand side to close the cost gap.

(4) OEM & Supply Chain

Vietnam has an annual production capacity of over 1 million electric motorcycles. Major OEMs are VinFast, PEGA, and Anbico, but local companies have a close share of the market. The main reason why major automakers such as Honda, Yamaha, and Suzuki have not started production of electric motorcycles in Vietnam can be attributed to the lack of clear Vietnamese government policy and support for electric motorcycle production.

As for the supply chain for battery production, among the main material, there are reportedly 1 million tons of lithium reserves in Quang Ngai Province in Central Vietnam but no information on cobalt reserves. In addition, there are abundant nickel reserves (3.6 million tons) in the country (at Thanah Hoa, Son La, and Cao Bang provinces). However, mining and processing have not yet been developed in Vietnam. The research, experience, and technology needed to develop these minerals are still very limited. Only one nickel mining project is underway, Ban Phuc Nickel Mine Ltd. in Son La province, which is expected to have a steady-state production capacity of 18,000 tons per year by 2025. Lithium resources still remain undeveloped. In other words, Vietnam does not have the capacity to mine and process battery cell raw materials, so battery raw materials will need to be imported for the time being.

With regard to battery cell manufacturing, lead-acid battery manufacturing technology is well established in Vietnam. Major lead-acid battery manufacturers and suppliers include the Dry Cell and Storage Battery Joint Venture (Pinaco), GS Battery Vietnam, Vision Group, and 365 Creative Technology Joint Venture. On the other hand, the production of lithium-ion cells has not yet started, and as for battery packs, Samsung SDI has established a plant to produce lithium-ion battery packs. Furthermore, in 2021, VinGroup began construction of a VinES battery manufacturing plant in Bun An Economic Zone (Ha Tinh) with an annual production capacity of 100,000 battery packs. In the second phase of the plant's construction, production will be expanded to include the manufacture of battery cells. Battery manufacturing systems (BMS) are now imported by almost all electric

motorcycle manufacturers as part of their battery packs, with BMS algorithms either developed in-house or co-developed (outsourced) by OEMs.

With regard to battery recycling, the recycling of lead-acid batteries is under the jurisdiction of the Ministry of Environment, which has licensed construction of smelters for recycling. The recycling ecosystem for lithium-ion batteries has not yet been developed.

The supply chain for drivetrains, on the other hand, is generally organized as follows (see Table 4-6).

Table 4-6 Drivetrain Procurement Methods in Vietnam

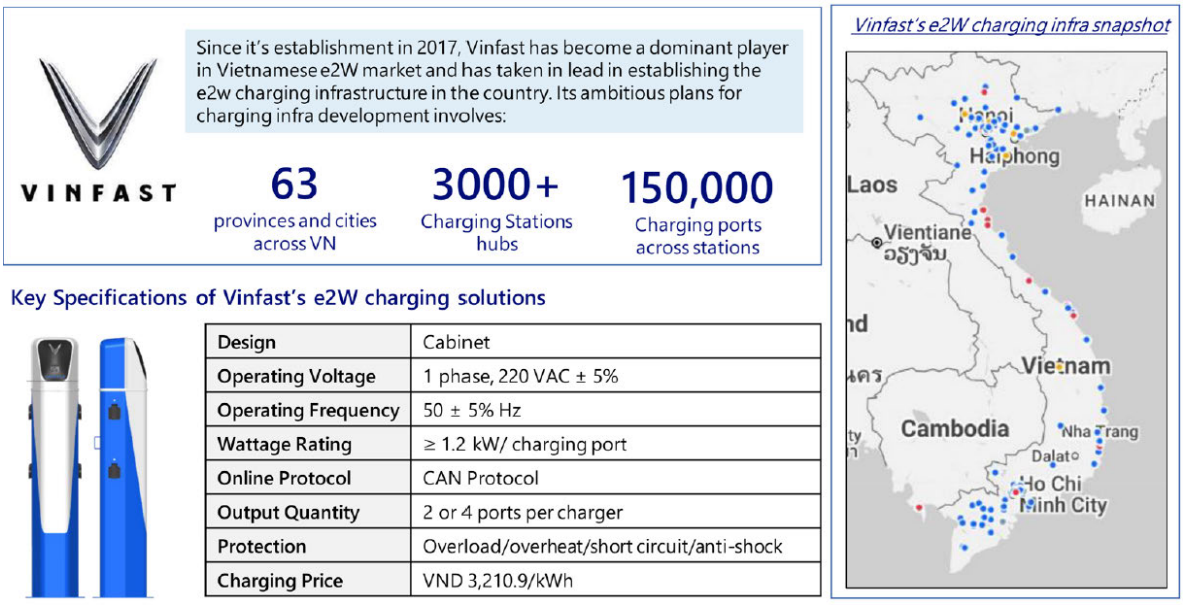
Major Parts	Manufacturer
Electric Motor	It has not yet developed and is mostly imported by electric motorcycle manufacturers. EV manufacturers such as BYD have announced that they will establish an EV component manufacturing plant in Vietnam.
Controller	Due to lack of manufacturing know-how in power electronic, controllers are usually imported by electric two-wheeler manufacturers.
Chassis and Body	Existing ICE component manufacturers are thought to be able to handle this.

Source: Survey Team

(5) Infrastructure

The development of charging networks and battery swapping systems for electric 2-wheeler is still limited. There are still few players in Vietnam that have taken the lead in the development of infrastructure such as battery swapping stations.

Among them, VinFast has emerged as a leading player in the installation of charging facilities for electric 2-wheelers. The company's plans for charging infrastructure development are summarized in the Figure 4-15 below.



Source: NRI India

Figure 4-15 VinFast's future plans for battery charging system development

Furthermore, in addition to Vinfast, other new players are emerging in Vietnam, such as Dat Bike and Eboost, which are participating in the construction of electric motorcycle charging infrastructure.

Until now, the growth of infrastructure for charging and battery swapping for electric 2-wheelers has been hindered mainly by a lack of technical regulations and standards. As a result, battery swapping for electric 2-wheelers has remained in a limited state of development, with only a limited number of

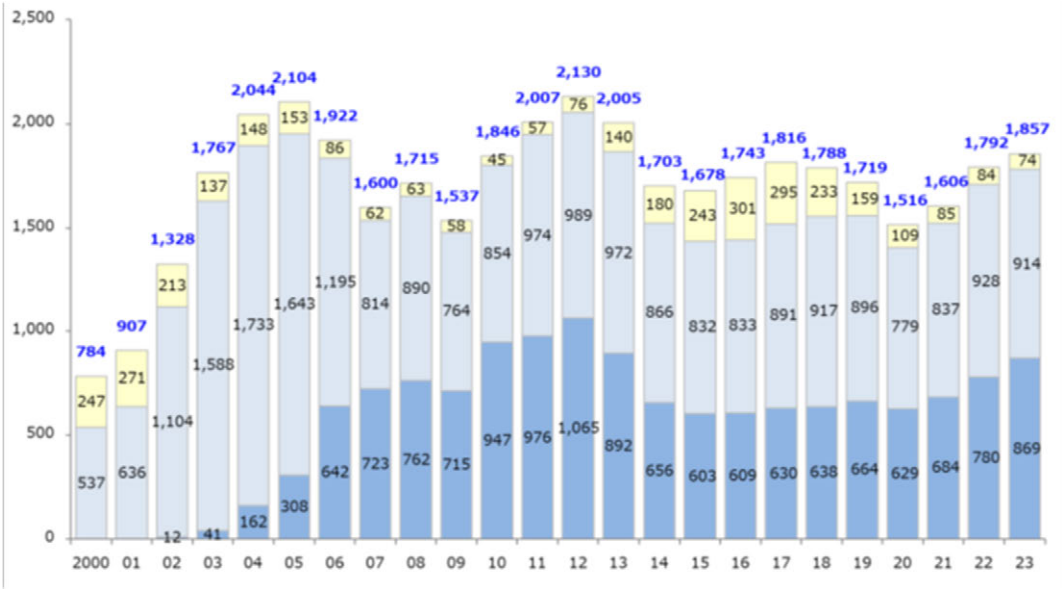
players offering solutions.

Thus, the development of battery swapping systems in Vietnam is expected in the near future. However, in Decision 1057/QD-BKHCN dated May 27, 2024, the Ministry of Science and Technology has issued a national standard (non-mandatory standard) for replaceable batteries used in electric motorcycles and electric two-wheeled vehicles, attempting to promote safety standards in accordance with international standards. With the establishment of national standards, battery replacement systems in Vietnam are expected to develop in the coming years.

4.3 Thailand

After peaking at 2.1 million units in 2012, the motorcycle market in Thailand has stabilized between 1.8 and 1.9 million units from the late 2010s through the 2020s (see Figure 4-16). In 2023, 1.86 million units were recorded, an 11% increase over the previous year, due in part to post-COVID-19 pent-up demand. However, the impact of the January 2023 cap on annual interest rates on motorcycle installment sales (23%) began to appear after August 2023, and the market began to decline.

By type, Thailand has traditionally been dominated by the underbone type, but the share of automatic (scooter) types has been increasing in recent years.

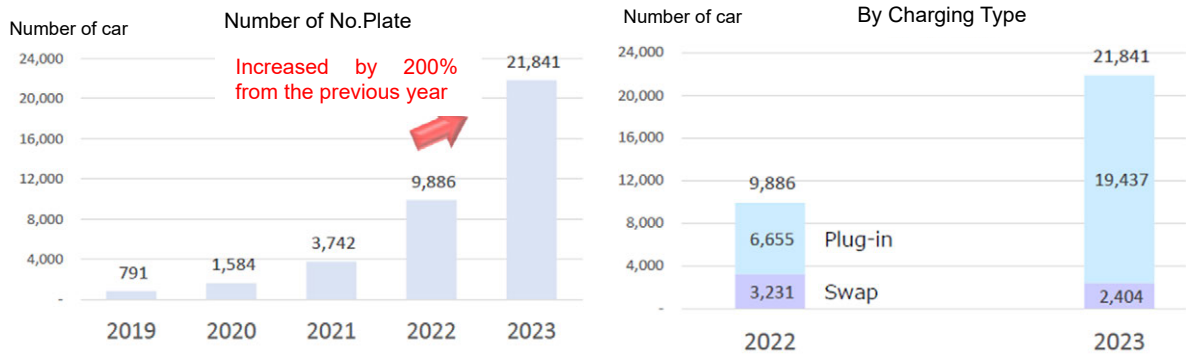


Source: Japanese Chamber of Commerce, Bangkok (JCC)

Figure 4-16 The motorcycle market in Thailand

(1) Market

As Figure 4-17 shows, sales of electric motorcycles in Thailand are growing steadily, reaching 22,000 units in 2023, up 120% from the previous year, due in part to the first subsidy for domestically produced electric motorcycles in 2023. The percentage of the total motorcycle market that is electrically powered is still low at 1.15%. Of the 22,000 units of the plug-in type, 19,000 are plug-in motorcycles, and 2,400 are swap-type motorcycles, which are not yet widely used.



Source: Japanese Chamber of Commerce, Bangkok (JCC)

Figure 4-17 Electric Motorcycle Market in Thailand

The specifications of major Thai manufacturers are shown in Table 4 7, but the battery types are mostly 60V and 72V. However, Winnonie and Swap & Go announced last year that they are changing from 60V to 72V. Major players focus on rentals, often for riders in food delivery and other fleets.

Table 4-7 Battery Specifications of Major Electric Motorcycle Manufacturers in Thailand

	Winnonie	Swap&Go	HSEM	Etran
Battery specifications (V/Ah/pieces)	60 / 26 / 2	60 / 10 / 2	72 / 30 / 2	72 / 51 / 2
Battery capacity (kWh)	3.12	1.2	4.32	734
Sales method	Rental	Rental	Rental	wholesale (wholesaler) in the auto body

Source: Japanese Chamber of Commerce, Bangkok (JCC)

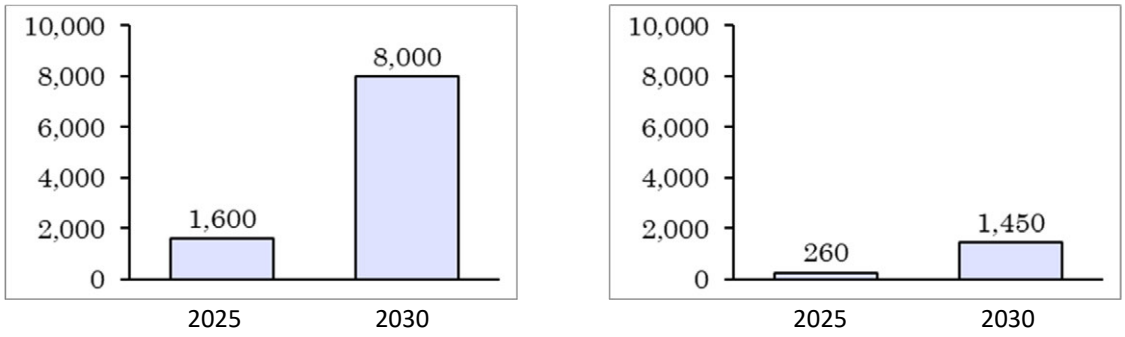
(2) Government guideline

The "30@30" (30% EV by 30 years) policy announced by the National Electric Vehicle Policy Commission (NEVC) in 2021 set a target of producing 360,000 motorcycles by 2025 and 675,000, or 30% of production, by 2030, as shown in Table 4-8. In addition, the Ministry of Industry's (OIE) goal calls for the installation of 8,000 charging stations for motorcycles and 1,450 stations for motorcycle cabs by 2030 (see Figure 4-18).

Table 4-8 Production Targets for Electric Vehicles and Motorcycles in Thailand

Target	Classification	Volume of ZEV (Year)	
		2025	2030
Utilization	Passenger Car / Pickup	225,000 (30%)	440,000 (50%)
	Motorcycles	360,000 (20%)	650,000 (40%)
	Bus / Truck	18,000 (20%)	33,000 (35%)
Production	Passenger Car / Pickup	225,000 (10%)	725,000 (30%)
	Motorcycles	360,000 (20%)	675,000 (30%)
	Bus / Truck	18,000 (35%)	34,000 (50%)

Source: The Bord of Investment of Thailand (BOI)



Source: OIE
Note: Unit is "number of charging station"

Figure 4-18 OIE's Forecast of Charging Stations for Two-Wheel and Three-Wheel EVs

The government has announced a subsidy policy to promote the spread of electric motorcycles, as shown in Table 4-9. Under Thailand EV3.0, which went into effect at the beginning of 2024, the conditions have been tightened, and subsidies will be provided only to vehicles with a battery capacity of 3 kWh or more and domestically produced vehicles (CKD). In addition, the subsidy has been lowered to 10,000 THB (approx. 42,000 yen).

Table 4-9 Subsidy Policy for Electric Motorcycles in Thailand

	Thailand EV3.0	Thailand EV3.5
Price	Less than 150,000 THB (approx. 640,000 yen)	Less than 150,000 THB (approx. 640,000 yen)
Battery Capasity		More than 3kWh
Subsidy	18,000 THB (approx. 76,000 yen) (2023-2024)	10,000 THB (approx. 42,000 yen) (2024-2027)
Production Conditions	For both CBU and CKD	For only CKD

Source: Prepared by Survey Team from BOI materials and other sources.

In terms of policies for producers, the BOI has announced the investment incentives shown in Table 4-10, with electric motorcycles falling under the third level of benefit, Level A3 status, which normally provides a three-year corporate tax exemption. The tax exemption period may be extended if additional conditions are met.

Table 4-10 BOI Investment Incentives for Electric Motorcycles in Thailand

	BOI Investment Incentives	
Conditions	・Propose a package deal ・Production must take place within 3 years of the release of the investment incentive certificate.	
Standard	In the case the product is to be sold in Indonesia, it mustpass the UN R136, UN R78 standards.	
Investment Incentives	Corporate tax exemption for 3 years (BOI investment status A3)	+1 year：In the case the production of battery cells or modules status within 3 years. +1 year：In the case BMS motor and DCU start production within 3 years. +1~5 year：In the case to implement R&D

Source: BOI

(3) Customer

Electric two-wheelers in Thailand follow the EU L2 standard and must pass the following three requirements: 1. a maximum speed of 45 km/h or higher, 2. a motor rated output of 0.25 kWh or higher, and 3. the ability to run at 45 km/h for 30 minutes or longer. Therefore, almost all motorcycles registered as electric motorcycles are powered by lithium-ion batteries.

Most of the customers of electric motorcycles in Thailand are fleet users. However, since fleet partners are not involved in the commercial distribution in Thailand, it is up to the driver to decide whether or not to choose a battery-powered vehicle. For example, EV manufacturer Etran has partnered with Shopee Food (food delivery) and Krungsri Bank to supply bikes to Shopee Food riders at special rental prices. Swap-Go has also partnered with 7-Eleven and Swag EV on a trial basis.Swap&Go has partnered with 7-Eleven and Swag EV on a trial basis to conduct swap electric motorcycle transportation trials at 30 Bangkok stores.

The price range for electric two-wheelers is 40,000 to 70,000 THB (about 170,000 to 300,000 yen), which is close to the price of internal combustion engines. However, according to the swapable battery supplier, users often provide feedback that electric motorcycles are generally underpowered, as Thai users value acceleration and high-speed stable driving. In light of this, Swap&Go and Winnonie will switch the battery voltage from 60V to 72V.

The reliability and durability of the batteries and lower trade-in value are also cited as factors that make users cautious about purchasing these vehicles.

(4) OEM & Supply Chain

There are no dominant players in the Thai electric motorcycle market. Major OEMs of swap battery-powered motorcycles include Swap&Go under PTT, Winnonie under Bangchak, H Sem under Hua Heng Lee Group, and start-up companies such as Etran and Strom. Winnonie focuses on rentals, while Etran and Strom are the ones that sell car bodies.

In Thailand, local production of electric motorcycles has begun, as subsidies are conditional on local production. However, most are importing battery packs from China and other countries; some manufacturers, such as Strom, have begun assembling modules locally.

Battery cell production is not yet in full swing in Thailand, but as Table 4 11 shows, Amita, a subsidiary of Energy Absolute, a renewable energy company, sells battery cell production mainly to its own affiliates, but has not yet supplied any to Thai motorcycles

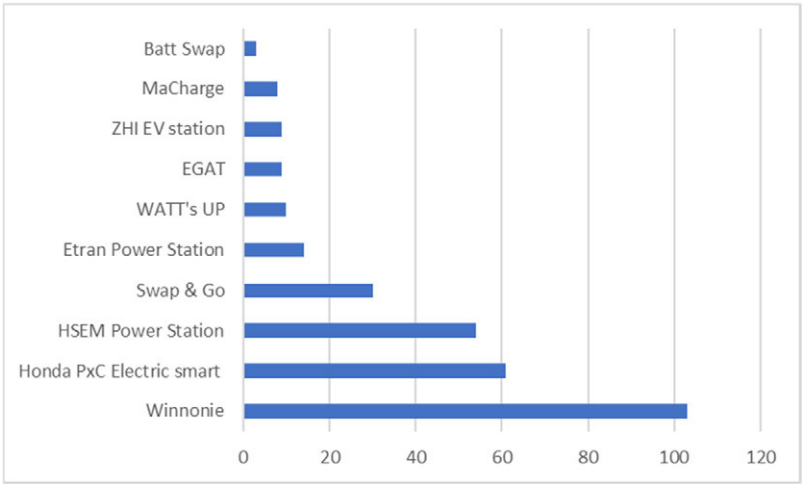
Table 4-11 Company profile of Amita

Main business	• High Power Battery for EV, E-Scooter, Power Plant • OEM (Original Equipment Manufacturer) • PDCA- Post Dry Cell Battery • Turnkeys of High Technology Battery Factory for EV
Products	• Battery cells, Energy storage system, E-bank, etc • Li-ion battery materials; Lithium Iron Phosphate (LFP), Lithium; Nickel Manganese (NMC), Lithium Titanate (LTO)
Facilities and production capacity	• Taiwan : Over 200MWh (already completed), Bejing Phase 1 : 250 MWh (already completed) Bejing Phase 2 : 2 GWh (during construction) • Thailand Phase 1 : 1 GWh (already completed) Phase 2 : to total 50 GWh
Battery Investment	• EA and Amita Technology opened "Gigafactory" the biggest plant in ASEAN. • EA and Amita are in the second-phase development of its battery factory to increase capacity to 4GWh annually within this year, up from 1GWh as of Aug 2023.(This 1 -4 GWh/Year project's duration is 2 years, started in 2023).
Clients	UPS Units, Power Bank, Power Tools, Battery- powered Vehicles, and Energy Storage Europe: EV (Electric Vehicle) Taiwan: E-Scooter Japanese: ESS (Energy Storage Systems) China: A turnkey solution including robotic manufacturing process, equipment design, and technology designed

Source: Prepared by Survey Team from the company website and local report

(5) Infrastructure

As of September 2023, as Figure 4-19 shows, there are about 300 public charging stations in Thailand, provided by Winnonie, Honda, Hsem, Swap&Go, Etran, and others. The number of stations is still growing at a slower pace due to the lack of significant growth in demand for EV bikes. Winnonie, which has the largest number of stations, has 103, while the scale of the swap station business in Thailand is still small.



Source: Statista

Figure 4-19 Electric motorcycle swapping stations of major manufacturers in Thailand

With the aim of promoting the spread of electric motorcycles through mass production by creating a standard, ENTEC under the National Science and Technology Development Agency of Thailand (NSDTA) took the lead in an R&D project for standardization of swap battery packs in collaboration with EV motorcycle manufacturers and others, which was completed this year. 2024 to 2024, the Swap

Battery Consortium will be formed in cooperation with companies and public organizations that participated in the R&D project, with about 30 companies participating, to formulate industry standards for swap batteries, which will be registered with TISI (Thailand's National Industrial Standards). The standards to be standardized include battery size, connectors, and communication protocols. These standards are not mandatory standards, but rather industry standards that are intended to be widely used.

In contrast to Indonesia, Thailand does not have a policy of limiting battery voltage and is open to standards from Japan and other countries. All electric motorcycles sold in Thailand are required to obtain UNR136 certification, and almost all items are tested and evaluated by MTEC under NSTDA of Thailand. According to the head of the research team for the standardization of swappable battery packs, most of the Chinese battery packs sold in Indonesia do not comply with UNR136 and will not be able to be sold in Thailand. From the above, Thailand is relatively advanced among ASEAN countries in battery standardization, testing, and evaluation, and further progress can be expected through the establishment of a consortium.

4.4 Summary of four-country comparison

India is the largest market in the four countries and has the highest potential as a market and production base. The last mile logistics service market is active in India, and fleet users are shifting to electric motorcycles with low TCO, which is contributing significantly to market growth. The government's electrification policy is consistent, with both incentives for consumers and suppliers. In the supply chain, local production is making progress in comparison to other countries in terms of domestic production, with the exception of cells,

In contrast, Vietnam is the country where the future direction of electric motorcycles is the least visible. Although the percentage of electric vehicles is high at 10%, 60% of these are mainly mopeds powered by lead-acid batteries; major electric four- and two-wheeler manufacturers such as Vinfast are emerging, but most are plug-in types. Battery swap stations are still less common than in India and Indonesia. The supply chain is dominated by imports due to its proximity to China, but in the future, batteries may be localized due to the growing electronics industry. Efforts to standardize standards for interchangeable batteries are expected to make progress in the future with Decision 1057/QD-BKHCN, dated May 27, 2024, of the Ministry of Science and Technology.

Thailand has the smallest market compared to the other three countries, with a penetration rate of only 1%. Plug-in types purchased by individual users make up the majority of the market, and the swappable market for fleets is small. On the other hand, however, Thailand has strict standards for electric motorcycles, and only vehicles equivalent to European L2 standards can be registered. As a condition for providing subsidies to users of electric two-wheelers, the country has relatively advanced measures to counter the influx of inferior batteries, including compliance with UNR 136 (safety) standards and an extensive testing and inspection system at domestic inspection agencies.

Indonesia is the second largest motorcycle market among the four countries, after India, and has high potential for electric motorcycles. The government provides subsidies for new motorcycles and modified motorcycles, offering the second most aggressive incentives after India. Indonesia is the only nickel producer among the four countries, and its government is the most active in promoting the inter-country production of cathode materials and cells. Cooperation between electric motorcycle manufacturers and fleets to promote battery swaps is also underway.

On the other hand, when compared among the four countries, the electrification rate is still 1%, which is one of the lowest, along with Thailand, and the country has not yet entered the electrification diffusion phase. While a certain degree of penetration is being achieved among fleets, the issue is how to spread the use of electrification among individual users. In addition, the lack of battery safety standards and a standardized testing and inspection system is an urgent issue.

CHAPTER 5 PROPOSED MEASURES TO CONTRIBUTE TO THE PROMOTION OF THE ELECTRIC MOTORCYCLE INDUSTRY IN JAPAN

As of the end of December 2023, based on discussions with government agencies and the private sector up to that point, as well as the knowledge gained from the Japan invitation program implemented in October of the same year, JICA Survey Team reviewed four promising project proposals for the next period together with the Ministry of Industry, and received a list of government agencies involved in these themes from the Ministry of Industry. The Ministry of Industry organized a "Study Group" for each theme. The themes and members of the study group are as Table 5-1.

Table 5-1 Themes for the next phase and members of the "Study Group" created in this study

Theme	Contents	Discussion Point	Member
1. Support for battery standardization	• Provide Japan's best battery testing equipment to test the safety of all batteries on the market. • Provide not only battery equipment but also Japanese experts to utilize and manage the equipment.	• What kind of equipment and experimental facilities are needed? • Where will they be managed and under what kind of system will the results be shared?	• BSKJI • P4SI • B4T • IMATAP • ESDM • NBRI
2. Research on battery recycling	• Research and propose the necessary system and framework for the reuse and recycling of batteries used in vehicles with 4-wheeled and 2-wheeled vehicles.	• Organize existing systems and the Ministry of Environment and Forestry's concept. • Examine the structure of the counterpart institution that will conduct the survey.	• KLHK • B4T • IMATAP
3. Human Resource Development for Battery and Electric Motorcycle-related Industry	• Develop educational programs and syllabuses for "high school students + teachers", "university (graduate) students", and "working people" in specific regions, especially focusing on "university (graduate) students" + Job Street activities. • The project will be implemented by having automobile and motorcycle OEMs, major parts companies, the battery manufacturing industry, recruiting companies, etc. share the roles and responsibilities.	• Confirmation of willingness of major private companies to participate in the project. • Pilot region and the government agency in charge.	• BPSDMI • PPP VI • Pusdiklat • NBRI • IMATAP • AISI
4. Support for electrification of component companies	• Support for companies that manufacture ICE parts in particular, including matching, subsidy support, and provision of information related to the manufacture of electrified parts, with reference to the “Mikata Project" implemented by Japan’s Ministry of Economy, Trade and Industry (METI).	• Confirmation of the results of the Mikata Project in Japan • Identify target companies and their needs in Indonesia	• IKMLMEAA • IMATAP • GIAMM • PIKKO • IOI

The group discussion (Working Group Discussions, WGD) and their follow-up meetings were held on the dates listed in Table 5-2 below.

Table 5-2 Working Group Discussions (WGS) and Follow-up Meeting Schedule

Schedule	Participants Organizations
1st WGD 2024	
Jan 16 Theme 1	ASDIPI, B4T, IMATAP, P4SI
Theme 2	B4T, KLHK, Center for Green
Jan 17 Theme 3	NBRI, BPSDMI
Jan 18 Theme 4	IKMLMEAA, GIAMM, PIKKO, IOI
Follow-up meeting 2024	
Feb 21 Theme 3	Politeknik STMI Jakarta
Feb 23 Theme 1	B4T
Feb 27 Theme 3	BPSDMI
Feb 28 Theme 3	AISI
Feb 29 Theme 4	IKMLMEAA
2nd WCD 2024	
Apr 23 Theme 1	ASDIPI, B4T, IMATAP, P4SI, NBRI
Theme 2	B4T, KLHK, Center for Green Industry, NBRI
Apr 24 Theme 4	IKMLMEAA, GIAMM, PIKKO, IOI
Theme 3	NBRI, BPSDMI
Apr 26 Theme 1	ASDIPI, B4T
Apr 27 Theme 4	IOI
3rd WCD 2024	
May 8 Theme 3	NBRI, BPSDMI
May 20 Theme 2	IKMLMEAA, GIAM, PIKKO, IOI
May 20 Theme 3	

As soon as 2024 began, the respective WGD began the process of fleshing out the project content. Here, JICA Survey Team took the approach of deepening the content of the project with advice and input from the constituent members. The following is a summary of the information and ideas surrounding each project.

5.1 (TP21003 standard promoted by 4 Japanese companies and Indonesia's SNI) Concept of Support for Battery Standardization Process

5.1.1 Current Measures

The SNI8928, revised in November 2023, has made revisions that provide some direction to the specifications for swappable batteries for 2 wheeler motorcycle. The main points are as follows;

1. Battery types were narrowed down, with 60V and 72V voltages becoming the standard. The 48V standard proposed by four Japanese motorcycle manufacturers and Gogoro of Taiwan was not adopted. Nominal voltage ranges (60V: 55-66, 72v: 67-78) were added to the standard voltages. In addition, the minimum current capacity (Ah), which indicates battery capacity, was changed to the minimum power capacity (Wh).

Table 5-3 Battery standards (voltage) adopted in the 2023 standards revision

[1] rated voltage (V)	Nominal voltage range (V)	Maximum mass (kg)	Minimum energy capacity (Wh)	Maximum size (mm)		
				Long	Width	High
60	55 - 66	13	1.300	220	200	385
72	67 - 78					
[1] The rated voltage is different from the working voltage.						

Source: SNI8928

2. As for connector type, open IP was defined, allowing Indonesian manufacturers to produce identical products without paying royalties. As a result, while the technology has become widely available, companies with patents and manufacturing know-how in this area have been forced to leak their technology.

   In addition, a new standard for rated voltage ≥80V was introduced as a milestone for the future of rapid recharging.

Table 5-4 Battery standards (connecter) adopted in the 2023 standards revision

No.	Location of the connector on the battery[1,2]	Connector pins	*Current rating* connectors
1	Above[1]	2 DC pins, 6 communication pins	≥ 80 A
2	Bottom[2]	2 DC pins, 12 communication pins	
3	Bottom[2]	2 DC pins, NFC	
[1] The side of the battery with the handle is the top of the battery. [2] The side of the battery opposite the top of the battery is the bottom of the battery. **NOTE** The connectors used are *Open IP*, i.e. they can be shared and can be produced by manufacturers and SPBKLU service providers in Indonesia without royalty fees.			

Source: SNI8928

3. The battery shape (Dimension) was not specified before the revision, but after the revision, the maximum size (L:220mm x W:200mm x H:385mm) is defined and the maximum weight (13kg/pack) is newly specified (see Table 5-3 above).
4. For the communication protocol, the CAN (Controller Area Network) system was adopted as the standard (see Table 5-5). Since the communication protocol is open, it is difficult to protect data, but at the same time, it facilitates the entry of new companies into the market.

Table 5-5 Battery standards (communication protocol) adopted in the 2023 standards revision

Types of communication protocols	*Baud Rate*	*Format*	*Message length*
CAN Bus 2.0B	250 Kbps	Big-endian[1]	8-Byte
[1] For unused data will be filled with the value 0xFF.			

Source: SNI8928

This standard is voluntary and not mandatory. However, the results did not meet the expectations of Gogoro of Taiwan, and a consortium of four Japanese companies, which had proposed a 48V standard[25].

According to interviews with AISI, the impact on AISI members (including Honda and Yamaha in Japan) has been minimal, and the organization is of the opinion that the standard may be changed again depending on future market share.

5.1.2 Views of Japanese Companies

There is no way to confirm how much impact the revision of SNI8928 has had in Indonesia. However, at the end of December 2023, Honda notified the following information through the Devices Sangyo Shimbun newspaper of Japan.

"The company will reduce the cost of complete electric motorcycles including swappable battery type by 50% in 2030, compared to the current price. To achieve this, Honda will use plug-in rechargeable batteries, optimize battery cells, adopt common solutions for procurement, increase production efficiency, and improve efficiency through dedicated factories."

Although some of the context is difficult to understand, it seems to be the appeal that "Honda will not confront competition focused solely on swappable batteries, but will examine the price of swappable battery bikes as an integrated unit and cut this price in half." In other words, this could be seen as a stepping stone to the following strategy.

- Reduce the price of swappable battery bikes by letting them ready-made, including the battery.
- Reduce costs by producing bikes with common parts and assembly specifications.
- Identify (possibly) a few assembly plants around the world and manufacture exclusively at those plants

This concept is considered to be Honda's basic strategy for swappable battery bikes, as similar comments were made by Japanese executives of Astro Honda when JICA Survey Team interviewed them during our field survey in January 2024.

5.1.3 Safety of Electric Motorcycles as a Whole Remains an Issue

As indicated in the above, Japanese manufacturers discuss batteries in the context of the entire electric motorcycle industry and take it for granted that the manufacturer will take responsibility in the event of a battery failure or accident. In November 2023, an interview with AISMOLI indicated that even if the battery in an electric motorcycle catches fire, it is the responsibility of the purchaser, and therefore, the purchaser should have adequate disaster insurance. The buyer should therefore have adequate disaster insurance. Thus, it is fair to say that there is no entity that can reliably guarantee the safety of batteries, which can be said to be the heart of the electric motorcycles that are becoming popular in Indonesia.

For example, a system in which no one takes responsibility in the event of a battery fire (as several cases are reported in China and India) threatens the credibility of electric motorcycles as a whole and is a major brake on the electrification policy being pursued by the Indonesian government. Furthermore, it would undermine the credibility of electric motorcycles as a whole, regardless of the nationality of the motorcycle manufacturer. As a result, it is expected that the negative effects of this system will be propagated to Japanese companies as well.

Other issues that directly or indirectly affect battery safety include;

- There is no industry association to coordinate and lead the automotive battery industry. This is because the automotive battery industry, which represents four-wheeled and two-wheeled vehicles, and the storage battery industry are both related to the automotive industry, which is

[25] ESDM/PLN is said to have led the 48V exemption, and PLN is leading the standardization discussions, including the establishment of a new EV battery industry association around February 2024 (apparently). As of November 2023, only four companies (SMOOT, SGB (Volta), Oyika, and Electrum) have SNI8928(2023) compliant batteries (Electrum appears to have terminated its partnership with Gogoro)..

positioned as an intermediate industry organization (in Japan, automotive storage batteries are under the jurisdiction of Japan Automotive Manufacturing Association (JAMA)).

- In the establishment of battery standards, there is also the influence of political power with a strong Chinese agenda, and it seems that political considerations have a large impact before performance is considered. As a result, the standards of Japanese and Taiwanese companies face an uphill battle.

5.1.4 The View of Japan's Contribution Measures

It is impossible for Japanese private companies to solve battery safety issues through self-help efforts. This is because, even if a manufacturer with a specific brand implements such a measure, the users will not take it seriously unless something happens to them.

If the Indonesian government considers this as an important issue and wants to draw on Japan's help, Japan's contribution would be to contribute to "preventive measures" to eliminate unsafe batteries on the market before they become widely used. In other words, Japan's contribution should be to the evaluation of battery safety.

Specifically, as shown in 6.2.1 of Chapter 6, Japan would provide equipment for conducting safety tests and expertise in measurement technology, and foster the ability to inspect and measure batteries on the market and judge their safety.

In this study, based on the awareness of the above issues, Indonesian officials visited Japanese organizations in charge of battery safety testing and gave lectures on related know-how as part of the Japan invitation program conducted in October 2023. The above was further reviewed and its contents are shown in the latter part of this report (refer to Chapter 6.3.1).

5.2 Institutional Design for Battery Recycling and Reuse

5.2.1 Current Policies

The industrial sector accounts for the largest share (18%) of Indonesia's gross domestic product (GDP). On the other hand, the development of the industrial sector may increase the generation of waste, so a balance with environmental protection is require[26].

Source: BAPENAS

Figure 5-1 Composition of GDP

Presidential Regulation No. 55 of the President of the Republic of Indonesia of 2019, "Presidential Decree on Acceleration of Battery Electric Vehicle Program for Road Transport" has been issued. The Ministry of Environment and Forestry states that this law is the basis for battery recycling and reuse,

[26] Indonesia's commitment at the 28th Conference of the Parties (COP28) to the United Nations Framework Convention on Climate Change (UNFCCC) in 2023 is to reduce its greenhouse gas (GHG) emissions by about 32% below the previous level by 2030, or by about 43% subject to adequate international financial support. The government has also submitted its first long-term strategy to UNFCCC, which indicates that Indonesia will peak its GHG emissions in 2030 and may achieve net zero GHG emissions by 2060 or earlier. It states that additional investments in the country's forestry and energy sectors are needed to achieve the 2030 climate target cap in Indonesia.

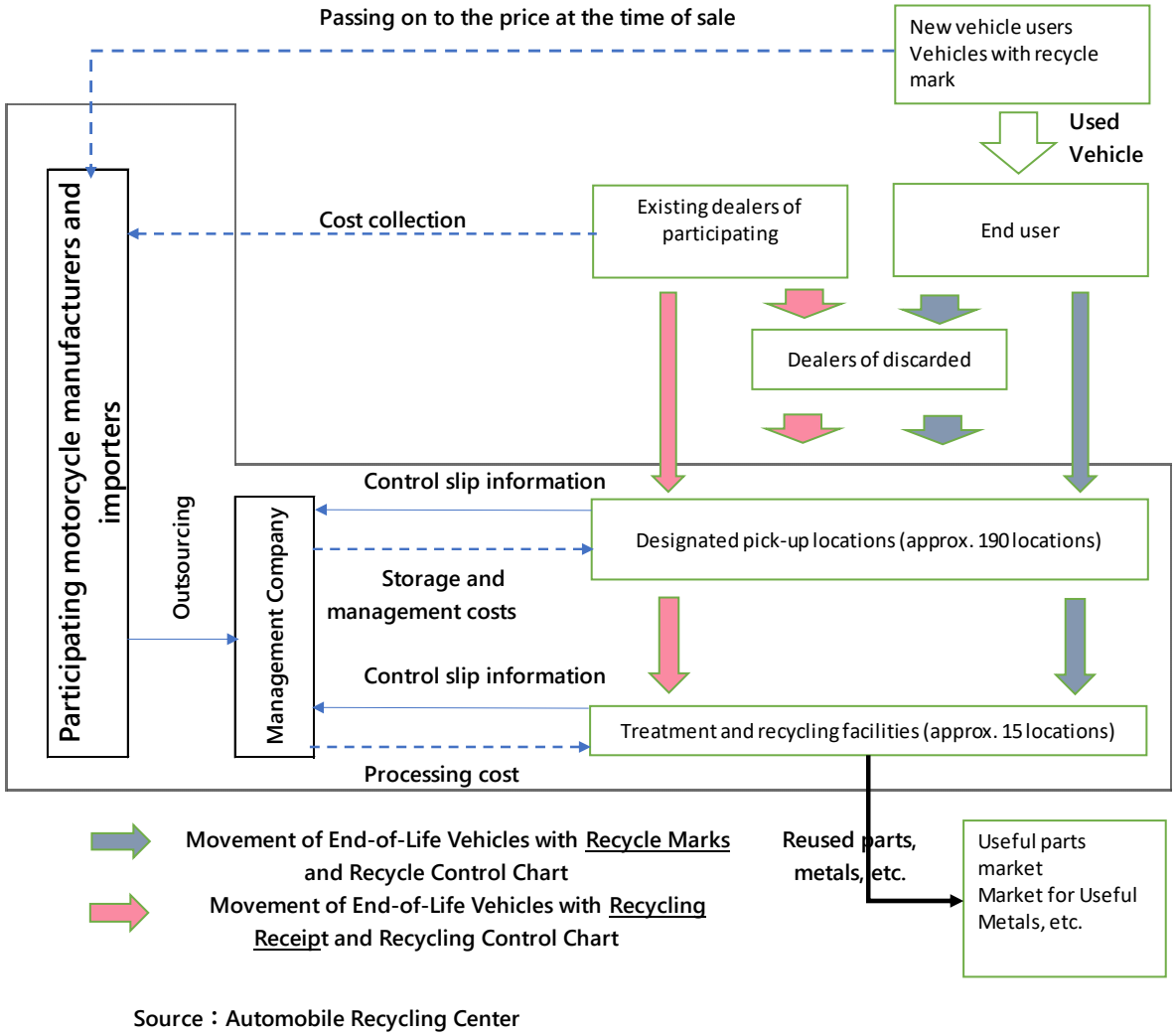
but in reality, it only states the need for recycling/management of battery-related waste, but does not provide specific responsibilities or methodologies[27].

Furthermore, regarding the disposal of uncategorized hazardous materials in car batteries, the "Minister of Environment and Forestry Regulation No. 6 of 2021 on HazTox Waste Management Procedures and Requirements" has been issued. This regulation also only considers a portion of used batteries (there is no indication of what constitutes "used") as waste and provides only a general disposal/utilization policy.

5.2.2 Situation in Japan

(1) Automobile 4-wheelers

In Japan, the Automobile Recycling Law came into effect in January 2005 with supply and demand each playing a role as shown in Figure 5-2. The law requires automobile manufacturers and importers to take back, recycle, and properly dispose of three existing recycling and disposal systems for 4-wheeled vehicles: i) shredder dust, ii) airbags, and iii) CFCs for car air conditioners (currently being collected and destroyed).



Source：Automobile Recycling Center

Figure 5-2 Roles of consumers and suppliers surrounding motorcycle recycling

[27] Peraturan Presiden Republik Indonesia Nomor 55 Tahun 2019 Tentang Percepaten Program Kendaraan Bermotor Listrik Berbasis Baterai Uutuk Transportasi Jalan

The law also defines the roles of automobile owners, new and used car dealers, maintenance companies, dismantling companies, shredding companies, and other related businesses. In other words, the law aims to create a recycling-oriented society in which all parties involved in the automobile industry cooperate to reduce waste and promote the effective use of resources. Currently, approximately 4 million end-of-life vehicles are generated annually, which are recycled and disposed of in Japan.

(2) 2-wheelers motorcycles

In Japan, motorcycles (including motorized bicycles) were initially considered within the same framework as the Automobile Recycling Law but were excluded from the law due to the small number of motorcycles disposed of in Japan and the different handling and flow of products before disposal between motorcycles and automobiles. Therefore, they are no longer subject to the Law (see Figure 5-3).

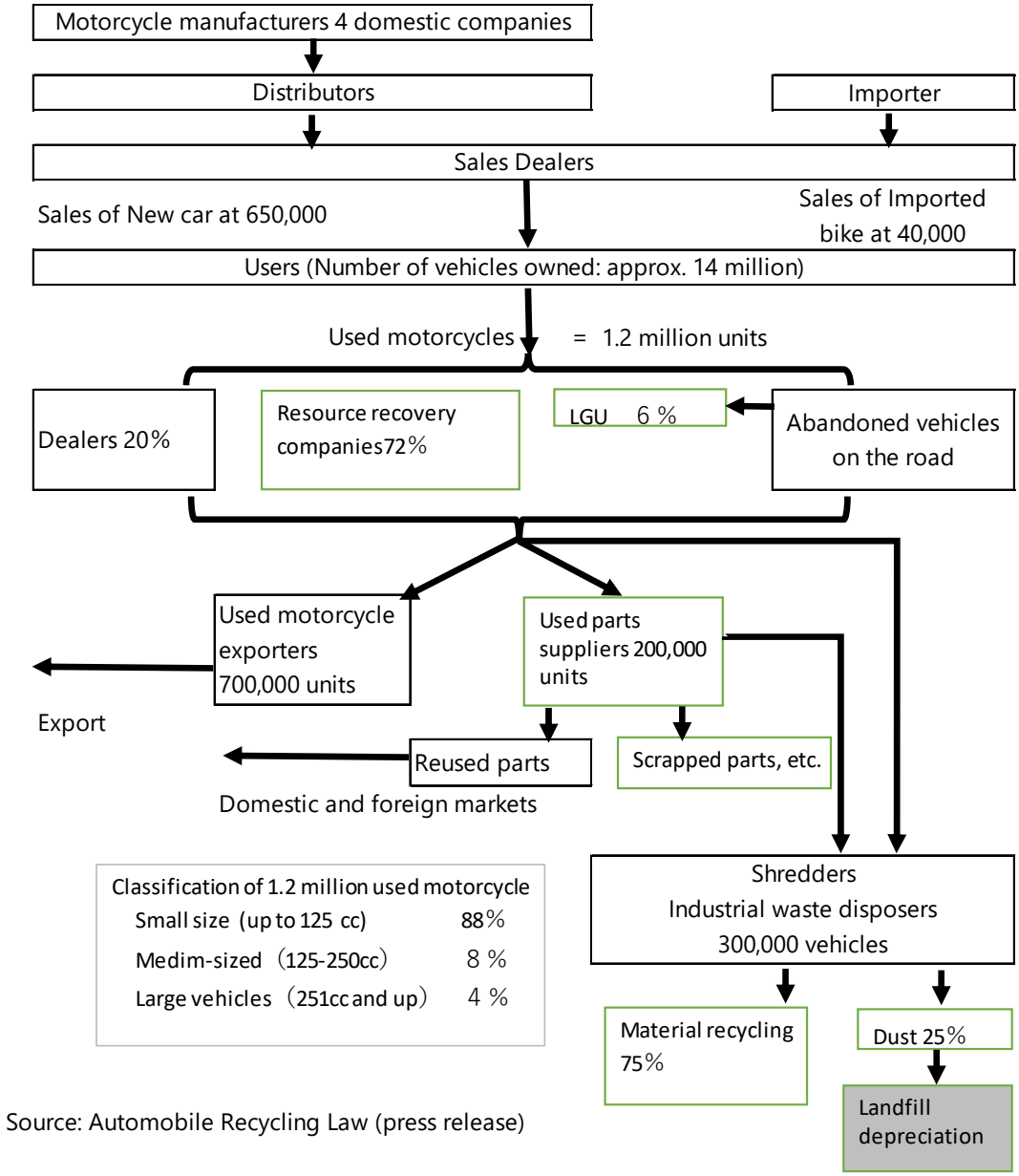


Figure 5-3 Overview of Used Motorcycle Flow and Recycling

About 80% of used four-wheeled vehicles are dismantled domestically, while the majority of used two-wheeled vehicles are exported for reuse.

It is estimated that approximately 1.2 million end-of-life motorcycles are discharged annually, of which about 700,000 are exported as used vehicles. Another 200,000 motorcycles are distributed in the domestic and international market as parts, and in the end, the number of vehicles shredded as waste is estimated to be from about 300,000 (including parts) to 500,000 at the most. The reuse rate of the products is extremely high, with only about 0.84 million tons by weight ultimately disposed of as dust. This is about one-hundredth of the 800,000 tons of dust generated annually by four-wheeled vehicles.

(3) Motorcycle Recycling Disposal Routes

The key to motorcycle recycling is the establishment of routes to recycle and properly dispose of discarded motorcycles in Japan.

The four motorcycle manufacturers in Japan have jointly established their own disposal routes for used motorcycles, including "designated pick-up sites," and have also introduced a new motorcycle recycling management system network to ensure that batteries, gasoline, oil, and other fluids are removed prior to shredding, and that the status of proper recycling and disposal can be confirmed. The introduction of a new motorcycle recycling management form and the development of an IT network were also implemented to ensure proper recycling and processing status.

In addition, for the convenience of the discharger, approximately 15,000 "waste motorcycle dealers" nationwide have been established so that the discharger can request the nearest dealer to bring the discarded vehicle to a "designated pick-up location.

Establishment of Recycling Processing Routes by Motorcycle Manufacturers and Related Organizations

1. Secure "collection points" for end-of-life motorcycles: Establish approximately 190 designated collection points nationwide.
2. For those unable to bring their motorcycles to the designated collection points: Approximately 15,000 of the nation's motorcycle dealers have been set up as "dealers for waste motorcycles".
3. Securing "treatment/recycling facilities"--About 13 treatment/recycling facilities have been designated nationwide.

(4) Management and Operation of Recycling Processing System

In the recycling system, motorcycle manufacturers, together with importers, collect motorcycle recycling fees from users and establish payment systems for designated collection sites and treatment/recycling facilities, and take the initiative in operating and managing the system.

In addition, the Motorcycle Business Department has been established within the Japan Automobile Recycling Promotion Center to ensure the implementation of this system.

Operation and management of the recycling system by motorcycle manufacturers and importers

1. Established a payment system for collection of recycling fees from motorcycle users (emitters) and information on disposal of motorcycles after designated collection points.
2. Introduced and implemented a "recycling management sheet" to manage the proper disposal of used motorcycles.
3. Outsourced the management of the recycling system to a specialized company.

Manufacturers and importers that have implemented the system are making their dealers who handle discarded motorcycles aware of the system, and are also conducting public relations activities for local governments, users, and the public. As part of these efforts, the Japan Automobile Recycling Promotion Center has established the Motorcycle Call Center to respond to various inquiries.

(5) Roles and Obligations of Users

On the other hand, motorcycle users are in a position to be held "responsible for the emission of waste", and they share in the recycling and proper disposal of used vehicles by bringing in waste vehicles and paying the recycling-related costs (recycling treatment costs and collection and transportation costs).

The recycling costs to be borne by the user are reflected in the product cost in advance. Vehicles that have the costs incorporated into the cost of recycling are marked with a "motorcycle recycling mark" so that they can be recognized at a glance (see Figure 5-4).

Figure 5-4 Motorcycle Recycling Mark

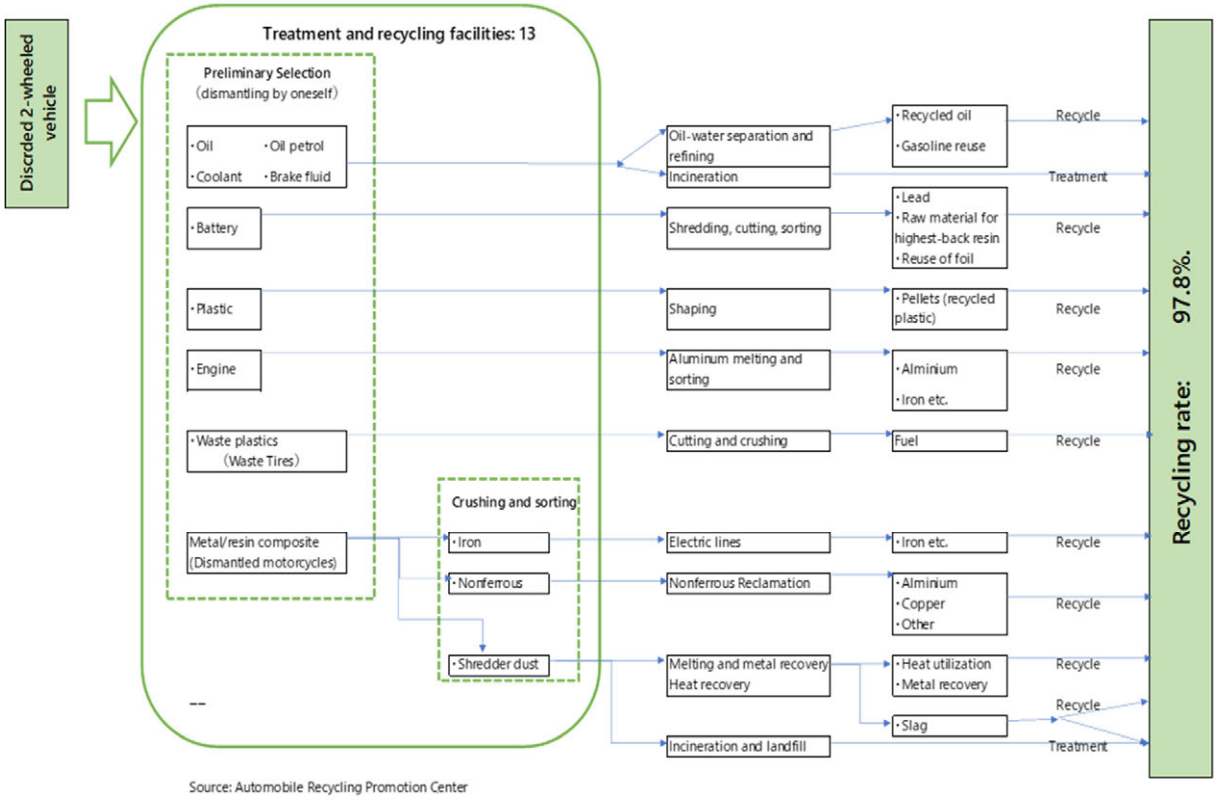
(6) Recycling

The motorcycle recycling system[28] has approximately 190 designated collection sites and 13 treatment/recycling facilities located throughout Japan. In addition, to enhance convenience for emitters, the system allows motorcycle dealers to collect discarded motorcycles and deliver them to the system with the cooperation of the Japan Light Motor Vehicle and Motorcycle Association[29].

The recycling rate for FY2022 was 97.8% (by weight). However, the number of electric motorcycles with lithium-ion batteries installed is very small (20 units), and Japan is still accumulating experience in the recycling and reuse of electric motorcycles.

[28] The motorcycle recycling system participants (as of April 1, 2023) are as follows;
Honda Motor Co., Ltd., Yamaha Motor Co., Ltd., Suzuki Motor Corporation, Kawasaki Motors Japan, Ducati Japan, Ltd.

[29] In 1991, in accordance with the provisions of Article 2, Item 4 and Article 9, Item 4 of the Enforcement Regulations of the Waste Disposal and Public Cleansing Law, the Japan Mini Vehicle Association (hereinafter referred to as "JAMA") was designated by the then Minister of Health and Welfare as a "designated wide-area waste disposal business". Motorcycle dealers notified to the Ministry of the Environment by the ZENKEIJIKYOKYO are allowed to collect and transport used motorcycles as waste in a wide area nationwide.



Source: Automobile Recycling Promotion Center

【Formula for calculating the recycling rate】

(Weight of oil and gasoline recovered + Weight of batteries recovered + Weight of resins and other recovered + Weight of ferrous and nonferrous recovered + Weight of shredder dust heat recovered, etc.) ÷Total weight received

Figure 5-5 Formula for Calculating the Recycling Ratio and Material Flow

5.2.3 Challenges and Measures in Indonesia that require an Urgent Response

How to manage used lithium batteries discharged from electric vehicles in Indonesia has become an issue.

At this stage, Indonesia does not have binding laws and regulations on recycling for both 4-wheeled and 2-wheeled vehicles, and only the development part of both is greatly expected. In addition, the Indonesian consumer community lacks knowledge about batteries, so product knowledge and safety concerns are extremely limited.

Japan is in the process of considering support for ELVs in Thailand through JICA (Project for Establishment of a Comprehensive System for Proper Management of End-of-Life Vehicles (ELVs) in Thailand), but Indonesia does not have the same environment-related infrastructure and government structure as Thailand, At the very least, Indonesia should consider in the next phase the implementation of technical project support to facilitate research and institutional support regarding batteries for electric two-wheeled vehicles, which, if unprotected, will have a devastating impact on future environmental issues[30].

[30] JICA Survey Team proposed to conduct a master plan study to grasp the current situation and propose an overall recycling and reuse project, but the Indonesian side strongly requested support not only for a planning study but also for implementation support to realize the policy (January 16, 2024: Thematic Project Establishment Meeting).

5.3 Human Resource Development Project for the Battery Industry

Although Indonesia has its own resources, it does not have a battery production line. Therefore, most of the batteries that consumers see are manufactured by foreign companies or imported. The majority of replacement batteries for electric motorcycles are made in China. Of the more than 50 batteries on the market as of January 2024, all of them are made in China, except for those from Japanese motorcycle manufacturers[31].

The Indonesian government is well aware of the importance of human resource development projects in the battery industry, and although there was a lively exchange of opinions at the survey meeting on human resource development held in January 2024, JICA Survey Team sees the following as issues to be addressed in the project formation process.

- The organizations in charge of human resource development differ according to the theme, target audience, and location, making it difficult to coordinate.
- The NBRI's human resource development activities for university students and working adults are functioning effectively, so if other donors target human resource development for the same target group as the NBRI, it will be necessary to avoid pressure from the private sector.
- The Ministry of Industry has facilities for training and human resource development, such as PIDI4.0 in the suburbs of Jakarta and the Indonesian Industrial Center (IMC), which is currently under construction[32].

5.3.1 Battery Human Resource Development in Indonesia

The only organization that is engaged in comprehensive battery-related human resource development is the National Battery Research Institute (NBRI)[33] in the private sector. From the government sector, there have been no notable activities except for BRIN, which has generally assigned two to three researchers to conduct research on batteries.

Although NBRI is in the private sector, its president has a strong network with government agencies, and it has already made a mark in human resource development projects for working people, such as contributing to the development of young human resources at IBC (see Table 5-6). Toyota Indonesia is also among its clients.

In addition, the company is internationally recognized for attending numerous international conferences and hosting the International Battery Summit (IBS)[34]. NBRI is supported by ODA from Switzerland, Australia, the United Kingdom, and other donors, and provides education mainly for university students and working professionals. It also provides education to high school students and polytechnics if funded by such donors.

[31] Based on interviews with Chinese battery manufacturers (e.g., Gotion) at the Periklindo exhibition.

[32] Demand surveys on these facilities are insufficient, and it is considered necessary to conduct resource utilization surveys, utilizing JICA's expertise if possible, and to organically link related facilities. Even if the Ministry of Industry requests that these facilities be utilized effectively, it is difficult to make an investment if the facilities cannot be organically linked.

[33] NBRI is a private organization that has no direct relationship with the Indonesian government (it is not a national research and development corporation in Japan), although it includes the word "national" in its name and engages in public interest activities and projects.
However, the founder of NBRI is a member of BRIN (National Research and Innovation Agency of Indonesia), a government agency, and thus has a personal relationship with the Indonesian government. In addition, NBRI received support from the Global Challenge Research Fund (GCRF), a type of ODA from the British government, via the Queen Mary University of London at the time of its incorporation in 2020. The company has strong ties to the United Kingdom, with a professor from Queen Mary University of London serving as a co-founder of the company.

[34] The most recent event was held on August 1-2, 2023.

Table 5-6 Battery Human Resource Dvelopment Programs Involving NBRI

Target Segment	Contents of Training	Training Period	Frequency/Participation fee
High School Student (SMK[35])	• General understanding of batteries (donor provides curriculum and syllabus)	30persons x 3days	UK government (irregular), Department of Labor and Employment
Technical School Student (Polytechnic[36]& Short-term University)	• Battery types, construction, applications, etc. (NBRI has a program in place but has not implemented it due to lack of budget.)	30persons x 5days	(Student)&(Teacher) Only when there is donor support
University, Graduate-school Student	• Teaches battery structure theory through theory and practice of battery manufacturing. • Open to applications from universities • Accepted for university credit. • Submission of thesis to international academy (graduation requirement) • Lecturers invited by NBRI as needed	3-6 months (Depend on the level of student)	• Open call for applications once a year (30 students). • Support from Switzerland and Germany (1-week curriculum). • Participation fee is Rd.5million/person. • Living expenses are to be borne by the individual.
Working people (General public)	• Educational content is more specialized with deeper content than college students	30persons x 2days	General course (2 days) for 30 students/class for 20 industries. Tuition fee is Rd5million/person.
Working people (Skilled or Professional)	• Polytechnic lectures for IBC, Japanese automotive companies, etc. • Structured in two areas: "Battery Standardization" and "Specialization".	30persons x days (Depend on doner)	There is also support from donors (GFA and Korea) (mostly 5-day course). Tuition is Rd7-8million/person.

Source: NBRI

Since NBRI is in the private sector, its main focus is naturally on human resource development for undergraduate and graduate students and working peoples who can obtain financial support from donors. Therefore, the curriculum in these fields is well-developed. On the other hand, human resource development for high school students and other young people, for whom foreign donor support is difficult to obtain, has not been implemented as well as expected[37].

NBRI has a strong network with the Indonesian government, foreign donors, and the Japanese private sector, and seems to have the capacity to consistently raise funds and speakers.

On the other hand, NBRI has little relationship with high schools and polytechnics that teach general

[35] In Indonesia, secondary education includes lower secondary school (junior high school), upper secondary school (high school), and upper secondary vocational school. Among these, SMK (vocational high school) has been established as an advanced secondary vocational school, which educates students in manufacturing know-how and supplies human resources to production sites in the manufacturing industry.

[36] For tertiary education, polytechnic academies (polytechnics), which correspond to technical colleges in Japan, have been established in addition to various universities. At universities, research and education in electrical engineering is conducted in the engineering department, while at polytechnics, practical training and production commissioned by companies are conducted.

[37] The survey team has suggested that NBRI should receive support from the government through a partnership with the Ministry of Industry and the Ministry of Education, but NBRI does not seem to be very enthusiastic about this.

battery knowledge and safety rather than specialized knowledge, and NBRI strongly hopes for Japanese government support to contribute to ToT and equipment that can be used for more practical education for high school and polytechnic teachers (battery structure models and experimental equipment for current generation mechanisms).

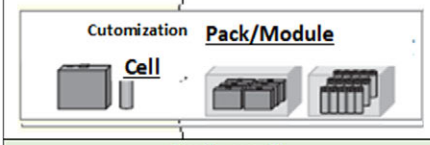
5.3.2 Japan's efforts

Japan has announced a policy (Storage Battery Industry Strategy / METI, 2022) to train and secure human resources that meet the needs of industry in order to secure storage batteries and materials manufacturing capacity of 150 GWh domestically and 600 GWh globally by 2030. The move to develop battery personnel is based on this policy, and specifically aims to develop and secure a total of 22,000 people by 2030 for storage battery manufacturing. In addition, a total of 30,000 people will be trained for the entire supply chain, including materials. The breakdown of the battery of human resources is as follows;

- 18,000 technical personnel directly responsible for manufacturing and equipment maintenance on the production line at the factory.
- 4,000 technical personnel for product and technology development, cell design, battery evaluation, design and improvement of production lines, installation and improvement of production facilities, etc.

The types of personnel involved in the battery and their respective job descriptions/expected roles are shown in Table 5-7 below.

Table 5-7 Type and job description/expected role of personnel related to batteries

Type	Job Description	Expected Role
Engineer A		**Maerial technology, element technology, mass production technology and smooth quantity production of batteries and packs/modules**
Mass Production Technology	· **Back Module & Technology and product development** (including control circuit design and development) · **Cell design and development** (material & process development) · **Cell quality control** · **Battery cell evaluation** 	(1) **Design and development of packs/modules to customer specifications** ·Structural design and development of concepts, outer cases (resin and metal), etc. ·Design and development of charge/discharge control circuit (BMS) (2) **Cell material development, cell design and development** ·Composition and synthesis process of main materials (positive and negative electrodes, separators, electrolyte, etc.) ·Sub-material (conductive agent, etc.) development and process development (electrode development, material synthesis) ·Cell development (design change and size development based on customer requirements) and start of mass production (3) **Cell process quality control and operator training** ·Daily operation control of the mass production line (operation rate, good rate, performance variation) ·Cell process quality control and worker training (materials, methods, equipment, operator training, improvement requests to R&D sections and suppliers)
Engineer B		**Evolution of processes and design/introduction of manufacturing equipment and production lines**
New Line Design Start-up production engineering area	· **Production line design** · **Introduction and improvement of production facilities**	·Evolution of basic cell methods ·Design and installation of manufacturing facilities and mass production line ·Improvement of manufacturing facilities (productivity/yield improvement, human resource saving, etc.)
Engineer C		**Improvement of battery cell manufacturing process utilization rate and yield/reduction of losses**
Manufacturing operations area	· **Equipment maintenance** · **Manufacturing**	·Pre-work inspection and adjustment, regular maintenance and operation of facilities. ·Improvement of yield and reduction of student losses by solving daily problems. ·Supervision of floor leaders, production display, etc.

Source：Kansai Consortium for Human Resource Development on Battery

As a regional initiative, the Consortium for Human Resource Development of Storage Batteries in Kansai, supported by the Ministry of Economy, Trade and Industry (METI), was established to promote initiatives to develop and secure battery personnel in the Kansai region, where storage battery-

related industries are concentrated. As of March 16, 2023, 41 organizations including industry, educational institutions, local governments, and support organizations are participating in the consortium[38].

The contents of Japan's human resource development projects are generally as follows.

1. Direction of educational programs for high school students

In order to promote interest in batteries, an educational program emphasizing practical training will be implemented. In addition, in order to promote understanding among teachers, the project will also hold explanatory meetings and training sessions for teachers.

2. Direction of educational programs for technical college students

In addition to the same direction as that for high school students, consider expanding opportunities for students to learn in a more practical and specialized manner.

3. Direction of educational programs for undergraduate and graduate students

Since it is important to expand opportunities for practical and specialized learning, classroom lectures and practical training will be conducted mainly at the Kansai Center of the National Institute of Advanced Industrial Science and Technology (AIST) to improve basic academic skills in chemistry, etc., and to acquire the knowledge required for battery engineers.

4. Direction of the educational program in the workforce

After sorting out the needs of industry, the possibility of collaboration with universities and other educational institutions, public vocational skill development facilities, etc. will be examined. In addition, industry associations will consider holding battery training sessions for newcomer companies.

5.3.3 Concept of Support for Battery Human Resource Development Project

The structure of batteries, the flow of electrons, and the concept of electronic circuits, which are subjects in Japanese higher education, are taught from high school to university in Indonesia, but it has been pointed out that the quality level of such education is not very high. The most significant factor is the quality of teachers, and the battery-related education received by teachers, who are on average between 30 and 45 years old, teaching high school students, is almost none or only some of them have graduated from university engineering departments.

Of the human resource development mentioned in 1 to 4 above, it seems necessary to strengthen the capacity of high school and polytechnic teachers, as mentioned by NBRI, in order to expand the base of battery human resources in Indonesia in the future. The scenario of JICA's support can be envisioned like;

"The capacity of the young student population is improved ⇨ the capacity of university students and working adults is upgraded" and it spills over to the Indonesian private sector, which in turn reflects the human resource development institutions and further facilitates business.

In order to increase the effectiveness of the training, it is necessary to provide more practical training that appeals not only to theory but also to the visual and auditory senses. Therefore, models of battery structures, experimental equipment to show the mechanism of current generation, and testers to continue current and voltage should be provided for students' education.

[38] The Kansai region is home to private companies such as Panasonic Energy, GS Yuasa, and Prime Planet Energy & Solutions, which are also members of the consortium, as well as universities and technical colleges, and government agencies such as NEDO, NITE, and AIST. In addition, Mr. Akira Yoshino of the Lithium Ion Battery Materials Technology Center (LIBTEC), a Nobel Prize winner in chemistry, serves as an advisor, further strengthening the bond between industry, government, and academia.

5.4 Support for Enterprises Affected by Electrification

5.4.1 Impact of Electrification of Motorcycles on Indonesian SMEs

As mentioned in Chapter 3- ("Impact of Electrification Policies"), the spread of electrified motorcycles will have a considerable impact on companies that have been manufacturing functional parts for ICE motorcycles. In general, it is said that the number of parts will decrease from 1,500 to 750.

1. Engine-related parts: e.g., cylinders, pistons, crankshafts, camshafts, valve-related parts, etc.
2. Fuel-related parts: e.g., tanks, fuel pumps, fuel injectors, carburetors, etc.
3. Exhaust related parts: exhaust system related parts such as mufflers, catalytic converters, etc.
4. Transmission related parts: clutch, gear, shifter related parts
5. Starter motor: starter motor is not required
6. Engine cooling parts: engine cooling fan, radiator, cooling water pump, and other cooling system parts
7. Engine control unit (ECU): ECU to control internal combustion engine

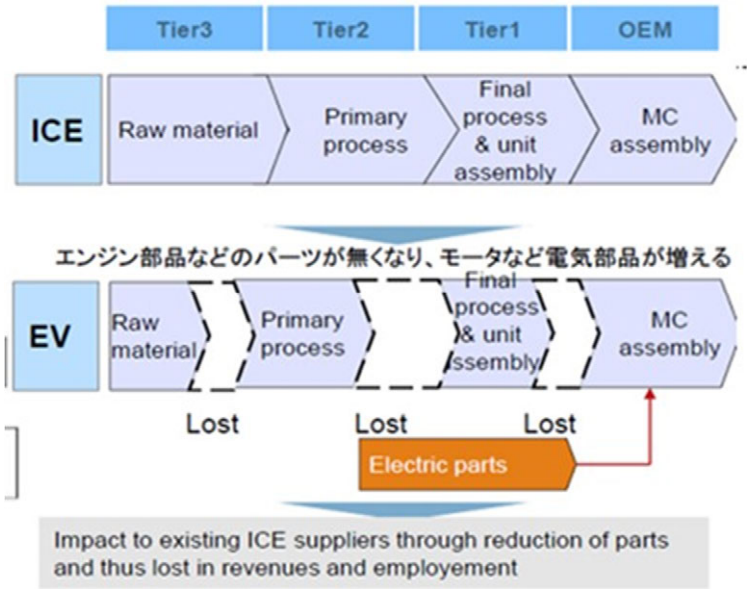


Figure 5-6 Influence on 2-wheeler's electrification

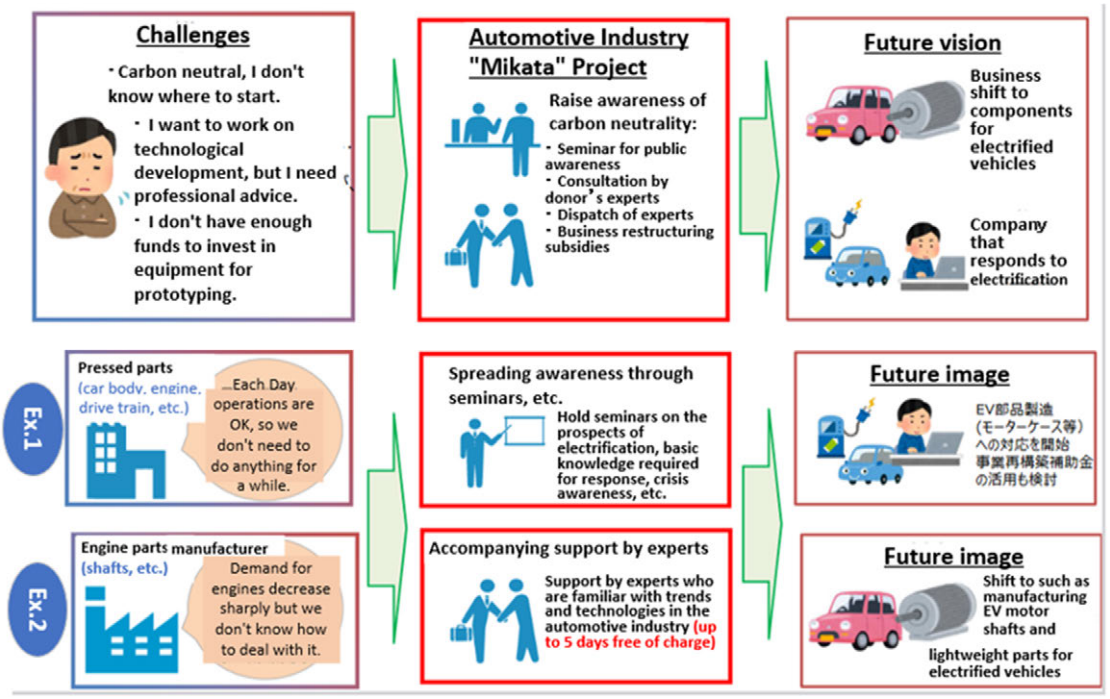
It is estimated that there are about 500 companies (equivalent to one-third of gasoline engine vehicle suppliers) in Indonesia that are under pressure to change their business or close down due to the impact of electrification (according to JICA Survey Team's estimation). In this survey, interviews were conducted with these companies to find out their current situation, direction of business transition, and needs for government support during the transition period. For local firms, a similar interview survey was conducted by a local consulting firm under a re-commissioning arrangement.

5.4.2 Examples of Support for Similar Companines in Japan

The automotive industry is expected to shift production from purely engine-powered vehicles to electrically powered vehicles due to changes in technological trends caused by CASE and the acceleration of electrification following the declaration of carbon neutrality in 2050. The Ministry of Economy, Trade and Industry (METI)-supported Mikata Project is a hands-on support program that encourages suppliers of automotive parts (engine parts, etc.), whose demand is declining due to the progress of electrification of automobiles, to "aggressively change their business model and restructure their business" (Figure 5-7).

The project's support includes providing consultation services for business strategies, as well as subsidizing the development of new technologies and capital investment. Seven support bases for suppliers have been established in Japan to provide consultation services and dispatch experts, and the company is considering increasing the number of bases in the future, aiming to support approximately 1,000 companies.

On the other hand, suppliers aiming to develop EV motor parts and reduce the weight of parts will be encouraged to make capital investment through the use of business restructuring subsidies. Currently, some of the requirements have been changed, such as raising the maximum subsidy amount, with a one-half subsidy rate and a maximum subsidy amount of 100 million yen (approx. 10,700 million rupiah) for small and medium-sized companies, and a one-third subsidy rate and a maximum subsidy amount of 150 million yen (approx. 16,030 million rupiah) for medium-sized companies.



Source: METI

Figure 5-7 Image of the Mikata Project

5.4.3 Supporting the Business Transformation of Motorcycle Parts Manufacturers

The Ministry of Industry recognizes the transformation of the auto industry's parts suppliers in electrification as an important issue, and has confirmed a high level of interest in Japan's Mikata project.

In terms of donor support, the following activities can be proposed to support business transformation.

- Organizing seminars and educational activities for carbon neutrality
- Dispatch of experts and corporate consulting regarding business establishment
- Support for corporate matching by experts

On the other hand, as mentioned above, support through financial facilities such as loans to SMEs to support capital investment should be provided by the Indonesian government.

CHAPTER 6 CONSIDERATION OF MEASURES TO CONTRUBUTE TO THE PROMOTION OF THE ELECTRIC MOTORCYCLE INDUSTRY IN JAPAN

6.1 Results of Pilot

6.1.1 Japan Invitation

(1) Objective

The Objective of the Japan Invitation Program is the following two points.

(Background 1) The Indonesian Ministry of Industry and related organizations are interested in standardizing standards for batteries, a key component, to improve convenience and ensure safety through conformity assessment.

(Objective 1) Introduce safety test methods, safety test facilities, and various measuring devices that contribute to the standardization of battery standards, and make participants aware of the information (human resources, facilities, and technology) necessary for the standardization of battery standards in Indonesia.

(Background 2) Although they have expressed a desire to evaluate and test lithium-ion batteries for use in electric two-wheeled vehicles, they do not have the appropriate facilities to test such batteries for use in electric two-wheeled vehicles.

(Objective 2) Support forming networks between Indonesia side and Japanese side by forming networks with Japanese private sector.

(2) Outline

To achieve objective 1 and 2 above, JICA Survey Team invited a total of 11 people from related organizations in Indonesia (mainly from the Ministry of Industry) and conducted awareness activities combining knowledge provision (classroom lectures) and actual observation (facility tours).

In addition, in order to strengthen the network with the Japanese side and to have the Japanese speakers and host institutions understand the situation in Indonesia, JICA Survey Team asked the Indonesian participants to give a presentation on the current situation and issues in Indonesia related to the theme, thereby creating an environment conducive to discussion on both sides.

As a result, there was a lively exchange of opinions at each event, and the satisfaction level of the Indonesian participants with this invitation project was very high.

(3) Implementation schedule

The invitation project was held on eight days, from October 15 to 22 in 2023. The Indonesian participants were 11 in total. Table xx shows the implementation schedule. The entire itinerary for this invitation project was coordinated by the Corporate Sales Department of Nippon Travel Agency, Inc. In the following schedule, there were cases in which some participants extended their stay for personal reasons or omitted presentations that they had requested in advance from the Indonesian side due to time constraints, but these details are not shown in consideration of the names of individuals.

Table 6-1 Schedule of Japan Invitation Project

Date	Schedule and Theme	Presenter / Host institution
October 15 (Sun)	Arrival in Japan (GA9350)	
October 16 (Mon)	Morning) Courtesy visit to JICA	Economic Development Division, JICA
	Afternoon) Courtesy visit to METI, Speech from METI about Japanese battery strategy	Automobile Division, METI
October 17 (Tue)	Morning) Contents of TP21003 and related safety inspection	JAMA
	Morning) Business and consulting experience in planning and conducting safety studies	Hosen Corporation (Trading company providing safety inspection equipment and consulting)
	Afternoon) Issues to be considered in the battery standardization process	Its EV Corporation (Consulting firm with experience in standardization, etc.)
	Afternoon) Rooted in Battery Recycling/Reuse 4R Energy's Business Domain Rooted in Battery Recycling / Reuse	4R Energy Corporation (battery recycling and reuse company of Nissan Leaf)
October 18 (Wed)	Site visit at Hioki Electric Co. (Ueda city, Nagano pref.) • Introduction of Indonesian members and their organizations • Introduction of battery measurement equipment • Factory visit	Hioki Electric Co.
October 19 (Thu)	Site visit at Sekisui Chemical (Tsukuba city, Ibaraki pref.) • Introduction of Indonesian members and their organizations • Introduction of Sekisui Chemical's battery inspection business • Inspection facility visit	Sekisui Chemical Co.
October 20 (Fri)	Site visit at National Institute of Technology and Evaluation (NITE) • Introduction of Indonesian members and their organizations • Role of NITE and its administrative position • Experimental facilities visit	NITE
October 21 (Sat)	Return to Indonesia (GA9151)	

As shown in the Table 6-1, this project included lectures at METI, JAMA, etc., and discussions with Indonesian counterparts, as well as site visits to Hioki Electric (Nagano), Sekisui Chemical (Tsukuba), NITE, etc.

(4) Participant Evaluation

A satisfaction survey was conducted with 12 participants of this invited project. Figure 6-1 shows the evaluation items and results of the satisfaction survey.

Evaluation item	Minor item	Average score	Distribution of respondents (*n=11)
Overall satisfaction with the Jaoan invitation	-	4.5	7 3 1
Overall schedule / Overall operation	Timing and duration of the invitation period	4.5	6 4 1
	Procedure/process for the advance collection of passports and personal information	4.2	4 5 2
	Provided meals	3.3	2 2 5 1 1
	Transportation	4.6	8 2 1
	Attendant's duties	4.5	5 6
	Visited places	4.4	6 3 2
Courtesy visit to JICA and METI on October 16	Lecture on "Japan's Battery Strategy" by METI	4.4	5 5 1
Lectures by JAMA, Hosen, EV consultant, and 4R Energy on October 17	Lecture on "TP21003" by JAMA	4.5	6 4 1
	Lecture on "Safety Testing Equipment and Methods" by Housen	4.6	8 2 1
	Lecture on "Considerations for Battery Standardization Process" by an EV Consultant	4.4	6 3 2
	Lecture on "Battery Recycling Business" by 4R Energy	4.7	8 3
Visit to Hioki Electric on October 18	Business introduction and Factory tour by Hioki Electric	4.6	7 4
Visit to Sekisui Chemical on October 19	Facility tour of safety testing by Sekisui Chemical	4.7	8 3
Visit to NITE on October 20	Explanation of business operations and Facility tour by NITE	4.6	7 4

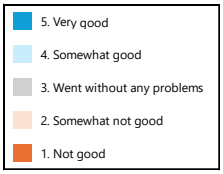


Figure 6-1 Evaluation items and results of the satisfaction survey

The average score for each item was calculated based on a 5-point scale, and the score were above 4 excepts for “provided meal”. This indicates that participants were generally satisfied with the content of the Japanese Invitation Program. When asked how they would apply what they learned in their workplaces, positive comments were received regarding "promotion of battery standardization and safety testing," "promotion of battery reuse and waste management," and "promotion of the electric vehicle industry, including batteries, and development of charging infrastructure.

On the other hand, the score for “provided meal” was 3.3, with one participant each answering “rather poor” and “poor”. It seems that the lack of opportunities to enjoy Japanese cuisine was unsatisfactory for some participants, and as a future improvement, it is necessary to consider increasing the number of opportunities to serve Japanese cuisine.

(5) Implementation for specific contribution measures

Participants in the Japan invitation program include representatives from the Ministry of Industry and other organizations related to the interchangeable battery standard that Indonesia is currently promoting, as well as organizations in charge of battery lifestyles and changes in the industrial structure due to electrification.

Therefore, the Japan invitation program was able to consider the Indonesian electric motorcycle industry from diversified perspectives and exchange opinions across ministries and agencies on how to solve problems.

Through a series of communications with the invitees during the period, the JICA research team identified the following four themes as appropriate for Japan's contribution to the next phase of the project. The following section summarizes these four themes as possible projects that can be formed by comparing them with Japan's resources and contribution achievements.

1. Plan to strengthen the battery inspection system
2. Study on ELV business in electric two-wheeled vehicles
3. Project to develop human resources for battery
4. Support for component industries affected by electrification

6.1.2 Local Seminars

The local seminar was titled "Stakeholder Meeting," and was held inviting the Ministry of Industry and other government ministries and agencies relevant to the electric motorcycle and battery industries, as well as the Association of Indonesian Motorcycle Industry (AISI), National Battery Research Institute (NBRI), and other organizations led by local Japanese motorcycle manufacturers. The following is an overview of the event. Table 6-2 shows a summary of the meeting. The second stakeholder meeting is scheduled to be held on May 29, 2024, with the main program being a report on the results of discussions at the working group meeting on the Japanese invitation project and subsequent future project proposals (Description about the activities will be added in FR).

Table 6-2 Outline of the Local Seminar (Stakeholder Meeting)

Date, time and place	July 4, 2023 (Tue.) Ministry of Industry, 2nd Floor Hall
Participants from Indonesia side	Ms. Iken Retnowulan (Director of Access for Industrial Resources and International Promotion (ASDIPI)) Ms. Evvy Kartini (BRIN/National Battery Research Institute) Hari Budianto (AISI/ Indonesian Association of Motorcycle Manufacturers) In addition, about 30 participants from the following organizations • DG of Metal, Machinery, Transportation Equipment & Electronic Industries (ILMATE) • Directorate of Maritime, Transportation & Defense Equipment Industries (IMATAP) • Agency for Standardization and Industrial Services Policy (BSKJI)) • Center for Formulation, Implementation and Enforcement of Industrial Standardization (P4SI) • National Standardization Agency (BSN) • DG of Small, Medium and Multifarious Industries (IKMA) • DG of Chemical, Pharmaceutical and Textile Industries (IKFT)
Participants from Japan side	JICA Indonesia Office • Mr. Ono (Deputy Representative, JICA Indonesia Office) • Mr. Miyake (JICA Indonesia Office) • Mr. Ando (JICA Expert dispatched to the Ministry of Industry) • Mr. Miyake JICA Project Team • akano, Abe, Sasaki, Yamamoto, Hara, Matsuoka, Onza, Asim Sharma
Agenda	Greetings from the Ministry of Industry Presentation from JICA Project Team • Share project overview • Market Trends of Electric Motorcycles in India • Comparison of Electric Motorcycle Markets in Indonesia, India, and Vietnam Question and answer session Closing Remarks by Mr. Ono, JICA Indonesia Office
Main results	JICA Project Team explained the purpose and significance of this project to the Ministry of Industry and attendees from private sectors who have influence on the electric motorcycle and battery industry in Indonesia, and obtained their understanding of the project. JICA Project Team requested cooperation for the Japan invitation project to be implemented as a pilot project, and major organizations expressed their willingness to cooperate. Case studies from India and Vietnam were introduced to increase participants' interest in this project.

6.2 Possibility of Collaboration with Japanese Companies and Organizations

6.2.1 Collaboration with Instrumentation Manufacturers in the Battery Standardization Process

NBRI's own verification shows that there are batteries sold in Indonesia that do not meet nominal specifications such as Ah (Ampere hour / battery capacity). Although a large-scale survey is required to clarify how often such inferior products are distributed, if a certain number of such products exist, even if battery standards are established, their performance will not be stable and consumers will be disadvantaged, which may hinder the establishment of electric mobility. Therefore, when standardizing battery standards, it is necessary to have a verification function to ensure that manufacturers are producing batteries that conform to the standard values of the standards to be established. (See Appendix 3 for details on SNI8928 regarding interchangeable batteries.)

Standardization of safety standards for interchangeable batteries is also being considered. In Indonesia, SNI8927 stipulates the implementation of safety tests required for interchangeable batteries, but as of the end of 2023, there is no public institution capable of comprehensively implementing the test items. The Indonesian Ministry of Industry believes that it is important to establish a system for the Indonesian government to conduct safety tests in order to promote the standardization of batteries as a national standard.

Table 6-3 Safety test items specified in SNI8927

Item	Main contents
Structural requirements	• Designed to avoid installation in incompatible battery boxes. • No leakage. • Designed to prevent battery pack failure and safety problems due to electrical arcing. • Enclosure/cover protection level complies with IPXXD requirements of ISO 20653 to avoid hazards due to human contact, etc.
Usage Requirements	• Power output must be off at the time of replacement. • Accurate positioning, etc.
Connector requirements	• Battery connector terminal spacing test • Contact resistance test • Durability test • High voltage resistance test • Insulation resistance test • Surface temperature test • Environmental Reliability Test • Salt spray test • Temperature and humidity cycling test • Thermal shock test • Vibration test

Source: Prepared by the Survey Team

Inspection equipment for conducting battery performance and safety tests can be supplied by Japanese companies such as Hioki Electric and Horiba (see Table 6-4).

Table 6-4 Major Japanese manufacturers and sellers of testing equipment

Major Japanese Companies	Available inspection equipment (inspection details)	Remarks
Hioki Electric	• Simultaneous inspection of temperature and voltage • Charging and discharging inspection • BMS evaluation and inspection • Internal resistance and open circuit voltage measurement • Quality check of tab welds and bus bars • Open circuit voltage measurement • Detection and analysis of cell failure factors, degradation analysis • Charge and discharge evaluation testing of complete vehicles	The company has a wholly owned subsidiary, HIOKI INDONESIA, in Indonesia, which provides maintenance services (HIOKICARE) for its inspection equipment.
HORIBA MFG.	• Charge-discharge cycle test (maximum output 1,000 kW)	Testing for all stages of battery testing, from material to recycling, including contract testing services
Hosen	• Charging and Discharging Tests • Overcharge test • Over-discharge test • External short-circuit test • Crush test (Crush) • Crash test (impact) • Drop Test (Free Hole) • Heat test • Burner test • Nail penetration test (of batteries) • Pressure valve release pressure test	Possesses a Hosen laboratory capable of conducting battery charge/discharge testing

Source: Prepared by the Survey Team

In addition, the following Japanese companies and institute provide services for battery safety and performance testing and have the facilities and engineers for this purpose (see Table 6-5). These companies and institute are expected to provide cooperation in the form of training in Japan and short-term expert dispatch of technicians to operate testing equipment.

Table 6-5 Major Companies and Institutions Providing Contract Testing Services in Japan

Major Japanese Companies	Tests that can be offered	Remarks
Jinnai Industry	• Conformity testing to UN38.3 and JISC8715-2 • High temperature retention (temperature test) • Simulcast test • External short-circuit test • Overcharge test • Over-discharge test • Internal short-circuit test • Nail penetration/crushing test • Crash test • Drop test • Heat test • Submersion/salt water immersion test • Vibration Test • Impact test • Analysis of evolved gases • Degradation Analysis • Charging and Discharging Tests • Cycle test	Capable of testing large cells, packs, and modules
HORIBA MFG.	• Module processing and cell removal • Module and Cell Performance Evaluation • Cell disassembly and material extraction • Agglomeration evaluation of electrode slurry • Battery degradation analysis • Analysis of conductive metallic foreign matter	For all stages of battery inspection from material to recycling
Sekisui Chemical	• Charging and Discharging Tests • Safety test	Providing contracted testing services by utilizing testing facilities developed for in-house battery manufacturing.
NITE	• Charge-discharge test • Submersion, immersion • BMS Operation • Incineration resistance test • Seismic Reproduction Tests • UN Transport Vibration Test • X-ray CT scan observation • Destructive test • Environmental testing (low temperature, high temperature, low humidity, high humidity) • Drop test • External short-circuit test	Japan's official inspection agency Large multi-purpose testing facility for testing large storage batteries

Source: Prepared by the Survey Team

6.2.2 Collaboration in the Field of Human Resource Development

The Indonesian side (mainly the Industrial Human Resource Development Agency of the Ministry of Industry (BPSDMI) and NBRI) believes that in order to ensure battery performance and safety, it is important to ensure that not only battery manufacturers but also employees of battery and electric mobility-related industry stakeholders, such as electric motorcycle manufacturers and PLN, the power supplier, have battery knowledge of the battery and electric mobility-related industries.

As an initiative to this end, the Ministry of Industry has already prepared a training program (1~2 weeks) related to EV passenger car/bus maintenance for engineers and repairmen working for manufacturers, dealers, etc., with the cooperation of IOI. On the other hand, NBRI, a private organization, is offering a 2- or 3-day battery-related training program for electric mobility and energy-related companies for a fee. NBRI has also applied for a SKKNI (National Labor Competency Standard) on battery packing, which is entitled "Permenaker No. 242/2022 "Penetapan Standar

Kompetensi Kerja Nasional Indonesia Kategori Industri Pengolahan Golongan Pokok Industri Peralatan Listrik Bidang Pak Baterai" with the Ministry of Manpower (Ministry of Labor). The SKKNI will set the standard for future human resource development programs for battery packing in Indonesia.

While these efforts are underway, there is a lack of specialized human resource development programs in the secondary and tertiary education sectors, which will provide future engineers and others for Indonesia's electric vehicle and battery industry. In particular, SMK (technical high school) under the Ministry of Industry and Polliteknik STMI Jakarta (polytechnic), which produce human resources who will mainly be employed by manufacturers, have curricula for the automotive industry, such as automotive engineering, but do not currently include EV and battery-related curricula. Currently, they are in the process of reviewing course content and coordinating with potential partner companies (to dispatch students for on-the-job training).

The Ministry of Industry is willing to increase the number of electric vehicle and battery-related curricula and content for SMK and Politeknik STMI students, as well as for those who are currently employed to acquire and improve their skills and for the unemployed to reacquire skills, with a view to expanding the electric mobility and battery industry in the future, and is particularly interested in They would like JICA and NBRI to cooperate in providing training (ToT) to teachers, instructors, etc. at educational and training institutions under the Ministry of Industry.

However, it is necessary to clarify quantitatively how many and what level of workers will be needed in the battery and electric mobility-related industries in the future, and to examine the current relevant data and future prospects within the Ministry of Industry to provide the necessary materials. The needs also vary by region: in Sulawesi, there is a need for human resources upstream in the supply chain (e.g., mining of nickel and other battery materials), and in the Jakarta area, there is a need for human resources downstream in the supply chain (e.g., battery manufacturing). In Bali, environmental awareness raising activities by the Province of Bali and the City of Denpasar have led to an increase in requests from existing electric motorcycle users for the recovery and reuse of batteries due to concerns about their environmental impact, and there is a great need for repairman personnel to respond to these requests. The removal and recovery of batteries is highly important as a preliminary step in the recycling and disposal process, and demand for personnel with an understanding of the structure and characteristics of batteries and electric vehicles is expected to increase as electric vehicles become more popular throughout Indonesia.

On the other hand, the training of technicians to operate and maintain battery testing equipment will serve as a foundation for expanding battery quality and safety inspections and eliminating inferior products in Indonesia and is expected to contribute to creating a superior market environment for Japanese manufacturers, which have an advantage in manufacturing high quality products with stable quality. In order to train technicians to operate and maintain battery testing equipment, it is expected that each testing equipment manufacturer will dispatch experts, that NITE and other public organizations will dispatch experts, and that JAMA (Japan Automobile Manufacturers Association) and other organizations will dispatch experts with a greater awareness of the need to ensure that testing is in conformance with standards.

6.2.3 Collaboration in the Supply of Electrification Parts

The results of interviews conducted in this study with local parts manufacturers in Indonesia indicated that, in addition to policy support to avoid or mitigate the impact of electrification (e.g., easing of import restrictions on steel and other materials, incentives such as interest rate relief, etc.), there are also requests for promotion of business matching and human resource development, which can be implemented with the participation and cooperation of Japanese firms.

JICA Survey Team will discuss with the Indonesian government the introduction of a support program similar to the "Mikata Project" currently being implemented by the Ministry of Economy, Trade and Industry (METI) of Japan, and expect Japanese parts manufacturers to participate in business matching and expert dispatchs within the program.

6.2.4 Discrepancies between TP21003 Standard and Indonesian Standardization Process that Remain as an Issue

JAMA has explained several times to the Indonesian government (mainly the Ministry of Industry and the Ministry of Transport) about Japan's JASO TP21003 and UNR136 part 2 promoted by JAMA, and explained its usefulness and that, in principle, Honda, Yamaha, Suzuki, and Kawasaki brands In principle, Honda, Yamaha, Suzuki, and Kawasaki will promote the use of TP21003 compliant batteries in the future. The same explanation has also been made in the Project, and a detailed explanation was given by JAMA at the seminar held in Japan on October 17 as part of the Project's invitation program in Japan. However, in the 2023 revision of SNI8928, the members of the review committee were invited not only from the Ministry of Industry but also from the Ministry of Energy and Mineral Resources and its affiliate PLN, and these committee members strongly insisted that "batteries currently on the market should be used as the standard," which led to the change of the nominal voltage to 48V, as specified in TP21003. The nominal voltage of 48V specified in TP21003 was excluded from SNI8928. In August 2023, the International Battery Summit (IBS) was held in Jakarta, and the 48 V nominal voltage was excluded from SNI8928. As indicated by Mr. Taufik, Director General of ILMATE, Ministry of Industry, Indonesia, at the International Battery Summit (IBS) held in Jakarta in August 2023, the current direction of standardization of battery standards in Indonesia seems to be to focus more on market trends, and after a certain degree of selection in the market, to adopt the standard as a national standard with mandatory nature. The Indonesian Ministry of Industry has announced that SNI8 is to be adopted as a national standard. The Indonesian Ministry of Industry has responded that SNI8928 is a voluntary standard, so it will have little impact on Japanese companies that use TP21003, and that SNI8928 may be further revised depending on changes in market conditions, such as the introduction of electric motorcycles with 48V batteries in the future.

6.3 Consideration of Specific Contribution Measures (ODA / non-ODA)

Based on the discussion in the study group shown in Table 5-1, the investigation team recommends the following four specific contribution measures. Please refer to Appendix 6 for details on each contribution measure.

6.3.1 Battery Inspection System Enhancement Plan

As mentioned in Chapter 5, Japan's contribution should go in the direction of "contributing to 'precautionary measures' to exclude unsafe batteries on the market before they become widely available. Here, as an example of the project, JICA Survey Team have developed a contribution plan that encompasses the following.

- Introduction of a system to evaluate the safety and performance of replaceable batteries, the heart of electric motorcycles in Indonesia (hardware and software)
- Evaluate the safety and performance of more than 50 replaceable batteries on the Indonesian market and provide the results to the agencies in charge of battery standardization and mandatory safety and performance testing, as well as to relevant organizations such as OJK, which oversees auto loans and other financial services, and to academic institutions engaged in battery R&D for effective use.
- Implementing human resource development with the battery testing equipment and expert human resources that JICA Survey Team have invested in. Especially the use of equipment for practical education.

As of 2023, more than 50 manufacturers and brands in the Indonesian electric motorcycle market are using batteries of different standards, the majority of which are made from imported cells from China, as mentioned above. As a result, there are variations in quality, and NBRI's pioneering research has reported batteries with actual performance below nominal performance and batteries with observed abnormal values that, if used, could cause failures and accidents. Users who hesitate to purchase or use electric motorcycles are concerned that they themselves may encounter such a situation, and there is a strong need among electric motorcycle dealers and users (especially for business use) to conduct

battery inspections to improve these points for the popularization of electric motorcycles.

Furthermore, if a system can be formed to constantly check the safety and performance of batteries, the elimination of inferior batteries will reduce variations among individual batteries and contribute to the appropriate assessment of used battery prices, which is a major issue in the supply chain for electric motorcycles as of 2024, as a result, this would contribute to risk reductions and an appropriate interest rate setting for finance companies.

The specific cooperation scheme will utilize Japan's technical cooperation scheme, combining the dispatch of experts along with the provision of inspection equipment, to continuously conduct pilot tests on more than 50 batteries on the market during the project period (an average of three years is assumed). The results obtained will be used mainly for feedback such as the standardization process and mandatory inspections.

JICA Survey Team propose that BSKJI (B4T higher authority in charge of inspection) or ILMATE (IMATAP higher authority in charge of standardization and EV motorcycle industries) of the Ministry of Industry should become the C/P, since Japanese support is not merely the provision of equipment, but the assistance with a major policy intent leading to standardization and mandatory safety and performance inspections. Under the management of the C/P[39], dispatch short-term experts who handle inspection equipment (transfer of specialized skills such as instruction on how to use the equipment) to B4T as an inspection implementation organization.

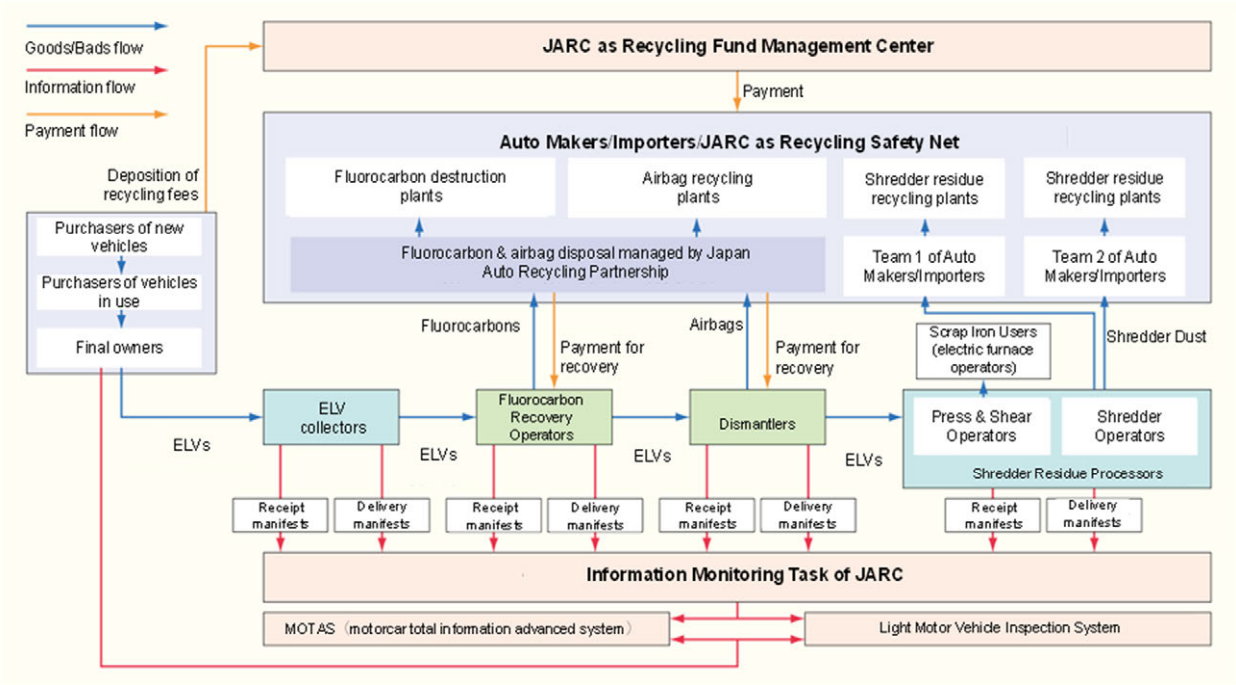
Note that a list of required equipment was submitted to the investigation team by B4T in January 2024 (see Appendix 4). As a result of the estimation of these procurement costs with the assistance of a Japanese trading company that handles inspection equipment, it was found that it would be difficult to fulfill all of them in a single proposed project, and support for the future development plan of inspection-related facilities in Indonesia is also a major candidate for output[40].

6.3.2 ELV and Battery Management Business Survey on Electric Motorcycles

The study group on this topic, which began in early 2024, developed its discussions with an explanation of Japan's recycling law and ELV treatment flow (see Figure 6-2). The participants on the Indonesian side were mainly from the Indonesian Ministry of Industry and the Ministry of Environment and Forestry, but the impression was that discussions on ELV treatment had just begun in Indonesia and that practical activities were yet to be carried out.

[39] Dispatch of long-term experts (for overall project planning and progress management as well as policy advice).

[40] Japan has implemented a number of technical cooperation projects of the same type, such as the "Project on Strengthening Inspections to Ensure the Safety of Agricultural and Fishery Food Products in the Socialist Republic of Vietnam," which was implemented from 2011 to 2014.



Source: Japan Automobile Manufacturers Association, Inc. website
(https://www.jama.or.jp/operation/ecology/recycle/index.html)

Figure 6-2 Image of Automobile Recycling System

The Ministry of Environment and Forestry introduced that recycling of lithium-ion batteries is under consideration for implementation in Sulawesi, as shown in Figure 6-3 below, but there are many issues on the Indonesian side regarding the treatment of ELVs including batteries, so JICA's cooperation is needed, including sharing best practices and technical cooperation. However, since there are many issues on the Indonesian side regarding the treatment of ELVs including batteries, JICA's cooperation in sharing best practices and technical cooperation is necessary.

- **Project Construction Location:** Indonesia Morowali Industrial Park (IMIP)
- **Land Area:** 133,000 square meters
- **Property of project land:** industrial land.
- **Project environment profile:**
- 1) At present, the industrial park already has nickel iron, stainless steel smelting, hot rolling, cold rolling, chromium iron, silicon iron, electrolytic manganese and other factory facilities, at the same time supporting coal-fired power plants and docks, infrastructure is complete.
- 2)The population around the industrial park is relatively sparse, with only 7263 permanent residents, accounting for 6.4% of the population of Morowali county. The location of the project is about 6km from the port of the industrial park and 2km from the coastline. The project site is surrounded by dense forest.

Figure 6-3 Attempts to recycle lithium-ion batteries in Indonesia

As for specific issues on the Indonesian side, Indonesia does not have a sufficient legal framework for the treatment and recycling of ELVs, including batteries, and in particular, although Presidential Decree No. 55/2019 on batteries states that "waste batteries must be recycled or treated," there is no legal system in place to ensure the effectiveness of this. However, there is no legal system in place to ensure the effectiveness of the law (laws and regulations to enforce and incentivize the collection, recycling, and treatment of batteries, cost sharing to ensure business feasibility, etc.). (e.g., laws and regulations to enforce and incentivize battery collection, recycling, and disposal; laws and regulations on cost sharing to ensure business viability (e.g., consumer burden, battery manufacturer/OEM burden, government tax expenditure).

In addition, there is no master plan that shows the overall picture of ELV and battery recycling and treatment, including the development of such legal systems, no roadmap or future plan for future promotion, and no division of roles among central government ministries and agencies and among local governments.

In addition, there are not enough staff from central government ministries and agencies and local governments who are in charge of system operation and management, and not enough private businesses that can recycle and treat ELVs and batteries while eliminating toxicity and hazards, and there is no mechanism to foster such businesses. Therefore, even if a system for recycling and processing ELVs and batteries is established, it is clear that there will be a shortage of public and private sector operators to implement the system.

JICA's cooperation will be effective in processing ELVs, and the beneficial effects are expected to be significant due to the large commitment of Japanese companies to the automobile industry.

Considering the level of policy on the Indonesian side and the level of recognition by the government at this stage, it is desirable to first support the formulation of national-level production, such as the creation of a roadmap for treating ELVs (4-wheels and 2-wheels). In doing so, it is desirable to take an approach by understanding of the current state of Indonesia's auto industry and environment, as well as using a macro analysis of Indonesia's position in the international framework.

From a microscopic viewpoint, it is possible to envision a major trend to define the goals and direction of the treatment of the main raw materials (metals, ceramics, and plastics) that make up automobiles as a large group, and to examine these goals and direction by component. The Ministry of Environment and Forestry would like to refer to Japan's experience in promoting recycling based on its various individual recycling laws, including those for automobiles, particularly with regard to system design and operation, as well as sharing a responsibility and costs with manufacturers, local governments, individuals, and others. In addition, it was introduced that the Center for Green Industry (Green Center) within the Indonesian Ministry of Industry, is responsible for measures for recycling, energy conservation, low-carbonization, etc. related to the manufacturing industry in a cross-sectoral manner. The Ministry of Environment and Forestry will be responsible for the introduction of a general recycling system, but if it is limited to industrial sector, it might be possible to be institutionalized as the Green Center of the Indonesian Ministry of Industry takes a leading role.

Regarding transportation equipment-related waste management/recycling, etc., while it may be appropriate as a pilot project to limit the number of regions and vehicle types involved, it is envisioned that this will become a nation-wide initiative in the future. In other words, it is required to make a decision to use state taxes.

In Japan, Europe, and the United States, government financial support for public goods such as automobiles is often provided in the following areas This is an area where private investment is not expected.

1. Recycling Facility Development: Provide funding for the development or expansion of a facility to recycle vehicles. This includes the introduction of equipment and technology to properly sort, process, reuse, and recycle parts and materials from vehicles.
2. R&D: Research and development to improve automotive recycling technologies and processes with the aim of developing efficient and environmentally friendly recycling methods.

3. Investments to support the private sector: for sustainable private sector involvement, including the development of scrap car lots, support for take-back companies, and support for the disposal of the above-mentioned non-recyclable items.
4. Education and awareness activities: Raise awareness among citizens and businesses to actively participate in recycling by educating the public about the importance of recycling.

For the above reasons, JICA Survey Team propose that the proposed study be conducted and reviewed in a future-oriented manner with the participation of the Indonesian Ministry of Finance (MOF) and the Indonesian Ministry of National Development Planning (BAPPENAS) as observers, in addition to the Ministry of Industry or the Ministry of Environment and Forestry, which are the CP candidates in charge of the study.

If it is a whole vehicle, as in the case of ELVs, there is a wide range of materials to be recycled. The Ministry of Industry believes that if recycling is led by the Ministry of Industry, it should be specific to batteries. However, even if the Ministry specializes in batteries, the private sector's livelihood is far from enough to handle all types of batteries.

Therefore, the proposed study is intended to be a "Touchstone to support the process of formulating the "National ELV Treatment Strategy (tentative name)" to be developed by Indonesia in the future, and it will be a study to understand the current status and issues related to 3R of used automotive batteries, and to investigate future strategies. Table 6-6 below provides a summary.

Table 6-6 Summary of Proposed Study

Business:	Planning study on used vehicle batteries
Main survey:	① International trends surrounding used batteries (for vehicle) and the socio-economic environment in Indonesia ② Understanding the current situation regarding the proper management of used car batteries • Key stakeholder analysis • Research on related legal systems • Supply chain analysis of used battery disposal • Consideration of response measures, required legal systems ③ Used battery issues and socioeconomic impact ④ Policy recommendations for the "National ELV Treatment Strategy (tentative name) ⑤ Related Assistance • Training in Japan (training on policy making and implementation systems) • Examples from other countries • In the electrification and EV introduction, consider a relationship between electric vehicles and electric motorcycles in terms of segregation and consistency

6.3.3 Human Resource Development Project for Electric Motorcycles

(1) Project description: Training of teachers for higher education in battery-related fields

In the initial stage of the study group, JICA Survey Team discussed the possibility of human resource development related to battery production, especially ToT (Training of Trainers) on subjects related to battery production at a four-year technical college (Politeknik) under the BPSDMI (Ministry of Industry) and pilot training by ToT lecturers. However, most of the electric two-wheelers in Indonesia are currently assembled from Chinese batteries, and JICA Survey Team cannot expect the scope to

expand beyond packing work. Based on comments from AISI and other industry groups, JICA Survey Team discussed the possibility of expanding the scope of human resource development to include electric two-wheelers and their peripheral systems.

In terms of benefits to Indonesian domestic industry, the ratio of domestically produced electric motorcycles in the market has not reached the current ratio of ICE motorcycles produced by Japanese companies (e.g., Honda motorcycles are approximately 90%), and it would be effective to first develop human resources to improve technical capabilities in the electric motorcycle industry and related systems in order to increase the domestic production ratio. The first step is to develop human resources who can contribute to improving the technical capabilities of the electric motorcycle industry and its peripheral systems in order to increase the domestic production ratio. In Indonesia, where electric motorcycles are gradually becoming popular, demand for technicians who can properly assemble electric parts on the production line and mechanics who can set up, maintain, and repair motorcycles in stores, rather than for R&D and advanced production management, is expected to be high. The demand for mechanics who can perform shop set-up, maintenance, and repair work is expected to increase in the future, according to the panel. Since these are mainly graduates of SMKs (technical high schools) who will be employed by manufacturers, dealers, etc., the program is envisioned to focus on engineering lectures for SMKs to acquire knowledge and skills related to electric motorcycle-related systems.

As part of the human resource development program, on-the-job training (OJT) in cooperation with industry associations such as AISI, and the formulation of SKKNI (domestic labor competency standards) for the electric motorcycle-related technology field in Indonesia at the initiative of industry associations such as AISI are also expected by the Indonesian side (Ministry of Industry, AISI, etc.) strongly expects.

(2) Project Summary

JICA Survey Team have confirmed from previous study groups that the needs of the Indonesian side are very high. As for the business scheme,

(1) Understand the current status of human resource development related to electric motorcycles and batteries in Indonesia (list of SMKs and Politekniks that already offer courses related to electric motorcycles and batteries, teaching materials used, syllabus, level and needs of teachers, etc.)

(2) Development of teaching materials, syllabus, and implementation plan for the project implementation

(3) Implementation of ToT (40 students× 3 months× 2 times/year during students' long vacation periods)

(4) Course monitoring from trained faculty to students

(5) Assistance in developing career paths for students who have taken the course (seminars, JobStreet, etc.)

Since the flow above is considered to be realistic, the scheme of a survey-based technical professional scheme (basically for 3 years) is proposed.

The core CP organization will be composed of SMK and Politeknik STMI under the Ministry of Industry, and the actual ToT will be supported by NBRI, engineers from the Japanese automobile/motorcycle industry, and others. In addition, Japan has a great deal of experience[41] in curriculum and implementation planning, which will be utilized.

In addition to overall progress management, the JICA expert team will prepare teaching materials and other materials related to (2) above, support the selection and implementation of ToT instructors related to (3), conduct monitoring related to (4), and provide implementation support related to (5).

[41] The Consortium for Human Resource Development of Kansai Region, Yamagata University, and others have experience in developing related curricula, syllabi, and implementation plans.

6.3.4 Support for component industries affected by electrification.

Component companies that will be nourished by electrification are oriented toward two types of business development: (1) development into new products and new businesses (Pattern A in Figure 6-4 below) and (2) process advancement (e.g., design enhancement) (Pattern B in Figure 6-4 below). Furthermore, there are also companies that intend to realize both (1) and (2) at once and manufacture their own products (in the Figure 6-4, designing and manufacturing electric motorcycle frames, electric bicycles, etc.).

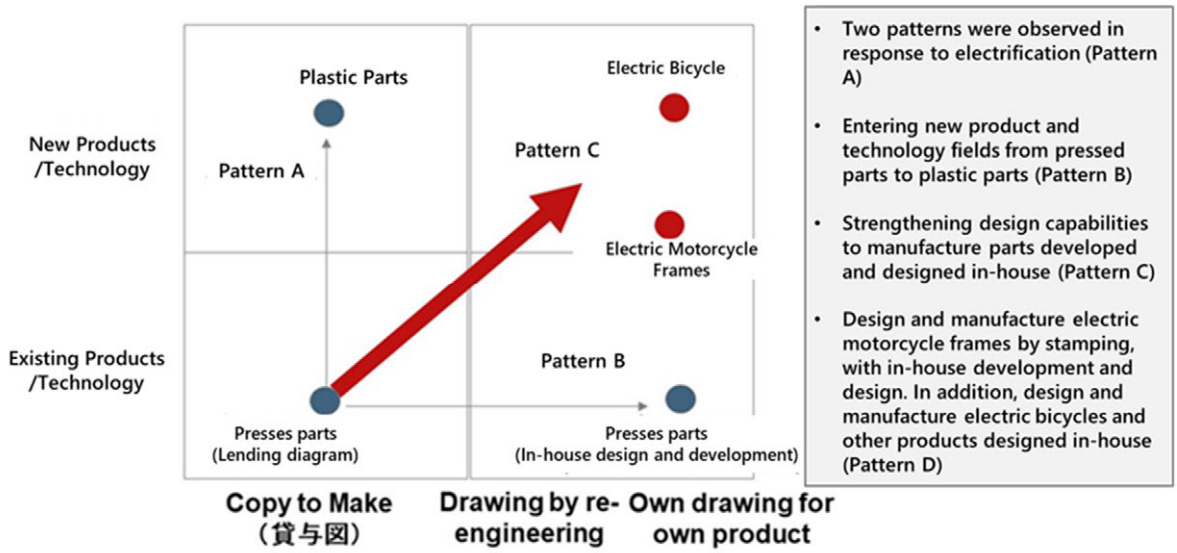


Figure 6-4 Chart of Support for component industries affected by electrification

For the above two basic business developments of component companies, support can be considered from four aspects: human resources, technology, facilities, and information. JICA Survey Team have organized the content of support with reference to the support that is being provided in Japan as the Mikata project (Table 6-7).

Table 6-7 Support Businesses by Business Development Pattern

Classification	(1) Support for development into new products and new businesses (Pattern A)	(2) Support for upgrading processes (e.g., design enhancement) (Pattern B)
Human resource	Reskilling, upskilling, operation of new equipment, etc. Support for new employment (new equipment operators, etc.), holding employment seminars, etc.	Reskilling, upskilling, design and development capacity improvement, etc. New employment support (development and design personnel, etc.), holding employment seminars, etc.
Technology	Dispatch of experts, operation of new equipment, design of molds and jigs, production technology advice, etc.	Dispatch of experts, advice on development and design know-how, etc.
Equipment	Support for equipment installation, accelerated depreciation for new production equipment, etc., low-interest loans, subsidies, personnel training in automation technology, etc.	Support for equipment introduction, accelerated depreciation of new equipment (CAD/CAM, etc.), etc., low-interest loans, subsidies, development of testing and evaluation facilities at IMC, etc. and promotion of use by discontinued companies, etc.
Information	Exhibitions, business meetings, reverse trade fairs, export support, provision of information on overseas markets, exhibitions, etc.	Same as left.

Supplement the explanation for each of the above classifications.

Human resource：	In (1), in addition to reskilling at the operational level, upskilling to higher skills and positions is also desirable. The reason for this is that Indonesia is facing a shortage of human resources at or above the level of field leader.
Technology：	In (1), in addition to mass production technology, it is desirable to provide support for securing and upskilling high-level human resources, such as mold and jig design and production technology for new products.
Equipment：	In (1), it is desirable to provide a set of training on operation, management, etc. of automation technology, as the introduction of new equipment is accompanied by more automation and IoT. In (2), support is provided to enable performance testing of new products at IMCs and public testing laboratories of the Ministry of Industry.
Information：	(1) If many suppliers expand into new products in the same field, there is a risk of oversupply and increased competition. Export support is also expected to alleviate oversupply in Japan.

Furthermore, when individual interviews were conducted with companies, they requested the following.

Deregulation	:	Easing of import restrictions on steel materials, etc. (When undertaking a new business, there are cases where it is difficult to procure new raw materials domestically and JICA Survey Team are forced to import them, but import restrictions make importing time-consuming and laborious.)
Fostering the Electric Motorcycle Industry in Japan	:	Efforts to promote domestic production of electric motorcycle parts include responding to low-cost Chinese and other parts, promoting domestic production of parts to achieve mass production scale, and providing investment incentives for new investment in electric parts.

The entities supporting these projects are organized as shown in Table 6-8.

Table 6-8 Project implementation structure

Classification	Support project	Supporting Entity
Human resource	Reskilling Operation of new facilities, etc. Design and development capacity improvement, etc. Upskilling New employment support Holding employment seminars, etc.	BPSDMI, NBRI etc.
Technology	Dispatch of experts Advice on operation of new equipment, etc. Advice on development know-how, design know-how, etc.	ILMATE, etc.
Equipment	Equipment Introduction Support Accelerated depreciation of new production equipment, low-interest loans, subsidies, etc. Development and promotion of test and evaluation facilities and their use Use of facilities in official test reports (IMC, etc.)	Ministry of Finance, KPAII, IMC, etc.
Information	Exhibitions and Business Meetings Export Support Provision of information on overseas markets, exhibitions, etc.	Ministry of Trade, ILMATE, etc.
Other	Deregulation: Relaxation of import restrictions on steel and other materials	Ministry of Trade, Customs, etc.
	Cultivation of the electric motorcycle industry in Japan	ILMATE, etc.

The Mikata Project will provide support to small and medium-sized enterprises (SMEs) involved in the automotive industry to decarbonize their operations. Since the Mikata Project supports small and medium-sized enterprises (SMEs) to make aggressive business transformation and to enter new markets, the following effects can be expected when trying to adapt this to Indonesia.

Effects of the Horizontal Expansion of the Mikata Project to Indonesia

1. Creation of new business opportunities:
   As the demand for electric vehicle parts increases with the electrification of automobiles, new business opportunities will be created for companies to provide products and services.
2. Improvement of technological capabilities:
   Companies that take on the challenge of manufacturing electric vehicle parts need to learn new technologies and manufacturing processes, and through the technical training and professional support provided by the Mikata Project, companies will be able to improve their technical capabilities. 3.
3. Building a sustainable business model:
   Decarbonization efforts through environmentally friendly manufacturing methods and more efficient energy use will facilitate the creation of sustainable business models.
4. Efficiency gains and cost reductions:
   New production efficiencies and cost reductions will improve the competitiveness of companies and enhance their viability in the marketplace.
5. Regional economic development:
   The growth of small and midsize businesses will positively impact the local economy through increased employment and increased demand for local suppliers.
6. Strengthening industrial linkages:
   Through stronger business-to-business/industry institution linkages, overall industry development will be encouraged.

At the "review meeting" shown in Chapter 5, Table 5-1, there was a great deal of interest in the Mikata project on the Indonesian side, and a lively question-and-answer session ensued. In particular, 500 SMEs in Indonesia whose livelihood depends on the manufacture of ICE components and approx. 16,000 employees are expected to be affected by electrification, and if the Mikata project is horizontally deployed, the effect is expected to be significant.

Regarding specific Japanese support, the Survey Team has the following image at this stage.

Regarding the cooperation scheme, Japan's technical cooperation scheme (average of 3 years) will be utilized, and experts specializing mainly in business transformation, management strategy, and technology strategy will be dispatched. The experts will focus on the following activities during the period.

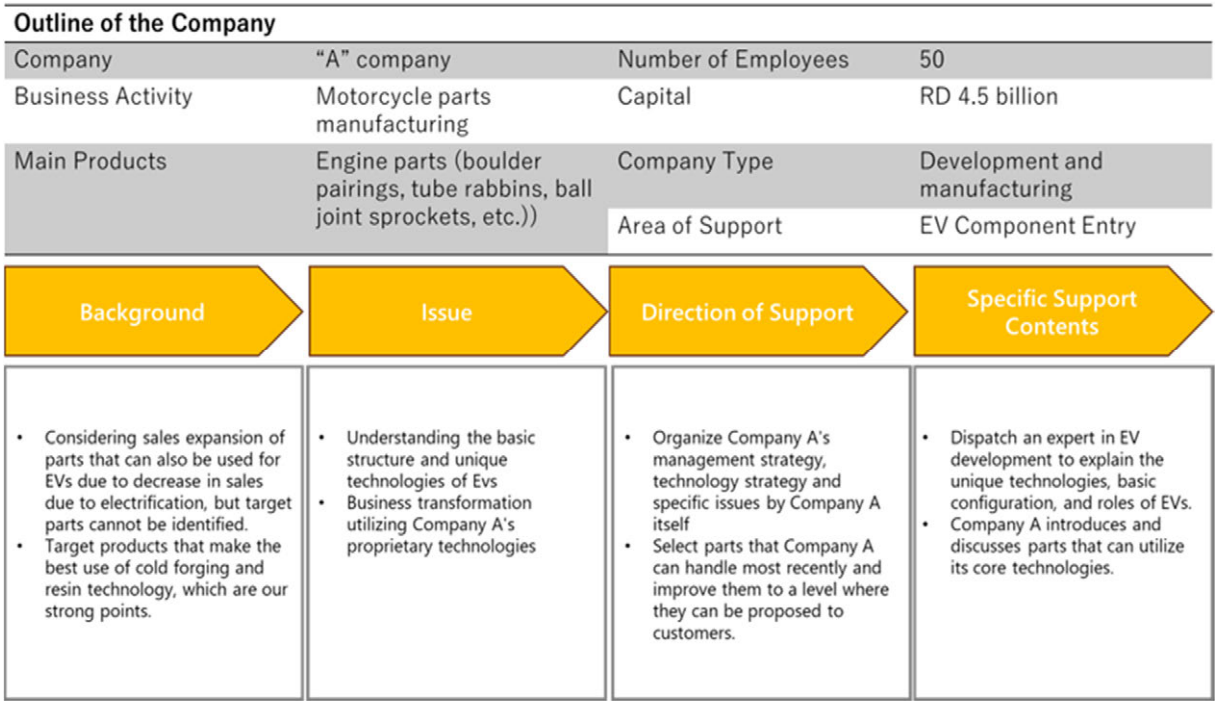
- Creation of an inventory of target companies (creation of a list of companies for each of the component categories shown in 5.4)
- Business building support and management consulting
- Company matching and related seminars
- Others (support for policy making by CP agencies, etc.)

The CP agency should be IKMLMEAA or IMATAP under the Ministry of Industry, and both GIAMM and PIKKO should function as support agencies. Furthermore, in order to realize financial support for the Mikata project, which is also being implemented in Japan, the support system for this project will be discussed in a future study.

The functions of financial support are (1) to subsidize the introduction of equipment, etc. necessary to

achieve business transformation, and (2) to support business operators who are restructuring their businesses to contribute to solving industrial policy[42] issues while conducting R&D, technology development, or human resource development. It is necessary to have the Indonesian side consider a financial scheme for this purpose[43].

The actual corporate consulting services for the proposed project are shown in Figure 6-5 below.



Source: Prepared by Survey Team

Figure 6-5 Image of the support provided by the corporate consulting services of the Mikata Project

To address any shortfalls in the areas of expertise of the experts dispatched from Japan, the project will maintain the ability to utilize the expertise of Japanese companies and government organizations in Indonesia, and to invite experts from Japan with flexibility. In addition, in order to ensure that this type of support is not transitory, a person in charge of the Indonesian government agency (IoI, etc.) will be permanently assigned as a coordinator to provide support in a companion manner with the target SMEs. The coordinator will also serve as the contact person for the project.

The number of target companies for business establishment support and management consulting over the three-year period is expected to be approximately 40 companies[44] in each component category.

[42] The "Making Indonesia 4.0" roadmap for the realization of Industry 4.0, published in April 2018, falls under this category.

[43] For your information, in Japan, the maximum loan amount is 100 million yen (approx. 10 billion rupiah) for small and medium-sized companies (maximum) and 150 million yen (approx. 15 billion rupiah) for medium-sized companies (maximum), and the subsidy rate is 1/2 for small and medium-sized companies and 1/3 for medium-sized companies.

[44] 1. engine related parts (10), 2. fuel related parts (10), 3. exhaust related parts (5), 4. transmission related parts (5), 6. engine cooling parts (5), 7. others (5)

Republic of Indonesia

Data Collection and Confirmation Survey on Electrical Motorcycle Industry Development and Strengthening of Supply Chain in Indonesia

Appendix

July 2024

Japan International Cooperation Agency (JICA)

Oriental Consultants Global Co., Ltd.
Pacific Consultants Co., Ltd.
NRI Consulting & Solutions (Thailand) Co., Ltd.

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APPENDIX 1 DEMAND SURVEY

(1) Details of Demand Survey

a. Survey Target

As described in the body of the report Section 3.4.3(1) "Outline of Demand Survey", survey target is classified as follows. In terms of "user attributes", we categorized users into two groups: "business users" and "private users". On the other hand, in terms of "motorcycle type", we categorized vehicles into 4 groups: "battery-swappable electric motorcycle", "plug-in electric motorcycle", "gasoline-powered motorcycle", and "electric bike".

The reason for targeting users of gasoline-powered motorcycles was to understand the impressions, concerns, and needs of potential users of electric motorcycles, and the reason for targeting users of electric bikes was to understand the actual use, issues, and future prospects for the spread of electric bikes, which can be considered a competitive means of transportation with electric motorcycles. The reason for targeting users of electric bikes was to understand the actual use of electric bikes, which can be considered a competitive means of transportation with electric motorcycles, as well as issues and future prospects for their widespread use. Since electric bikes are not used by businesses, only private users were included in the survey.

The overall classification of the survey respondents is shown in the table below.

Table 1-1 Classification of Survey Target ("○" is surveyed)

		Type of motorcycle			
		Battery swappable electric motorcycle	Plug-in electric motorcycle	Gasoline-powered motorcycle	Electric bike
User category	Business user	○	○	○	-
	Private user	○	○*	○	○

* Private users of electric motorcycle converted from gasoline-powered motorcycle were also surveyed.

Source: Project team

b. Survey methodology

The survey methodology for each category of survey targets is shown in the table below.

Table 1-2 Survey Methodology for Each Category of Survey Targets

#	Classification of Survey Targets		Survey Method			
	User Category	Type of Motorcycle	Off-line Interview (1:1)	Online Survey	Focus Group Discussion	House Visit
1	Business user	Battery-swappable electric motorcycles	○	-	○	-
2		Plug-in electric motorcycles	-	○	○	-
3		Gasoline-powered motorcycle	○	-	-	-
4	Private user	Battery-swappable electric motorcycles	-	○	○	-
5		Plug-in electric motorcycles	-	○	○	○
6		gasoline-powered motorcycle	○	-	-	-
7		electric bike	-	-	○	-

Note: In the "Survey Methodology" column, "○" if the survey was conducted and "-" if not.
Source: Project team

c. Survey Schedule and Location

This survey was conducted in three phases: Phase 1 (September-October 2023), Phase 2 (December 2023), and Phase 3 (February-March 2024), following the implementation of the trial survey (July 2023).

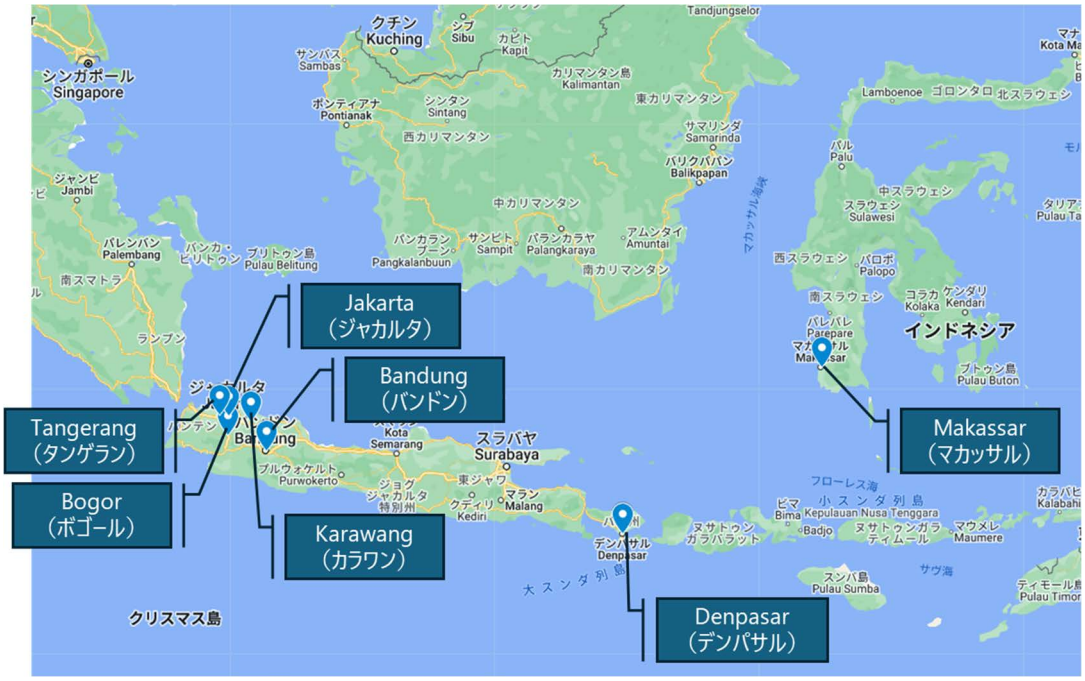
The timing, content, and location of each survey are shown in the table below. Approx. 500 users were surveyed in total.

Table 1-3 Survey Period, Content, and Location

Phase	Period	Methodology	Survey Target		Total number of respondents	Location
			User Category	Type of Motorcycle		
Trial	July 2023	Offline interview (1:1)	Business user	Battery-swappable electric motorcycle	20	Jakarta
Phase 1	September -October 2023	Offline interview (1:1)	Business user	Battery-swappable electric motorcycle	10	Bogor
		Offline interview (1:1)	Business user	Gasoline-powered motorcycle	20	Jakarta, Bogor
		Offline interview (1:1)	Private user	Gasoline-powered motorcycle	20	Jakarta, Bogor
		Online survey	Private user	Battery-swappable electric motorcycle	48	Online*
		Online survey	Business user	Plug-in electric motorcycle	40	Online*
		Online survey	Private user	Plug-in electric motorcycle	100	Online*
Phase 2	December 2023	Focus group discussion	Business user	Battery-swappable/ Plug-in electric motorcycle	20	Karawang, Denpasar, Makassar
		Focus group discussion	Private user	Battery-swappable/ Plug-in electric motorcycle	12	Karawang, Denpasar
		Focus group discussion	Private user	Electric bike	5	Makassar
Phase 3	February - March 2024	Online survey	Private user	Battery-swappable electric motorcycles	96	Online*
		Online survey	Private user	Plug-in electric motorcycle	102	Online*
		Online survey	Private user	Electric motorcycle converted from gasoline-powered motorcycle	10	Online*
		House visit	Private user	Plug-in electric motorcycle	7	Jakarta, Tangerang, Bandung

* Online survey covered all of Indonesia

Source: Project team



Source: Compiled by Project team from Google Maps

Figure 1.1 Geographic Distribution of Survey Location

(2) Demand Survey Results

a. Results of Trial and Phase 1 Survey

In the trial and Phase 1 surveys, basic information on the actual use of and issues related to electric motorcycles was collected through offline interviews (one-on-one) and online questionnaires.

(i) Survey results for business users

It was found that users of electric motorcycles with interchangeable batteries traveled longer distances than users of plug-in electric motorcycles, traveling an average of approximately 165 km per day. This suggests that users who travel longer distances prefer the battery-swappable electric motorcycles. In addition, the battery was replaced approximately five times a day on average (every time the vehicle traveled approximately 30 km), indicating that the battery was replaced at a much earlier time than the battery range (approximately 60 km) in the specifications.

Regarding challenges to the popularization of electric motorcycles, electric motorcycle users cited (1) short cruising range, (2) lack of battery swapping and quick charging stations, and (3) the mindset of the general public (lack of awareness of electric motorcycles) as the main ones.

On the other hand, the results of the survey of gasoline-powered motorcycle users showed that 45% of them are interested in using electric motorcycles, but (1) lack of battery swapping and quick charging stations, (2) inadequate maintenance and parts supply systems, and (3) short cruising range, were cited as major concerns.

The results of the survey of business users are shown in the table below.

Table 1-4 Results of Survey of Business Users (Trial and Phase 1 Surveys)

Item	Results		
	Battery swappable Electric Motorcycle Users	**Plug-in Electric Motorcycle Users**	**Gasoline-Powered Motorcycle Users**
Number of Respondents	30 persons (Jakarta: 20, Bogor: 10)	40 persons (DKI Jakarta: 29, West Java: 8, Banten: 2, East Java: 2)	20 persons (Jakarta: 10, Bogor: 10)
Current Usage	・ **Brands used**: Volta, Smoot, etc. ・ **Type of use**: Often rented or leased ・ Average **duration of use**: about 9 months ・ **Distance traveled / day**: average approx. 165 km ・ **Battery swapping frequency/day**: average approx. 5 times	・ **Brands used**: Volta, Viar, etc. ・ **Type of use**: Often rented or leased ・ Average **duration of use**: approx. 10 months ・ **Distance traveled/day**: average approx. 130 km ・ **Charging times/day**: average approx. 2.5 times	・ **Brand**: Honda, Yamaha ・ **Type of use**: Self-owned ・ **Duration of use**: Average of about 6 years ・ **Distance/day**: average approx. 90-100 km ・ **Refueling frequency/day**: average approx. 1.7 times
Key Purchasing Factors	・ Started using electric motorcycles to improve revenue (save on running costs) based on recommendations from Grab/Gojek. ・ Brand selection factor: comfort when driving.	・ Started using electric motorcycles to improve revenue (save on running costs) based on recommendations from Grab/Gojek. ・ Brand selection factor: comfort when driving.	・ 45% of respondents are interested in using electric motorcycles. ・ The brand of most interest is Volta.
Convenience and User Experience	・ **Pros**: Environmentally friendly, low running costs, easy maintenance. ・ **Cons**: Slow speed, fast battery drain, lack of battery swapping stations. ・ No problems with battery swapping process or mobile app usability.	・ **Pros**: Low running costs, easy maintenance, quiet. ・ **Cons**: Fast battery depletion, lack of fast charging stations, short range.	The advantages and disadvantages of electric motorcycles in terms of convenience, as considered by gasoline-powered motorcycles, are as follows. ・ **Pros**: Environmentally friendly, easy maintenance, low running costs. ・ **Cons:** Lack of battery swapping/charging stations, short range, limited maintenance and parts supply.
Issues and Needs	・ **Bottlenecks for widespread adoption**: public mindset (lack of awareness of electric motorcycles), short range, slow speed. ・ Majority of Indonesian government officials agree that the amount of subsidy (7 million rupiah) for the purchase of electric motorcycles is sufficient.	・ **Bottlenecks to widespread adoption**: short range, lack of quick charging stations, public mindset (lack of awareness of electric motorcycles). ・ Half of the respondents said that the amount of subsidy (7 million rupiah) provided by the Indonesian government for the purchase of electric motorcycles is inadequate.	・ **Bottlenecks to widespread adoption**: lack of battery swapping and charging stations, inadequate maintenance and parts supply systems, short range. ・ Majority of Indonesian government officials agree that the amount of subsidy (7 million rupiah) for the purchase of electric motorcycles is sufficient.

Source: Project team based on demand survey results

(ii) Results of survey of private users

As in the case of the business users, it was found that the users of the battery-swappable electric motorcycles traveled longer distances than the users of the plug-in electric motorcycles. Based on the trend in mileage for each user, it can be seen that plug-in electric motorcycles are preferred when the daily mileage is 60 km or less because they can be used for a full day on a single charge, and that when the daily mileage exceeds 60 km, recharging or battery swapping is necessary during the day, and that interchangeable-battery electric motorcycles, which save recharging time, are preferred. Therefore, it can be seen that electric motorcycles with interchangeable batteries, which save charging time, are preferred.

As in the case of business users, the key issue cited by electric two-wheeled vehicle users in terms of challenges to the widespread use of electric motorcycles was the public's mindset (lack of awareness of electric motorcycles). In addition, a lack of battery swapping stations was cited by battery-replacement type users, and a short cruising range was cited by plug-in type users as a major issue.

On the other hand, the results of the survey of gasoline-powered motorcycle users showed that 35% of them were interested in using electric motorcycles, but (1) lack of battery swapping and quick charging stations, (2) short cruising range, and (3) safety concerns (electrical shorts, explosions, etc.) were cited as the main concerns.

A summary of the results of the survey of private users is shown in the table below.

Table 1-5 Results of Survey of Private users (Trial and Phase 1 Surveys)

Item	Results		
	Battery swappable Electric motorcycle users	**Plug-in Electric motorcycle users**	**Gasoline-powered motorcycle users**
Number of Respondents	48 persons (DKI Jakarta: 32, West Java: 6, Banten: 6, East Java: 3, Bali: 1)	100 persons (DKI Jakarta: 45, West Java: 26, East Java: 14, Others: 15)	20 persons (Jakarta: 10, Bogor: 10)
Current Usage	・ **Brands**: Smoot, Niu, etc. ・ **Type of use**: Mostly self-owned ・ Average **duration of use**: approx. 10 months ・ **Distance traveled/day**: average approx. 70 km	・ **Brands used**: Volta, Gesits, etc. ・ **Type of use**: Mostly self-owned ・ Average **duration of use**: approx. 11 months ・ **Distance/day**: average approx. 50 km ・ **Charging times/day**: average approx. 1.1 times	・ **Brand**: Honda, Yamaha ・ **Type of use**: Self-owned ・ **Duration of use**: Average of about 6 years ・ **Distance/day**: average approx. 40-50 km ・ **Refueling frequency/day**: average approx. 1.2 times
Key Purchasing Factors	・ Started using electric motorcycles for economy (running cost savings). ・ Brand selection factors: service, quality, driving comfort. ・ Attractive brands: Alva, Smoot, Polytron.	・ Started using electric motorcycles for economy (running cost savings). ・ Brand selection factors: quality, driving comfort, price. ・ Attractive brands: Alva, Polytron, Gesits.	・ 35% of respondents are interested in electric motorcycles. ・ The brand of most interest is Volta.
Convenience and User Experience	・ **Advantages**: reduced waiting time for refueling, low running costs, easy maintenance. ・ **Cons**: short range, slow speed, fast battery depletion. ・ No problems with battery swapping process or mobile app usability.	・ **Pros**: Low running costs, easy maintenance, saves refueling standby time. ・ **Disadvantages**: short range, limited maintenance and parts supply, high price.	The advantages and disadvantages of electric motorcycles in terms of convenience, as considered by gasoline-powered motorcycles, are as follows.; ・ **Pros**: Environmentally friendly, quiet, low running costs. ・ **Cons:** Smaller vehicle, concerns about electrical shorts, lack of battery swapping/charging stations.
Issues and Needs	・ **Bottleneck factors for diffusion**: general public mindset (lack of awareness of electric motorcycles), inadequate maintenance and parts supply system, lack of battery swapping stations. ・ Majority of Indonesian government's subsidy amount (7 million rupiah) for the purchase of electric motorcycles is sufficient.	・ **Bottleneck factors for diffusion**: public mindset (lack of awareness of electric motorcycles), high price, short range. ・ Majority of Indonesian government's subsidy amount (7 million rupiah) for the purchase of electric motorcycles is sufficient.	・ **Bottlenecks factors for diffusion** : lack of battery swapping/charging stations, short range, safety concerns (short circuits, explosions, etc.). ・ Majority of Indonesian government officials agree that the amount of subsidy (7 million rupiah) for the purchase of electric motorcycles is sufficient.

Source: Project team based on demand survey results

b. Results of Phase 2 Survey

In the Phase 2 survey, based on the results of the trial and Phase 1 survey, in-depth surveys were conducted with electric motorcycle and electric bike users through focus group discussions.

(i) Results of Survey of Electric Motorcycle Users

First, regarding the current use of electric motorcycles, it was found that business users mainly use the battery-swappable type (150-200 km per day) and private users mainly use the plug-in type (15-70 km per day), and that the mileage has hardly changed from that of gasoline-powered motorcycles The mileage did not change much from that of gasoline-powered motorcycles. Business users of electric motorcycles with replaceable batteries changed the batteries 3-10 times per day, and generally changed the batteries when the remaining battery charge reached 30-50%.

Next, regarding the main purchasing factors of electric motorcycles, it was found that business users selected brands based on factors such as the number of batteries swapping stations, cruising range, and horsepower (necessary in areas with many hills). On the other hand, personal users were found to be the so-called early adopter group (sensitive to new things and trends), and in addition to price and functionality/performance, they also placed importance on appearance and reputation.

Regarding the convenience and experience of using electric motorcycles, both business and personal users cited economy, ease of maintenance, and comfort as advantages of electric motorcycles. On the other hand, they considered electric motorcycles to be inferior to gasoline-powered motorcycles in terms of performance, maintenance and parts supply system, and safety. In addition, it was found that users of the battery swapping type (mainly business users) were dissatisfied with the quality of batteries at battery swapping stations, as well as the number of stations, their hours of operation, and their management.

Finally, regarding the challenges and needs of electric motorcycles, the following concerns were raised during use: running out of battery power on the road, lack of horsepower, and electrical shorts during heavy rain and flooding. However, some business users said that their concerns were dispelled because they were actually able to ride without problems during heavy rain and flooding. The bottleneck factors in the diffusion of electric motorcycles were (1) lack of battery swapping and charging stations, (2) performance issues (mileage and horsepower per battery), (3) public mindset (lack of awareness of electric motorcycles), and (4) inadequate maintenance and parts supply systems.

The results of the survey of electric motorcycle users are shown in the table below.

Table 1-6 Results of Survey of Electric Motorcycle Users (Phase 2 Survey)

Item	Results	
	Business user	**Private user**
Number of Respondents	20 persons (Karawang: 6, Denpasar: 6, Makassar: 8)	12 persons (Karawang: 6, Denpasar: 6)
Current Usage	**Purpose of use, mileage, etc.** ・ **18 of 20** used the **battery-swappable type** and 2 used the plug-in type. Duration of use ranged from 1 to 24 months (average about 6 months). ・ **Swap type has a daily mileage of 150-200 km**, which is longer than the recharge type (100 km). ・ Swap type **swaps 3-10 times per day**. It is common to **swap when the battery level reaches 30-50%**. ・ Drivers believe it is better to swap batteries as soon as possible because the quality of the battery will deteriorate if the battery is used up to 0%. **Maintenance status** ・ Maintenance is supported by the company (Gojek, Grab) and drivers do not bear the cost. **Differences from gasoline-powered motorcycles** ・ Mileage and earnings are almost the same as with gasoline bikes, but **running costs (swap fees) are lower than for gasoline.** ・ The location of the swap station **limits the scope of activities** (you can't go where there is no station).	**Purpose of use, mileage, etc.** ・ **10 out of 12** used the **plug-in type** and 2 used the battery swapping type. Duration of use ranged from 1 to 18 months (average about 5 months) ・ **The purpose of use is mainly commuting**, with a **daily mileage of 15-70 km.** ・ **Recharging is** performed **once a day**, at home at night. **Maintenance status** ・ Maintenance is covered by Warranty at this time, so there is no cost burden; maintenance is performed at the OEM's service center. **Differences from gasoline-powered motorcycles** ・ Mileage is virtually unchanged from that of gasoline bikes. **Maintenance is easier than with gasoline bikes.**
Key Purchasing Factors	**Motivation for Electric Motorcycle Use** ・ Received referrals from companies (Gojek, Grab) and were interested from the perspective of **cost savings, etc.** **Reasons for brand selection** ・ Many people choose the battery swapping type to save charging time. ・ Brands are selected based on factors **such as the number of battery-swappable stations**, **range, and horsepower.** **Attractive brands and why** ・ In addition to the brands actually used by drivers (Smoot, Gesits, Volta), Alva, iMoto, and Kymco were mentioned as attractive brands in terms of good looks and high performance.	**Motivation for Electric Motorcycle Use** ・ The main motivation for using electric motorcycles is cost savings (gasoline savings). **Reasons for brand selection** ・ Because the mileage is not long, there is little need to choose a battery swapping type, and many people choose a plug-in type that allows them to manage the battery themselves. ・ In selecting a brand, the company emphasizes price, function, and performance, as well as appearance and reputation. Those who can afford to spend money on a motorcycle choose a brand (Alva) with a higher price but better performance and design. **Attractive brands and why** ・ Electric bikes from brands with good quality, performance, and appearance

Item	Results	
	Business user	**Private user**
		(Honda PCX Electric, Kawasaki Ninja EV, Alva, Vespa, etc.) are appealing, but their high prices keep them out of reach of all but a few wealthy individuals.
Convenience and User Experience	**Advantages and disadvantages compared to gasoline-powered motorcycles** ・ Advantages of electric motorcycles compared to gasoline-powered motorcycles included (1) economy (saving gasoline and time spent waiting at gas stations), (2) ease of maintenance, (3) environmental friendliness, and (4) comfort and quietness when driving. ・ On the other hand, the following disadvantages were cited: 1) inadequate number of swap stations, 2) inferior performance (mileage, horsepower, speed, etc.), 3) concerns about maintenance and parts supply systems, and 4) safety concerns (short circuit during heavy rain and floods, overheating of motors, etc.). **Convenience and satisfaction with batteries, battery swapping/charging, maintenance, and mobile apps** ・ Regarding the battery, the short range is unsatisfactory. ・ In addition, the battery swapping station may replace the battery with a battery that has a quality problem but cannot be addressed because the quality cannot be discerned in advance. ・ Dissatisfied with battery swapping stations in terms of number (not located in some areas), hours of operation (not operating late at night), and management conditions (stopped due to problems).	**Advantages and disadvantages compared to gasoline-powered motorcycles** ・ When comparing electric motorcycles to gasoline-powered motorcycles, the advantages of electric motorcycles were (1) economy (saving on gasoline and time spent waiting at gas stations) and (2) comfort and quietness when driving. Users of the higher-priced model (Alva) also cited (3) advanced technology and good design as advantages. ・ On the other hand, the disadvantages were inferior performance (mileage, horsepower, etc.), concerns about maintenance and parts supply systems, and safety concerns (short-circuit during heavy rain and flooding, etc.). **Convenience and satisfaction with batteries, battery swapping/charging, maintenance, and mobile apps** ・ No major complaints about the battery except for the high price. ・ Positive about the battery rental service (deployed by Polytron)[1] because of its low cost and guaranteed battery quality. ・ Regarding battery swapping service, dissatisfied that battery quality is not guaranteed (some batteries are of poor quality). ・ Regarding recharging, there are both those who are dissatisfied with the long recharging time and those who say that recharging at home in 3~4 hours is not a problem.
Issues and Needs	**Problems or concerns experienced** ・ Regarding batteries, there may be a quality problem with the replaced batteries (e.g., batteries run down too quickly, get hot, etc.). ・ Concerns have been raised about electrical shorts during heavy rain and flooding. However, some drivers said that their concerns were dispelled because they were actually able to drive without problems during heavy rain and flooding. ・ **Bottleneck Factors for diffusion** ・ The following factors were cited as	**Problems or concerns experienced** ・ Experienced problems with electric motorcycles suddenly stopping, battery swapping service hit with poor quality batteries, etc. ・ Concerns have been raised about dead batteries on the road, lack of horsepower (cannot go up steep hills), and electrical short circuits during heavy rain and flooding. **Bottleneck Factors for diffusion** ・ Bottleneck factors in the diffusion of electric motorcycles were identified as (1)

[1] Polytron's business model is to sell the electric two-wheeler itself without the battery and rent the battery for 200,000 rupiah per month.

Item	Results	
	Business user	**Private user**
	bottlenecks in the diffusion of electric motorcycles: 1) Inadequate battery swapping and charging station infrastructure, 2) Performance issues (cruising range, horsepower), 3) general public mindset (anxiety due to insufficient information about electric motorcycles), and 4) inadequate maintenance and parts supply systems. ・ Regarding the price, there were both opinions that it is still too high and that the current price level (including subsidies) is not a problem. **Recommended measures** ・ Recommended measures to promote the use of electric motorcycles include: 1) expansion of battery swapping and recharging stations (even distribution and extension of operating hours), 2) performance improvement of electric motorcycles (battery capacity, horsepower), 3) increased publicity to the general public (use SNS, etc. to educate people about the benefits of electric motorcycles), and 4) expansion of maintenance service locations (especially in rural areas). (especially in rural areas).	insufficient battery swapping and charging station infrastructure, (2) performance issues (horsepower, range), (3) general public mindset (lack of awareness of electric bikes, safety concerns), and (4) inadequate maintenance and parts supply systems. ・ Regarding the price, there were both opinions that it is still too high and that the current price level (including subsidies) is not a problem. **Recommended measures** ・ Recommended measures for popularization included (1) expansion of battery swapping and recharging stations, (2) performance improvement of electric motorcycles, (3) public awareness of the safety of electric motorcycles, and (4) enhancement of maintenance and parts supply systems.

Source: Project team based on demand survey results

(ii) Results of Survey of Electric bike Users

Electric bikes were found to be increasingly popular among those with a high sensitivity to trends, as a means of short-distance travel and as a form of entertainment and hobby. In addition, electric bikes have the advantage that they are much cheaper and easier to use than electric motorcycles. The cruising range (up to 40 km) and recharging time (about 4 hours) are acceptable to users. On the other hand, it was found that there are concerns about safety (traffic accident risk) and quality.

Regarding the challenges to the popularization of electric motorcycles, one respondent commented that the lack of brand recognition of electric motorcycles is a bottleneck in their popularization, and that while Japanese brands for gasoline-powered motorcycles have an image of good quality, there is still no such brand for electric motorcycles.

The results of the survey of electric bike users are shown in the table below.

Table 1-7 Results of Survey of Electric bike Users (Phase 2 Survey)

Item	Results
Number of Respondents	5 persons (Makassar)
Current Usage	・ Electric bikes are mainly used for short-distance transportation, such as in residential areas, commuting to school, and for shopping purposes. Some people also use electric bikes for entertainment/hobby. ・ Electric bikes are preferred over electric bikes by those who travel short distances per day (40 km or less), those who value affordability, and those who are interested in electric vehicles and want to try them easily.
Key Purchasing Factors	・ Electric bikes are mainly used for short-distance transportation, such as in residential areas, commuting to school, and for shopping purposes. Some people also use electric bikes for entertainment/hobby. ・ Electric bikes are preferred over electric bikes by those who travel short distances per day (40 km or less), those who value affordability, and those who are interested in electric vehicles and want to try them out easily.
Convenience and User Experience	・ Electric bikes are mainly used for short-distance transportation, such as in residential areas, commuting to school, and for shopping purposes. Some people also use electric bikes for entertainment/hobby. ・ Electric bikes are preferred over electric bikes by those who travel short distances per day (40 km or less), those who value affordability, and those who are interested in electric vehicles and want to try them out easily.
Issues and Needs	・ In Makassar (the core city of the region), interest in new technologies and products is high and electric bikes are becoming more popular, while in smaller cities in the region, the price is still perceived as too expensive, and the use of electric bikes is not widespread. ・ Interest in electric motorcycles is also growing, but the lack of brand recognition has been a bottleneck in their spread. Japanese brands have an image of good quality for gasoline-powered motorcycles, but there is no such brand for electric motorcycles yet. ・ Therefore, it was suggested that measures for dissemination should include increased publicity to the general public (e.g., digital marketing using influencers, etc.).

Source: Project team based on demand survey results

c. Results of Phase 3 Survey

In the Phase 3 survey, the following 3 items were surveyed to obtain further information that was not available in the previous 2 surveys.

Table 1-8 Survey Methodology for Each Category of Survey Targets

	Survey Item	Survey Target	Methodology
1	**Actual purchase conditions, Key buying factors, and Willingness to pay for electric motorcycle**	Private user of electric motorcycle (Battery-swappable/ Plug-in)	Online survey
2	**Actual situation and issues of home charging of electric motorcycle**	Private user of electric motorcycle (Plug-in)	House visit
3	**Actual situation and issues of conversion from gasoline-powered motorcycle to electric motorcycle**	Private user of electric motorcycle (Converted from gasoline-powered motorcycle)	Online survey and Visit to conversion workshop

Source: Project team

(i) Key findings from the Phase 3 survey

Below are the key findings from the Phase 3 survey.

Table 1-9 Key findings (Phase 3 Survey)

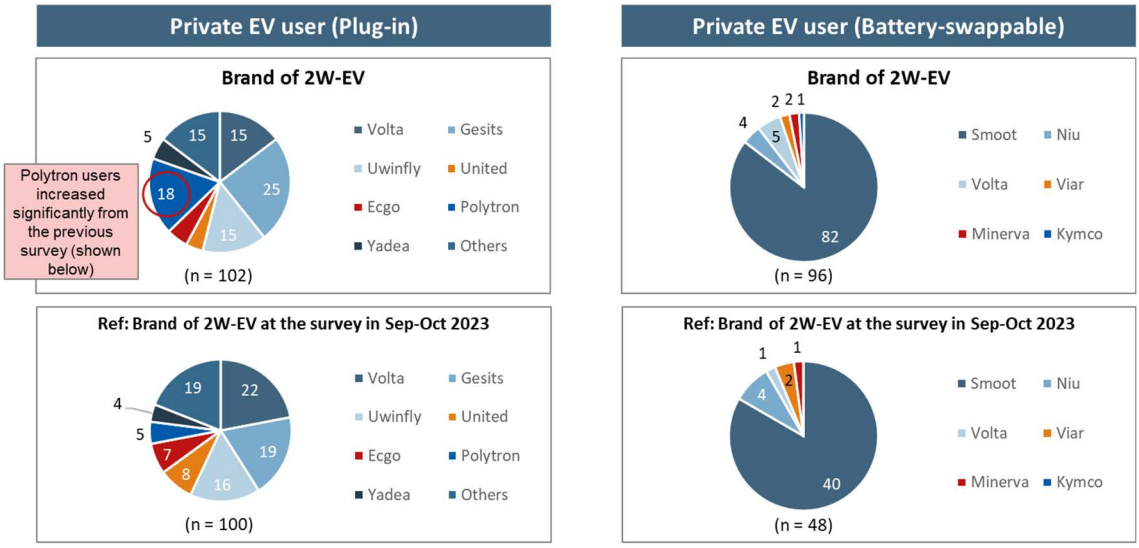
Item	Key findings
Actual purchase conditions, Key buying factors, and Willingness to pay for electric motorcycle	**[Purchased brands and Actual purchase conditions]** ・ For Plug-in electric motorcycle, Volta, Gesits, Uwinfly and Polytron are popular. Polytron has recently increased significantly. ・ For Battery-swappable electric motorcycle, the large majority use Smoot. ・ The price of Plug-in electric motorcycle is higher than that of Battery-swappable electric motorcycle on average. ・ Many electric motorcycle purchasers paid 100% up front. **[Key buying factors]** ・ Plug-in electric motorcycle users consider "Mileage per battery" and "Charging time" as more important, while Battery-swappable electric motorcycle users prioritize "Availability of swapping stations" and "Power". **[Willingness to pay]** ・ Both Plug-in and Battery-swappable electric motorcycle users are willing to pay higher prices for electric motorcycle with longer mileage and higher power output.
Actual situation and issues of home charging of electric motorcycle	・ Plug-in electric motorcycle users typically charge the battery once a day, late at night, at home. ・ They use a brand's charger/cable, but some use fast-charging devices purchased by themselves. ・ Most Plug-in electric motorcycle users live in Rumah Tapak (house with land) owned by themselves. ・ Home electricity capacity of 2,200W is considered enough to cater for charging electric motorcycle. The respondents expressed no complaints about home charging.
Actual situation and issues of conversion from gasoline-powered motorcycle to electric motorcycle	・ Main motivation for conversion is to save costs while keeping the body of the gasoline-powered motorcycle which they liked. ・ Conversion cost is around Rp15-20M (incl. battery). Most respondents did not utilize the subsidy. ・ Conversion took less than 2 weeks in most cases, and the respondents experienced no problems. ・ Demand for conversion is steady, especially among younger generation. There are small workshops providing conversion service, but they don't utilize the subsidy due to costly requirements.

Source: Project team based on demand survey results

(ii) Results – Purchased brands –

For Plug-in electric motorcycle, Volta, Gesits, Uwinfly and Polytron are popular. Especially, Polytron users have increased significantly from the previous survey (conducted a half year ago).

For Battery-swappable electric motorcycle, the large majority use Smoot.



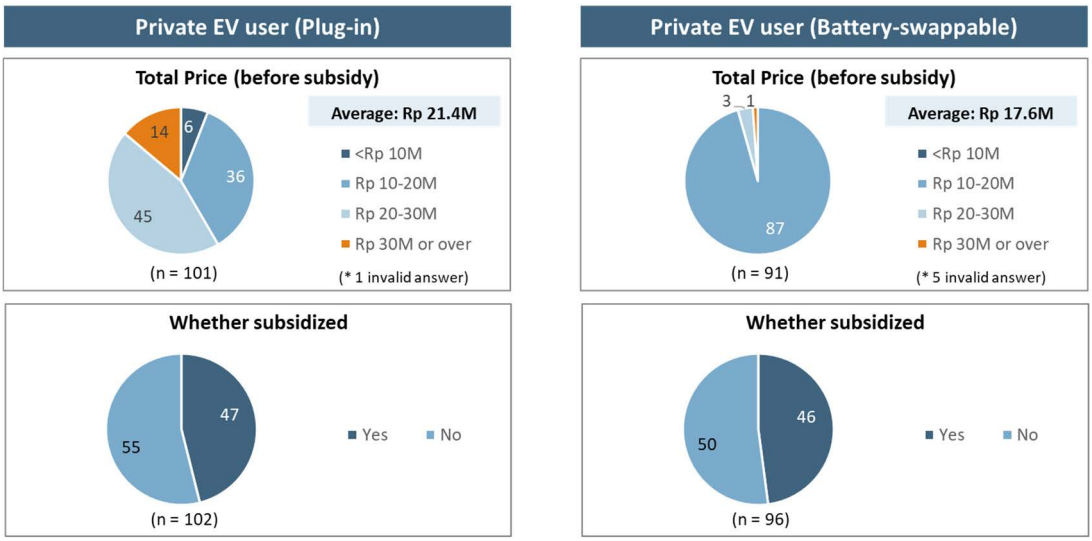
Source: Project team based on demand survey results

Figure 1.2 Purchased brands (Private user of Plug-in / Battery-swappable electric motorcycle)

(iii) Results – Purchase conditions –

The price of Plug-in electric motorcycle is higher than that of Battery-swappable electric motorcycle on average.

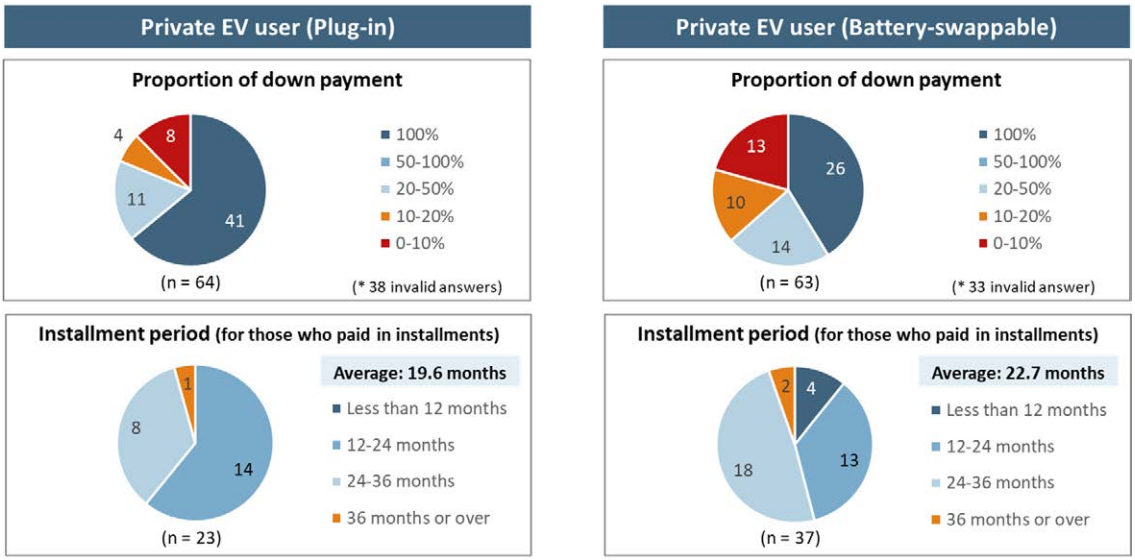
Around half of the respondents used the government subsidy, while the other half didn't because they purchased electric motorcycle before the introduction of the subsidy.



Source: Project team based on demand survey results

Figure 1.3 Purhase price and use of subsidy (Private user of Plug-in / Battery-swappable electric motorcycle)

More than half of Plug-in electric motorcycle purchasers paid 100% up front, while Battery-swappable electric motorcycle users tend to rely more on installment payments.

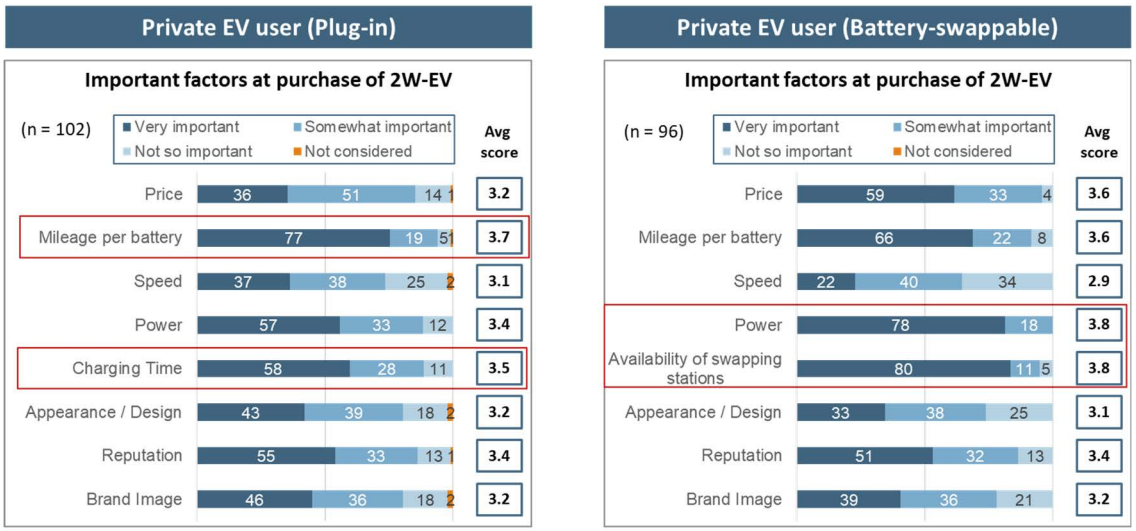


Source: Project team based on demand survey results

Figure 1.4 Payment conditions (Private user of Plug-in / Battery-swappable electric motorcycle)

(iv) Results – Key buying factors –

Plug-in electric motorcycle users consider "Mileage per battery" and "Charging time" as more important, while Battery-swappable electric motorcycle users prioritize "Availability of swapping stations" and "Power".



Note:

- Score is calculated by arithmetic mean: Very important: 4pt , Somewhat important: 3 pt, Not so important: 2 pt, Not considered: 1 pt.
- 36 respondents (Plug-in) and 21 respondents (Battery-swappable) answered "aftersales support" as the other factor that they considered important.

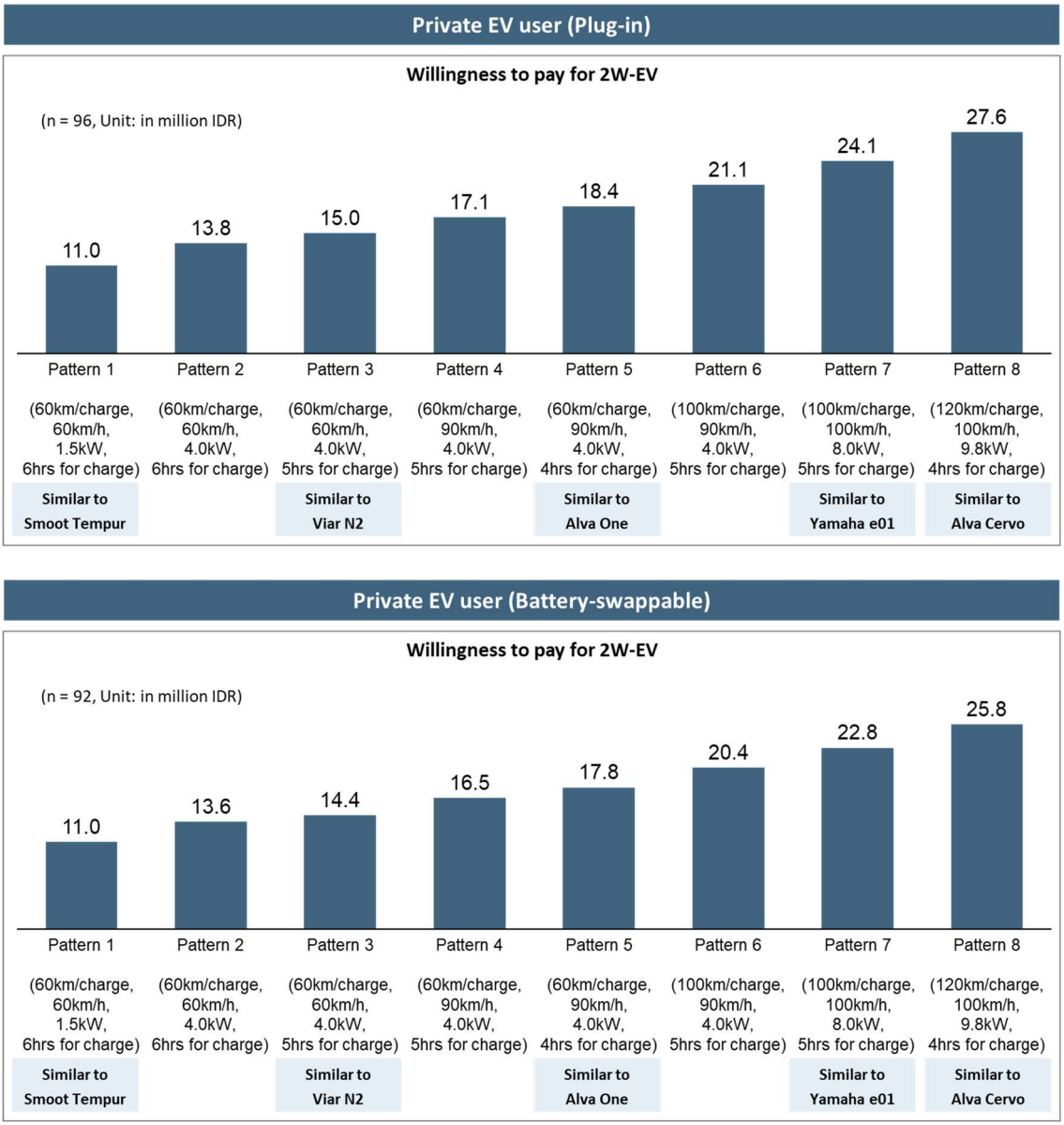
Source: Project team based on demand survey results

Figure 1.5 Key buying factors (Private user of Plug-in / Battery-swappable electric motorcycle)

(v) Results – Willingness to pay –

Plug-in electric motorcycle users are willing to pay higher prices for electric motorcycle with longer mileage and higher power output.

Battery-swappable electric motorcycle users are willing to pay higher prices for electric motorcycle with longer mileage and higher power output, but the level of Willingness-to-pay is lower than that of Plug-in electric motorcycle users.



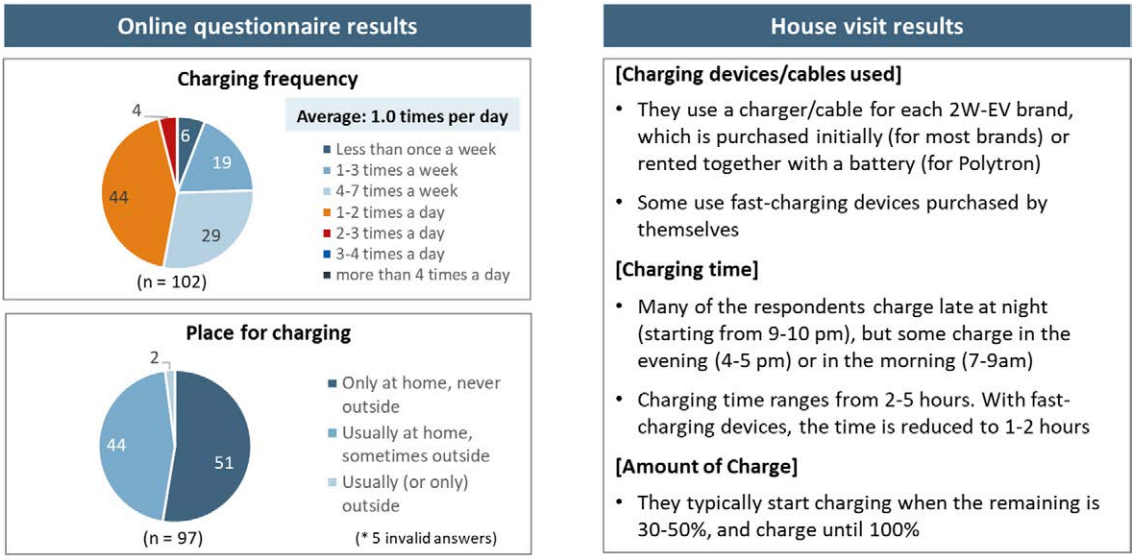
Source: Project team based on demand survey results

Figure 1.6 Willingness to pay for electric motorcycle (Private user of Plug-in / Battery-swappable electric motorcycle)

(vi) Results – Charging habits of Plug-in electric motorcycle user –

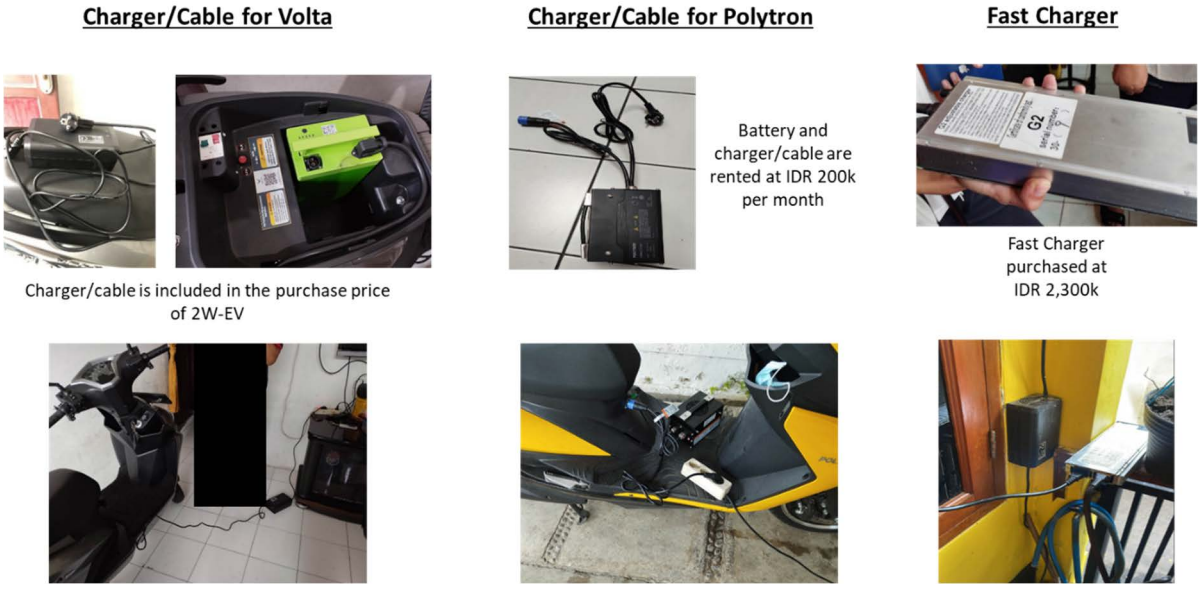
Plug-in electric motorcycle users typically charge the battery once a day, late at night, at home.

They use a brand's charger/cable purchased initially, but some use fast-charging devices purchased by themselves.



Source: Project team based on demand survey results

Figure 1.7 Charging habits of Plug-in electric motorcycle user



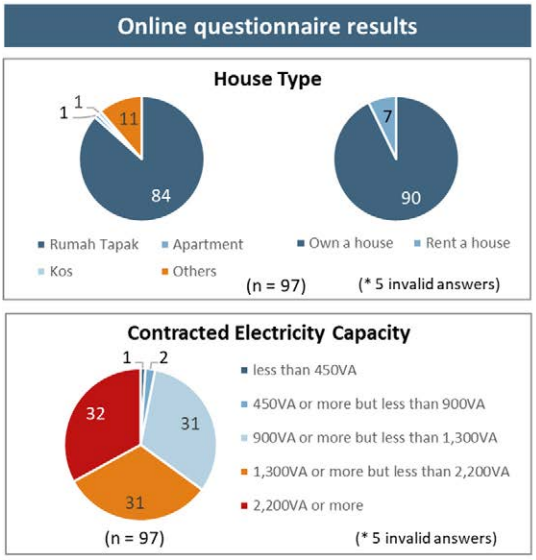
Source: Project team

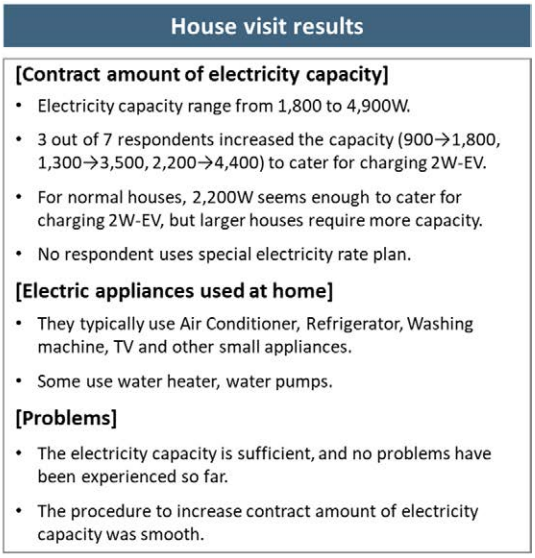
Figure 1.8 Home charging of electric motorcycle (Photos taken at house visits)

(vii) Results – Home electricity –

Most Plug-in electric motorcycle users live in Rumah Tapak (house with land) owned by themselves.

Home electricity capacity of 2,200W is considered enough to cater for charging electric motorcycle. The respondents expressed no complaints about home charging.





Source: Project team based on demand survey results

Figure 1.9 Home electricity of Plug-in electric motorcycle user

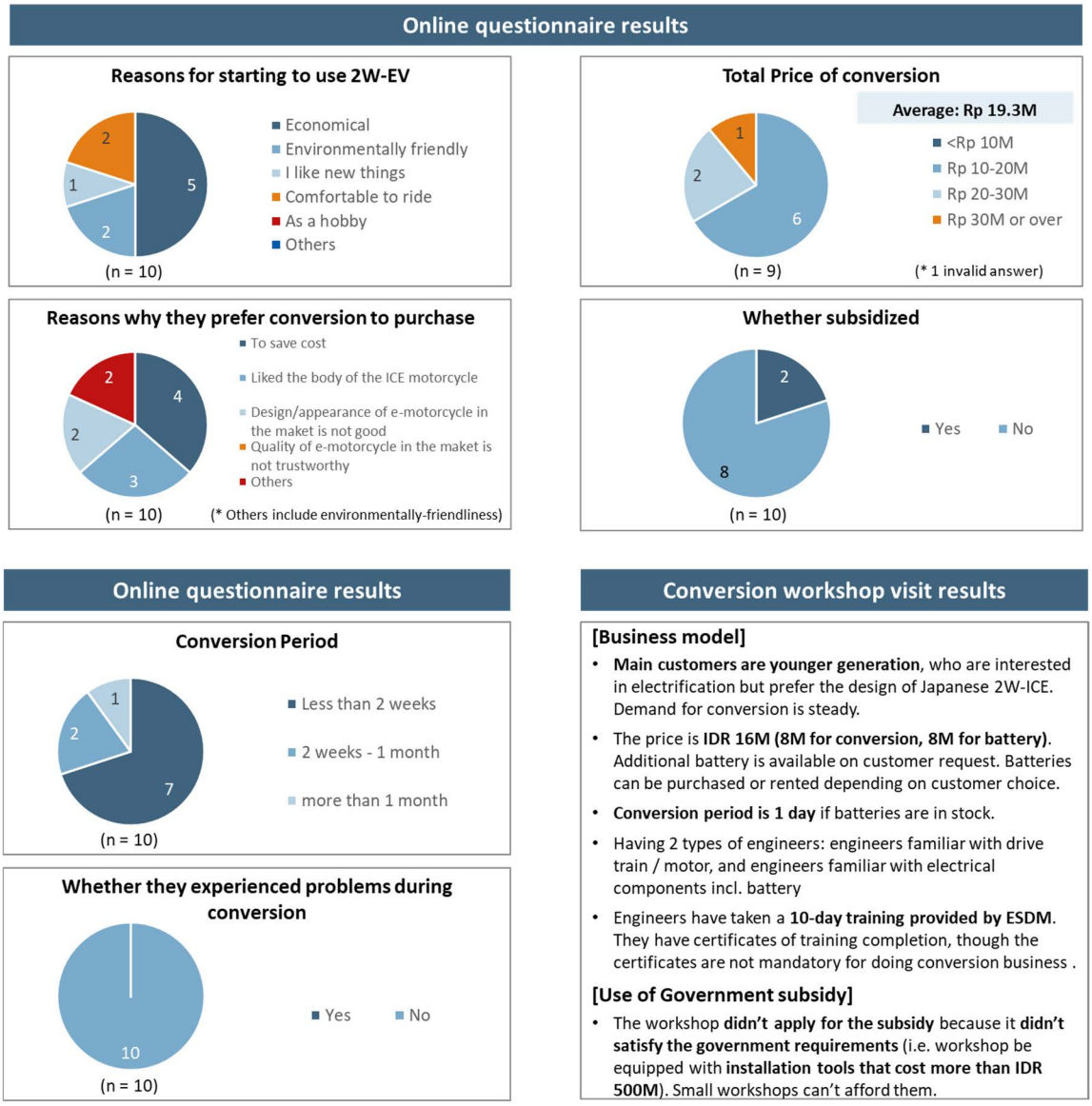
(viii) Results – Conversion –

Many respondents converted gasoline-powered motorcycle to electric motorcycle to save running costs (gasoline costs) while keeping the body of the gasoline-powered motorcycle which they liked.

Conversion cost is around Rp15-20M (incl. battery). Most respondents did not utilize the subsidy.

Conversion took less than 2 weeks in most cases, and the respondents experienced no problems.

Demand for conversion is steady, especially among younger generation. There are small workshops providing conversion service, but they don't utilize the subsidy because they can't afford costly equipment which are needed to meet government subsidy application requirements.



Source: Project team based on demand survey results

Figure 1.10 Conversion from gasoline-powered motorcycle to electric motorcycle

APPENDIX 2 COMPANIES AFFECTED BY ELECTRIFICATION

Table 2-1 Interview Survey Results

Company	Company Profile	Impact of electrification	Countermeasures in to respond to the impact of electrification	Requests to the Government and Japan
Company A (Japanese parts supplier)	Manufacture and sales of transmissions and engine shafts for automobiles and motorcycles.	The shift to EVs is progressing rapidly, and production of flagship products will surely decline. By 2035, we are looking at closing our base in China OR/AND Indonesia.	Expansion into new businesses (e.g., manufacturing shafts for motors), etc.	Support for business meetings to develop other sectors, and subsidy for charging stations for companies.
Company B (Japanese parts supplier)	Manufacture and sales of shift forks, control shafts, and four-wheel selector lever units for automobiles and motorcycles.	We had expected sales to remain flat until 2030, but the shift to EVs is progressing more rapidly than expected, and it is difficult to maintain sales.	Received orders for work for Hyundai Motor Company, a newly established company, among others. Developing new customers and greedily accepting orders for work that can be handled.	Planning for business matching, including introduction of local companies, etc.
Company C (Japanese parts supplier)	Manufacture and sales of transmission parts (mainly gears) for automobiles and motorcycles.	The number of orders is not expected to change as EV bikes will also be installed with transmissions. Business may expand due to inquiries from Chinese companies and others for EV bikes.	The production of hybrids for cars (four-wheelers) is planned to start, and preparations to cope with this are busy.	Subsidy for charging station in companies.
Company D (Japanese parts supplier)	Design, manufacture, and sales of die-casting dies for automobile, motorcycle, and other parts (covers, etc.).	We hear a lot of EV shifts, but we have not affected.	No particular action has been taken. It is difficult to secure human resources in Japan and plans to strengthen the functions of the Indonesian base.	None in particular. If anything, relaxation or elimination of import restrictions on used machinery, steel products, etc.
Company E (Japanese parts supplier)	Development, manufacture and sales of brake systems and aluminum products for automobiles and motorcycles.	While brake-related parts, which is a flagship product, are not expected to be affected much, engine-related parts such as transmission covers and plank cases are expected to see a decrease in production.	Expand into agricultural equipment.	None

Company	Company Profile	Impact of electrification	Countermeasures in to respond to the impact of electrification	Requests to the Government and Japan
Company F (Japanese OEM)	Manufactures and exports complete motorbike as well as engine assemblies and body parts.	We do not expect any drastic impact on mission-related components. On the other hand, 60% of the company's 125 suppliers could be significantly affected.	We have been conducting trials by introducing EV motorcycles for test marketing to see how the market and customers respond.	Clarification of guidelines and development of charging infrastructure to promote EV motorbikes.
Company G (Japanese parts supplier)	Manufactures engine timing chains for four-wheeled and two-wheeled vehicles.	Our Indonesian base has not experienced a decline in sales and is not expected to be affected in the immediate future.	In addition to focusing on sales of repair parts for future business development, the group as a whole plans to develop new business fields such as chains for industrial machinery.	Relaxation or elimination of import restrictions on steel products used in industrial chains.
Company H (Japanese parts supplier)	Manufacture of mufflers for four-wheeled and two-wheeled vehicles.	The main type of motorcycles that will be electrified in the future will be scooters, and we, a manufacturer mufflers for large motorcycles, do not expect any major impact. We believe that the shift to EVs for four-wheeled vehicles will have an impact.	We are expanding into double mugs utilizing its thin stainless steel processing technology and into motorcycle parts utilizing its four-wheeled vehicle muffler bender technology.	Relaxation or elimination of import restrictions on steel (stainless steel) used as material for mufflers, etc.
Company I (Japanese parts supplier)	Manufacturer of brake and air conditioning hoses for four-wheeled and two-wheeled vehicles. In Indonesia, assembly for motorcycles is the main business.	Brake hoses and hydraulic and pneumatic system hoses may be affected, while the main products are expected to be replaced by air conditioning hoses to cool the heat generated by the battery.	In addition to replacing existing products, new products are being developed, etc., taking electrification into account.	Relaxation or removal of import restrictions.
Company J (Japanese parts supplier)	Engine-related components for four-wheeled and two-wheeled vehicles. In Indonesia, the company mainly manufactures throttle bodies, sensors and motors associated with throttle bodies.	The company's main focus is on engine-related components, which will be significantly affected if EVs become the mainstream.	While keeping a close eye on market and customer trends, the company is calculating earnings and conducting other studies as a manufacturing plant in the event of the shift to EVs, but at present it is monitoring how it goes.	Relaxation or removal of import restriction, development of a concrete and realistic roadmap by the Government.
Company K (Japanese parts supplier)	Manufactures mainly conventional components such as ECUs, ECG starters, powertrains, air conditioners and radiators.	Overall sales of motorcycle-related components may be affected, as the company mainly manufactures products that will be lost due to the shift to EVs.	Although we are sceptical about the spread of EVs, the company is considering whether there is anything they can propose in terms of EVs in cooperation with Headquarters.	Relaxation or removal of import restrictions, human resource development for mechanical engineers.

Company	Company Profile	Impact of electrification	Countermeasures in to respond to the impact of electrification	Requests to the Government and Japan
Company L (Japanese parts supplier)	Supply of steering for four-wheelers and bearings for two-wheelers.	Sales are expected to decrease by 30-40%, as the number of bearings will be reduced from 15 to 10 and the cost of sales will be smaller.	No specific enquiries have been received from motorcycle manufacturers and no measures to deal with this have yet been considered.	Improve custom procedures so the company does not face changes in HS code categorization as well as import restriction of materials
Company M (Local parts supplier)	Molds and jigs, mufflers for Yamaha (existing), frames (new). 80% share of motorcycle market.	In the future, 30% of sales, mainly muffler parts, will be affected by electrification.	Design and produce frames for an emerging electric motorcycle manufacturer. Design of frames is drawn and manufactured by RE (no drawings provided by Chinese manufacturer). Develop and sell own electric bicycles: 300Watt electric capacity bicycles.	Design and produce frames for an emerging electric motorcycle manufacturer. Design of frames is drawn and manufactured by RE (no drawings provided by Chinese manufacturer). Develop and sell own electric bicycles: 300Watt electric capacity bicycles.
Company N (Local parts supplier)	Member of Tier 1, PIKKO. Stamped parts for motorcycles, welding, control cable assembly, etc. Sales by product: 90% for motorcycles, 10% for agricultural machinery	Engine parts account for 50% of total sales and are greatly affected by the spread of electric motorcycles.	Diversification of the business → Started manufacturing plastic parts at a new plant in Tegal this year.	Relaxation of import restrictions on raw materials (steel products); Promotion of technical assistance for products for EVs. Business matching: Tegal City and IKMA intermediary.
Company O (Local parts supplier)	Pressed parts, plastic parts, etc.(Motorcycle market share: over 70%)	10% of sales, mainly engine parts such as engine covers, are affected by electrification	To increase production of plastic parts, a new plant is being built in Cikarang and equipment is being brought in.	We wish to form a joint venture with a Japanese company and have already participated in matching with a Japanese company, etc. Since we are not a SME, we are not eligible for investment and other preferential treatment.
Company P (Local parts supplier)	Stamping, welding, galvanizing, plastic molding (new)80% share of motorcycle market.	In the future, 30% of sales, mainly muffler parts, will be affected by electrification.	In Majanka, West Java Established a plastic molding factory in Majanka, West Java.	Provide and lean training related to EV technology Improvement of productivity through production guidance Technical cooperation from Japan for production of batteries, motors and controllers. Technical cooperation from Japan in the production of batteries, motors, and controllers.

Company	Company Profile	Impact of electrification	Countermeasures in to respond to the impact of electrification	Requests to the Government and Japan
Company Q (Local parts supplier)	25% share of the motorcycle market Stamping parts for automobiles and motorcycles, welding, dies and jigs, etc.	The spread of electric motorcycles depends on government policy - Parts for motorcycles are mainly body parts, so there is no impact.	We supply frame parts to electric bike brands developed and manufactured by local electric bike manufacturers.	Transfer and diffusion of battery technology suitable for long-distance travel Unification of battery standards.

Table 2-2 Survey results (excerpts)

Impact on motorcycle business				
No.	**Question**	**Options**	**Number of responses (Japanese)**	**Number of responses (Local)**
1	How do you think the electrification of motorcycles will penetrate in the future?	Grow fast in 4-5 years.	1	5
		Not expect to grow very fast in the last 4-5 years but expect to grow very fast in the next 5-10 years.	2	9
		Do not grow so much in 5-10 years.	4	1
		Don't know.	5	1
2	To what extent do you expect your existing businesses to be affected by the electrification of motorcycles within the next four to five years?	Very big	2	1
		Somewhat big	6	9
		Not so much	3	6
		None	0	0
		Don't know.	1	0
3	(For those who answered "very big" or "somewhat big" in 2) What will be the concrete effect on your motorcycle sales?	More than 50 %	4	4
		20-50% or more	4	4
		10-20% or more	0	0
		10% or less	0	0
4	In the longer term, to what extent do you expect your existing businesses to be affected by the electrification of motorcycles in 5-10 years?	Very big	2	7
		Somewhat big	6	6
		Not so much	3	3
		None	0	0
		Don't know.	1	0
Electrification measures				
5	Are you considering counter measures against the effect of electrification?	Already considering and under implementation.	9	10
		Considering countermeasures	0	6
		Not yet considered but will consider in the future.	3	0
		No plans to consider	0	0
6	If you answered, "Already considering and under implementation" or "Considering countermeasures" in 1, what kind of countermeasures are you considering?	Enter into Motorcycle Electric Parts.	2	15
		Enter into four-wheeled vehicle related parts.	2	8
		Enter into new businesses.	2	10
		None specifically	2	2
7	What specific actions are you planning to take to address electrification internally?	Establishment of an electric parts sales division or a new business division.	1	8
		Strengthen R&D	2	13
		Expand collaboration with domestic companies.	2	13
		Expand collaboration with overseas companies.	3	12
		Collaboration with universities and research institutions.	1	4
		Preparation or start of production of electric components.	4	8
		Other	3	1

APPENDIX 3 COMPARISON OF THE 2020 EDITION OF THE STANDARD FOR SWAPPABLE BATTERIES IN INDONESIA (SNI8928) WITH ITS REVISED EDITION OF 2023

The standardization of batteries for electric motorcycles in Indonesia is being promoted with the aim of unifying the battery standards for electric motorcycles, of which there are more than 50 types in Indonesia as of 2023, in order to lower the manufacturing and installation costs of batteries and vehicles, and to stimulate the market.

However, at this point, no conclusion has been reached on what value should be set as the standard, and none of the existing batteries from any manufacturer is sufficient in terms of sales volume or market share to make any of them the de facto standard.

Therefore, Indonesian National Standard (SNI) 8928 (2020) for removable battery-type electric motorcycle batteries was a synthesis of the battery standards that existed as of 2020. SNI 8928 was amended in December 2023 to specify a narrower scope, although it is still a voluntary standard. The following is a description of the main items. And the six changes in SNI 8928 (2023) are also as follows.

- Change in scope due to elimination of removable battery type.
- Change of battery dimensions.
- Addition of nominal voltage range and maximum mass parameters.
- Parameter change from rated capacity (Ah) to energy capacity (Wh).
- Change of battery connector type.
- Change in battery communication protocol.

Table 3-1 Comparison of the 2020 and 2023 Revisions of SNI8928

<table>
<tr><th>Main Item</th><th>2020 Edition</th><th>2023 Edition</th></tr>
<tr><td>Specifications of rated voltage, rated capacity, and battery pack size</td><td>
<table>
<tr><th rowspan="2">定格電圧 (V)</th><th rowspan="2">最低定格容量 (Ah)</th><th colspan="3">サイズ(mm)</th></tr>
<tr><th>N1</th><th>N2</th><th>N3</th></tr>
<tr><td rowspan="3">48</td><td rowspan="2">12</td><td>77</td><td>179</td><td>425</td></tr>
<tr><td rowspan="2">20</td><td>290</td><td>103</td><td>218</td></tr>
<tr><td>155</td><td>178</td><td>296</td></tr>
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<tr><td>200</td><td>170</td><td>270</td></tr>
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</td><td>
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<tr><th rowspan="2">[1]定格電圧 (V)</th><th rowspan="2">公称電圧範囲 (V)</th><th rowspan="2">最大質量 (kg)</th><th rowspan="2">最小エネルギー容量 (Wh)</th><th colspan="3">最大サイズ (mm)</th></tr>
<tr><th>ロング</th><th>幅</th><th>高い</th></tr>
<tr><td>60</td><td rowspan="2">55 - 66
67 - 78</td><td rowspan="2">13</td><td rowspan="2">1.300</td><td rowspan="2">220</td><td rowspan="2">200</td><td rowspan="2">385</td></tr>
<tr><td>72</td></tr>
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48V is excluded.
</td></tr>
<tr><td>Battery connector</td><td>
<table>
<tr><th>No</th><th>コネクター・タイプ</th></tr>
<tr><td>1</td><td>DCピン×2、通信ピン×5</td></tr>
<tr><td>2</td><td>DCピン×3、通信ピン×4</td></tr>
</table>
</td><td>
<table>
<tr><th>No</th><th>バッテリーのコネクターの位置</th><th>コネクタピン</th><th>電流値</th></tr>
<tr><td>1</td><td>上部</td><td>DCピン×2、通信ピン×6</td><td rowspan="3">≥ 80 A</td></tr>
<tr><td>2</td><td>底部</td><td>DCピン×2、通信ピン×12</td></tr>
<tr><td>3</td><td>底部</td><td>2 DCピン、NFC</td></tr>
</table>
*The connectors are open IP and may be shared and manufactured by battery replacement service manufacturers and service providers in Indonesia without incurring royalties.
</td></tr>
<tr><td>Communication protocol</td><td>
<table>
<tr><th>No</th><th>プロトコル・タイプ</th></tr>
<tr><td>1</td><td>RS 232</td></tr>
<tr><td>2</td><td>RS 485</td></tr>
<tr><td>3</td><td>Can Bus</td></tr>
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<tr><th>通信プロトコル</th><th>ボーレート</th><th>Format</th><th>Message length</th></tr>
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</td></tr>
<tr><td>Parameter measurement accuracy</td><td>
<table>
<tr><th>パラメータ</th><th>レンジ</th><th>測定精度</th></tr>
<tr><td>電圧</td><td></td><td></td></tr>
<tr><td rowspan="4">≤ 1000V</td><td>≤ 1 kHz</td><td>± 1,5 %</td></tr>
<tr><td>> 1 kHz ≤ 5 kHz</td><td>± 2%</td></tr>
<tr><td>> 5 kHz ≤ 20 kHz</td><td>± 3%</td></tr>
<tr><td>> 20 kHz</td><td>± 5%</td></tr>
<tr><td rowspan="2">> 1000V</td><td>a.s ≤ 20 kHz</td><td>± 3%</td></tr>
<tr><td>> 20 kHz</td><td>± 5%</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>現在</td><td></td><td></td></tr>
<tr><td rowspan="4">≤ 5 A</td><td>a.s ≤ 60 Hz</td><td>± 1,5 %</td></tr>
<tr><td>> 60 Hz ≤ 5 kHz</td><td>± 2,5 %</td></tr>
<tr><td>> 5 kHz ≤ 20 kHz</td><td>± 3,5 %</td></tr>
<tr><td>> 20 kHz</td><td>± 5%</td></tr>
<tr><td rowspan="3">> 5 A</td><td>a.s ≤ 5 kHz</td><td>± 2,5 %</td></tr>
<tr><td>> 5 kHz ≤ 20 kHz</td><td>± 3,5 %</td></tr>
<tr><td>> 20 kHz</td><td>± 5%</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="4">抵抗</td><td>1 mΩ ≤ 100 mΩ</td><td>± 5%</td></tr>
<tr><td>> 1 mΩ ≤ 100 TΩ</td><td>± 5%</td></tr>
<tr><td>> 1 TΩ</td><td>± 10%</td></tr>
<tr><td>その他の場合</td><td>± 3%</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="3">温度</td><td>≥ -35°C < 100°C</td><td>± 2° C</td></tr>
<tr><td>100°C ≤ 500°C</td><td>± 3%</td></tr>
<tr><td>< -35°C</td><td>± 3° C</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="3">時間</td><td>10 ms ≤ 200 ms</td><td>± 5%</td></tr>
<tr><td>>200 ms ≤ 1 s</td><td>± 10 ms</td></tr>
<tr><td>> 1 s</td><td>± 1%</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="3">リニア寸法</td><td>≤ 1 mm</td><td>± 0.05 mm</td></tr>
<tr><td>> 1 mm ≤ 25 mm</td><td>± 0.1 mm</td></tr>
<tr><td>> 25mm</td><td>± 0,5%</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>相対湿度</td><td>30% ≤ 95% RH</td><td>±6 %RH</td></tr>
</table>
</td><td>
<table>
<tr><th>パラメータ</th><th>レンジ</th><th>測定精度</th></tr>
<tr><td>電圧</td><td></td><td></td></tr>
<tr><td rowspan="4">≤ 1.000 V</td><td>≤ 1 kHz</td><td>± 1,5 %</td></tr>
<tr><td>> 1 kHz ≤ 5 kHz</td><td>± 2 %</td></tr>
<tr><td>> 5 kHz ≤ 20 kHz</td><td>± 3 %</td></tr>
<tr><td>> 20 kHz</td><td>± 5 %</td></tr>
<tr><td rowspan="2">> 1.000 V</td><td>AS ≤ 20 kHz</td><td>± 3 %</td></tr>
<tr><td>> 20 kHz</td><td>± 5 %</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>現在</td><td></td><td></td></tr>
<tr><td rowspan="4">≤ 5 A</td><td>AS ≤ 60 Hz</td><td>± 1,5 %</td></tr>
<tr><td>> 60 Hz ≤ 5 kHz</td><td>± 2,5 %</td></tr>
<tr><td>> 5 kHz ≤ 20 kHz</td><td>± 3,5 %</td></tr>
<tr><td>> 20 kHz</td><td>± 5 %</td></tr>
<tr><td rowspan="3">> 5 A</td><td>AS ≤ 5 kHz</td><td>± 2,5 %</td></tr>
<tr><td>> 5 kHz ≤ 20 kHz</td><td>± 3,5 %</td></tr>
<tr><td>> 20 kHz</td><td>± 5 %</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="4">抵抗</td><td>1 mΩ ≤ 100 mΩ</td><td>± 5 %</td></tr>
<tr><td>> 1 mΩ ≤ 100 TΩ</td><td>± 5 %</td></tr>
<tr><td>> 1 TΩ</td><td>± 10 %</td></tr>
<tr><td>その他の場合</td><td>± 3 %</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="3">温度</td><td>≥ -35°C < 100°C</td><td>± 2 °C</td></tr>
<tr><td>100°C ≤ 500°C</td><td>± 3 %</td></tr>
<tr><td>< -35 °C</td><td>± 3 °C</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="3">時間</td><td>10 ms ≤ 200 ms</td><td>± 5 %</td></tr>
<tr><td>> 200 ms ≤ 1 s</td><td>± 10 ms</td></tr>
<tr><td>> 1 s</td><td>± 1 %</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="3">リニア寸法</td><td>≤ 1 mm</td><td>± 0.05 mm</td></tr>
<tr><td>> 1 mm ≤ 25 mm</td><td>± 0.1 mm</td></tr>
<tr><td>> 25mm</td><td>± 0,5 %</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>相対湿度</td><td>30% ≤ 95% RH</td><td>±6% RH</td></tr>
</table>
</td></tr>
<tr><td>Dimensional Measurement</td><td>
<table>
<tr><th>バッテリーパックサイズ (mm)</th><th>公差 (寸法限界) (mm)</th></tr>
<tr><td><10</td><td>±0.5</td></tr>
<tr><td>≥10, <100</td><td>±2.0</td></tr>
<tr><td>≥100, <500</td><td>±5.0</td></tr>
<tr><td>≥500</td><td>±10.0</td></tr>
</table>
</td><td>Dimensional measurements shall be made using calibrated measuring instruments. Length, height, and width must meet battery pack size requirements.</td></tr>
</table>

Main Item	2020 Edition	2023 Edition
Voltage measurement	Voltage measurements are made with a voltmeter calibrated according to the tolerances in section 5.1.	The nominal voltage shall meet the requirements of the table. Tests shall be conducted using calibrated test equipment in accordance with the parameter measurement accuracy in Section 5.1.
Capacitance measurement	Battery capacity test in accordance with ISO 18243.	The maximum mass of the battery shall meet the requirements. Tests shall be performed using calibrated test equipment in accordance with the parameter measurement accuracy in clause 5.1. The minimum energy capacity must meet the requirements. Battery energy capacity testing is performed at room temperature (25±2) C in accordance with SNI 9102: 2022 Section 7.1.
Verification of battery connector	Verification of connectors is done by matching the design with information and technical documentation provided by the manufacturer.	Verification of the battery connector is done by checking if the design matches the information and technical documentation provided by the manufacturer.
Verification of communication protocols	Verification of the communication protocol and/or its adapter (if provided by the manufacturer) is done by matching the design with the information and technical documentation provided by the manufacturer.	-

Source: Prepared by the survey team

APPENDIX 4 LIST OF EQUIPMENT NEEDS FOR TESTING OF ELECTRIC MOTORCYCLE BATTERIES

Table 4-1 List of equipment needs for testing of electric motorcycle batteries

Reference Standard of ISO 18243 (SNI 8872:2019, SIN 8927:2020, and SNI 9102:2022)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
1.	• 6.1 Pre-conditioning cycles • 6.2 Standard cycle • 6.2.2.2 Standard discharge • 6.2.2.3 Standard charge • 7.1 Energy and capacity at Room Temperature • 7.2 Energy & capacity at different temperature and discharge rates • 7.3 Power & internal resistance • 7.4 No load State Of Charge loss • 7.5 State Of Charge loss at storage • 7.6 Cycle	Battery tester	•Programmable automatic charge-discharge tester & cycler. •3 channels. •Electrically isolated. •Voltage max 300 VDC. •Output power 60 kilo-Watt at 300 VDC. •Output current ±600 A at 100 VDC. •Current rise time < 2 mili-second. •Voltage measurement accuracy ± 0.1% FS (full scale) at 300 VDC. Current measurement accuracy ± 0.1% FS (full scale) at ± 600 A. •Sampling rate 10 ms, or better. •High voltage cables, connectors, and sockets housing. •Testing parallel and independent each Device Under Test in chamber. •Low voltage cables, connectors, and sockets housing. •Testing parallel and independent each Devices Under Test in chamber. •Active and passive overcurrent protection, short circuit protection and in-rush current protection. •Capable of continuing test after electrical shutdown or disturbances. Take note in history. Send notification to operator on-line. •Calibrated. **•Three Phase Power Supply required.**	Total of 40 Billions for Equipment No. 1, 2, 3, and 4 (Performance test)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
2.	• 6.1 Pre-conditioning cycles • 6.2 Standard cycle • 6.2.2.2 Standard discharge • 6.2.2.3 Standard charge • 7.1 Energy and capacity at Room Temperature • 7.2 Energy & capacity at different temperature and discharge rates • 7.3 Power & internal resistance • 7.4 No load State Of Charge loss • 7.5 State Of Charge loss at storage • 7.6 Cycle	Test Chamber	• Programmable climatic cycles. • Interior volume min. 0.8 m^3. • Three racks of Device Under Test. • Support total Device Under Test weight up to 200 kg. • Support effectively with maximum Device Under Test load for temperature of testing range -20 ℃ to 40 ℃. • Testing temperature changing rate from -20 ℃ to 40 ℃ (vice versa) is 2 K/minute, or better. • Temperature deviation ± 0.2 K, or better. Temperature homogeneity ± 0.3 K, or better. Temperature accuracy ± 0.2 K at testing range, or better. • EUCAR hazard level 6, or better. Flooding system. • Safety fireproof interlock system. • Overpressure protection (burst disc) & overpressure outlet. • Gas sensors (CO, CO_2, H_2, HC, H_2S, O_2) • Smoke detection. Nitrogen purging & inertisation. Fire detection and alarm. Certified EN 54 or equivalent. • Cut-off testing, on-line notification, and alarm when hazard occur. • Water spray system & water inlet, valves & piping. Water outlet for drain. • Venting gas high temperature. • Valve air, gas, and water system. • Isolated Input/Output data acquisition panel/connection/module (any measurements). • High grade steel corrosion resistance chamber. • Test Chamber comply with Directive 1999/92/EC and 2014/34/EU ATmostphère Explosible (ATEX). • Calibrated. • **Three Phase Power Supply required.**	Total of 40 Billions for Equipment No. 1, 2, 3, and 4 (Performance test)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
3.	• 6.1 Pre-conditioning cycles • 6.2 Standard cycle • 6.2.2.2 Standard discharge • 6.2.2.3 Standard charge • 7.1 Energy and capacity at Room Temperature • 7.2 Energy & capacity at different temperature and discharge rates • 7.3 Power & internal resistance • 7.4 No load State Of Charge loss • 7.5 State Of Charge loss at storage • 7.6 Cycle	Integration system	• Hardware integration network (electrical power and bus signal/data), racks & cabinet. • Integration software, test automation and control system, configuration, system management, simple and complete user interface, data presentation/graphic & reporting. • Test profile emulation, algorithms & diagnostic. • Data acquisition, data logging, measurement system & real-time monitoring. • Software development environment & library for customization. • System protection and electrically isolated. • Plug & play hardware (machine/instrument/modules/electronics) detection and installation. • On-line calibration tools. Parameter setting tool. History of tests. Database. Data comparation from database. Data comparation between data in database and real-time testing. Mathematical formula calculation for power, capacity, internal resistance, energy efficiency (round-trip) & State Of Charge. • Driver software for devices and communication. • Security and access log. • Software updates and license. • Communication system to any DUT by CAN bus & others. • Capable of integration Add-on user's library for communication. • Calibrated system. • Three Phase Power Supply required.	Total of 40 Billion for Equipment No. 1, 2, 3, and 4 (Performance test)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
4.	• 6.1 Pre-conditioning cycles • 6.2 Standard cycle • 6.2.2.2 Standard discharge • 6.2.2.3 Standard charge • 7.1 Energy and capacity at Room Temperature • 7.2 Energy & capacity at different temperature and discharge rates • 7.3 Power & internal resistance • 7.4 No load State Of Charge loss • 7.5 State Of Charge loss at storage • 7.6 Cycle	Supporting units and Additional feature for Equipments No. 1, 2, and 3	• Temperature sensors up to 1000 VDC of electric isolation, shielded, isolated, open-ended, accuracy ± 0.2 K at testing range, or better. Temperature measurement range -20 °C to 150 °C. Data acquisition module and connected to integrated system. • Integrated system is capable of automatically resume/continue testing after blackout of Mains from electric Grid. • Reporting: current, voltage, ambient temperature, Device Under Test temperature, discharge capacity, average power, energy, charge capacity, energy round-trip efficiency, discharge energy as function of SOC, end-of-discharge-voltage (EODV) of each cell (data obtained by Battery Management System), calculation of resistance and power according to Table 6 ISO 18243. • Mandatory function to test ISO 18243 clause: 6.1, 6.2, 6.2.2.2, 6.2.2.3, 7.1, 7.2, 7.3, 7.4, 7.5 & 7.6. Adapter for user's cooling system. Capable of controlling Device Under Test cooling system as customer's request. • Universal bus communication (programmable and adapted user's procedures), interconnection and communication protocol with battery control unit (BCU) of Device Under Test. • Computer set with Intel Core i5 Gen-11, RAM 2x8 GB, VGA 4 GB. • Monitor Flat 34inch bezel-less height adjustment tilt swivel stand, • HD 1 TB, HDMI. Keyboard & noise-less wireless mouse. Wireless • internet networking/Wi-Fi & Bluetooth. On-line/Wi-Fi printer. • Licensed software office related such as Office, Windows 10, Acrobat Reader, internet browsers, licensed antivirus. • Diagnostic of electrical supply stability & supply required. • Uninterrupted Power System 1500 VA for computer set and control devices.	Total of 40 Billions for Equipment No. 1, 2, 3, and 4 (Performance test)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
5.	• 7.4 No load State Of Charge loss • 7.5 State Of Charge loss at storage	Independent Oven chamber 2 units for storage tests	• Non-convective oven chamber. • Temperature setting & timer-alarm. Interior volume min. 0.3 m3. • Support for temperature of testing up to 70 °C. • Temperature deviation ± 0.3 K. • Temperature homogeneity ± 0.5 K. • Safety fireproof interlock system. • Fire detection, alarm, and exhaust smoke/gas. • High grade steel corrosion resistant oven. • Calibrated.	Total of 35 Billion for Equipment No. 5, 9, 10, 14 and 15 (Environmental test)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
6.	• 8.1 Vibration	Vibration testing machine	• Device Under Test load: 250 kg. • Programmable sequence of tests (sine, random, shock). • Single axis electrodynamic vibration generator/shaker (these system performances below are included table mounting fixture and 300 kg DUT): ➢ Frequency range 5 Hz - 2500 Hz. ➢ Sinusoidal waveform mode. Swept sine. Random motion mode. Shock mode. ➢ Maximum displacement: sine 51 milli-meter (peak-to-peak). ➢ Force sine 22 kilo-Newton. Force random 22 kilo-Newton (rms). ➢ Maximum acceleration: sine 1000 m/s^2, random 600 m/s^2 (rms). Maximum velocity: sine 2.0 m/s. ➢ Close-loop control of power spectral density (PSD) for random mode. PSD multi-random control dynamic range more than 90 dB. ➢ Fire-proof shaker. Withstand Device Under Test burned. • Capable of logarithmic sweep from 7 Hz – 200 Hz and back to 7 Hz traversed in 15 minutes. Repeating cycles program. • Capable of PSD 0.03 $((m/s^2)2/Hz)$ at all frequency range, or better. • Using high grade corrosion resistant steel. • Computer controller, display and controller hardware. Software control. Windows 10. Licensed Office. Licensed anti-virus. Online/Wi-Fi___33 ethernet printer • Calibrated. Comply with ISO 5433. • Mounting accessories and tools. Installation, foundation, electrical connection and supporting equipment. • **Three Phase Power Supply required.**	Total of 40 Billion for Equipment No. 1, 2, 3, and 4 (Performance test)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
7.	• 8.2 Mechanical shock	Mechanical shock tester	• Device Under Test load: 250 kg. • Programmable sequence of tests. • Programmable controlling combination of peak acceleration & shock pulse duration. • Acceleration range (at 300 kg): 10 g – 300 g (3000 m/s^2) with shock pulse 6 milli-second, or better. • Capable of testing for DUT up to 12 kg, half-sine shock of peak acceleration 150 gn. Shock pulse duration of 6 milli-second. • Capable of testing for DUT up to 200 kg, half-sine shock of peak acceleration 50 gn. Shock pulse duration of 11 milli-second. • Fire-proof shock machine. Withstand DUT burned. • Using high grade corrosion resistant steel. • Computer controller, display and controller hardware. Software control. Windows 10. Licensed Office. Licensed anti-virus. • Mounting accessories and tools. Installation, foundation, electrical connection and supporting equipment. • Calibrated. • **Three Phase Power Supply required.**	Total of 30 Billion for Equipment No. 6, 7, 8, and 11 (Mechanical equipments)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
8.	• 8.3 Drop	Drop machine	• Concrete floor 1.5 m (Width), 1.5 m (Length). • Minimum class III concrete K-500. • Inspected by certified building inspector. • Steel barrier surrounding drop area. • Measuring tape stand. • Drop machine. Maximum load 300 kg. • Fire extinguisher. Water fire spray.	Total of 30 Billion for Equipment No. 6, 7, 8, and 11 (Mechanical equipments)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
9.	• 8.4 Thermal shock (cycle)	Thermal shock chamber	• Programmable temperature cycles. Interior volume min 0.3 m^3. Maximum Device Under Test 220 kg. • Support for temperature of testing range - 40 °C to 85 °C. • Support for air temperature changing rate between - 40 °C & 85 °C is 5 K/minute, or better. • Temperature deviation ± 0.3 K, or better. • Temperature homogeneity ± 0.5 K, or better. • EUCAR hazard level 6, or better. Flooding system. Safety fireproof interlock system. Overpressure protection (burst disc) & overpressure outlet. Gas sensors (CO, CO_2, H_2, HC, H_2S, O_2). Smoke detection. Fire detection and alarm. • Certified EN 54 or equivalent. Water spray system. • Venting gas temperature up to 600 K, or better. Valve air, gas, and water system. • Nitrogen gas purging & interstation. • High grade steel corrosion resistant chamber. • Test Chamber comply with Directive 1999/92/EC and 2014/34/EU ATmostphère EXplosible (ATEX). • Calibrated. • **Three Phase Power Supply required.**	Total of 30 Billion for Equipment No. 6, 7, 8, and 11 (Mechanical equipments)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
10.	• 8.7 Overtemperature condition	Oven chamber	• Programmable oven chamber. • Convective oven. • Interior volume min 0.3 m^3. • Maximum Device Under Test 200 kg. • Support for temperature of testing up to 85 °C. • Temperature deviation ± 0.3 K, or better. • Temperature homogeneity ± 0.5 K, or better. • Safety fireproof interlock system. • Overpressure protection & overpressure outlet • Smoke detection • Fire detection and alarm. Certified EN 54 or equivalent. • Cut-off testing and alarm when hazard occur. • Charge-discharge controller panel/connection. • Connection to charge-discharge cycler. • High grade steel corrosion resistant chamber. • Calibrated.	Total of 35 Billion for Equipment No. 5, 9, 10, 14 and 15 (Environmental test)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
11.	• 8.6 Fire resistance	Fire resistance test set-up	• Fire extinguisher. • Water spray firefighting unit. • Fire pan: 310 mm (W), 445 mm (L), 100 mm (H). • Screen for fire protection according to Figure B.1 ISO 18243. • Screen refractory material should have parameters according to Annex B ISO 18243. • Motor controlled test rail (Device Under Test fixture, screen, fire pan). • Test space: 1000 mm (L), 1000 mm (W). • Maximum load 300 kg. • Distance between fuel and Device Under Test can be adjusted. • Outdoor test. • Digitally controlled. 	Total of 30 Billion for Equipment No. 6, 7, 8, and 11 (Mechanical equipments)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
12.	• 8.8 Shot-circuit protection	Large current battery short circuit test device	• Large current battery short circuit test device. • Positive & negative terminals of battery pack are short-circuited (S/C). Test is conducted at room temperature. • Short-circuit unit: ➢ Unit 1: Resistance of S/C connection (including wiring) used to create S/C should between 10 milli-Ohm to 20 milli-Ohm. ➢ Unit 2: Resistance of S/C connection (including wiring) used to create S/C should less than 5 milli-Ohm. • DC high-speed breaker. Circuit resistance measurement unit. • 5 channels DUT temperature measurement. • High speed voltage and current short-circuit measurement. • Current sampling rate 0.1 milli-second, or better. Maximum voltage and maximum current measured. Calculated S/C connector resistance by measured max voltage & max current. Graphical data presentation. • Maximum current 24 kilo-Ampere. • Calibrated. • Remote control operation by computer and remote control. • Remote test breaking. • Explosion-proof cabinet min 0.3 m^3, with camera. Smoke exhaust. • Smoke alarm system. Explosion protection system. Overcurrent protection and breaking. Maximum Device Under Test 200 kg. • Mechanism to avoid spark at S/C. • Data acquisition and computer set. • **Three Phase Power Supply required**	Total of 10 Billion for Equipment No. 12 and 13 (Electrical safety test)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
13.	• 8.9 Overcharge protection • 8.10 Overdischarge protection	Charge and Electronic load	• Charger: ➢ 1 channel. Electrically isolated. Voltage max 300 VDC. ➢ Power 60 kilo-Watt at 300 VDC. ➢ Output current 600 A at 100 VDC. ➢ Voltage measurement accuracy ± 0.1% FS (full scale) at 300 VDC. Current measurement accuracy ± 0.1% FS (full scale) at 600 A. ➢ Sampling rate 10 ms, or better. ➢ Active and passive overcurrent protection, short circuit protection and inrush current protection. • Electronic load: ➢ 1 channel. Electrically isolated. Voltage max 300 VDC. ➢ Power 60 kilo-Watt at 300 VDC. ➢ Output current 600 A at 100 VDC. ➢ Voltage measurement accuracy ± 0.1% FS (full scale) at 300 VDC. Current measurement accuracy ± 0.1% FS (full scale) at 600 A. ➢ Sampling rate 10 ms, or better. ➢ Active and passive overcurrent protection, short circuit protection and inrush current protection. • Explosion-proof chamber/cabinet min 0.3 m3 with camera. Smoke exhaust. Smoke alarm system. • Maximum Device Under Test 220 kg. • 5 Temperature sensors up to 1000 VDC of electric isolation, shielded, isolated, open-ended, accuracy ± 0.2 K at testing range, or better. Temperature testing range -20 ˚C to 150 ˚C. Data acquisition module and connected to computer set. • Calibrated. • **Three Phase Power Supply required.**	Total of 10 Billion for Equipment No. 12 and 13 (Electrical safety test)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
14.	• 8.11 Dewing	Climatic chamber	• Programmable climatic (temperature & humidity) cycles. • Support testing profile according to Figure 4 ISO 18243. • Interior minimum 0.3 m^3. • Maximum Device Under Test 300 kg. • Support for temperature of testing range 5 °C to 85 °C. • Temperature change rate 4 K/minutes. • Temperature deviation ± 0.3 K, or better. • Temperature homogeneity ± 0.5 K, or better. • Temperature accuracy ± 0.3 K at testing range, or better. • Humidity range 40% to 98% RH. • Humidity deviation ± 0.5 %, or better. • Accuracy at 80 °C is ± 1.7% RH, or better. • High grade steel corrosion resistant chamber. • Calibrated. • **Three Phase Power Supply required.**	Total of 35 Billion for Equipment No. 5, 9, 10, 14 and 15 (Electrical safety test)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
15.	• 8.12 Salt spray	Salt spray unit	• Test temperature 35 ^{0}C ± 1 ^{0}C. • Container 1.0 m3. • Salt water condition 5 ±1% NaCl aqueous solution. • Test time: 16, 24, 48, 96, 168, 336, or 672 hours. • Salt mist rate 1.5 milli-liter/hour ± 0.5 milli-liter/hour at 80 cm^2. • Maximum Device Under Test 200 kg. • Supporting test standard IEC 60068-2-52, at least with a severity level of 3. • **Three Phase Power Supply required.**	Total of 35 Billion for Equipment No. 5, 9, 10, 14 and 15 (Environmental test)

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
16.	• Insulation resistance	Programmable digital Insulation resistance tester	• 1000 V test voltage. Resolution 1 V. High speed 50 ms, 24bits. Accuracy ± 2% rdg. ±5 dgt at 25 V-100V & 20 Mega-Ohm. • Internal memory. LCD Display. Test cables & lead. 4-wire contact check. Comparator contact check. Short-circuit check. Contact check function. Data cable. • Calibrated.	Total of 10 Billion for Equipment No. 16 until 24 (General test and support)
17.	• General support	Thermal imaging camera	• Infra-Red resolution 128x96 pixels thermal sensors. • Thermal sensitivity < 70 mK. • Accuracy 0°C -100°C ± 3K. • Digital camera 5 MP resolution. • Display IPS touchscreen 640 x 480 pixels. • Image mode infrared image, visual image, MSX, picture-inpicture. • Software for computer. • Cloud connectivity	
18.	• General support	Testing room monitoring/ambient	• Environment recorder 15 ~ 30°C; 20 ~ 70% RH. Resolution 0.1 °C and 1% RH. Wireless connection. Data log & memory. LCD display.	
19.	• General support	Battery weight measurement	• Digital scale 20 kg and 300 kg.	
20.	• General support	Battery dimension	• Measuring tape and caliper	
21.	• General support	Safety storage cabinet for sample	• Metal insulated cabinet. Using high grade corrosion resistance steel. • Insulation layer to prevent short circuit of DUT. • 12 compartments. Volume of each compartment is 0.8 m^3. • Maximum Device Under Test load of each compartment is 220 kg. • Temperature monitoring at each compartment. • Safety explosive-proof door each compartment. • Exhaust fan, fire extinguisher, smoke sensors, temperature sensors, flooding system at each compartment. On-line monitoring. • On-line notification to smartphone, alarm protection system.	
22.	• General support	Computer set, network & IP Camera	• Hardware and software for on-line monitoring storage cabinet & room conditions. Calibrated. Its software connectivity to smartphone Android for on-line monitoring. Update-able. Licensed. • Computer set with Intel Core i5 Gen-11, RAM 2x8 GB, VGA 4 GB. Monitor Flat 34inch bezel-less height adjustment tilt	

No.	Clause and parameter	Name of equipment	Specification requirement	Cost estimation in Indonesian Rupiah
			swivel stand, HD 1 TB, HDMI. Keyboard & noise-less wireless mouse. Mini WebCam. Mini PC active speakers. Wireless internet networking/Wi-Fi & Bluetooth. • Licensed software office related such as Office, Windows 11, Acrobat Reader, internet browsers, licensed antivirus. • On-line/Wi-Fi ethernet printer-scanner-copier-fax. Max printing resolution 5760x1440 dpi bi-directional printing. Optical resolution 1200x2400 dpi. • 4 units IP camera wireless, full color with night vision, access point mode, digital zoom, Wi-Fi 2.4G, NVR, memory on-board card-slot up to 256 GB, connectivity to smartphone Android. • Smart-UPS 1500 VA, 900 Watts, software. Output voltage distortion < 5%. Lead acid battery. Surge protection 459 J. Stabilizer. Pure sine wave output. Input 230V/output 230 V. Network/serial connection & USB.	
23.	General support	Diesel electric generator	• Diesel electric generator 100 KVA 3-phase, alternating current 50 Hz support. • Output power 80 kW at maximum load (measurement test load at B4T). • Automatic-digital quick response starter when blackout/Grid disconnected & automatic shutdown when grid connected. • Outdoor housing extra super silent with non-flammable noise suppression acoustic foam. • Level of noise is less than 68 decibels at 3 meters. Silencer hospital type. • Weatherproof. • Balanced intake & exhaust. • Ease of checking and maintenance. • Corrosion resistant housing plat. • Voltage, current, heat & fuel monitoring. • SMS sending message & internet monitoring system. • Automatic fuel pump control. • Overload & unbalanced power protection.	
24.	• General support	General supply and requirement	• Electrical supply. Water supply for safety. Gas N_2 supply. Grounding. • All equipment shall comply with Indonesia electric supply requirement	

APPENDIX 5 CASE STUDY ON INDIA, VIETNAM, AND THAILAND

JICA Survey Team planned to conduct case studies in India, Vietnam, and Thailand, and to refer the results of these case studies in the future when determining the standards for Swappable Battery in Indonesia. These three countries, like Indonesia, are currently in the process of determining the standards for interchangeable batteries, and all are aiming to become future Asian sales bases for electric motorcycles.

Since the Ministry of Industry had targeted that the standardization of swappable batteries in Indonesia would be implemented by the end of 2023, JICA Survey Team was re-commissioned to conduct the India and Vietnam case studies as soon as possible after receiving the order for this Survey[2]. As for Thailand survey, the JICA Survey Team directly managed the survey by March 2024, since the interest of the Indonesian side was not as high as that of the other two countries.

Mr. Ashim Sharma, a partner of NRI India, was invited to the first Workshop with the Ministry of Industry (July 2023) to report the results of the survey comparing the situation in India and Vietnam with that in Indonesia. JICA Survey Team was also asked to report on the results at the International Battery Summit (IBS) organized by the NBRI, which was achieved in August 2023 in front of an audience of over 200 people.

The comparison of the four countries including Indonesia is shown, focusing on Indonesia's competitive advantage[3].

5.1 Indonesia’s Advantages from the Perspective of Other Countries’ Cases

Indonesia is well positioned to adopt electric motorcycles on a large scale and at the same time secure an important position in the manufacturing value chain for such products. The reasons for this are analyzed below.

[2] The project was re-commissioned to NRI India.

[3] For a detailed comparative analysis of the three countries, see "Appendix 5: Presentation Materials at the International Battery Summit" at the end of this volume.

(1) Indonesia's 2W market is the third largest in the world, rivaling India and Vietnam in terms of 2W market share.

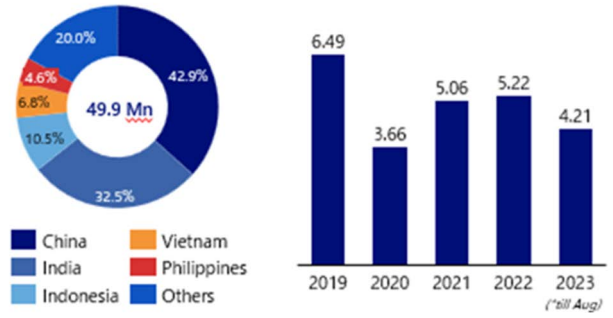


Figure 5.1 Motorcycle production share (left) and sales volume in Indonesia (right)

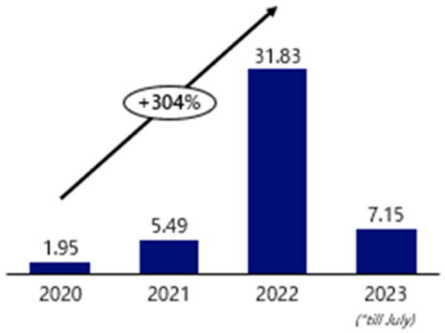


Figure 5.2 Sales of Electric Motorcycles in Indonesia

- Indonesia is currently the world's third largest 2W market, with an average of more than 5 million vehicles sold over the past 10 years (see Figure 5.1).
- Motorcycles are the primary mode of transportation in Indonesia, accounting for more than 85% of vehicle sales. However, sales of electric motorcycles are currently limited, with a penetration rate of less than 1%.
- Conversion programs from ICE to electric motorcycles have also been initiated, but have been virtually unsuccessful due to high costs and low customer confidence.
- After the COVID-19 pandemic, there has been a sharp recovery and sales are expected to reach pre-pandemic levels in a few years (see Figure 5.2).
- More than 90% of electric motorcycles sold in Indonesia are powered by advanced lithium batteries.
- A comparison of the market and customer preference status of electric motorcycles in the four countries is organized in the Table 5-1 below.

Table 5-1 Comparison of Electric Motorcycle Markets and Customer Preferences in the Four Countries

	INDIA	*VIETNAM*	*THAILAND*	*INDONESIA*
Share of 2W sales	2Ws make up around **~71%** share in total automobile sales by units.	2Ws account for **~87.7%** share in total automobile sales by units.	2Ws account for **~85%** share in total automobile sales by units.	2Ws account for **~85%** share in total automobile sales by units.
e2W Sales Penetration (2022)	**~5%** **2023 sales = 926K units**	**~10%** **2023 sales =300K units**	**1.15%** **2023 sales = 22K units** (All EVs registered in Thailand are equivalent to L2)	**~1%** **2023 sales = ~62K units**
Preference for Li-ion batteries	**~95%** share of e2W's sold are using li-ion batteries.	**~60%** of e2W are powered by Lead Acid Batteries.	Almost 100% of e2W's sold are powered by li-ion batteries.	**~90%** of e2W's sold are powered by li-ion batteries.
Typical Daily Usage	Private: **50~60km** Commercial: **100~120km**	**Private: 20~30km** Commercial: **80~100km**	Private: **20-50km** Commercial: ave. **100-200kKm**	Private: **15-70km** Commercial: **100-200km**
e2W Fleet Maturity	Various companies are typing up with e2W manufacturers for fleet operations. E.g. Zypp electric utilizing Hero electric models, eBikeGo providing fleet for Zomato, Swiggy, etc.	Very limited cases (pilots) of fleet operators typing up with OEMs for e2W fleet. E.g. Gojek and Dat Bike, Baemin and Selex, etc.	In thailand, fleet partners are not involved in the commercial process, so it's up to the driver to decide whether to choose a battery-powered vehicle.Plug in type direct sales, swap battery is b2c for b: bike owned by driver used for business such as delivery ; if run 200km/ day EVbike will reach break even point in short term ; E.g. EV manufacturer Etran has partnered with ShopeeFood (food delivery) and Krungsri Bank to offer special rental prices to ShopeeFood riders; Swap-Go and 7-Eleven have partnered with SwapEV, etc. (swap market 10%, plug in hybrid ; 90%	Emerging scenarios of fleet operators utilizing e2W fleet. E.g. Gogoro and Gojek, Grab and Kymco, etc.

Low Medium High

Source: NRI Analysis, Secondary Research

Major global OEMs have already established a presence in Indonesia, and the supply chain for the ICE model is well established.

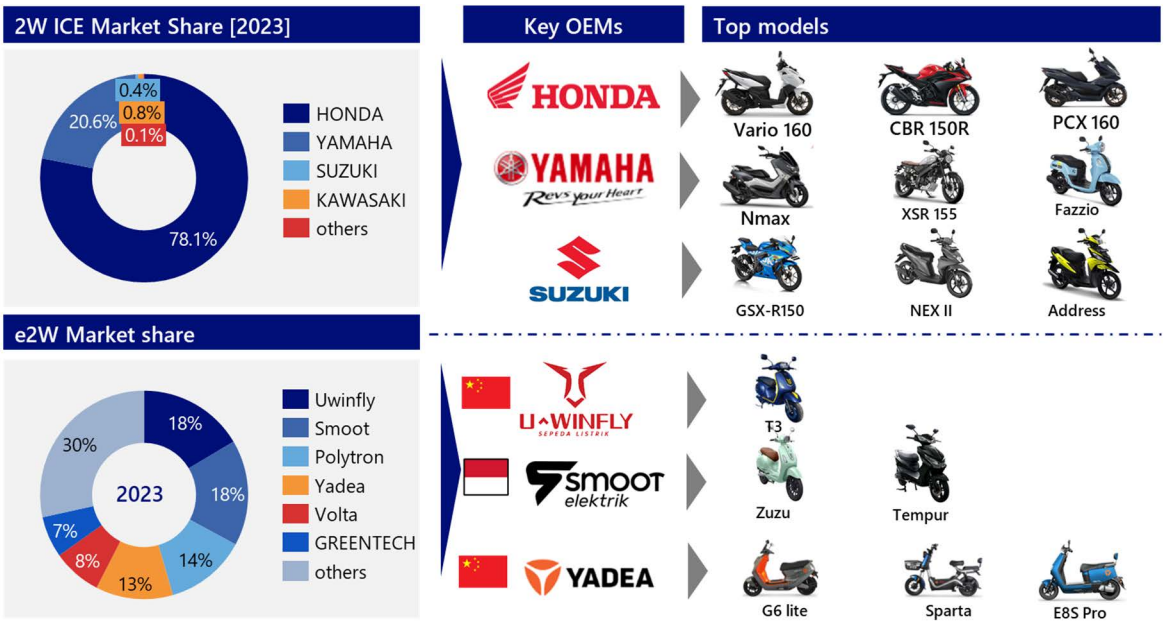


Figure 5.3 Market Share of Motorcycles and Electric Motorcycles in indonesia

- Honda and Yamaha have 94% share of the motorcycle market in Indonesia, and Gesits, a local EV brand, has over 50% share of the electric motorcycle market.

(2) Government policies and roadmaps for 2W electrification in Indonesia have been defined and published, and detailed action plans have been developed to achieve electrification targets.

Table 5-2 Government Support Measures Aimed at Stimulating Demand for Indonesia's Electric Motorcycle Industry

Policy Area	Description
National EV Roadmap	• Well defined EV Policy and roadmap; Regular Policy interventions since enactment of **Presidential Regulation No. 55/2019**
National Targets	• As per Indonesia's NDC*, **target of 1.8M and 13M e2W by 2025 and 2030 respectively**
Demand Side Incentives	• BEVs are exempted from sales tax on luxury goods (PPNBM[1]) • Exemption on title transfer & ownership fee (BBNKB[2]), vehicle tax (PKB[3]) will start in 2025 • **More fiscal incentives are required to bridge gap between EV and ICEV vehicles**
Supply Side Incentives	• Risk Weighted Assets for EV financing (Producing & buying) reduced from 75% to 50% • **Type Test Certification for E2W is 25 times cheaper than ICEV** • **7M rupiah (~$450) subsidy to manufacturers and retailers for every electric motorcycle sold and each converted to electric;** Covers 200,000 electric motorcycles and 50,000 conversion to electric ones
Charging Infrastructure Support	• As per National Grand Energy Strategy Indonesia, **~2,500 new Charging Stations required per year to meet target of 25,000 by 2030** • ~1400 Public Electric Vehicle Battery Exchange Stations (SPBKLU[4]) built for 2-wheelers • **~88% of the charging stations are located in Java and Bali,** need for more distributed deployment of charging stations
Recycling Enabler	• **End-of-life battery recycling measures and detailed roadmap for recycling ecosystem need to be developed**

1. Pajak penjualan atas barang mewah 2. Bea Balik Nama Kendaraan Bermotor 3. Pajak Kendaraan Bermotor 4. Stasiun Penukaran Baterai Kendaraan Listrik Umum

Source: IESR Indonesia, Secondary Research *Nationally Determined Contribution

Source: JICA Survey Team

A comparison of government policies and support for the promotion of electric motorcycles in the four countries are summarized in the following Table 5-3.

Table 5-3 A Four-Country Comparison of Government Regulations and Incentives Surrounding Electric Motorcycles

	INDIA	*VIETNAM*	*THAILAND*	*INDONESIA*
National EV Roadmap	Well defined EV policy and Roadmap.	No EV roadmap defined.	Well defined EV policy and Roadmap.	Well defined EV policy and Roadmap.
National Targets	80% of e2W sales penetration by 2030.	Defined EV penetrations targets, with 100% green transport network to be achieved by 2050.	Defined target of 360,000 units by 2025 and 675,000 units (30% of production) by 2030. In 2023, 22,000 motocycles sold vs target 80,000	By 2030: e2Ws shall outpace fossil units in newly sold units, target of 12 mn e2W (culumilative sales) in Indonesia by 2030.
Demand Side Incentives	Financial incentives, tax incentives and preferential access.	No incentives for e2W Import tax exemption for e4Ws.	Subsidy of 10,000* baht (reduced from 18,000 baht last year) for domestically produced vehicles* only. (year 2025, old models already registed UNR 136 Thailand introduces safety standards with 2-5 years time lag) (* already registered models can use 180,000 unitl 2025) (**Battery capacity of 3kwh, retail price of 150,000 baht or less)	Financial incentives(7million Rupiah subsidies) , tax incentives and preferential access.
Supply Side Incentives	Financial incentives, tax incentives, regulatory hurdle reduction and capability building.	No incentives for e2W Import tax exemption for e4Ws.	e2W corporate tax exemption (3 years: BOI's A4Status).	Low risk weightage of loans, CIT holiday, Import duty exemption.
Charging Infrastructure Support	Incentives for charging equipment procurement and setting up of charging stations, announced policy for industry standardization.	No support announced for development of charging infra.	Chargers: e2W corporate tax exemption (3~5 years) Swap station: A3 status in BOI (5 years)；no one invest for now.	Discount on electricity rates, relaxed credit score evaluation, standard for EV charging infrastructure, Battery swapping infrastructure, Battery swapping standards are under development as voluntary standards
Recycling Eneber	Buyback and scrappage incentives. Promotion for circular economy through EPR (extended producer's responsibility).	No support announced for li-ion battery recycling ecosystem development.	For measures to recycle used batteries, a subcommittee on ELVs has been formed under the National Electric Vehicle Policy Committee (NEVC). No specific law (setup a fine for not well managed) Battery recycling is currently under consideration by TESTA, TAI, ENTEC, and other government agencies.	End-of-life battery recycling measures; detailed roadmap for recycling ecosystem need to be developed.

Low Medium High

Source: NRI Analysis, Secondary Research

(3) Indonesia's ability to supply key raw materials such as nickel and cobalt is critical for the country to become a manufacturing hub for electric motorcycles, especially in the ASEAN region.

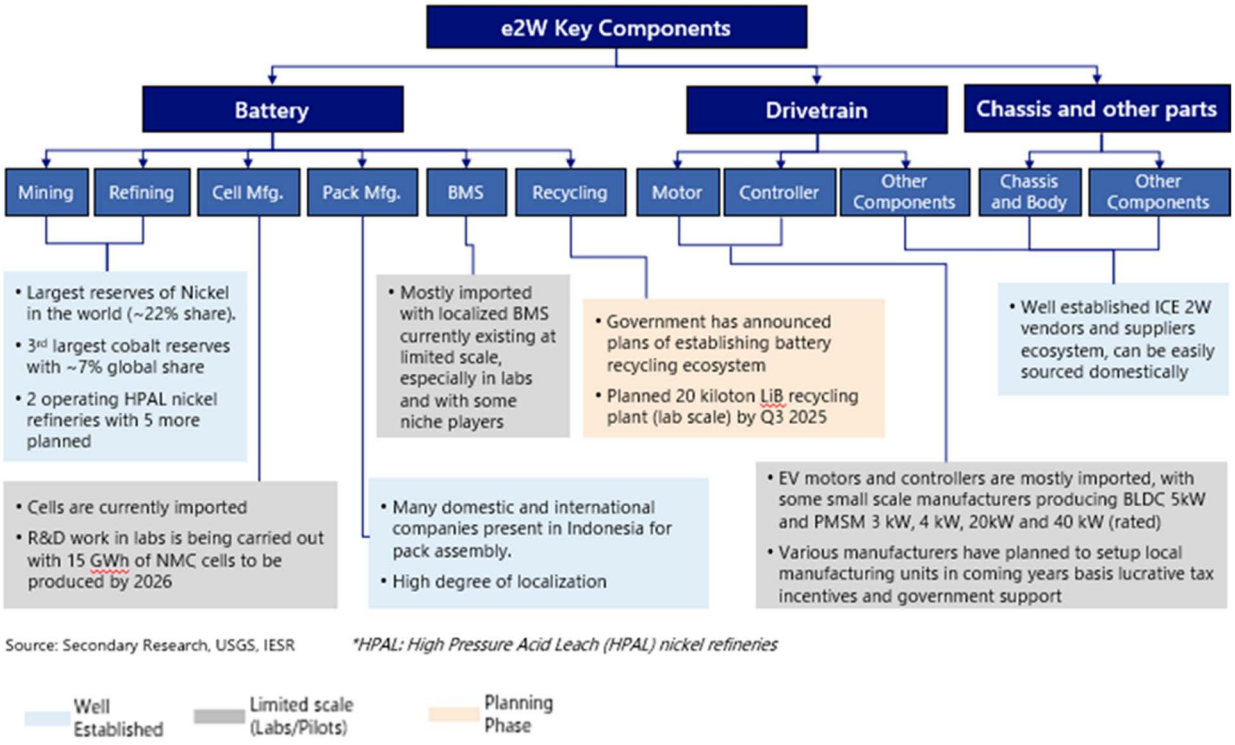


Figure 5.4 Ecosystem surrouding the electric motorcycle supply chain in Indonesia

Indonesia has an abundance of key raw materials needed for battery manufacturing and can leverage the supply chain for electric motorcycle components.

A comparison of the supply chain situation in the four countries is summarized in the Table 5-4 below.

Table 5-4 Four-country comparison of the supply chain surrouding electric two-wheelers

	INDIA	*VIETNAM*	*THAILAND*	*INDONESIA*
Raw Material Reserves	No significant reserves of Nickel, lithium or cobalt.	Abundant reserves of Nickel and Cobalt.	There are no significant reserves of Nickel and Cobalt. On the otherhand, there were recent reports of 15 million tons of lithium reserves in the south, but the government later revised downward.	Largest reserves of Nickel, Abundant copper and cobalt reserves.
Raw Material Mining and Processing	Very limited scale of Nickel and cobalt mining and processing. No lithium processing currently.	No mining is being done currently. Only one Nickel project being undertaken.	No mining is being done currently.	Established Nickel mining and processing industry.
Cell Manufacturing	Though currently imported, many companies are setting local cell manufacturing plants.	No cell manufacturing currently. Few players expected to start production in 5 years.	Cells are produced at Amita, a subsidiary of Energy Absolute (EA), but not for motorcycles. (production capacity 1 GWh)	Currently imported; domestic production expected by 2026.
Pack Manufacturing	Battery pack assembly mostly done in-house.	Battery packs usually imported, limited companies doing pack assembly in-house.	Battery packs usually imported. Brands such as Storm manufacture packs in-house. Currenlty battery import tariffs is high : imported from China and India	Battery packs usually imported, limited companies doing pack assembly in-house.
BMS	BMS developed in-house. Many players offering domestic solutions.	Mostly imported as part of battery pack.	Mostly imported as part of battery pack.	Mostly imported as part of battery pack.
Recycling Enabler	Li-ion battery recycling at limited scale, with GOI imposing EPR.	Li-ion battery recycling ecosystem needs to be developed.	Li-ion battery recycling ecosystem needs to be developed.	Li-ion battery recycling ecosystem needs to be developed.
Electric Motor & Controllers	Various companies manufacturing and supplying locally.	Mostly imported, very few domestic suppliers.	Mostly imported, very few domestic suppliers.; mainly imported from China	Mostly imported, very few domestic suppliers.

Low Medium High

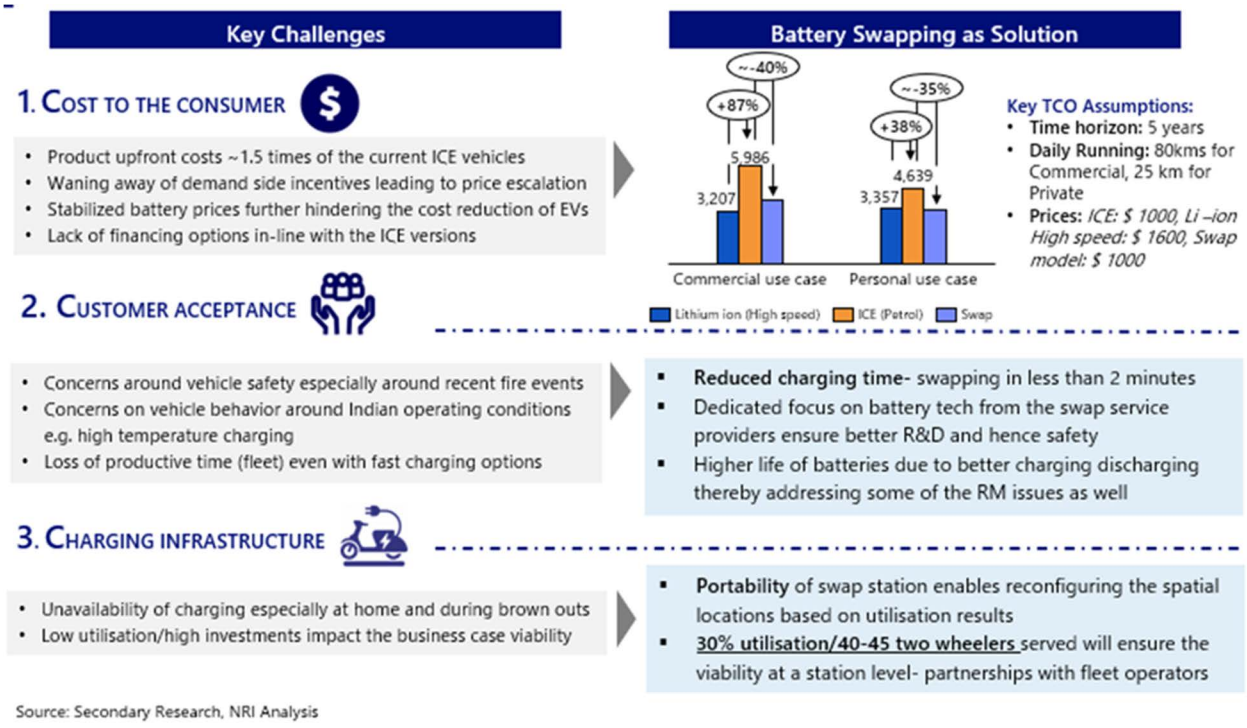
Source: NRI Analysis, Secondary Research

(4) Battery swapping for the fleet segment could help promote the penetration rate of electric motorcycles. Therefore, a fine balance of standardization and innovation needs to be struck for swapping batteries, and incentives need to be provided for swapping batteries on par with fixed battery models. Indonesia also needs to work with global players in swapping to implement best practices from around the world.

Source: NRI-India

Figure 5.5 Private Sector Players Related to Battery Swapping System

Charging infrastructure and battery swapping technology is still in its infancy and requires strategic deployment of chargers and standardization of batteries.



Source: JICA-Survey team & NRI-India

Figure 5.6 Issues Surrounding Battery Swapping System for Electric Motorcycles

Applying the experiences in India and Vietnam to Indonesia, it can be inferred from the above table that the following factors are important for the diffusion of electric motorcycles with interchangeable batteries: i) affordability for users, ii) awareness-raising activities regarding safety, and iii) development of charging stations.

A comparison of the state of electric motorcycle charging infrastructure in the four countries and a comparison of the state of battery swapping infrastructure in the four countries are organized in the Table 5-5 and Table 5-6 each, below.

Table 5-5 Comparison of the four countries regarding the development of battery charging facilities

	INDIA	*VIETNAM*	*THAILAND*	*INDONESIA*
Targets	One public charger within 3km x 3km grid in cities and one charging station every 25km and one fast charging station on every 100km on highways.	No clear goal. Some private companies have announced individual targets.	The Ministry of Industry's Bureau of Economy, Trade and Industry targets 8,000 charging stations for motorcycles and 1,450 for motorcycle cabs by 2030.	No clear goal. PLN needs 31,000 charging stations by 2030.
Installation Base	More than 6,800 public charging stations for more than 1.5 million e2Ws sold in the last 7 years.	Over 1,500 public e2W charging stations for 1mn+ e2W sold in last 4 years.	As of September 2023, approximately 300 public charging stations have been installed. HSEM and Niu(Winonnie around 200) Honda 40	Over 400 charging stations on more than 89,000 e2W units sold in the past 5 years.
Policy and Standards	Well defined standards for chargers and charging station setup. Adherence to charging sockets is not mandatory with OEMs using their proprietary chargers such as Ather, Ola Electric, etc.	No particular standards defined for setting up charging stations. Companies are relying on global standards for guidance.	Specific criteria for the installation of charging stations are not defined. The electrical connections of the stations are required to comply with the IEC standards set forth by the Electric Power Authority.	Ministry of Energy and Mineral Resources Regulation No.13/2020 establishes detailed requirements for changing stations.
Charging Business viability	Large number of players offering charging station facilities such as Ather Grid, Ola Electric, Etc.	Limited number of players such as VinFast, Eboost and Dat Bike providing charging station facilities.	Charging stations are mainly supplied for four-wheelers, with limited availability for two-wheelers.	Only a limited number of companies provide station facilities, and in Indonesia, the state-owned power company PLN has taken the lead in charging infrastructure development.
Grid Impact	99% of urban and 95% of rural households have electricity access. India is self-sufficient in electricity production. Low impact of e2W's.	Vietnam already has challenges in meeting the electricity demand. EV charging infra is expected to further aggravate the challenges.	Officials from the electric utilities (PEA and MEA) believe that the demand for charging batteries for electric two-wheelers has a low impact on the overall grid. PEA; Provincial Energy Authority MEA: Meropolitan Energy Authority TSTA ; Thailand Energy Storage Technology Association (TESTA)	Limited Impact. 4% impact on grid with expected e2W penetration by 2030.

Low Medium High

Source：JICA Survey Team

Table 5-6 Comparison of the four countries regarding the development of battery swapping stations

	INDIA	*VIETNAM*	*THAILAND*	*INDONESIA*
Growth of Swap Stations	High growth seen in battery swap stations being set up by key players: Sun Mobility – 240+ swap stations Battery Smart – 690+ swap stations Yulu (Yuma Energy) – 85+ swap stations	Very limited growth, with Selex setting up 50+ swap stations and pilot project by MO batteries. Vinfast discontinued swap station services in favor of rental services.	Swap stations are offered by WinnonieHonda, Hsem, Swap&Go, Etran, and others. The pace of growth in the number of stations is still slow due to the lack of significant growth in demand for EV bikes. Winnonie, which has the most, has 103 stations, and the scale of the swap station business in Thailand is still small.	Moderate growth, with over 1.401 swap stations setup by June 2023 State power company PLN is taking the lead by setting up SBPKLU swapping stations.
Interoperability Standards	BIS announced draft battery swapping standards for 4W EVs, with e2W consideration at later stages.	Ministry of Science and technology annouced battery standards for swappable battery iinteroperability standards	Currently, companies are using customized batteries. ENTEC, under the National Science and Technology Development Agency (NSDTA) of Thailand, is taking the lead in conducting an R&D project with EV motorcycle manufacturers and others to standardize swap battery packs, and plans to form the Swap Battery Consortium this year to establish standards.	Currently 9 standardization (SNI) on battery infrastructure of swappping/ charging infrastructures are under developmen, and mostly cater to models made by China
Swapping business viability	Large number of players offering battery swapping services such as Battery Smart, Sun Mobility, Yulu, Bounce Infinity, etc.	In initial stages of development, with very few players such as Selex and MO batteries in battery swapping space.	Thai motorcycle users traditionally demand high acceleration and power, and EV bikes are still not very popular. The price of EV is alomost double of ICE. Therefore, EV bikes remain mainly rental for fleet riders, and there is a need to improve the merchantability of the bikes and standardize swap batteries. Difficult to sell to buyers who buy as asset as EV bikes value drops faster than ICE: 40% down in 1	Battery swapping has picked up with increasing number of players such as Gogoro, Volta, Swap Energy, etc. offering battery swapping services.
Battery standards	Battery standards defined by Bureau of Indian Standards (BIS) on safety and performance in 2022	Battery standards for swappable batteries are defined.under 1057/QD-BKHCN on 27th May, 2024	The UNR 136 (safety) standard is already mandatory.for subsidized EV bikes	Battery standards are not defined: volunatry stadards :SNI 8928 for swappable battery revised in 2023

Low Medium High

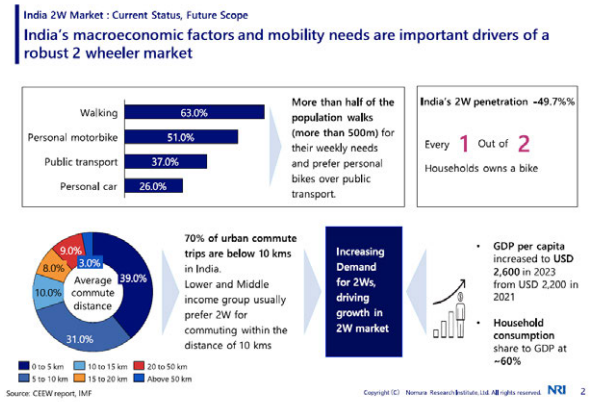
5.2 Case study in India, Vietnam, and Thailand

The case studies for the above three countries are summarized below.

India (1)

1

2



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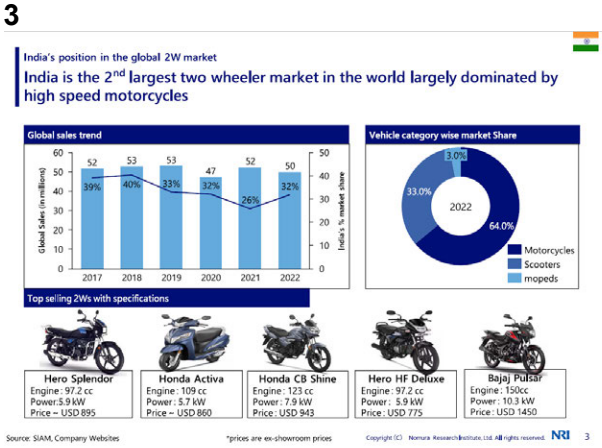

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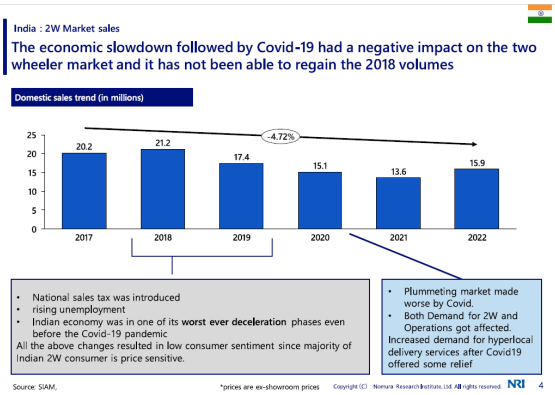

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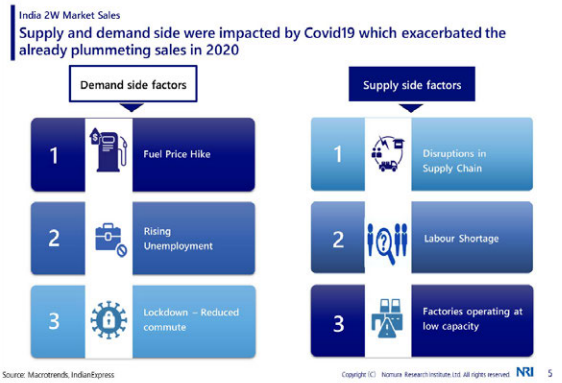

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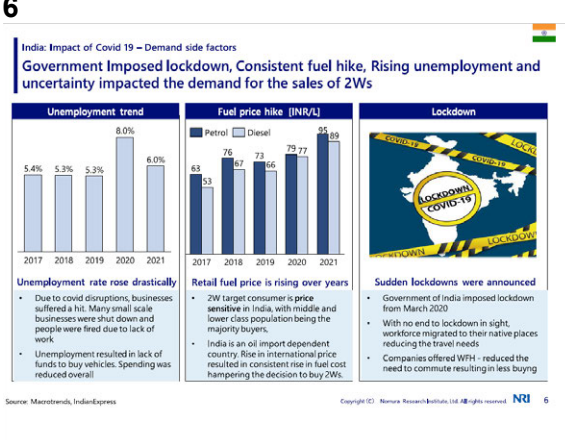

India (2)

7

India: Impact of Covid 19 – Supply side factors

Labour shortage, supply chain disruption and factories running on low capacity due to lockdown restrictions affected the supply of 2Ws

Labour shortage	Disruptions in Supply chain	Factories shut down
Country faced labor shortage	Supply chain was disrupted	Sudden lockdowns were announced
• **Uncertainty of duration of lockdown**, and **cash crunch** due to initial complete lockdown impacted labor • Migrant workers went back home for unannounced duration. Resulted in **Labor shortage** due to unorganized, displaced workforce	• Logistics sector got affected the most causing **disruptions in supply chain** • Global as well as local supply chain had an adverse impact due to state wide lockdowns • Mfg. companies operating on JIT principles were adversely impacted by disruptions	• Initial phase of lockdown saw a **complete shutdown** of Factories. • During next phase , all corporations were running at low capacity. • This hampered the production majorly

Source: Economic Times

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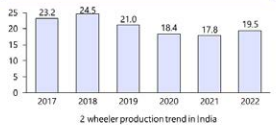
8

India : 2W Market Production

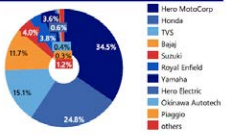
India is also a leading producer of two wheelers with 4 key players dominating more than 85% production share

Domestic production trend (in millions)



2 wheeler production trend in India

Market share



Top 4 OEMs contributing to 86% market share

Hero Moto corp	Honda	TVS	Bajaj
COO: India ICE 2W	COO: Japan ICE 2W	COO: India ICE and E2W	COO: India ICE and E2W
Established : 1984	Established : 1996	Established : 1978	Established : 1945
Market Share : 34.5%	Market Share : 24.8%	Market Share : 15.1%	Market Share : 11.7%
Production capacity: 7.6 million units	Production capacity: 1.8 million units	Production capacity: 4 million units	Production capacity: 7.5 million units

Source: Statista, ET Auto, Company Websites

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9

Indian 2W market – Collaborations

NON EXHAUSTIVE

Japanese companies have played major role in bringing in motorcycle technology in India through technical alliances

	Hero & Honda	TVS & Suzuki	Bajaj and Kawasaki
Details	• 1984 – 2010 • Honda had 26% stake in Hero Honda	• 1984 – 2001 • Suzuki had 25.97% stake in TVS	• 1983 – 2016 • Technical assistance agreement
Purpose	Created a Joint Venture focussing on technical Assistance • Hero got **the technology access** to enter motorcycle market • Honda could establish it's presence in India by leveraging Hero's in depth **knowledge of Indian Markets.**	Collaborated through partnership for technical Assistance • TVS gained the **advanced technology** access to enter motorcycle market. • Suzuki got **entry into Indian 2W market through the partnership**	Bajaj collaborated with Kawasaki through Technical Assistance agreement **to jointly manufacture motorcycles** **Agreement modified to include** Sales and after sales service from 2009, leveraging Bajaj's **Probiking** dealerships for Kawasaki bikes
Impact	• Through collaboration, Hero Honda launched various 2w models from 1984-2010 such as **CD100, Sleek, CBZ series, Passion, Karizma series, Splendor series, Glamor, Achiever**	• Key products launched through the partnership: **Fiero, Max 100, Shogun, Shaolin, Samurai, Max 100 and Victor**	• The alliance brought forth below products in the Indian 2W market. • **KB 100 , KB 125, Caliber, Pulsar, Champion, Aspire, Boxer, Avenger, Discover**

Source: Company Websites, Business-Standard

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Indian 2W market – Collaboration

NON EXHAUSTIVE

Traditional ICE 2W OEMs have started investing in EV based start ups to establish their foothold in E2W market space.

Hero Motocorp -> Ather Energy

Ather Energy

Manufacturer of electric scooters
Founded: in 2013, Bengaluru (India)
Profile: *The company designs and develops electric scooters that include BLDC motors, fast charging, Li-ion batteries etc*

Investor: Hero MotoCorp
USD 51 million (34.58% Stake)

TVS -> Ultraviolette

Ultraviolette

Manufacturer of electric motorcycles
Founded in 2016, Bengaluru (India)
Profile: *The company design, prototypes, and manufacture electric motorcycles with max travel range and speed, interactive dashboard, home charging pod, optimum charging, etc.*

Investor: TVS motors
USD 4.08 million (~33.95% stake)

Bajaj Auto -> Yulu

YULU

App-based rental platform for electric bicycles
Founded: in 2017, Bengaluru (India)
Profile: *Yulu provides users with a platform to ride Ebike by scanning the QR code and end the rental period by parking it in designated zones. It also offers long-term rental services*

Investor: Bajaj Auto
USD 8 million (~20% stake)

Source: Tracxn

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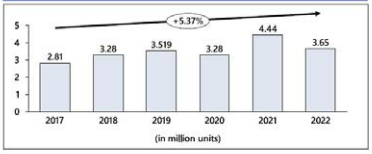
11

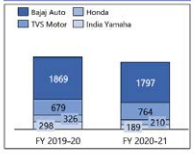
India: 2W Market Exports

India's 2 wheeler exports market stands strong even during geopolitical uncertainties.

2W exports trend



2W export volume by OEM ('000 units)



Top markets for exports of 2 wheelers

India currently exports 2W to **140 countries** with ~**26%** export share to Columbia (10%), Nigeria (9%) and Philippines (7%)

Exports declining (2021-22)

- Inflation spiraling past 20% in Nigeria
- Demonetization of the naira
- Nepal's 10-month ban on imports
- Ethiopia is in the middle of a drought and a brutal civil conflict, battling inflation of over 30% and facing foreign exchange shortages

Source: Statista, Ministry of Commerce, ET

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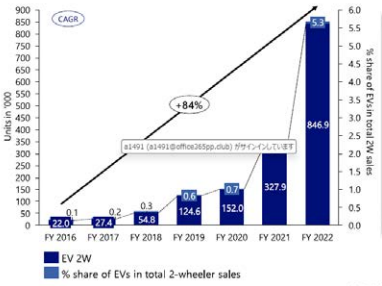
India: EV 2W Sales & Penetration

Domestic sales of EV 2W grew at a CAGR of 84% from 2016 to 2022 to post a total of 846,976 in FY22; Penetration has increased from <1% to ~5% now

Domestic Sales of Electric 2-Wheelers (in 1000 Units)



Sales of E2W in India is growing at a **CAGR of 84%**

Over **last 2 years (FY21-FY22)**, E2W segment saw **158% increase in sales number**
- **846,976 units** sold in FY22

Share of EV among total 2W sales in India:
- Significant growth at **5.3%** in FY22
- Growth over last year: **120%**

Source: EVReporter, WRI India

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India (3)

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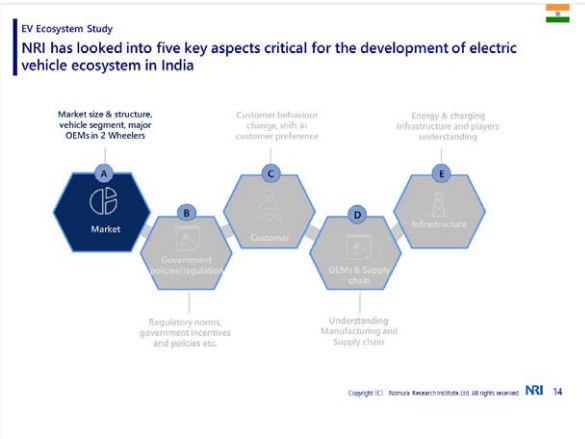

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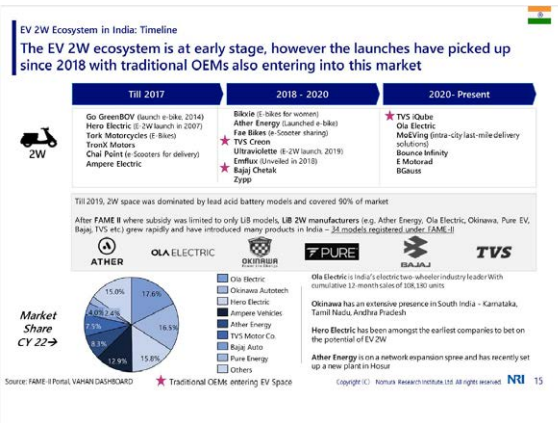

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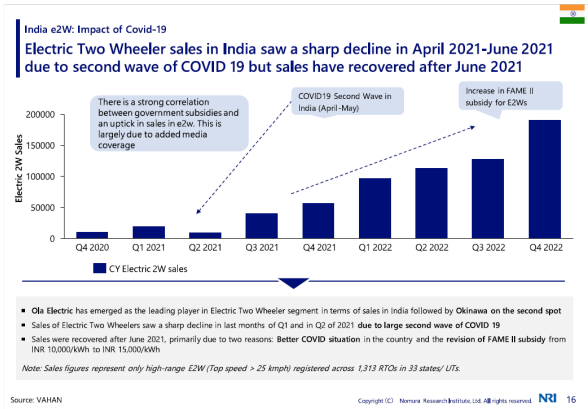

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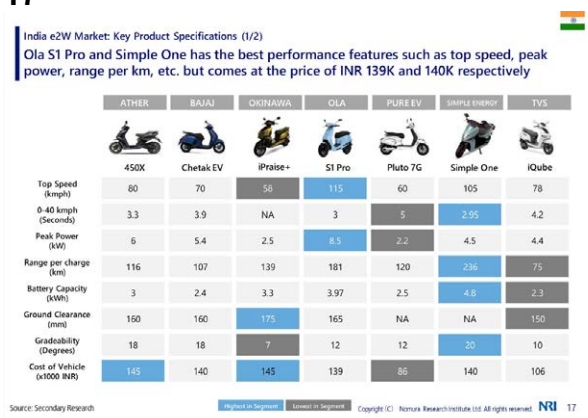

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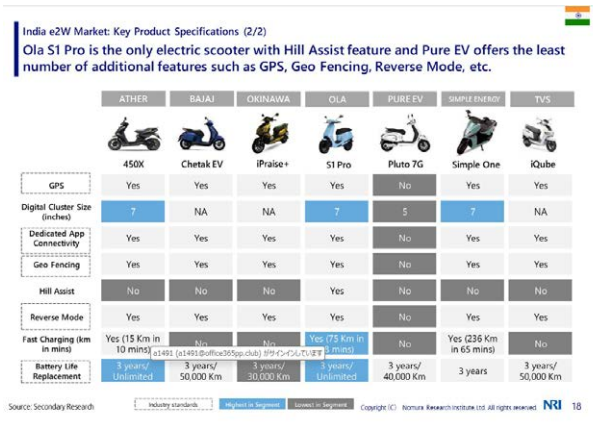

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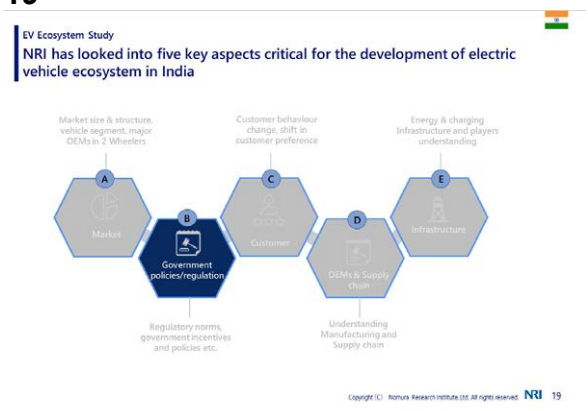

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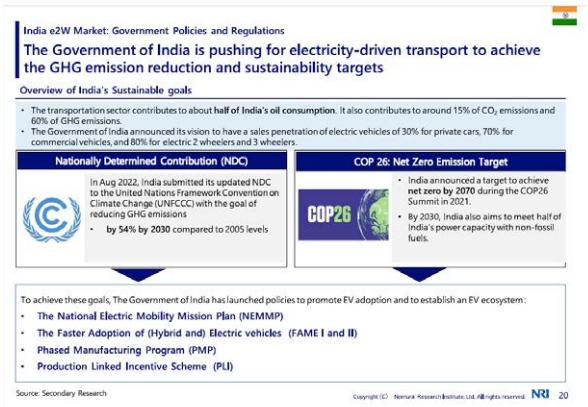

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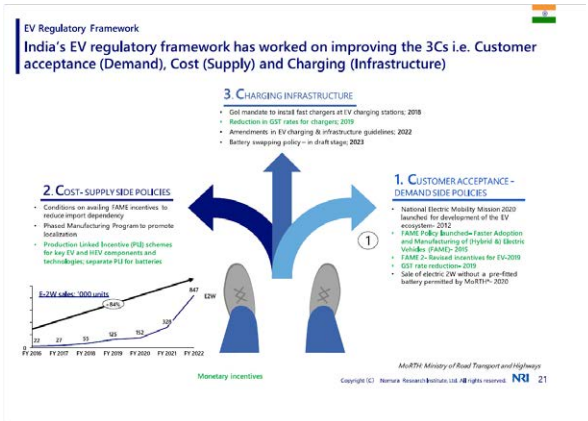

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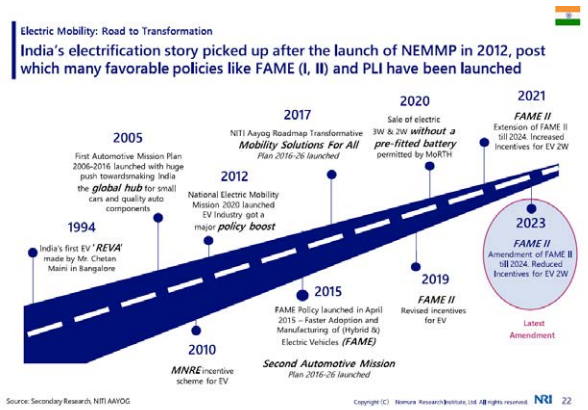

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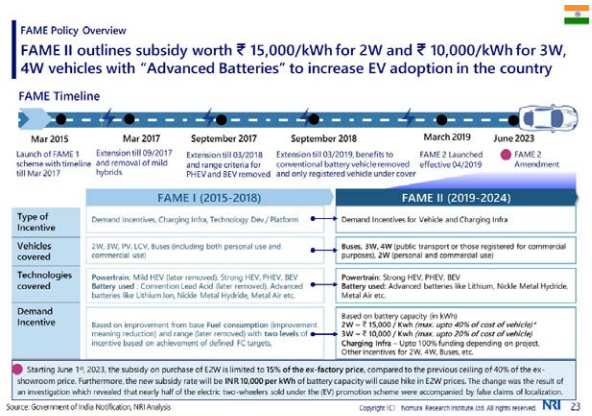

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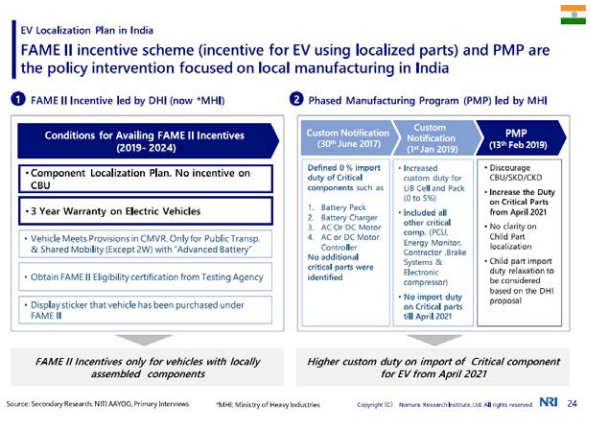

India (5)

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PLI Policy Overview

Government of India intends to incentivize potential investors to set up Giga-scale ACC manufacturing facilities with maximum value addition & quality output


भारत का राजपत्र
The Gazette of India

Objective:
- Setting up of a cumulative ACC manufacturing capacity of 50 GWh for ACCs
- Setting up an additional cumulative capacity of 5 GWh for Niche ACC Technologies

Fund allocation
The total incentive pay out over the period of 5 years of the Scheme will be INR 18,100 crore

FY	2022-23 2023-24	202 4-25	2025 -26	2026- 27	2027- 28	2028- 29	Total
Subsidy (INR Cr)	Establishment of Manufacturing facilities	2700	3800	4500	4300	2800	18100

Incentive is contingent on:
- The beneficiary has to achieve a **domestic value addition of at least 25%** and make the **mandatory investment (INR 225 crore/GWh)** within 2 years (at the mother unit level)
- Must increase the **domestic value addition to 60% within 5 years**

Source: Government of India Notification

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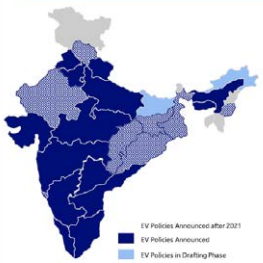
State Govt. Support

More than 10 states have announced EV policies which provide incentives and benefits above those offered by Central government through FAME II policy

India States and Union Territories (UT) offering EV Subsidies



State/UT	Policy/Incentives
Maharashtra (Announced in 2021)	• Subsidy of 5% on E2W with an upper cap of INR 10K for 5 yrs. • 100% exemption on road tax and registration fee
Karnataka (Announced in 2017)	• Target: 100% e-mobility by 2030 for all two wheelers involved in e-commerce & delivery • 100% exemption of taxes for all EVs
Delhi (Announced in 2020)	• Target: 25% EVs penetration by 2024 • Exemption from road tax and registration fees of vehicles • Purchase incentive of INR 5 K per kWh of battery
Kerala (Announced in 2019)	• Target: 1 Million EVs on road by 2022 • 25% exemption on road tax of E2W Vehicles for initial 5 yrs.
Tamil Nadu (Announced in 2017)	• 100% exemption on road tax & registration fees till 2022 for all EVs
Telangana (Announced in 2020)	• 100% exemption from road tax & registration fees for first 200 K buyers of EV in the state
Madhya Pradesh (Announced in 2017)	• 1% MVT for first 5 yrs. on first 15 K E2Ws & 5 K E3Ws sold • 100% exemption from registration fees on first 22.5 K E2W & 7.5 K E3W Vehicles or all E2W & E3W Vehicles

Source: Department of Heavy Industries (DHI)

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NON EXHAUSTIVE STATE LIST

State policies

Most states have a policy framework for electrification with varying focus on EV adoption, Charging infra, Industrial promotion, Recycling and EV fund

	Policy Status	EV Target	EV Adoption Incentives	Charging Infrastructure Incentives	Industrial Promotion	Recycling	EV Fund	Review & Monitoring
Andhra Pradesh	Final	☑	🟡	☑	☑	☑	🟡	☑
Assam	Final	☑	☑	☑	🟡	☑	☒	☑
Bihar	Draft	☑	☑	🟡	🟡	☒	☒	☑
Chandigarh	Final	☑	☑	☑	🟡	🟡	☑	☑
Delhi	Final	☑	☑	☑	☒	🟡	☑	☑
Goa	Final	☑	☑	☑	☑	🟡	☑	☑
Gujarat	Final	☑	🟡	☑	☒	☒	☒	☑
Haryana	Final	☑	☑	🟡	☑	☑	🟡	☒
Karnataka	Final	☑	🟡	🟡	☑	☒	🟡	☑
Kerala	Final	☑	🟡	☑	☒	☒	☒	☑
Madhya Pradesh	Final	☑	🟡	☑	☒	☑	☑	☑
Maharashtra	Final	☑	☑	☑	☒	🟡	☑	☑
Meghalaya	Final	☑	☑	☒	☒	🟡	☑	☑
Odisha	Draft	☑	☑	☑	☑	☑	☑	☑
Punjab	Draft	☑	🟡	☑	🟡	🟡	🟡	☑
Rajasthan	Final	☑	☑	☒	☒	☒	☒	☒
Tamil Nadu	Final	☑	🟡	🟡	☑	☑	🟡	☑
Telangana	Final	☑	🟡	☒	☑	☑	🟡	☑
Uttar Pradesh	Final	☑	🟡	🟡	☒	☑	🟡	🟡
Uttarakhand	Final	☒	☑	☒	☑	☒	☒	☒
West Bengal	Final	☑	🟡	☒	☒	🟡	☒	☑

☑ Clear directions 🟡 Low Definition ☒ No Policy

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REPRESENTATIVE SAMPLE

India e2W market: Technical Standards

Indian government has been proactively announcing standards and regulations pertaining to electric vehicles for their safe deployment on Indian roads

Overview of Key e2W standards in India — *AIS: Automotive Indian Standards, BIS: Bureau of Indian Standards*

Standard	Year*	Description	UNECE Ref.
AIS 038: Revision 2	2022	Electric Power Train Vehicles- Construction and Functional Safety Requirements, Specific Requirements and EV battery Testing Standards	UN ECE R100
AIS 156: Amendment 3	2022	Specific Requirements for L Category Electric Power Train Vehicles	UN ECE R136
AIS 048: Amendment 1	2016	Battery Operated Vehicles - Safety Requirements of Traction Batteries	N/A
AIS 039: Revision 1	2017	Electric Power Train Vehicles- Measurement of Electrical Energy Consumption	UN ECE R101
AIS 040: Revision 1	2017	Electric Power Train Vehicles - Method of Measuring the Range	UN ECE R101
AIS 041: Revision 1	2015	Electric Power Train Vehicles Measurement of Net Power and The Maximum 30 Minute Power	UN ECE R85
AIS 049: Revision 1	2016	Electric Power Train Vehicles - CMVR Type Approval for Electric Power Train Vehicles	N/A
AIS 131	2015	Type Approval Procedure for Electric and Hybrid Electric Vehicles introduced in market for Pilot / Demonstration Projects intended for Government Scheme	N/A
BIS Draft	2022	Electric Vehicle Battery Swap System – Part 4 Light Electric Vehicles – Section 1 Guidelines And Pack Dimensions	N/A

Represent regulations related to e2W Battery safety and usage

On 27th Sep 2022, Ministry of Road Transport and Highways (**MoRTH**) **announced amendment 3 to AIS 156 and Revision 2 to AIS 038** to be implemented in two phases:
- **Phase 1 with enforcement date 1st December 2022:** The BMS is required to be run by a microprocessor, making it smarter and faster, the cells used in a battery pack must be thoroughly tested to meet the IS 16893 cell testing requirement, Inclusion of external safety fuse, etc.
- **Phase 2 with enforcement date 31st March 2023:** Introduces even higher safety standards, following the IP67 ingress protection standard; All battery packs must have at least four temperature sensors to constantly monitor temperature variations, and an audio-visual alarm, etc.

**Only the latest revisions/amendments of standards are mentioned, with respective date of issuance*

Source: Secondary Research, websites: AIS, BIS

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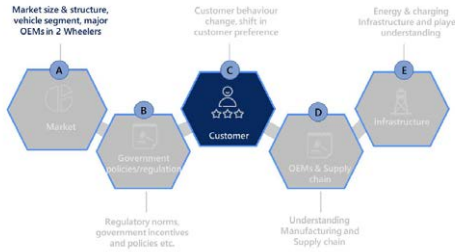
EV Ecosystem Study

NRI has looked into five key aspects critical for the development of electric vehicle ecosystem in India



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WHY ELECTRIC 2W: Motivation for Electric for private segment

Preference for electric vehicle is driven by the combination of environment-friendly & social imagery along with lower TCO* & Tech features

Motivation to choose an Electric Scooter

A Environment-friendly & Social Standing

INTRINSIC MOTIVATOR (EMOTIONAL)

Conscious of the Environmental Impact
Eco-friendly, and reduction in carbon footprint

"Rising air and noise pollution prompted a thought of purchasing an EV 2-wheeler in my mind. It makes me feel good that I'm contributing to saving the planet" - Bajaj Chetak EV Owner

"Points that come to my mind about EV vehicles are eco-friendly, less pollution, going towards better environment in the future, easy mode of transport, going into a better generation..." - Ather 450X Owner

"Electric vehicles make me think of green initiative, which is being done by the government. This is my bit supporting them..." - TVS iQube Owner

Social Standing in Society
Differentiation and first mover image

"I was the first to buy the EV-2W in my circle. It always gets eyeballs on the road. Now 2-3 friends have also bought after me" - Ather Owner

B Significantly Lower 'Total Cost of Ownership' + Tech Features

EXTRINSIC MOTIVATOR (FUNCTIONAL)

Rising Fuel Prices & Cost of Ownership
Significant rise in fuel costs & maintenance of ICE

"We have minimised usage of Activa in the house due to rising fuel prices. Running cost is becoming higher and therefore I am looking at purchasing an EV" - Bajaj Chetak EV Owner

"If you have to ride 100 km in a petrol bike it will require Rs. 300 petrol but if you do have to ride the same distance in an electric scooter it will require you 15 rupees..." - EPluto 7G Owner

New Technology Features
Customers wish to try out new tech innovations

"We own both an Activa and Bajaj Chetak EV. The best part of Chetak is the tech and other features in the vehicle like digital display etc." - Bajaj Chetak EV Owner

*TCO: Total Cost of Ownership Sample Size (n) = 535; Qualitative survey; N=15

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India (6)

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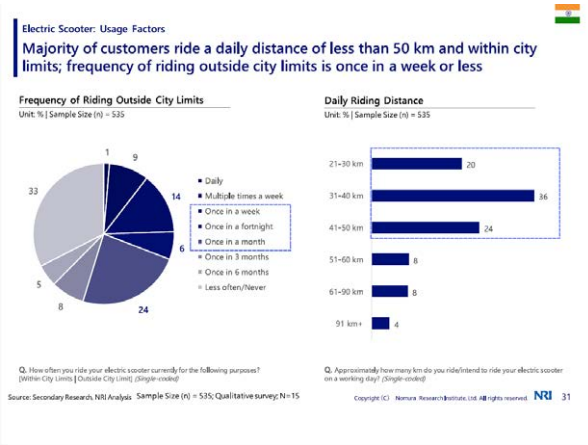

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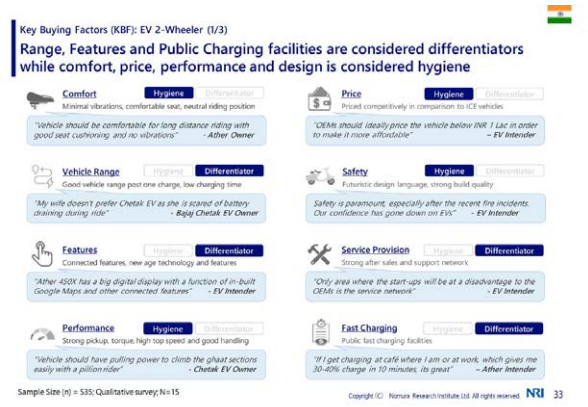

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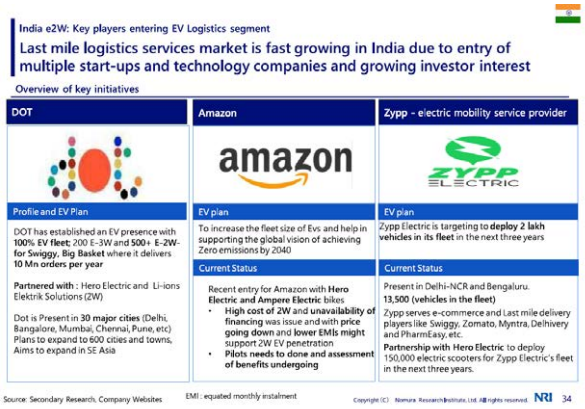

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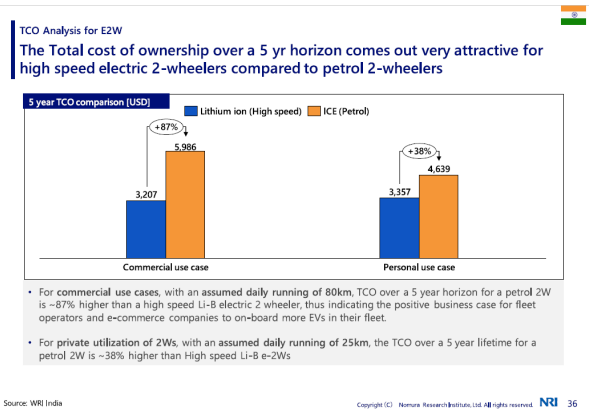

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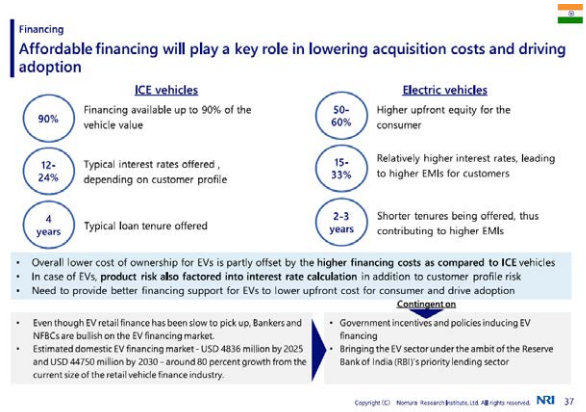

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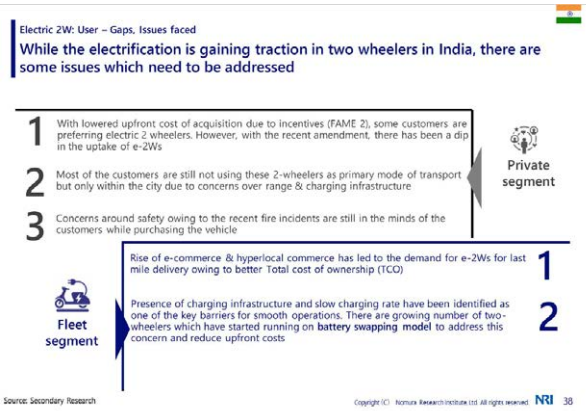

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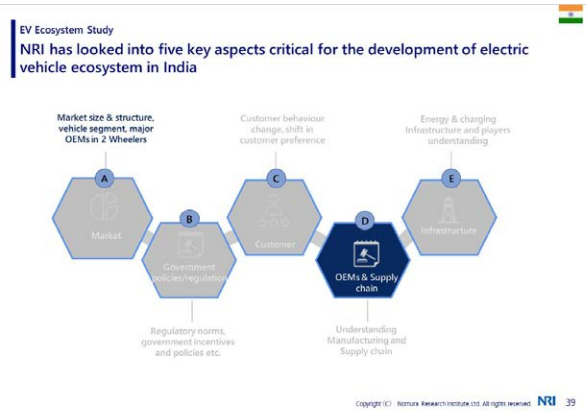

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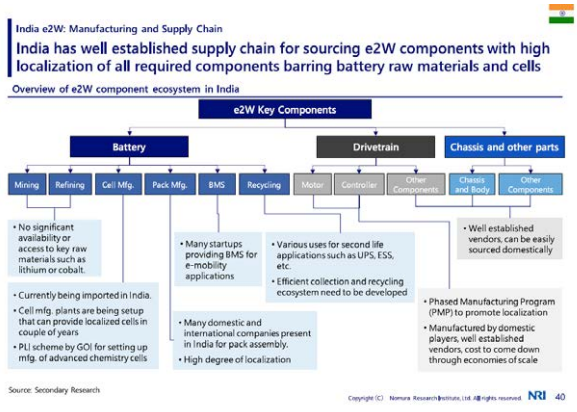

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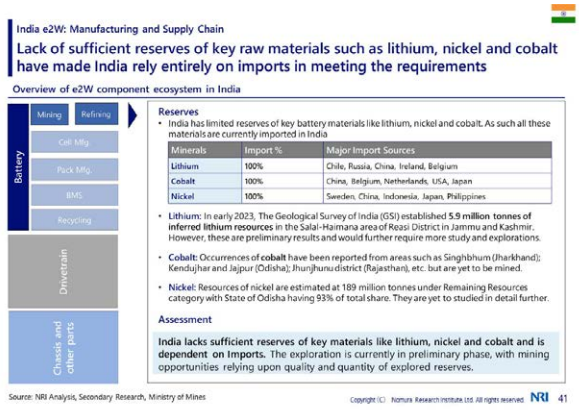

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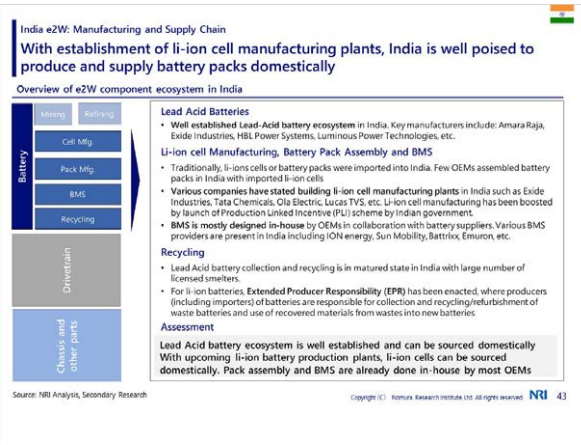

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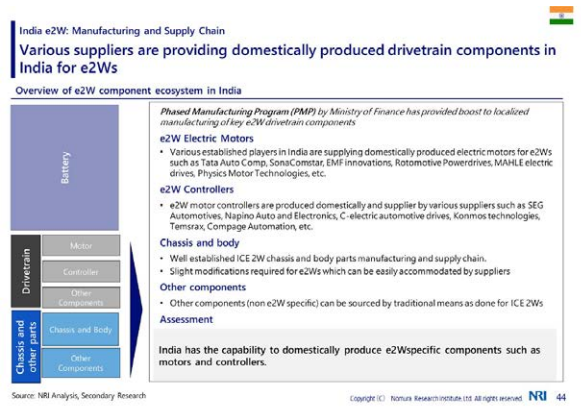

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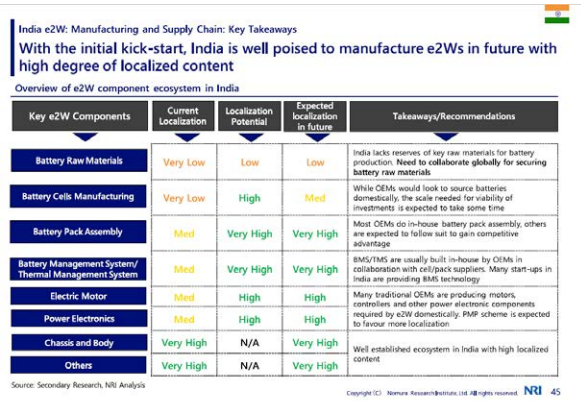

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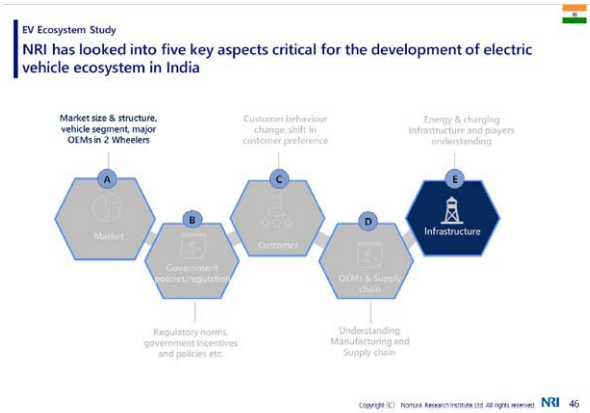

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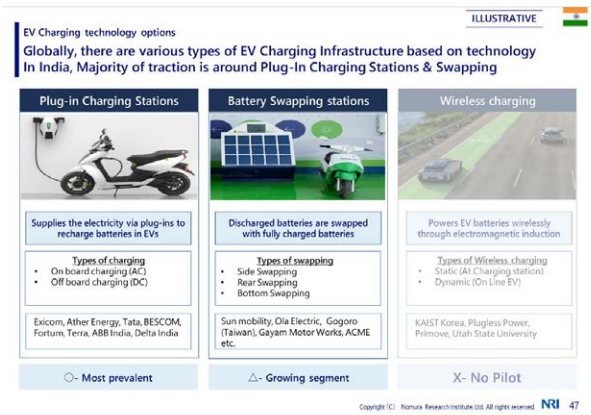

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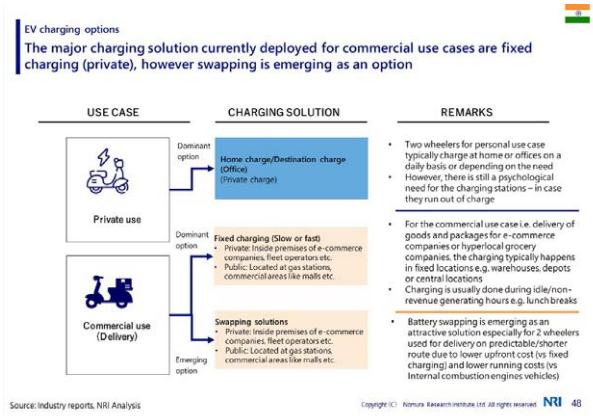

India (9)

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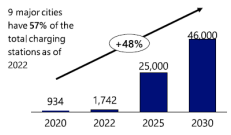
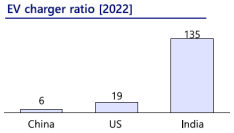
Plug in charging: Current state & future outlook

With increasing EV sales, the charging infrastructure need to keep pace and become ubiquitous as the fossil fuel network

Public charging stations in India



EV charger ratio [2022]



Source: Government of India, PIB

Key Insights

- India current has 1742 charging stations, with plans to increase to ~ **25,000 by 2025 and would need ~ 46,000 chargers by 2030**
- DHI has already sanctioned development of ~ **3,000 charging stations** with ~ 1,600 being fast charging
- India lags behind major markets in terms of charging infrastructure
  - **While China and US have an EV charger ratio of 6 and 19, the same for India is 135**
- Sustained investment and government support is required to ensure charging infrastructure development in the country

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Plug in charging: Charging standards

Based on type of charging (fast/slow),Govt. has established guidelines for chargers at public charging stations

Charger type	Sl.no	Charger connectors	Rated output voltage	No. of connector guns	Charging vehicle type
Fast charger	1	Combined charging system (CCS) – min 50 kW	200-750 V or higher	1CG	4W
	2	CHAdeMO- min 50 kW	200- 500 V or higher	1CG	4W
	3	Type 2 AC- min 22kW	380-415V	1CG	4W, 3W, 2W
Slow charger	1	Bharat DC-001- 15 kW	48 V	1CG	4W, 3W, 2W
	2	Bharat DC-001- 15 kW	72V or higher	1CG	4W
	3	Bharat AC-001- 15 kW	230V	3CH of 3.3 kW each	4W, 3W, 2W

- Current EV charging equipment , particularly connector types are aligned with global usage, where CHAdeMO and CCS are prevalent
- **Bureau of Indian standards** is the nodal body for defining the standards for EV charging station-**IS 17017** is the key standard in India
- Charging station for **2W/3W EVs can install charger different from the specified types** as well
- No standards have been defined for battery swapping stations

- Key players such as Ola Electric and Ather Energy are using proprietary chargers for fast charging. Some e2W start-ups like Ultraviolette automotive are using standard CCS charging sockets.

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India e2W: Battery Swapping Infrastructure

Some of the major concerns with the fixed charging model are being addressed by the battery swapping services

ISSUES IN THE FIXED CHARGING MODEL	SWAPPING AS A SOLUTION
Ownership costs • Product costs ~ 1.5 times of the current ICE vehicles • Lack of financing options in-line with the ICE versions	◿ Lower upfront vehicle costs on account of de-coupling with the vehicle ◿ Homologation of vehicles without batteries is a catalyst
Safety • Concerns around vehicle safety especially around recent fire events • Concerns on vehicle behaviour around Indian operating conditions	◿ Dedicated focus on battery tech from the swap service providers ensure better R&D and hence safety ◿ Battery safety standards are being defined which is a catalyst towards adoption of swapping as a viable model
Battery charging time & life • Loss of productive time (fleet segment) even with fast charging options • Battery replacement concerns thereby reducing the cost advantage from ICE vehicles	◿ Higher life of batteries due to better charging discharging thereby addressing some of the RM issues as well
Station Business viability • Unavailability of charging especially at home and during brown outs • Low utilisation and high investments impact the business case viability	◿ **Portability** of swap station enables reconfiguring the spatial locations based on utilisation results ◿ Low capex, low battery weight and portability of swapping stations makes the case for swapping in 2Ws attractive from a swap service provider's perspective

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India e2W: Battery Swapping Infrastructure

The share of swapping in 2W charging is low (4-5% by fleet catered); however it is expected to grow, given the private sector investments and policy measures

Sun Mobility

Founded in 2017, Bangalore, (India)

Current Infrastructure:
- 210 battery swapping points, 240+ quick interchange stations in 18 cities
- Onboarded 10+ OEMs on Platform, 25+ fleet & infrastructure providers

Future Plan: to Power 1 million EVs by the year 2025 by
- Setting up 16000 swapping stations.
- Scaling up to 3 lakh batteries by FY24.

Bounce Infiniti

Founded in 2020, Gurgaon (India)

Current Infrastructure: over 1.2M battery swaps on its energy infrastructure

Future Scope: setting up 3000 swapping stations at BPCL fuel stations across top 10 cities in next 2-3 years

Battery Smart

Founded in 2020 New Delhi, (India)

Current status:
- Present in 11 cities
- 699 swapping stations
- ~14 million swaps offered
- 536 million electric kms Covered

Future Plan: setting up presence of its swap stations at Park+ powered real estates in 25 cities by 2025
Capturing $17b swapping market by 2025

Yuma network (YULU)

Founded in 2021, Bangalore, (India)

Current Status: Yuma has a network of more than 85 Yuma Stations across Bangalore, Mumbai, and Delhi

Future Plan: To reach 500+ max stations across Bangalore, Mumbai and Delhi.

Source: Company websites, Secondary Research

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Battery swapping

With government mandates and policy frameworks that assure safety and interoperability, Battery swapping may catalyse the EV adoption by nearly 30%

Overview of key draft battery swapping policy in India

NITI Aayog (GoI) has introduced a draft battery swapping policy on interoperability standards for E2W and E3Ws

Key Features/Highlights

Key Objectives	• Promotion of battery swapping with ACC batteries • Establishing principles behind technical standards to enable interoperability • Promote partnerships among Battery providers, OEMs and other partners
Key Technical and Operating Requirements	• General requirements for ACC batteries, BMS etc. • Battery and Swapping Station Unique Identification Number to implement unique traceability • Testing & Certification for Battery Swapping Components • Battery charging and swapping infrastructure • Data sharing and communication
Fiscal Support	• Grievance redressal and compensation • Tariff for supply of electricity to Public Battery Charging Stations • Promote partnerships among Battery providers, OEMs and other partners • Provision of land at promotional rates for Public Battery Swapping Stations • Applicable rates of Goods and Services Tax
Key Challenges, warranting redraft of policy	EV battery swapping policy is going to be **redrafted** as industry raised **interoperability concerns** • battery swapping technology is in its nascent stage • It is set to evolve in the coming years • **Impossible to adopt a battery standardization** model at this point.

Source: , NITI Aayog

ACC: Advanced Chemistry Cell, BMS: Battery Management System

 NRI 53

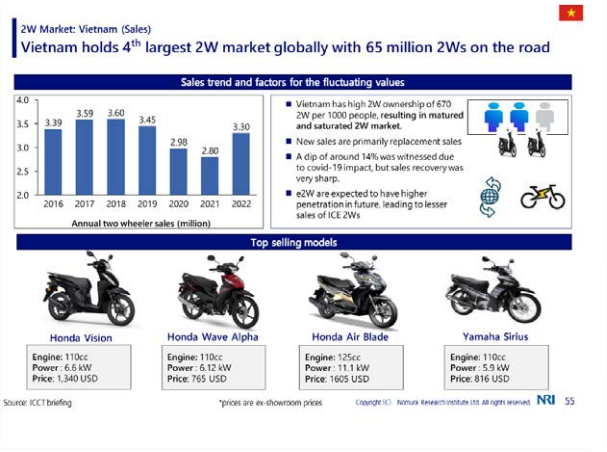
Vietnam (1)

1

VIETNAM

 NRI 54

2



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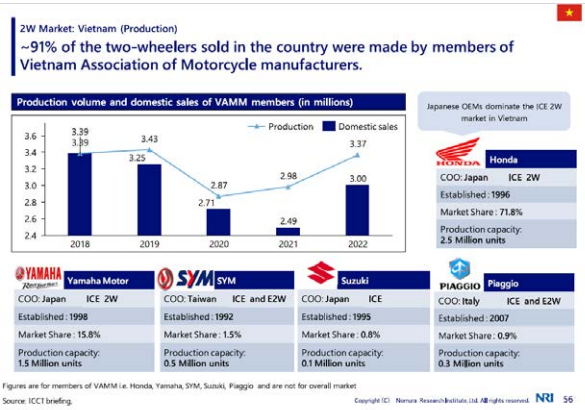

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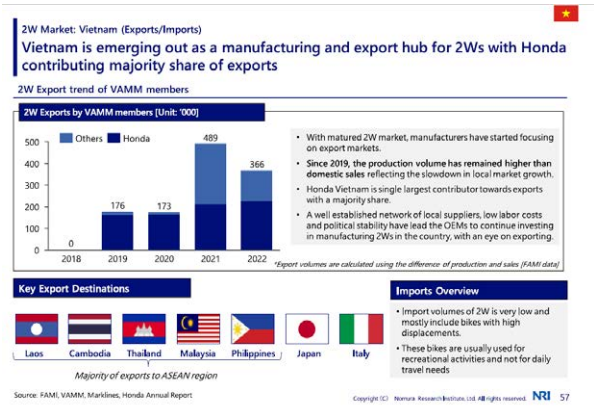

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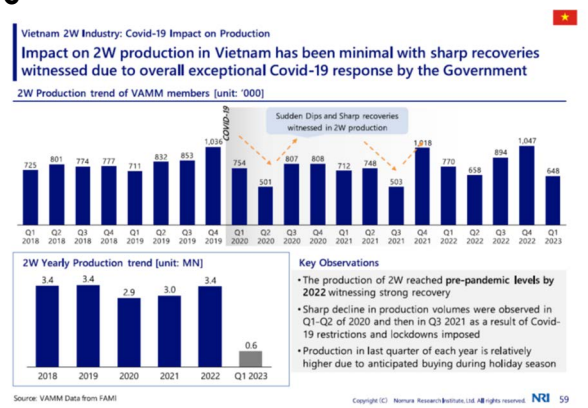

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Vietnam (2)

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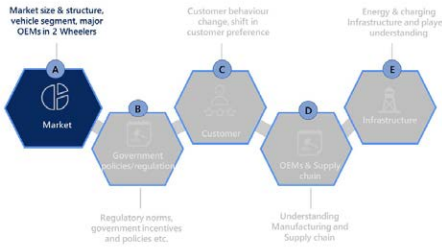
EV Ecosystem Study

NRI has looked into five key aspects critical for the development of electric vehicle ecosystem in Vietnam



 NRI 60

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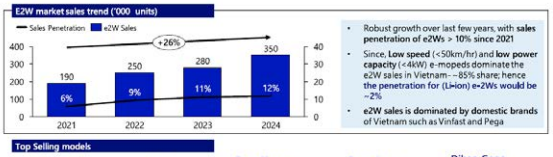
Vietnam e2W: Market

Vietnam's e2W sales have shown steep growth in recent years with sales exceeding 350,000 in 2022



Top Selling models

Klara A2	Theon	Pega X men	Pega Aura	Dibao Gogo
1.2 kWh battery pack	49.6 Ah Li-ion battery	Lead-Acid battery 60V-20Ah	Lead-Acid battery 60V-20Ah	Lead-Acid battery 60V-20Ah
90 km travel range	100 km travel range	100 km travel range	100 km travel range	100 km travel range
Top speed: 60 km/h	Top speed: 90 km/h	Top speed: 50 km/h	Top speed: 50 km/h	Top speed: 50 km/h
Price: 1137 USD	Price: 2700 USD	Price: 753 USD	Price: 735 USD	Price: 800 USD

Source: Secondary Research

 NRI 61

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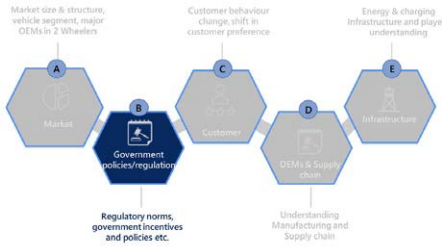
EV Ecosystem Study

NRI has looked into five key aspects critical for the development of electric vehicle ecosystem in Vietnam



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10

Vietnam e2W Market: Government Policies and Regulations

Development of e2W ecosystem is a promising approach for Vietnam to achieve its ambitious GHG emission reduction and sustainability targets

Overview of Vietnam's Sustainable goals

- The transport sector is a major contributor to GHG and air pollution in Vietnam and responsible for **18% of total GHG emissions**.
- **2Ws account for over 90% of all national motorized vehicles** and are responsible for more than 90 % of CO and VOC (volatile organic carbon) emissions and 60 % of suspended particle emissions within the transport sector

Nationally Determined Contribution (NDC)

In Sep 2020, Vietnam submitted its updated NDC to the United Nations Framework Convention on Climate Change (UNFCCC) with a goal of reducing GHG emissions

- **by 9% (using domestic resources only)**
- **by 27% (with international support)**

by 2030 compared to 2014 levels

COP 26: Net Zero Emission Target

- Vietnam announced a target to achieve **net zero by 2050** during the COP26 Summit in 2021.
- In July 2022, Vietnam enshrined its net zero target in law. It has also developed a **National Climate Change Strategy** to guide its planning to achieve the target.

In general, four key national strategies are used to provide guidance for developing transport policies in Vietnam:

The National Climate Change Strategy	(Decision No. 2139/QD-TTg)
The National Sustainable Development Strategy	(Decision No. 432/QD-TTg)
The National Green Growth strategy	(Decision No. 1393/QD-TTg)
The Environmental Protection Law	(Law No. 72/2020/QH14)

Based on these strategies, specific action plans are developed.

Source: Secondary Research

 NRI 63

11

Vietnam e2W Market: Government Policies and Regulations

Vietnam Government has announced certain plans for achieving sustainability goals, but specific details and action plans are missing

Overview of Key Targets announced for e2Ws

Phasing out of fossil fuel powered vehicles

On 22nd July 2022, Deputy Prime Minister signed **Decision No. 876/QD-TTg** approving the Action Program on green energy transformation, reducing carbon and methane emissions in the transport sector.

Key highlights include:

- By 2025, 100% of buses will use electricity and green energy.
- **By 2030, the percentage of vehicles using electricity and green energy will reach at least 50%**, and 100% of taxis will use electricity and green energy.
- **By 2040, the production, assembly and import of automobiles and motorcycles using fossil fuels will be discontinued.**
- By 2050, the country will have a complete green transport network with net-zero greenhouse gas emissions.

Motorbike ban in cities by 2030

- To reduce traffic congestion and emissions, the Vietnamese Government has asked **Hanoi and four other major cities, including Ho Chi Minh City, Haiphong, Danang, and Cantho to plan a motorbike ban after 2030**
- The request was made in a government resolution issued on 6th April, 2022 on ensuring traffic safety and preventing traffic congestion in the 2022-2025 period.
- For Hanoi, the ban will apply to 12 downtown districts and 3 major roads: Truong Sa, Hoang Sa and National Highway 5,
- After 2030, the ban will expand to all the city's 30 districts (including 18 outskirt ones) and the motorbikes from other provinces.

*Though high level directions are being provided at city and national level, **a detailed roadmap for achieving the e2W adoption targets has not been formulated.***

Specific actions and plans for execution are lacking at both state and national level.

Source: Secondary Research

 NRI 64

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Vietnam e2W market: Regulatory Framework

Vietnam's government have shown interest in improving the 3C's pillars for e2W adoption, however no specific actions or plans have been formulated yet

2. Cost- supply side policies

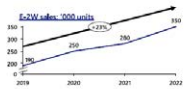
- No policies have been developed to incentivize e2W and e2W component manufacturing.
- Subsidies/incentives in form of tax rebates, electricity duty exemption, capex subsidy, etc. have been announced

1. Customer acceptance - demand side policies

- No specific policies aimed at e2W demand generation have been formulated
- e2W are taxed at same rate as of ICE vehicles, no purchase incentives, tax exemptions or preferential access is provided

3. Charging infrastructure

- No specific plans for charging infra have been announced
- No incentives/subsidies on charging equipment or setting up of charging stations have been announced



Source: Secondary Research, NRI Analysis

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Vietnam (3)

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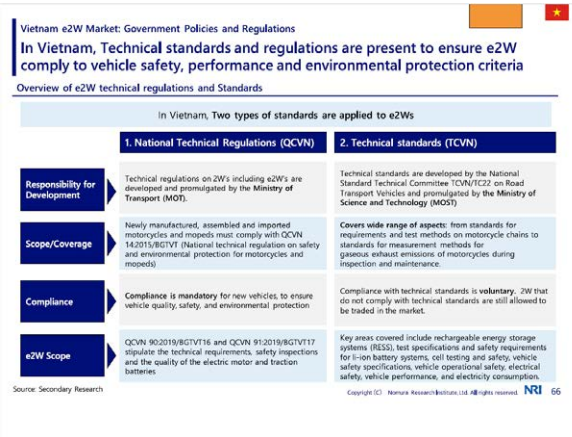

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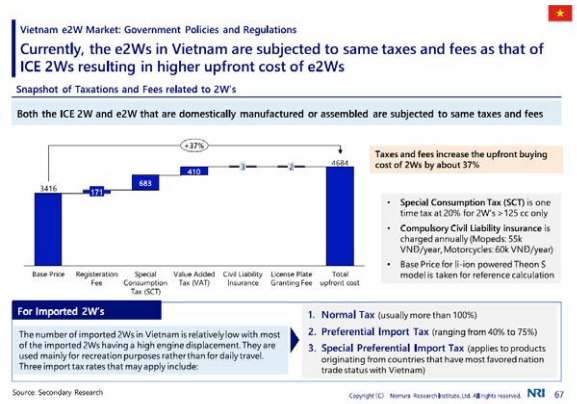

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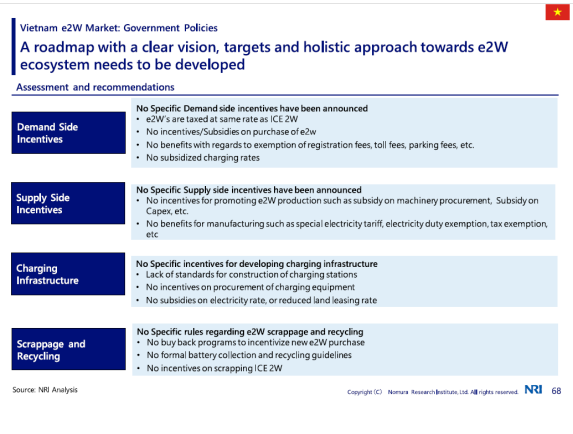

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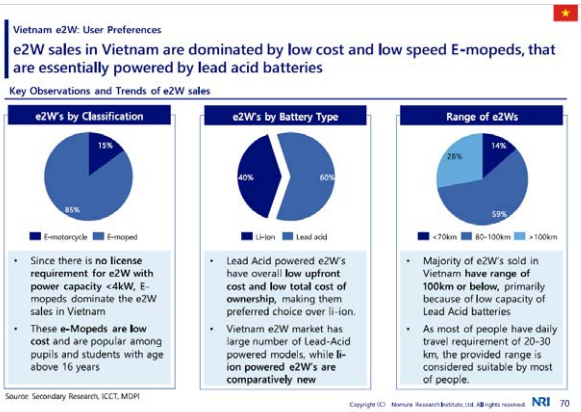

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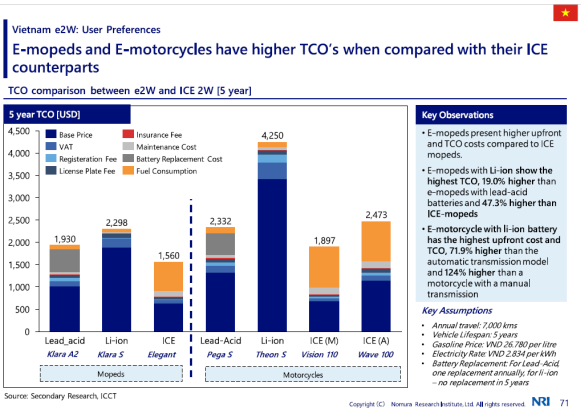

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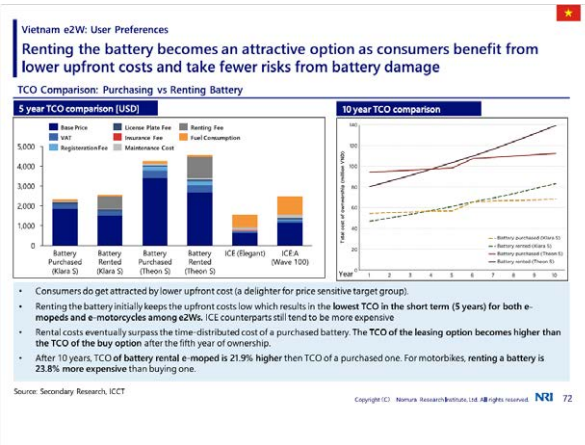

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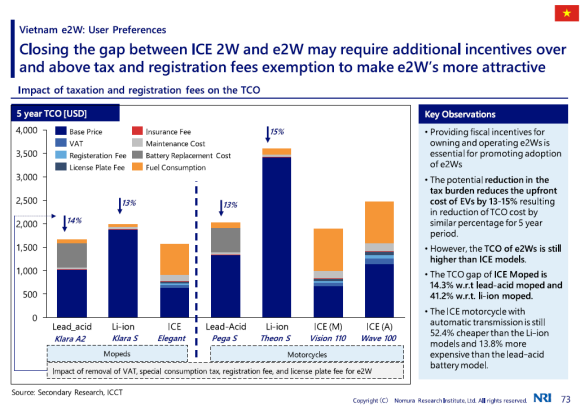

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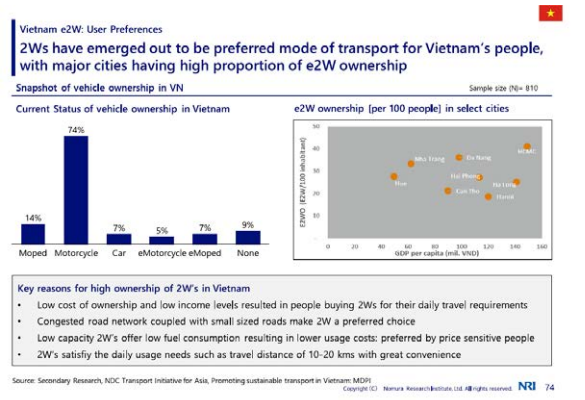

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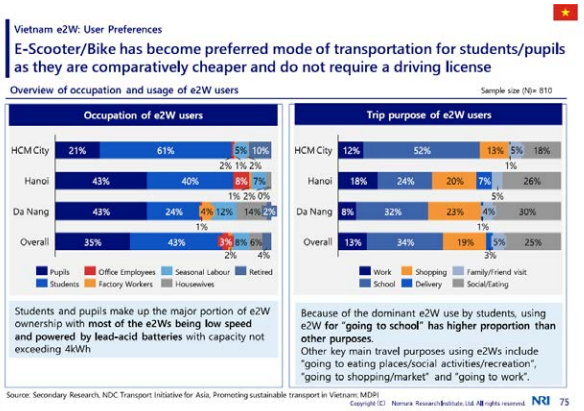

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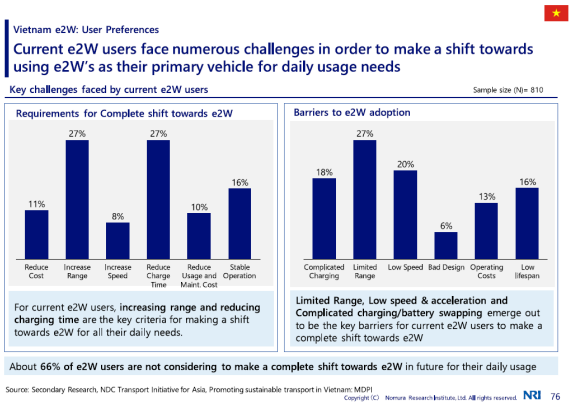

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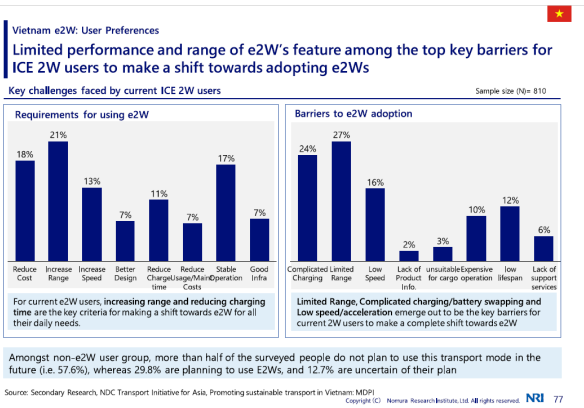

Vietnam (5)

25

Vietnam e2W: User Preferences-Fleet

Use of e2W for fleet operations such as ride hailing or logistics has started to pick up pace with OEMs starting to collaborating with fleet owners

Key Challenges faced by e2W fleet users — Sample size (N)= 810

Recent developments in using e2W for fleet operations

gojek + DAT.BIKE

- In May 2023, **Gojek announced collaboration with Dat Bike,** enabling Gojek driver-partners in Vietnam to provide **transportation, food delivery and courier services** through GoRide, GoFood, and GoSend, respectively.
- Dat Bike's **Weaver++ will be used** which provides for 200 km range and 90kmph top speed. Additionally, it can be fast charged at Dat Charge stations in 20 mins for 100 km range

BAEMIN + SELEX

- In April 2023, Baemin, a food delivery service company announced partnership with Selex for a pilot project.
- BAEMIN riders will use Selex's electric motorcycles and utilize Selex's battery swapping infrastructure for higher utilization
- Selex provides commercial e2Ws with 50% higher weight and volume capacity than other models present in market

Reasons to not use e2Ws by delivery staff

For delivery drivers who want to switch to e2Ws, the main attributes relate to the technology and charging infrastructure:
- increasing travel distance for each charge
- increasing movement speed and acceleration
- reducing battery charge time
- good service for charging / battery swapping station

Limited travel distance and complicated charging/swapping batteries emerge out as the most significant reasons for the delivery staff for not using e2Ws

Source: Secondary Research, NDC Transport Initiative for Asia, Promoting sustainable transport in Vietnam: MDPI

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Vietnam e2W: User Preferences – Key Challenges

High upfront cost of e2Ws becomes a major barrier for widespread adoption, certain fiscal and non fiscal incentives are required to close the cost gap

Overview of key challenges

High Upfront Cost	• **e2W's have high upfront cost** and TCO when compared with ICE counterparts, making them less attractive to buyers • All the additional taxes and registration fees applicable to ICE 2W are also applicable for e2W. **No special incentives for e2W purchase are provided**
Reduction of charging time	• **e2Ws with lead acid batteries lack fast charging capacities** • Users are accustomed to **overnight charging at home** that usually takes 4 to 6 hours for a full charge • Home based chargers usually have limited power rating, hence, charging is also relatively slower for li-ion based e2Ws.
Increase in range and performance	• **Majority (over 60%) of e2W sold in Vietnam are powered by Lead Acid batteries,** which have lower energy and power density as compared to li-ion batteries. • Li-ion batteries can provide high performance and range within same shape and size of lead-acid batteries
No special incentives for e2W usage	• **No demand side specific incentives or subsidies** have been announced for promoting e2W usage • **Subsidized charging rates** along with exemption from tolls, parking fees, etc can help promote uptake of e2Ws
Inconvenient Cargo handling – fleet users	• e2W models available in the market are usually designed for personal usage. With more and more companies collaborating for using e2Ws for fleet operations, it becomes essential that cargo space is conveniently designed for delivery partners

Source: Primary Research, Secondary Research, Company Websites

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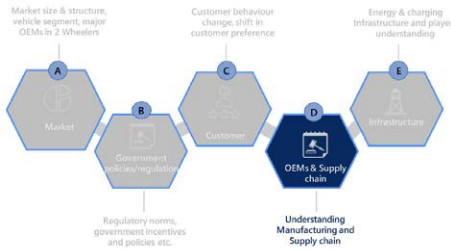
EV Ecosystem Study

NRI has looked into five key aspects critical for the development of electric vehicle ecosystem in Vietnam



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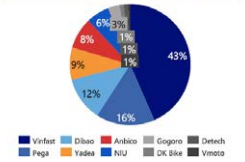
28

Vietnam e2W Market: Manufacturing and Supply Chain

e2W production capacity has exceeded 1 million units per year in Vietnam, with home grown player Vinfast having a major share of production

Snapshot of key e2W manufacturers in Vietnam

e2W Production share by OEM



- Unlike ICE 2W market which is dominated by Japanese OEMs, the e2W market is Vietnam is dominated by domestic players like Vinfast and Pega
- Key 2W manufactures such as Honda, Yamaha or Suzuki have not yet initiated e2W production in Vietnam primarily due to lack of clear policies or support by Vietnam govt. for e2W development

VINFAST

Year of Establishment	2017
Country of Origin	Vietnam
Plant Location	Dinh Vu, Hai Phong
Production Capacity	5,00,000 per year
e2W Models	9 models

PEGA

Year of Establishment	2012
Country of Origin	Vietnam
Plant Location	Yen Dung, Bac Giang
Production Capacity	4,80,000 per year
e2W Models	6+ models

Anbico

Year of Establishment	2015
Country of Origin	Vietnam
Plant Location	Vinh Yen, Vinh Phuc
Production Capacity	4,80,000 per year
e2W Models	15+ models

Source: Secondary Research

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Vietnam e2W: Manufacturing and Supply Chain

Vietnam has well established ecosystem for ICE 2W manufacturing and can take lessons from it to establish e2W manufacturing and supply chain

Overview of e2W component ecosystem in Vietnam

Reserves
- Lithium and Cobalt are one of the key materials required for cell manufacturing.
- Vietnam has abundant reserves nickel (3.6 mn tons) mainly in provinces of Thanah Hoa , Son La and Cao Bang.
- Vietnam also have relatively abundant lithium reserves of 1 mn tons located primarily in Quang Ngai Province in Central Vietnam.

Mining and Processing
- Nickel or lithium extraction/mining industry is still not developed in Vietnam. The research, experience and technology needed to exploit these minerals is still very limited.
- Only one nickel extraction project is being carried out by Ban Phuc Nickel Mine Ltd. in Son La province and is expected to be production ready by 2025 with steady state production rate of 18,000 tons per year.
- 90% of Ban Phuc Nickel Mine Ltd. company's shares are owned by Blackstone Minerals, an Australian company and 10% are owned by Son La Engineering and Mechanical Joint Stock company.
- Lithium resources still remain untapped.

Assessment

Vietnam currently does not have any mining and processing capacity to domestically produce key raw materials for battery cell production.
Battery raw materials need to be imported

Source: NRI Analysis, Secondary Research

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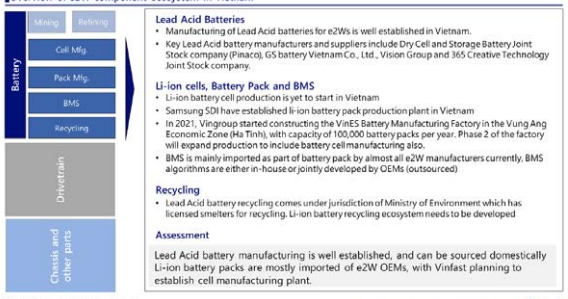
30

Vietnam e2W: Manufacturing and Supply Chain

Vietnam has well established ecosystem for ICE 2W manufacturing and can take lessons from it to establish e2W manufacturing and supply chain

Overview of e2W component ecosystem in Vietnam



Lead Acid Batteries
- Manufacturing of Lead Acid batteries for e2Ws is well established in Vietnam.
- Key Lead Acid battery manufacturers and suppliers include Dry Cell and Storage Battery Joint Stock company (Pinaco), GS battery Vietnam Co., Ltd., Vision Group and 365 Creative Technology Joint Stock company.

Li-ion cells, Battery Pack and BMS
- Li-ion battery cell production is yet to start in Vietnam
- Samsung SDI have established li-ion battery pack production plant in Vietnam
- In 2021, Vingroup started constructing the VinES Battery Manufacturing Factory in the Vung Ang Economic Zone (Ha Tinh), with capacity of 100,000 battery packs per year. Phase 2 of the factory will expand production to include battery cell manufacturing also.
- BMS is mainly imported as part of battery pack by almost all e2W manufacturers currently. BMS algorithms are either in-house or jointly developed by OEMs (outsourced)

Recycling
- Lead Acid battery recycling comes under jurisdiction of Ministry of Environment which has licensed smelters for recycling. Li-ion battery recycling ecosystem needs to be developed

Assessment

Lead Acid battery manufacturing is well established, and can be sourced domestically Li-ion battery packs are mostly imported of e2W OEMs, with Vinfast planning to establish cell manufacturing plant.

Source: NRI Analysis, Secondary Research

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Vietnam (6)

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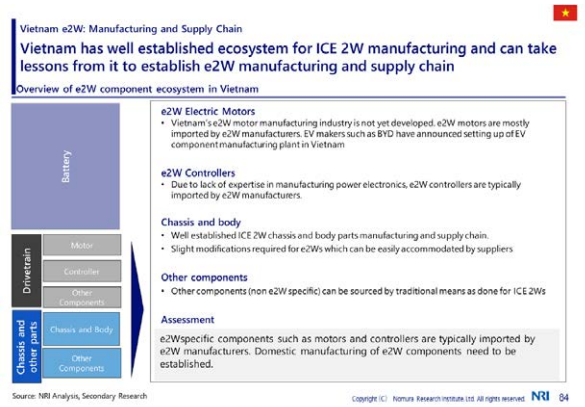

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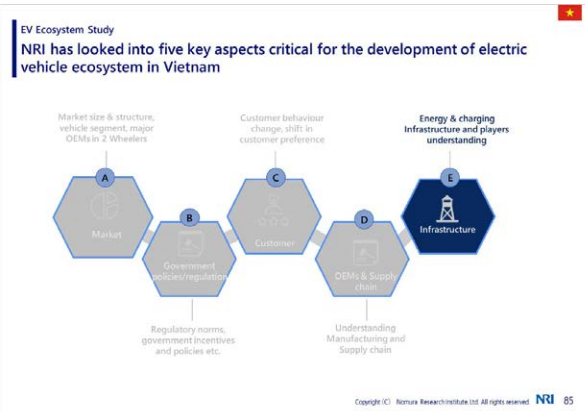

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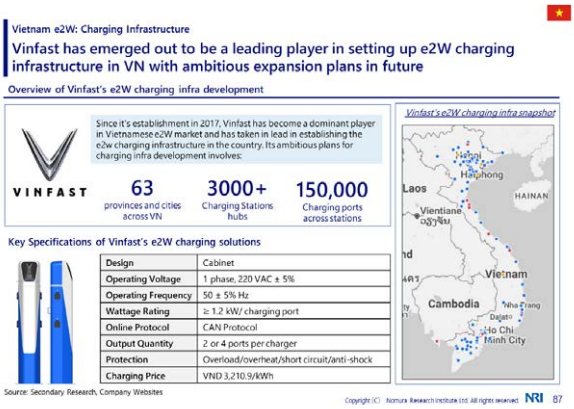

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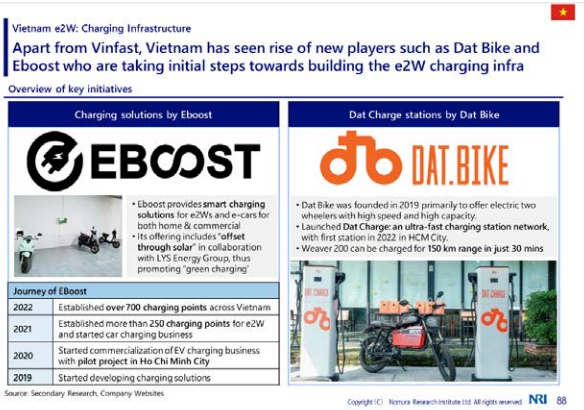

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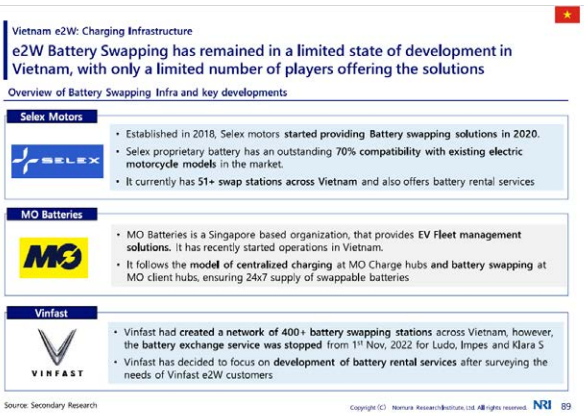


Vietnam (7)

37

Vietnam e2W: Charging Infrastructure

The growth of e2W charging and battery swapping infra has been primarily hindered by lack of technical regulations and standards

Overview of key challenges

Lack of charging station construction guidelines	• **No set of standards for building charging stations**, e.g. electrical connection system or the protection device system. • Challenges related to the legal framework guiding the **installation of charging stations in each specific locality** as each locality will have different interpretations and different instructions.
Absence of Inter-operability standards	• Bike to car ownership in Vietnam is around 30:1, resulting in population preferring 2W for their primary travelling needs • Though Vietnam government has specified the charging standards for electric cars and electric two wheelers, **Interoperability standards are absent**
Preference for home charging	• **Majority (over 60%) of e2W sold in Vietnam are powered by Lead Acid batteries**, that essentially lack the capability of fast charging. • **Buyers are accustomed to slow charging at home** during night time and hence, do not feel the need to go to charging station
Lack of incentives/subsidies for charging stations	• **No supply side specific incentives or subsidies** have been announced for development of e2W charging infrastructure • **No particular incentives such as subsidized charging rates**, etc. have been announced for e2W users to promote use of e2W charging stations
Power Quality concerns	• Vietnam's robust growth has resulted in strong electricity demand, leading to localized power shortages especially in HCM City. • Also, there exists a **limitation on the power supply to the charging station**, the level of power provided is uneven and sometimes not even available

Source: NRI Analysis, Secondary Research

 NRI 90

APPENDIX 6　PRESENTATION OF MAY 29, 2024

Data Collection Survey on Promoting the Electric Motorcycle Industry and Strengthening the Supply Chain in Indonesia

Final Seminar

Joint Venture:
Oriental Consultants Global
Pacific Consultants KK
NRI CONSULTING & SOLUTIONS (THAILAND) COMPANY LIMITED

Confide

Activities in the Survey


Interviews to users


Discussion withB4T


Discussion withNBRI

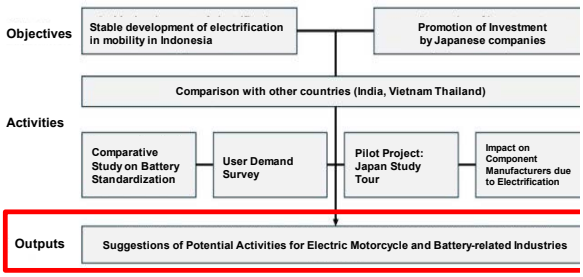

Discussion withITB


Discussion with AISI


Visit to B4T Lab

Framework of the Survey

Survey period: May 2023– July 2024 (15 months)



Today's Presentation

1. Survey Activities

1. Study on Battery Standardization
2. Study on Electric Motorcycle Demand
3. Interview Research for Components Manufacturers
4. Comparison analysis between India, Vietnam, Thailand, and Indonesia

Morning Session

2. Suggestions of "Potential Activities"

1. Battery Standardization
2. Battery Recycling
3. Human Resource Development
4. Motorcycle Parts Industry Support

Afternoon Session

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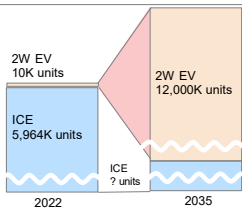
Background and Objectives of this JICA Survey

Background of this JICA Survey

- The Indonesian has set a target of **increasing the number of electric motorcycle production to 1 million units per annum (totally 12 million units) by 2035**, and is aiming to promote the spread of electric motorcycles domestically and **make it a sales/manufacturing base for key components such as batteries in Southeast Asia**.
- Most recently, **the government plans to install 32,000 public battery charging/swapping stations by 2030**, and has introduced **incentives for electric motorcycle owners, such as subsidy** for the purchase of an electric motorcycle.



2

Today's Presentation

1. Survey Activities

- Study on Battery Standardization
- Study on Electric Motorcycle Demand
- Interview Research for Components Manufacturers
- Comparison analysis between India, Vietnam, Thailand, and Indonesia

2. Suggestions of "Potential Activities"

- Battery Standardization
- Battery Recycling
- Human Resource Development
- Motorcycle Parts Industry Support

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Comments on SNI 8928 (Revised in 2023) in the hearing survey

■SNI8928 (2020)

Rated Voltage (V)	Minimum Rated Capacity (Ah)	Size (mm) N1	N2	N3
48	12	77	179	425
	20	290	103	218
		155	178	296
60	20	200	155	248
		230	90	350
		195	165	350
		200	170	270
		225	165	350
72	20	118	127	410
		190	160	305

Revisions:

- Narrowing down of battery types → Battery types around 48V adopted by Japan, Taiwan, etc. are excluded.
- Change in battery size (only the upper limit was changed to the regulation)
- Addition of nominal voltage range and maximum weight
- Change from current capacity (Ah) to power capacity (Wh)

Point:

- The narrowing down of battery types will not have a significant impact on manufacturers other than 60 and 72V in the immediate future because it is a voluntary standard.
- Concerns about future mandates.

■SNI8928 (2023)

[1] rated voltage (V)	Nominal voltage range (V)	Maximum mass (kg)	Minimum energy capacity (Wh)	Maximum size (mm) Long	Width	High
60	55 - 66	13	1.300	220	200	385
72	67 - 78					

[1] The rated voltage is different from the working voltage.

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Major swappable batteries in Indonesia
The market has more than 50, which is expanding.

	Gesits	Volta	Smoot	AHM	Oyika	Kymco	United	Electrum
Voltage	72 V	60/64 V	64/72 V	Approx. 50.26V	60 V	50.82 V	60/72 V	72 V
Capacity	1,440 Wh/unit	1,380/1,344 Wh/unit	1,300/2,100 Wh/unit	1,314 Wh/unit	1,680 Wh/unit	1,743 Wh/unit	1,680/1,440 Wh/unit	1,800 Wh
Dimension	120 x 160 x 420	240 × 150 × 20mm	140 × 177 × 330mm	Approx. 298 × 177. 3 × 156.3	120 × 170 × 340mm	-	-	-
Type	MNC	LFP	LFP	-(Lithium)	NMC	NMC	SLA/-(Lithium)	NMC
Certificate	-	-	IP67, CE, IEC 62133, UN 38.3	UNR 136	-	-	-	-
Weight	8 kg/unit	-	11/12 kg/unit	10.3 kg	-	10 kg/unit	-	10 kg/unit
SNI8928	-	Fulfilled	Fulfilled	-	Fulfilled	-	-	Fulfilled

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Comments on SNI 8928 (Revised in 2023) in the hearing survey

- Some commentators suggested that the intention to narrow down the battery types covered by SNI and to revitalize the market worked in the revision at the end of 2023. Since then, the annual number of newly registered electric motorcycles in 2023 has increased to over 60,000 units, or slightly more than 1% of total motorcycle sales, but the contribution of the subsidy policy is significant, and the contribution of narrowing the battery type is not large enough to be apparent at this point. It is expected to depend on the sharing of batteries among manufacturers and progress in the development of shared infrastructure (e.g., exchange stations).
- Even if a standard is established and certified, it is doubtful that the batteries supplied will always comply with the standard (meet the required performance and safety) (A pioneering study by the National Battery Research Institute has shown that batteries do not meet their stated performance and that there is a wide variation in quality among the cells within them).

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Standards about Electric Motorcycles

Standards related to Electric Motorcycles	No.	
Dimension of battery cells	ISO/PAS 16898	
Performance and safety test of battery cells	SNI IEC 62660-1-2017	
	SNI IEC 62660-2-2017	
	SNI IEC 62660-3-2016	All of these SNIs are voluntary
Performance test of battery packs	SNI 9102:2022	
Safety test of battery packs	SNI 8872:2019	
Performance test of swappable battery packs	SNI 8927:2020	
Safety test of swappable battery packs	SNI 8928:2023	

Source: NBRI, BSN

<Others>

- **BSN: Conformity Assessment Scheme for Indonesian National Standards of Electrotechnical, Telecommunications, and Optical Products (2021)**
- **MOT: Regulation No. 44 of 2020 proi all vehicles produced in the country or imported from abroad must obtain a type test certificate according to UNR 100 (electric vehicles) and UNR 136 (electric motorcycles)**

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- Motorcycle Parts Industry Support

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Demand Survey

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Outline of the Demand Survey

Objective: To identify issues for the diffusion of Electric motorcycles (2W-EV) from the users' perspective

Research Questions & Survey Items

Key Research Questions	Main Survey Items
Understanding the actual (objective) use of 2W-EV ▪ What are the current use of 2W -EV and how do they differ from those of 2W-ICE (increase/decrease in mileage, increase/decrease in maintenance, etc.)?	1 Current Usage (Actual usage, Maintenance status, Differences from 2W-ICE)
Identification of Key Purchasing Factors ▪ What do users consider important when selecting and purchasing 2W-EV?	2 Key Purchasing Factors (Motivation for using 2WEV, Selection criteria, Attractive brands)
Understanding the subjective experience ▪ What do users think about the convenience and experience of using 2WEV (especially the advantages and disadvantages compared to 2WICE)?	3 Convenience and User Experience (Pros/Cons of 2W-EV compared to 2W-ICE, Satisfaction with use of 2WEV)
Identification of key issues for diffusion ▪ What do users consider critical for the diffusion of 2W EV?	4 Issues and Needs (Encountered problems, Bottleneck factors in the diffusion of 2WEV, Recommended measures)

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Demand Survey

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Survey Targets and Overall Survey Process

- Survey targets are classified from 2 perspectives: "User attribute" and "Type of 2W".
- Survey was conducted in 3 phases through a combination of interviews, questionnaires, FGDs, and House visits.

Survey Target Segments

Legend ◎: Main target, ○: Target for comparison

User Attribute \ Type of 2W	EV (Battey-swappable)	EV (Plug-in)	ICE	E-Bike
Business user	◎	◎	○	–
Private user	◎	◎*	○	○

* Private users of EV converted from ICE were also surveyed.

Overall Survey Process

Phase	Period	Methodology	No. of respondents	Location
Trial	Jul 2023	Offline interview	20	Jakarta
Phase 1	Sep-Oct 2023	Offline interview	50	Jakarta, Bogor
		Online questionnaire	188	Online*
Phase 2	Dec 2023	FGDs	37	Karawang, Denpasar, Makassar
Phase 3	Feb-Mar 2024	Online questionnaire	208	Online*
		House visits	7	Jakarta, Tangerang, Bandung

* Online questionnaire survey covered all of Indonesia.

Approx. 500 users are surveyed in total

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Demand Survey

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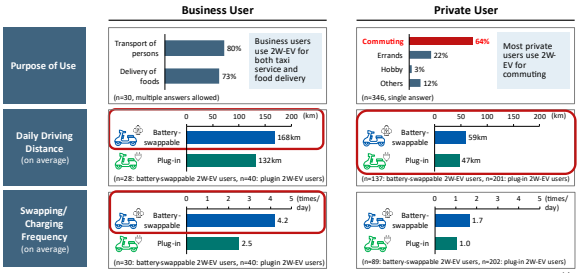
Key Findings | 1. Current Usage (1/2)

- **Business users** of battery-swappable EV drive 150-200km, and **swap batteries 4-5 times per day**.
- **Private users use 2W-EV for commuting**, and travel less than 60km (within mileage per battery).



Source: JICA Survey Team

Note: "n" means number of valid responses for each item.

Demand Survey

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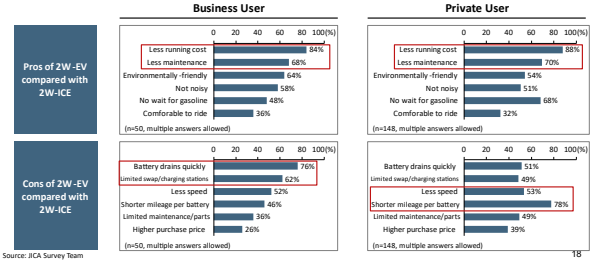
Key Findings | 3. Convenience and User Experience (1/2)

- Both business and private users find **2W-EV more convenient than 2W-ICE** because of **less running cost and less maintenance**
- **Business users** tend to **complain about fast battery depletion and difficulty to find swap stations** while **private users** are more likely to be **dissatisfied with shorter mileage and less speed**



Source: JICA Survey Team

Demand Survey

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Key Findings | 1. Current Usage (2/2)

- **Business users prefer battery-swappable 2W-EV**, which can save charging time.
- **Private users prefer plug-in 2W-EV**, which allow them to manage the battery by themselves.
- Some users complain about **limited-service places and swap stations outside Jakarta** . Therefore, **expansion of swap stations, maintenance and parts supply** are important issue for further diffusion of 2W -EV.

	Business User	Private User
Swapping/ Charging Behavior	*"Prefer battery-swappable type because you don't have to wait a long time for charging"* - Business User in Bali "Usually swap when the battery level is at 30-50% to avoid the quality deterioration of the battery" - Business User in Makassar	*"Prefer plug-in type because I can control battery health"* – Private User in Karawang "Usually charge at home around 7 to 9am, from 50% to 100%. Home electricity capacity of 2,200W is sufficient and I have experienced no problems about home charging" – Private User in Jakarta
Maintenance	"Have replaced shock breakers and brake parts, but the cost is covered by Grab. Safer I have experienced no problems. - Business User in Makassar "Sometimes parts need to be supplied from outside the city (Cakung or Cikarang) and takes time" - Business User in Karawang	"There are no costs as the motorcycle is still under warranty. 2 years for spare parts and 3 years for battery. Maintenance is carried out at the OEM service center because general workshops refuse EV repair because they don't have knowledge" - Private User in Bali
Difference from ICE	"Income is not changed, but I think customer satisfaction has increased because of the comfort. - Business User in Bali "Running cost of EV is lower, but transport areas are limited due to lack of swap stations in some areas" - Business User in Makassar	"Driving distance is the same so far. Regarding service, the problem is that EV service places are still limited" - Private User in Bali *"Maintenance is easier because you don't need to change oil, buy petrol and do routine service"* - Private User in Karawang

Source: JICA Survey Team

Demand Survey

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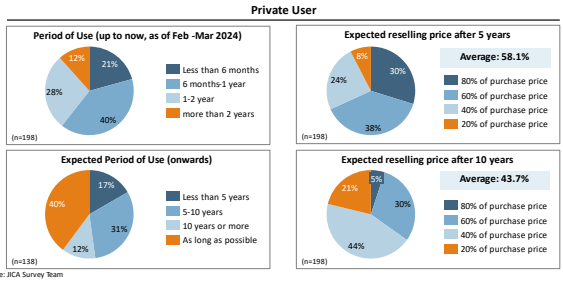
Key Findings | 3. Convenience and User Experience (2/2)

- **The period of use of 2W-EV is short so far, less than two years in most cases** and no major problems have arisen among users. However, it is necessary to be aware of the **risk of a decline in the resale value of 2W-EV after a few years**, which may affect the demand for 2W-EV.



Source: JICA Survey Team

Demand Survey

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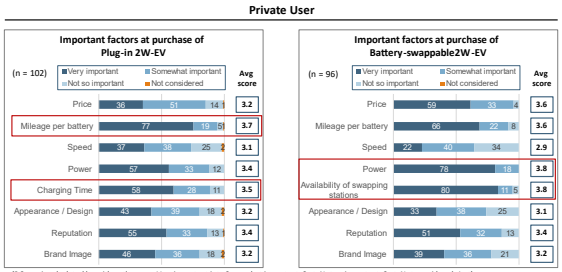
Key Findings | 2. Key Purchasing Factors (1/2)

- **Plug-in EV users** consider **"Mileage per battery"** and **"Charging time"** as more important, while **Battery-swappable EV users** prioritize **"Availability of swapping stations"** and **"Power"**.



(* Score is calculated by arithmetic mean: Very important4pt , Somewhat important: 3 pt, Not so important: 2 pt, Not considered: 1 pt)
(** 36 respondents (Plug-in) and 21 respondents (Battery-swappable) answered "aftersales support" as the other factor that they considered important)

Source: JICA Survey Team

Demand Survey

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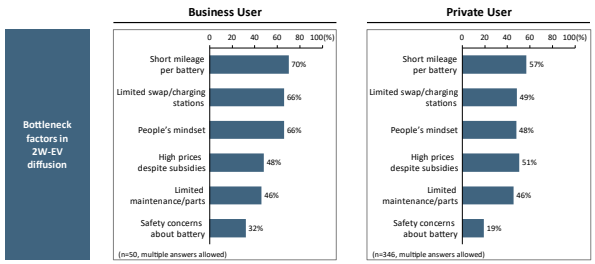
Key Findings | 4. Issues and Needs (1/2)

- Other than prices, **bottleneck factors in the diffusion of 2W-EV** include (1) **performance issues (mileage per battery)**, (2) **inadequate swap/charging stations** (3) **mindset of people**, and (4) **inadequate maintenance and parts supply**



Source: JICA Survey Team

Demand Survey

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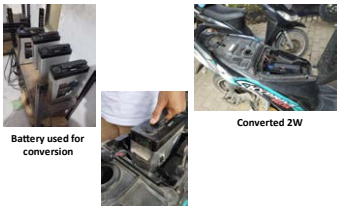
Key Findings | 2. Key Purchasing Factors (2/2)

- The survey found that there was **a certain demand for conversion of 2W-ICE to 2W-EV** among users who want to save gasoline costs while keeping the body of 2W-ICE.
- However, there is a **disadvantage of warranty expiration after conversion** Therefore, the issue is whether government incentives can cover this disadvantage.

Case study of small conversion workshop



Battery used for conversion

Converted 2W

- **Conversion Cost**: IDR 16M (8M for conversion, 8M for battery).
- **Conversion period**: 1 day if batteries are in stock
- **Human resources**: 2 engineers who have taken a 10-day training provided by ESDM
- **Subsidy:** Not applied because the workshop didn't satisfy the government requirements.
  The workshop must be equipped with installation tools that cost more than IDR 500M, but the workshop couldn't afford them

Source: JICA Survey Team

Demand Survey

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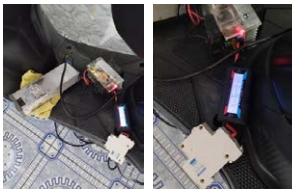
Key Findings | 4. Issues and Needs (2/2)

- Though most users did not consider "safety" as an issue, the survey found unsafe usage, incl. modifications to high-capacity batteries and the use of second-hand fast-charging devices.

Modification to high-capacity battery

Use of second-hand fast-charging devices



There were dangerous sparks during fast -charging

Source: JICA Survey Team

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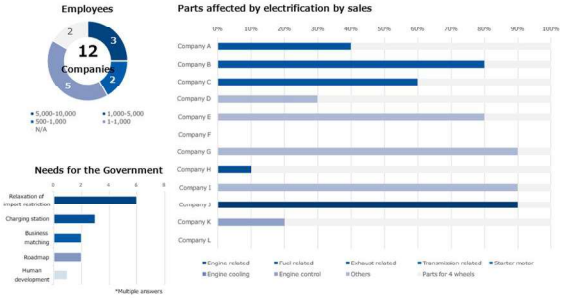
Results of Interview Survey in Indonesia (Japanese suppliers in IDN)



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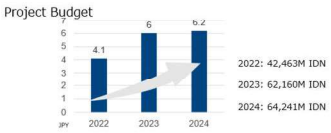
Mikata Project in Japan ～ Achievements ～

KPI for Short term
1,200 companies (2023,2024)
Number of company supported by training, seminars and expert dispatches.

Support Menu	2023	2024	Achievement
Seminars and trainings	84 times 2,938 companies	180 times 3,892 companies	↗
Individual consultation	675 times	1,192 times	↗
Expert dispatches	63 companies 136 times	111 companies 371 times	↗

KPI for Middle term
1,000 companies
Number of SMEs that were able to progress through the stages of business transformation.



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Results of Interview Survey in Indonesia (Local suppliers in IDN) 1/2

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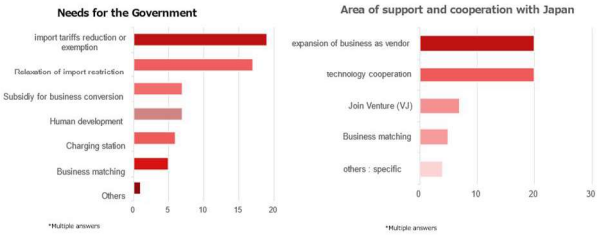
Results of Interview Survey in Indonesia (Local suppliers in IDN) 2/2



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Suggestions for the Government of Indonesia

Number of suppliers to be affected : Approx.500 suppliers

1 Current actions by suppliers

- The majority of Japanese and local companies expect that there will be no major impact around by 2030.
- However, they are considering specific measures based on the assumption that there will be some or significant impact in the next five to ten years.
- Local companies are particularly concerned about the significant impact, and many of them are trying to develop their business models by moving away from conventional business models "copy to make" and expanding into new fields.

2 Needs for support by the government

- A realistic roadmap and measures based on communication with related industry in promoting EVs.
- Relaxation of import restrictions on steel materials
- Technical cooperation by the Japanese Government
- Support for business matching with new customers, etc.

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Comparison between India, Vietnam, Thailand, and Indonesia

Background and Targets

- Case studies will be conducted in India, Vietnam, and Thailand, and the results will be used in the future when determining standards for interchangeable batteries in Indonesia.
- These countries were selected because, like Indonesia, they are "currently in the process of determining the standards for interchangeable batteries," and they are "aiming to become future Asian sales bases for electric motorcycles.

Comparison Items

- Market and Customer Preferences
- Market Share
- Policies and Regulations
- Manufacturing and Supply Chain
- Charging/Exchanging Infrastructure

} These were compiled with a focus on Indonesia's competitive advantages.

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Comparison between India, Vietnam, Thailand, and Indonesia
Market and Customer Preferences

Low Medium High

	INDIA	VIETNAM	THAILAND	INDONESIA
Share of 2W sales	2Ws make up around ~75% share in total automobile sales by units.	2Ws account for ~90% share in total automobile sales by units.	2Ws account for ~85% share in total automobile sales by units.	2Ws account for ~85% share in total automobile sales by units.
e2W Sales Penetration (2022)	~5% 2022 sales = 845K units	~10% 2022 sales = 350K units	1.15% 2023 sales = 22K units (All EVs registered in Thailand are equivalent to L2)	~1% 2023 sales = ~62K units
Preference for Li-ion batteries	~95% share of e2W's sold are using li -ion batteries.	~60% of e2W are powered by Lead Acid Batteries.	Almost 100% of e2W's sold are powered by li -ion batteries.	~90% of e2W's sold are powered by li -ion batteries.
Typical Daily Usage	Private: 25~30km Commercial: 75~80km	Private: 20~30km Commercial: 80~100km	Private: 20-50km Commercial: ave. 100-200kKm	Private: 15-70km Commercial: 100-200km
e2W Fleet Maturity	Various companies are typing up with e2W manufacturers for fleet operations. E.g. Zypp electric utilizing Hero electric models, eBikeGo providing fleet for Zomato, Swiggy, etc.	Very limited cases (pilots) of fleet operators typing up with OEMs for e2W fleet. E.g. Gojek and Dat Bike, Baemin and Selex, etc.	In thailand, fleet partners are not involved in the commercial process, so it's up to the driver to decide whether to choose a battery -powered vehicle.Plug in type direct sales, swap battery is b2c for b: bike owned by driver used for business such as delivery ; if run 200km/ day EVbike will reach break even point in short term ; E.g. EV manufacturer Etran has partnered with ShopeeFood (food delivery) and Krungsri Bank to offer special rental prices to ShopeeFood riders; Swap-Go and 7-Eleven have partnered with SwapEV, etc. (swap market 10%, plug in hybrid ; 90% mainly upcoutnry performance is low ; power and charging 5-7 hours are the hindrance of pnettration) covid ; food delivery is already gone, rental scheme (revolving type will not increase) investment for charging station Nieu, HSEM , Etrans, no company has any profit.	Emerging scenarios of fleet operators utilizing e2W fleet. E.g. Gogoro and Gojek, Grab and Kymco, etc.

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Comparison between India, Vietnam, Thailand, and Indonesia
Charging Infrastructure

Low Medium High

	INDIA	VIETNAM	THAILAND	INDONESIA
Targets	One public charger within 3km x 3km grid in cities and one charging station every 25km and one fast charging station on every 100km on highways.	No clear goal. Some private companies have announced individual targets.	The Ministry of Industry's Bureau of Economy, Trade and Industry targets 8,000 charging stations for motorcycles and 1,450 for motorcycle cabs by 2030.	No clear goal. PLN needs 31,000 charging stations by 2030.
Installation Base	More than 6,800 public charging stations for more than 1.5 million e2Ws sold in the last 7 years.	Over 1,500 public e2W charging stations for 1mn+ e2W sold in last 4 years.	As of September 2023, approximately 300 public charging stations have been installed. HSEM and Niu(Winnonnie around 200) Honda 40	Over 400 charging stations on more than 89,000 e2W units sold in the past 5 years.
Policy and Standards	Well defined standards for chargers and charging station setup. Adherence to charging sockets is not mandatory with OEMs using their proprietary chargers such as Ather, Ola Electric, etc.	No particular standards defined for setting up charging stations. Companies are relying on global standards for guidance.	Specific criteria for the installation of charging stations are not defined. The electrical connections of the stations are required to comply with the IEC standards set forth by the Electric Power Authority.	Ministry of Energy and Mineral Resources Regulation No.13/202 establishes detailed requirement for changing stations.
Charging Business viability	Large number of players offering charging station facilities such as Ather Grid, Ola Electric, Etc.	Limited number of players such as VinFast, Ebcost and Dat Bike providing charging station facilities.	Charging stations are mainly supplied for four-wheelers, with limited availability for two-wheelers.	Only a limited number of companies provide station facilities, and in Indonesia, the state-owned power company PLI has taken the lead in charging infrastructure development.
Grid Impact	99% of urban and 95% of rural households have electricity access. India is self-sufficient in electricity production. Low impact of e2W's.	Vietnam already has challenges in meeting the electricity demand. EV charging infra is expected to further aggravate the challenges.	Officials from the electric utilities (PEA and MEA) believe that the demand for charging batteries for electric two-wheelers has a low impact on the overall grid.	Limited Impact. 4% impact on grid with expected e2W penetration by 2030.

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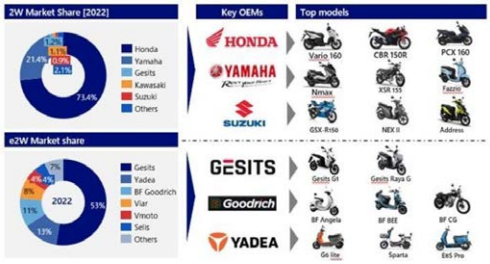
Comparison between India, Vietnam, Thailand, and Indonesia
Market Share

Indonesia's Competitive Advantage **Major global OEMs have already entered the market and have established supply chains for ICE models**(Note that Honda and Yamaha have a 94% share of the motorcycle market, while local EV brands dominate the electric motorcycle market.)



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Comparison between India, Vietnam, Thailand, and Indonesia
Exchanging Infrastructure

Low Medium High

	INDIA	VIETNAM	THAILAND	INDONESIA
Growth of Swap Stations	High growth seen in battery swap stations being set up by key players: Sun Mobility – 240+ swap stations Battery Smart – 690+ swap stations Yulu (Yuma Energy) – 85+ swap stations	Very limited growth, with Selex setting up 50+ swap stations and pilot project by MO batteries. Vinfast discontinued swap station services in favor of rental services.	Swap stations are offered byWinnonnieHonda, Hsem, Swap&Go, Etran, and others. The pace of growth in the number of stations is still slow due to the lack of significant growth in demand for EV bikes. Winnonie, which has the most, has 103 stations, and the scale of the swap station business in Thailand is still small.	Moderate growth, with over 960 swap stations setup by March 2023 State power company PLN is taking the lead by setting up SBPKLU swapping stations.
Interoperability Standards	BIS announced draft battery swapping standards for4W EVs, with e2W consideration at later stages.	No interoperability standards have been announced, with OEMs using customized battery packs and subsequent swapping systems.	Currently, companies are using customized batteries. ENTEC, under the National Science and Technology Development Agency (NSDTA) of Thailand, is taking the lead in conducting an R&D project with EV motorcycle manufacturers and others to standardize swap battery packs, and plans to form the Swap Battery Consortium this year to establish standards.	No Standardization of batteries for swapping.e2W OEMs are using customized batteries resulting in each battery swap station caterin to limited number of models only. Plans to standardize batteries for e2W usage and swapping services.
Swapping business viability	Large number of players offering battery swapping services such as Battery Smart, Sun Mobility, Yulu, Bounce Infinity, etc.	In initial stages of development, with very few players such as Selex and MO batteries in battery swapping space.	Thai motorcycle users traditionally demand high acceleration and power, and EV bikes are still not very popular. The price of EV is alomostdouble of ICE. Therefore, EV bikes remain mainly rental for fleet riders, and there is a need to improve the merchantability of the bikes and standardize swap batteries. Difficult to sell to buyers who buy as asset as EV bikes value drops faster than ICE: 40% down in 1 year VS Honda ICE only 20-30%	Battery swapping has picked up with increasing number o players such as Gogoro, Volta, Swap Energy, etc. offering battery swapping services.
Battery standards	Battery standards defined on safety and performance.	Battery standards are not defined.	The UNR 136 (safety) standard is already mandatory.forsubsidized EV bikes	Battery standards are not defined.

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Comparison between India, Vietnam, Thailand, and Indonesia
Policies and Regulations

Low Medium High

	INDIA	VIETNAM	THAILAND	INDONESIA
National EV Roadmap	Well defined EV policy and Roadmap.	No EV roadmap defined.	Well defined EV policy and Roadmap.	Well defined EV policy and Roadmap.
National Targets	80% of e2W sales penetration by 2030.	Defined EV penetrations targets, with 100% green transport network to be achieved by 2050.	Defined target of 360,000 units by 2025 and 675,000 units (30% of production) by 2030. In 2023, 22,000 motocyclessold vs target 80,000	By 2030: e2Ws shall outpace fossil units in newly sold units, target of 12mn e2W (culumlativ sales) in Indonesia by 2030.
Demand Side Incentives	Financial incentives, tax incentives and preferential access.	No incentives for e2W Import tax exemption for e4Ws.	Subsidy of 10,000* baht (reduced from 18,000 baht last year) for domestically produced vehicles* only. (year 2025, old models alreadyregisted UNR 136 Thailand introduces safety standards with 2-5 years time lag) (* already registered models can use 180,000unit 2025) (**Battery capacity of3kwh, retail price of 150,000 baht or less)	Financial incentives, tax incentiv and preferential access.
Supply Side Incentives	Financial incentives, tax incentives, regulatory hurdle reduction and capability building.	No incentives for e2W Import tax exemption for e4Ws.	e2W corporate tax exemption (3 years:BOI's A4Status).	Low risk weightage of loans, CIT holiday, Import duty exemption.
Charging Infrastructure Support	Incentives for charging equipment procurement and setting up of charging stations, announced policy for industry standardization.	No support announced for development of charging infra.	Chargers: e2W corporate tax exemption (3~5 years) Swap station:A3 status in BOI (5 years) ; no one invest for now.	Discount on electricity rates, relaxed credit score evaluation, standard for EV charging infrastructure, Battery swapping infrastructure, Battery swapping standards are missing.
Recycling Eneber	Buyback and scrappage incentives. Promotion for circular economy through EPR (extended producer's responsibility).	No support announced for li-ion battery recycling ecosystem development.	For measures to recycle used batteries, a subcommittee on ELVs has been formed under the National Electric Vehicle Polic Committee (NEVC). No specific law (setup a fine for not well managed) Battery recycling is currently under consideration by TESTA, TAI ENTEC, and other government agencies. Testa = Thailand energy storage association TAI=Thailand Automotive Association ENTEC=National Energy Technology Center	End-of-life battery recycling measures; detailed roadmap for recycling ecosystem need to be developed.

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Confidenti

Comparison between India, Vietnam, Thailand, and Indonesia
Summary

Comparison Items	Indonesia's Competitive Advantage
Market and customer preferences	Indonesia's motorcycle market is the world's third largest, rivaling India and Vietnam in terms of production share.
Market Share	Major global OEMs have already entered the market and have established supply chains for ICE models.(Note that Honda and Yamaha have a 94% share of the motorcycle market, while local EV brands dominate the electric motorcycle market.)
Policies and Regulations	A clearly defined government policy and roadmap for the electrification of motorcycles and a detailed action plan to achieve the electrification goals.
Manufacturing and Supply Chain	The supply chain for electric motorcycle components can be leveraged due to the abundance of key raw materials (e.g., nickel and cobalt) needed to manufacture batteries.
Charging/Exchanging Infrastructure	While the readiness to develop charging infrastructure is in place, clear goals need to be established to guide specific actions.

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Confident

Comparison between India, Vietnam, Thailand, and Indonesia
Manufacturing and Supply Chain

Low Medium High

	INDIA	VIETNAM	THAILAND	INDONESIA
Raw Material Reserves	No significant reserves of Nickel, lithium or cobalt.	Abundant reserves of Nickel and Cobalt.	There are no significant reserves of Nickel and Cobalt. On the otherhand, there were recent reports of 15 million tons of lithium reserves in the south, but the government later revised downward.	Largest reserves of Nickel, Abundant copper and cobalt reserves.
Raw Material Mining and Processing	Very limited scale of Nickel and cobalt mining and processing. No lithium processing currently.	No mining is being done currently. Only one Nickel project being undertaken.	No mining is being done currently.	Established Nickel mining and processing industry.
Cell Manufacturing	Though currently imported, many companies are setting local cell manufacturing plants.	No cell manufacturing currently. Few players expected to start production in 5 years.	Cells are produced atAmita, a subsidiary of Energy Absolute (EA), but not for motorcycles. (production capacity 1 GWh)	Currently imported; domestic production expected by 2026.
Pack Manufacturing	Battery pack assembly mostly done in-house.	Battery packs usually imported, limited companies doing pack assembly in-house.	Battery packs usually imported. Brands such as Storm manufacture packs in-house. Currently battery import tariffs is high : imported from China and India	Battery packs usually imported, limited companies doing pack assembly in-house.
BMS	BMS developed in-house. Many players offering domestic solutions.	Mostly imported as part of battery pack.	Mostly imported as part of battery pack.	Mostly imported as part of batte pack.
Recycling Enabler	Li-ion battery recycling at limited scale, with GOI imposing EPR.	Li-ion battery recycling ecosystem needs to be developed.	Li-ion battery recycling ecosystem needs to be developed.	Li-ion battery recycling ecosystem needs to be developed.
Electric Motor & Controllers	Various companies manufacturing and supplying locally.	Mostly imported, very few domestic suppliers.	Mostly imported, very few domestic suppliers.; mainly imported from China	Mostly imported, very few domestic suppliers.

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Potential Idea

The Process to come to 4 proposed Potential Activities

1. Japan Invitation Program

JAMA, Hioki (Standardization, Test)	4R Energy (Battery Refurbish)	SEKISUI, NITE (Test, HRD)	METI (Mikata Project)

2. Issues clarified in the Survey Activities

- Safety of imported batteries, no system to pursue liability in case of accidents **(Battery Standardization Survey, User Demand Survey)**
- No attention is paid to recycling and reuse of batteries and ELVs **(Case Studies of Other Countries)**
- HRD for business persons is already monetalized by the private sector and the education for high-school level will accelerate the bottom-up **(Battery Standardization Survey)**
- Rapid electrification is forcing more SMEs to change their business **(Components Survey).**

Potential Cooperation Activities

1. Battery Standardization
2. Battery Recycling
3. Human Resource Development
4. Motorcycle Parts Industry Support

3. Global trend

- Accidents caused by defective batte becoming more frequent and increas need for testing laboratories for qua safety control.
- From the perspective of preserving global environment, there is a move penalize countries that fail to comply
- There is a shortage of human resou every country to take charge of batt semiconductors, and AI.
- The business transformation of the I component industry into the electrifi industry is considered to form the ba the next generation of industrial development.

4. Perspective of Japan

- Aiming rebound on battery related industries
- Late penetration in Indonesian 2W-EV market
- Pioneer in End Life Vehicle (ELV) and battery management in the world
- Lack of engineers, and Battery HRD consortium being active
- EV and battery education course being established in higher education
- Mikata Project (Sup SMEs for applying converting their bus to electrification)

Potential Idea

Idea to Strengthen the Implementation System of Safety and Performance Test of Swappable Batteries for Future Battery Standardization

Output	Activities
1) Safety and performance test skills will be acquired by B4T staff and the training will be manualized.	1-1 Based on SNI8927 and other standards, make a list of test items required to ensu safety and performance and the test facilities (equipment, buildings, and other f for these test items. 1-2 Select highly prior test equipment in terms of importance, versatility, and procur cost, and install them in B4T. 1-3 Training on the installed test equipment will be provided to B4T technicians. 1-4 Training of other test equipment will be conducted in Japan. 1-5 Organize the training program for test equipment as a manual.
2) Conduct safety and performance tests of batteries on the market.	2-1 Establish a cooperative relationship with battery manufacturers (or electric moto manufacturers) to conduct safety and performance tests of batteries on the Indo market as a pilot project. 2-2 Study test items for the pilot project. For items that require test equipment othe those already installed, the possibility of cooperation with private test organizati be considered. 2-3 Conduct safety and performance tests of batteries from battery manufacturers (e motorcycle manufacturers) that cooperate with the pilot project. 2-4 Analyze the test results jointly with cooperating manufacturers and identify issue

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2. Suggestions of "Potential Activities"

- Battery Standardization
- Battery Recycling
- Human Resource Development
- Motorcycle Parts Industry Support

Potential Idea (TE

Idea to Strengthen the Implementation System of Safety and Performance Test of Swappable Batteries for Future Battery Standardization

Output	Activities
3) Draft a mid and long term development plan for battery safety and performance testing equipment and functions	3-1 Based on the test results and future battery demand/supply forecasts, implementatic system and requirement of safety and performance tests in the future will be discuss together with cooperating manufacturers. 3-2 A mid and long term development plan for text facilities managed by a governmental agency (e.g., B4T) will be developed.
4) Develop a draft policy for mandatory battery safety and performance testing.	4-1 Based on the results of the pilot project, conduct discussions on mandatory battery safety and performance tests and the test items that should be made mandatorywit the Ministry of Industry. 4-2 Conduct interviews with battery (or electric motorcycle) manufacturers and organize their opinions on mandatory tests. 4-3 Make suggestions to the Ministry of Industry regarding mandatory tests.

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Potential Idea

Idea to Strengthen the Implementation System of Safety and Performance Test of Swappable Batteries for Future Battery Standardization

Overall Goal	Contribute to improving the reliability and competitiveness of electric motorcycle and battery-rela industries in Indonesia.
Purpose:	The system for conducting safety and performance tests of swappable batteries in Indonesia will b strengthened.
Background	• There are more than 60 electric motorcycle manufacturers in Indonesia. • Many of them use Chinese-made batteries (cells imported from China and packed in Indonesia Indonesian battery manufacturers). • In a pioneering research conducted by the NBRI, actual measured values were observed to be than the performance claimed by the manufacturers. • Cases of ignition of on-board batteries of electric two-wheelers have been reported in Indones and as the number of units (number of units) on the market further increases, there is concern accidents will occur with the frequency currently reported in India, China, and other countries. • Currently, tests of the safety and performance of on-board batteries are voluntary, but it is important to implement battery tests to ensure safety and performance as the number of veh increases. • When the Indonesian government aims to standardize batteries, tests to demonstrate compli with standards are essential, and are indispensable for the development of the electric motor and battery industries in Indonesia. • Strengthening the test function of B4T will contribute to the development of a healthy market of fraudulent and inferior products, and such a market is expected to attract investment by for capital, including Japanese companies.

Potential Idea (TE

Idea to Strengthen the Implementation System of Safety and Performance Test of Swappable Batteries for Future Battery Standardization

Expected Schedule

Phase	1st Year	2nd Year	3rd Year
Phase 1 For Output 1	Procurement Training with cooperative test agencies	Training using procured equipment	
Phase 2 For Output 2	Discussions for establishing the cooperation with manufacturers	Pilot project: test batteries	
Phase 3 For Output 3			Discussions for mid and long term development plan
Phase 4 For Output 4			Discussions for mandatory safety and performance tests

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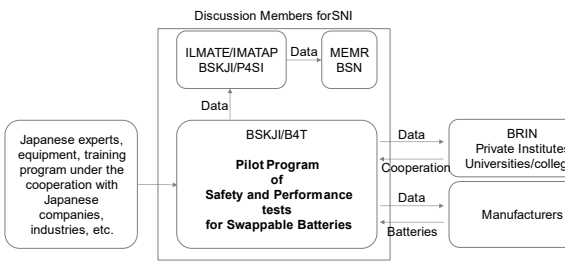
Potential Idea

Idea to Strengthen the Implementation System of Safety and Performance Test of Swappable Batteries for Future Battery Standardization



Idea to Strengthen the Implementation System of Safety and Performance Test of Swappable Batteries for Future Battery Standardization

Kansai Human Resource Development Consortium

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Idea to Strengthen the Implementation System of Safety and Performance Test of Swappable Batteries for Future Battery Standardization

Equipment required to perform SNI test items

No	Equipment Name	No	Equipment Name
1	Charging and Discharging Devices	13	External short-circuit device
2	Thermostatic tanks for charging and discharging equipment	14	Over-charge and over-discharge protection
3	Charging and Discharging Systems	15	Insulation resistance tester
4	Vibration testers	16	Thermal camera
5	Shock testers	17	Monitoring system
6	Drop testers	18	Weighing scales
7	Fire resistance testers	19	Measuring instruments
8	Thermostatic chambers for storage tests	20	Vaults
9	Thermal shock	21	Network Systems
10	Oven chambers	22	Generators
11	Environmental tester 1	23	Utilities
12	Environmental tester 2 (salt water)		

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Potential Idea (TE

Activity Idea for Used Automotive Batteries in Indonesia

Survey Items	
	1. Stakeholder Analysis The following stakeholders related to automotive batteries in Indonesia will be analyzed in terms of thei individual organizational status, industry size, and correlations: automotive battery packers, cel importers, cell manufacturers, manufacturers of electric motorcycles used, replacement service provider dismantlers, and collectors, 2. used vehicle battery packers, cell importers, cell manufacturers manufacturers of electric motorcycles used, replacement service providers, dismantlers, collectors processors, final disposal site operators, recyclers, reuse companies, repurpose companies in Indonesia **2. Analysis of the present situation of used automotive battery management** Current situation of collection, recycling/reuse/re-purposing, and disposal of used automotive batterie in Indonesia **3. Survey of legal systems related to used automotive batteries** Survey on legal systems related to the manufacture, transportation, storage, use, collection recycling/reuse/repurpose, and disposal of batteries in Indonesia.

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   - Battery Recycling
   - Human Resource Development
   - Motorcycle Parts Industry Support

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Potential Idea (TE

Activity Idea for Used Automotive Batteries in Indonesia

Survey Items	
	4. Demand Forecast Based on the roadmap in the Ministerial Decree No. 28 of Industry 2023 and other projections of futur increase in automotive batteries, conduct demand forecasting for recycling/reuse/repurpose an disposal of used automotive batteries. **5. Case Study** Study on the used battery management system in Japan, Europe, the U.S., and China. Especiall pioneering activities for NISSAN Leaf is a good example. **6. Identifying issues and policy suggestions for used battery management system in Indonesia** Based on the results of each survey item above, identify issues that need to be resolved in order t realize appropriate management of used automotive batteries in Indonesia. Policy suggestions will als be made to resolve these issues. **7. Training in Japan** Visit public and private facilities related to the used battery management in Japan and utilize the resul for policy formulation in Indonesia.

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Potential Idea (TBD

Activity Idea for Used Automotive Batteries in Indonesia

Purpose	Preparatory survey for a system of used automotive battery management in Indonesia: collection, recycling/reuse/repurpose, disposal, etc.
Expected Achievement	The Survey will provide the first step in realizing appropriate management of used automotive batteries in Indonesia, including a review of the current situation, future demand forecasts, case studies from other countries, and finding issues, and will provide policy suggestions regarding the realization of appropriate management of used automotive batteries.
Expected Following Activities	Based on the achievement of the Survey, each component of the proper management system for used automotive batteries in Indonesia may be improved and strengthened by the Indonesian government and by cooperation with the Japanese government.
Background	• Indonesia is expected to generate a large volume of used lithium-ion batteries in the future. • Lithium-ion batteries are toxic and can cause ignition due to shock and other hazards, so they must be disposed of properly. • In addition, considering the finite nature of the scarce metal resources used in battery production and the fact that reuse and repurposing are possible depending on the degree of deterioration, Indonesia should consider recycling and other measures in Indonesia, where a certain number of used batteries can be secured. • In Indonesia, although there are plans and individual initiatives for the development of recycling and proper disposal facilities, there is no such thing as a master plan based on a basic survey that accurately captures the current situation, a roadmap for the future, and the development of a legal system and implementation framework.

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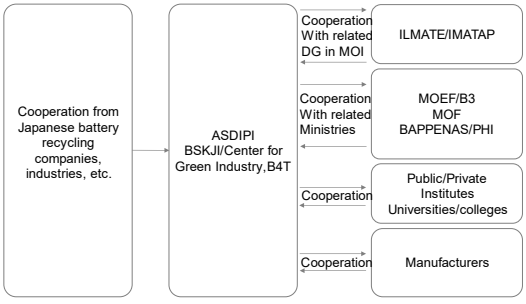
Activity Idea for Used Automotive Batteries in Indonesia

Example: KLHK/B3 introduced current situation of battery management in Indonesia

Potential Idea (TE

Activity Idea for Used Automotive Batteries in Indonesia

■ Implementation Structure:



■ Period: 12-18 months

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   - Human Resource Development
   - Motorcycle Parts Industry Support

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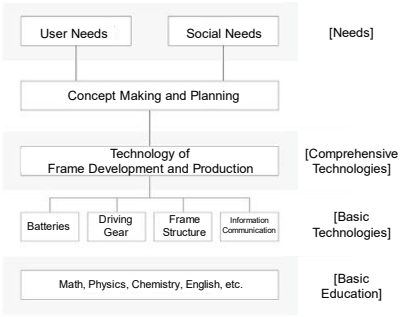
Potential Idea

Idea to Enhance Human Resource Development for Battery related Industries

Overall Goal	Contribute to the competitiveness of battery-related industries in Indonesia.
Projec Purpose:	Establish a system to develop industrial human resources engaged in batteryrelated industries i Indonesia.
Background	• In Indonesia, the localization of manufacturing is progressing, with plans to build a factory th will manufacture electric motorcycles and batteries from cells, rather than only packing them • As the number of electric motorcycles manufactured and sold increases, demand for personr with expertise in batteries is expected to increase. Demand is particularly high for mechanics charge of maintenance and repair of electric motorcycles. • n Japan, there are already programs that provide specialized education on electric motorcycl and batteries, and the Kansai Battery Human Resource Development Consortium is conducti human resource development through industry-academia-government collaboration. • Training services for working people on electric motorcycles and batteries are provided by the NBRI as a private-sector project, and are in demand by PLN, IBC, and others.

Example: Educational System in Professional University of Electric Mobility Systems in Japan



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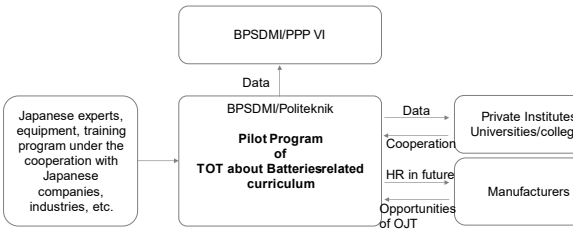
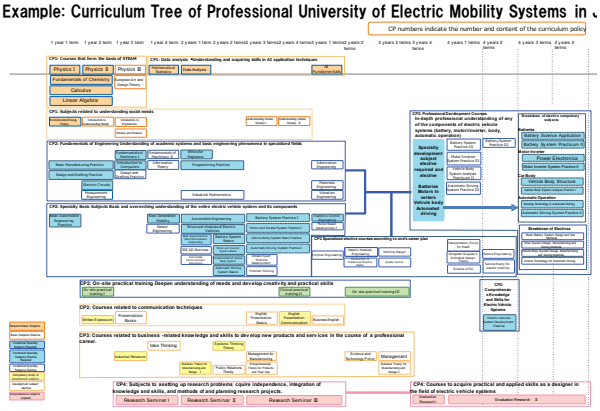
Potential Idea

Idea to Enhance Human Resource Development for Battery related Industries



Example: Curriculum Tree of Professional University of Electric Mobility Systems in



Potential Idea

Idea to Enhance Human Resource Development for Battery related Industries

Output	Activities
1) Through a study, curriculum and programs will be developed for Politeknik to provide the knowledge and skills necessary to work in battery related industries	1-1 Review current automotive engineering related curriculum in Politeknik 1-2 List up the knowledge and skills needed in battery related industr Conduct interviews with relevant private companies to ensure consiste with the knowledge and skills required. 1-3 Create a curriculum for human resource development in battery-rela industries, utilizing the existing curriculum.
2) TOT for faculty members of Politeknik will be implemented based on the established curriculum and program.	2-1 Confirm the professional skills of Politeknik faculty members and se candidates to participate in the TOT. 2-2 Conduct TOT considering Politeknik's annual schedule, respectively (Locat Jakarta + α)
3) Training will be provided to Politeknik students by the trainers who have received TOT.	3-1 Training will be provided to Politeknik students by trainers who h received TOT. 3-2 Training will be monitored by JICA Experts and feedback will be providec areas for improvement.

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Potential Idea

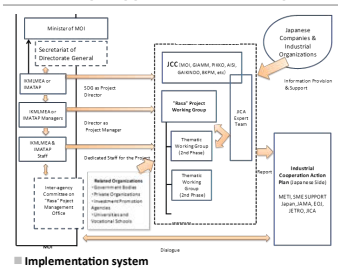
Idea to Enhance Human Resource Development for Battery related Industries

Expected Schedule

Phase	1st Year	2nd Year	3rd Year
Phase 1 For Output 1	Study for curriculum and programs development →		
Phase 2 For Output 2	Intensive TOT for faculty members ofPoliteknik between semesters →		
Phase 3 For Output 3			Training Politeknik studer by trainers who took TOT →

Potential Idea (TBD)

Motorcycle Parts Industry Support
～ Self-help support for Parts companies affected by electrification ～



Implementation system
- IKMLMEAA or IMATAP under the Ministry of Industry implement, supported by GIAMM and PIKKO.
- This idea, currently focused on motorcycle parts, plans to expand to automotive components, including automotive associations like GAIKINDO.

Category: Survey + Technical Cooperation

Expected Outcomes:

1) This idea is to analyze motorcycle and automotive component companies to identify characteristics of companies affected by EV shift and their responses to the shift.
- Statistical surveys, company visits research
- Involve R&D organizations
- Possibility of co -operation with lending institutions.

2) Plans to support each company's EV shift will be developed on the basis of the consensus of the relevant system organizations.

3) Some of the measures in the plan for preparing the EV shift are implemented as pilot projects.
e.g. In-house improvement activities for the plan of the EV shift, Job Matching with promising partner companies such as establishing or integration of R&D departments, Human resource development such as reskilling of in-house personnel.

4) The policy-making capacity of MOI staff is improved through enterprise analysis and the development of the plans for electrification.

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Potential Idea (TBD)

Outcome 1
Summary of the interviews with the motorcycle parts industry

	Category	Detail
Expectation for the government of Indonesia	Matching opportunity/Trade fair	Participation in matching events and other activities currently supported by IKMA and local authorities (e.g. Tegal Municipality)
	Relaxation of regulations	Relaxation of steel import restrictions.
	Investment incentive	Investment incentives for new investments in electric components
	Domestic production of components	Promotion of domestic production of components in order to cope with low-cost Chinese components and to achieve mass production scale etc.
Expectation for the government of Japan	Technical cooperation, Joint venture	Batteries, motors, controllers, etc.
	Human resources development	Human resource development related to electrification technology

- Local suppliers are trying to cope with electrification on their own, without relying on government support.
- The greatest demand is for the government to promote domestic production.
- Some companies expect preferential investment measures, as the cost of investing in new products is high for SMEs due to high interest costs and strict financial screening.
- Expectations for technical cooperation and joint ventures with Japan are high.

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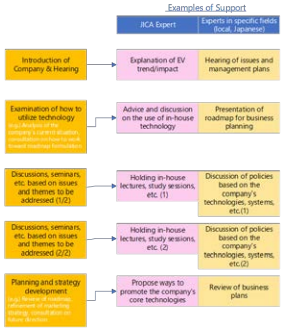
Potential Idea (TBD)

Outcome 2
Supporting target companies to develop plans to enable them to adapt to electrification

Image of Dispatch of JICA Experts (Free of charge up to five times)



Description

- Supporting the 'transformation of the business category of responsibility and business building' of automotive parts suppliers (e.g. engine parts), where demand is declining.

1. Free online consultation
   - Contact points are set up at MOI headquarters and at the main regional offices to receive reception consultations via SMS and other means.
   - JICA expert team (handled through re - commissioning) visits SMEs to organize and examine their issues.
2. Dispatch of experts (free of charge up to five times)
   - Activities flow is as shown in the left
3. On-the-job training and seminars (free of charge)
   - On-the-job training: Provide several courses on the function and structure of electric vehicle components and opportunities to consider projects that can be developed using their own technology.
   - Seminars: Provide information on domestic and international trends in carbon neutrality and the status of initiatives in the automotive industry, and encourage participants to use the information as a foothold for future business development.

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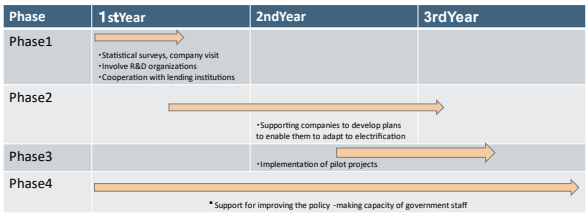
Potential Idea (TBD)

Motorcycle Parts Industry Support
～ Self-help support for Parts companies affected by electrification ～

Schedule

- Phase I（Approx. 6 months）: Expected outcome 1 and 2 in addition to human resources development
- Phase 2,3（Approx. 24 months）: Expected outcome 2 and 3
- Phase 4（37 months）: Expected outcome 4



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