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Identification of the Ecosystem Readiness of Battery Based Electrical Vehicles in Indonesia - Preliminary Assessment

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Abstract**—** *Identification has been made related to the readiness of the ecosystem development of the battery-based electric vehicle industry in Indonesia. The identification results show that the readiness of providing electricity is still quite safe, there is still a power reserve of more than 30% during peak load. To prepare the charging station still needs to be developed, the number of public electric charging station (SPLU), is still around 7000 units spread throughout Indonesia with a power of 5.5 kVA to 22 kVA, while the number of public electric vehicle charging station (SPKLU) is still around 13 units with a power of 22 kW to 150 kW, spread over 4 cities namely Jakarta, Tangerang, Bandung and Bali. Administrative, technical provisions & roadworthy test readiness, the regulation is now in the finalization stage, one of which is related to sound intensity and classification of electric motors. For two-wheeled electric vehicles and electric buses, currently there is a domestic industry that is developing, but for four-wheeled electric vehicles, there is still not formed, althaugh the drivetrain industry is ready. As for the battery and the handling of the industrial battery waste, it has not yet been formed, it is still in the development of research scale.*

Keywords**— Ecosystem, Electric Vehicle, Charging Station, Regulation, Battery.**

I. INTRODUCTION

The increasing number of motorized vehicles every year results in demand for fuel oil continues to increase. In 2017, the number of car ownership in Indonesia was recorded at 25.51 million units, consisting of 15.49 million units of passenger cars and 10.02 million buses and trucks. While the number of two-wheeled vehicles has reached 113.03 million units [(1)]. This condition is certainly a burden on the government in terms of providing fuel oil.

Therefore, in line with the development of electric vehicle technology, the government is gradually planning to replace vehicles based on internal combustion engines (ICE) into battery based electric vehicles (BEV). This electric vehicle is considered to improve energy efficiency and have a positive impact on various sectors, one of which is reducing imports of fuel oil and reducing pollution due to emissions of ICE-based vehicles. Regarding energy efficiency, research shows that electric cars are 60-80 percent more energy efficient than conventional cars. Therefore, the Indonesian government through Presidential Regulation No. 55 of 2019 on August 8, 2019 concerning the Acceleration of the Battery-Based Electric Vehicle Program, is committed to encouraging the development of the domestic electric car industry [(2).]

In Presidential Regulation (PERPRES) 55/2019 article 3 it is stated, the acceleration of the Battery-Based Electric Motorized Vehicle (KBL) program for road transportation is carried out through:

a) Accelerating the development of the domestic KBL industry;

b) Providing electricity charging infrastructure and regulating electricity tariffs for KBL;

c) Compliance with the technical provisions of the KBL; and

d) Protection of the environment.

e) Providing incentives;

In the presidential regulation also stated stages of achievement of Level of Domestic Content (TKDN) which can be graphically seen in Figure 1.

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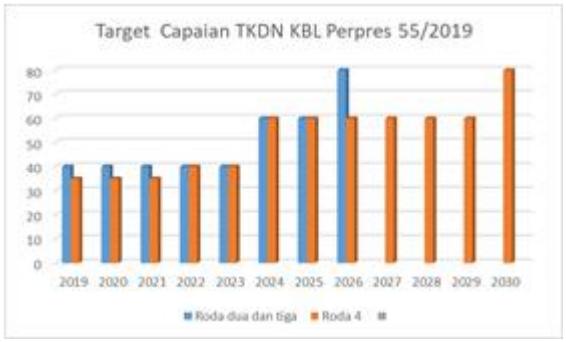

Fig.1: TKDN stages of electric vehicles

Source : Perpres 55/2019 is processed by PPIMTE-BPPT

To be able to reach the stage of TKDN it is necessary to immediately prepare supporting facilities and infrastructure. In this paper, an assessment of the readiness of the battery-based electric motor vehicle ecosystem will be carried out in Indonesia and activities that have been carried out in an effort to achieve TKDN.

II. METODOLOGY

The method used in the assessment of ecosystem readiness for battery-based electric vehicles is by :

- Survey of drive industries (electric motors, inverter control systems)
- Survey of several universities involved in the Molina Program
- Focus group discussion
- invite speakers / experts
- and desk assessment

III. ELECTRIC VEHICLE ECOSYSTEM

The conceptual design in developing a battery-based Electrical Vehicle ecosystem in this case consists of:

1. Infrastructure readiness consisting of :
   - Power requirements,
   - The existence of a battery charging / exchange station,
   - Battery industry.
2. Readiness of the electric motor vehicle manufacturing industry, consisting of
   - Chassis & body industry,
   - Drive industry (electric motors, inverter control systems) and
   - Other component industries.
3. Readiness of policy instruments that can encourage the growth of the electric vehicle industry, which consists of fiscal and non-fiscal policies.

The diagram of the ecosystem of electric vehicles can be seen in Figure 2. [3]

Fig.2. Electric Vehicle Ecosystem

Source : evercharge.net. To Win With EV You Need to Build an Ecosystem

3.1. Infrastructure Readiness for Power Needs

Power infrastructure readiness in this case can be seen from the national electricity program, where PT. PLN as a State-Owned Enterprise is given the authority to manage it. Judging from the electrification ratio until the end of 2018, it can be seen that the electrification ratio in Indonesia is already above 98.30% [4]. Figure 3. below shows the achievement of the electrification ratio in semester III of 2018.

Source : PLN Presentation documents

Fig.3: Electrification Ratio in semester III 2018

Judging from the electrification ratio that has reached 98.30%, it can be said that the power requirements for the Batteray based Electrical Vehicle are considered to be quite safe, especially since the 35 thousand MW program launched by the government is not yet fully realized. Even now in some areas, especially Java, PT. PLN is overloaded.

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So that the infrastructure needs for the power needs of KBL can be said to be ready.

Electrification ratio data and large electrical conditions during the highest peak load indicate that the readiness of PLN electricity supplies is still quite safe to anticipate battery-based electric motorized vehicles. Electrical conditions are divided into 3 categories, namely:

• The system is said to be normal if the power reserve is more than 30%

• The system is said to be standby if the power reserve is less than 30%

• The system is said to be defaoult if at the highest peak load the power is able to be less than the peak load.

The distribution of large system electrical conditions when the highest peak load in all regions of Indonesia can be seen in Figure 4. [4]

Fig.4: The condition of the electricity system is large when the peak load is highest (2018)

Source : PLN Presentation documents

Figure 4. The condition of the electricity system is large when the peak load is highest (net able to January 2018. From Figure 4. It can be seen that the electrical condition of the system is large when the highest peak load is still mostly gray, a small portion is yellow and none is red. This shows that the net capable power at the highest peak load still has a power reserve of more than 30%.

3.2. Battery Charge / Exchange Station Infrastructure Readiness

In accordance with PERPRES 55/2019, the acceleration of the battery based KBL program is supported by the readiness of the electric charging infrastructure for electric vehicles, which includes battery recharging facilities and battery exchange facilities. Until now, commercial battery exchange stations still do not exist, while battery charging stations have been held in several locations in an effort to introduce / socialize the use of KBL. Some locations that have been installed by electric vehicle charging stations include Java, Sumatra, Sulawesi and Kalimantan. In DKI Jakarta 1661 units public electric charging station (SPLU) have been installed which are scattered and the total installed has reached 3000 points in the territory of Indonesia (Figure 3.12). BPPT itself has been installed in 3 (three) location, namely in the Central BPPT (Thamrin), in BPPT Puspiptek Serpong and in PT. LEN Bandung. What needs to be underlined is that all SPKLU facilities, the equipment is still obtained from imports. Currently BPPT is cooperating with PT. LEN has developed SPKLU products whose products are placed at the head office of PT. LEN Bandung.

Fig.5: SPLU distribution that has been built by PLN

Source : PLN Presentation documents

3.3. Battery Industry Readiness

Currently in Indonesia there is still no industry that develops / manufactures batteries for use in electric cars. Its development is still being carried out by universities in this case the Center for Business Development (Pusbangnis) of Solo State University (UNS). UNS Pusbangnis began the initiation of the development of electric car batteries when the national electric car R&D program was launched by the ministry of education and culture in 2012. The batteries developed by UNS are increasing the capacity of LFP and NCA Lithium batteries from 700mAH to 1100mAH. Research carried out in this matter covers material, design, energy storage and its standardization [5].

At present the lithium batteries produced consist of 2 types, namely:

1. Type LFP 18650 with a voltage of 3.2 volts and a capacity of 1400mAH
2. Type NCA 18650 with a voltage of 3.7 volts and a capacity of 2700 MAH

The battery product features that have been developed and produced by the UNS Pusbangnis, are claimed to have several advantages, including:

- It lasts longer with a usage life of up to 3000 cycles,

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- Heat resistance where the battery can withstand temperatures of 70 degrees Celsius,
- Safe technology does not cause an explosion if there is a short circuit, economical and environmentally friendly.

In developing this battery, UNS is collaborating with Pertamina and is currently able to produce LFP batteries in the economic scale of a pilot plan with a production capacity of 1000 cells / day from Pertamina's target of reaching 5000 cells / day. UNS has not been able to meet all Pertamina's requests because when the production scale is increased, it turns out that the battery product produced has changed specifications (decreased spec). At present the Team continues to conduct R&D research to find the right formula for a larger scale of production. The batteries produced by UNS can now be applied to electric cars, electric bicycles / motorcycles, PJU lights, Notebooks, UPS and powerbanks.

The development of batteries themselves has also been carried out by various countries, one of the countries that consistently develops batteries is China. From a literature review, the price of batteries for electric vehicles from 2010 to 2019 has decreased but with improved quality [6]. As seen in Figure 6.

Fig.6: Bateray Pack Price of Electric Vehicle Batteries 2010 - 2019

Source : BloombergNEF

Associated with the percentage of local content, some of the constituent materials of batteries, can already be obtained from within the country namely Nickel and Cobalt. As for Lithium raw materials themselves, they are still imported. The results of calculations by self-assessment, TKDN for this battery product ranges from 50-60%. The competitors of Smart lithium batteries in Indonesia are Samsung and Panasonic where the company's production batteries are still more reliable than Smart lithium batteries because of the higher level of quality raw materials and technology.

PT. Pertamina, as one of the players engaged in the supply of motorized vehicle fuel, should be able to act more quickly, pushing the results of the research scale to an industrial scale. because if the battery-based KBL successfully develops and replaces ICE-tech vehicles (by 2040), some Pertamina businesses in the supply of motorized vehicle fuel will become extinct and shift to the supply of batteries and charging stations.

3.4. Readiness of the battery-based electric vehicle industry

The difference between an Baterai based Electric Vehicle (BEV) and an Internal Combustion Engine (ICE) based vehicle is the drivetrain and the fuel as well as where it is stored.

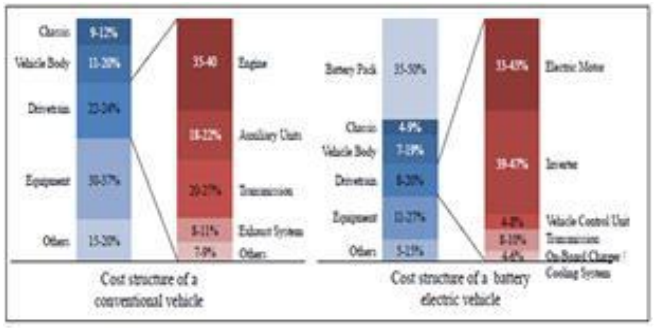

Fig.7. Differences in components in ICE vehicles and BEV vehicles

Source : Robert Kochhan, et all.(2017)

From Figure 7 it can be seen that in battery-based electric vehicles, the drivetrain components consist of electric motors, inverters, vehicle control units, transmissions, onboard chargers / clooling systems and battery management systems, coupled with batteries for storing electrical energy [7].

In this paper, the discussion on the readiness of the electric vehicle industry will be limited to the drivetrain industry. industries that develop electric vehicle drivetrain systems are PT. Pindad and PT. LEN. PT. Pindad is currently one of the electric motor manufacturers in Indonesia. With its design, development and engineering capabilities, PT. PINDAD develops permanent magnet type 5 kV electric motor used in two-wheeled electric vehicles. PT. Len developed inverter and vehicle control unit. The order for electric vehicle inverters coming from PT. Fast Cooperation with Gesits begins at the end of 2018. Orders that come from PT Gesists are still based on a limited number of customized. Because the number of products produced by order is still small, the selling price becomes uncompetitive, this is partly due to the high purchase value of imported raw materials because they are purchased in units (due to a small quantity) and also due to

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the use of machines that cannot reach the value of optimization and efficiency in production is due to production that is not continuous. In other words, the calculation of production cannot be included in the economies of scale.

In addition to these two industries there are also universities that develop electric motors and control systems, namely ITS, ITB,UI, UGM dan UNS. National electric vehicle development is carried out under the coordination of the Director General of Higher Education. There are two types of motors developed, namely axial type busless DC motors by ITS and radial type brusless DC motors by ITB. Table 1 shows the development of the ecosystem in universities.

Table 1. The Development of The Ecosystem in Universities

Componen	ITB	ITS	UNS	UGM
Drivetrain	Radial BLDC 30 KW	Axial BLDC 0,5 – 25 KW		
Battery			LiFePO4 SmartUNS Lithium Battery	
Battery Recycle				Dismantling Machine

In its application ITS has made several prototypes of two-wheeled electric vehicles, four-wheeled vehicles and electric buses . ITS in collaboration with Garasindo Electric Scooter has succeeded in developing a two-wheeled electric vehicle named GESITS [8].

Fig.8: ITS Electric Vehicle Prototype

Source : sko.its.ac.id

The motor used in this ITB-1electric car is radial brushless dc (BLDC) motor type. A controller will be used to convert the dc source into ac for BLDC motor power source. BLDC motor 10 kW and its energy storage i.e LiFePO4 battery types, will be evaluated based on their performance result from the tests [9].

The UI National Electric Car Team has launched Molina UI-EV Bus, The EV bus is a vehicle with a capacity of 60 passengers with motor power of 120 kW and 300 Ah. For commercialization UI has conducted an MOU with Perum Damri and PT Indonesia Tourism Development [10]

Fig.9: UI-EV Bus designed by the University of Indonesia.

Source : https://www.ui.ac.id

UNS has developed a lithium battery based on the LiFePO4 cathode material. The battery, named SmartUNS-Lithium Battery, was developed with nano technology that can increase its energy density. The current prototype continues to be developed in the form of a battery pack so that it can be applied to electric motorcycles and electric cars. In the effort to downstream the industry, UNS cooperates with two companies, namely PT LEN Industri and PT NIPRESS. But in the course of commercialization of this battery product, UNS encountered obstacles in terms of standardization [5].

3.5. Battery Waste Processing Industry Readiness

In addition to research on electric vehicles, UGM also focuses on research into the development of battery recycle, whose research funding is sponsored by LPDP. Research carried out by the UGM Faculty of Chemical Engineering and Mechanical Engineering is research on the manufacture of dismantring machines (type 8165 battery disassembly machines to be recycled into sheet shapes) where this machine will break down battery packs and then take lithium. Then the lithium that has been released is specially formulated to be ready to use lithium with a purity level of 98%. This discovery itself has been patented and is currently being explored in collaboration with PT. Astra, which is currently in the lithium battery recycle business and has production facilities and infrastructure in Jakarta. In the future, it is planned that PT Astra will order 100 units of UGM dismantring machines at an early stage. At present, a business scheme negotiation process is

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underway between UGM and PT. Astra for the implementation of the business [11].

Fig.10: Dismantling Machine, UGM

Source : Survey Gajahmada University

This lithium battery recyle research is an internal research where there is no connection with other universities such as UNS which also develops lithium battery research. So far UGM itself has never cooperated and synergized with UNS in developing lithium batteries or lithium battery recycle.

3.6. Type Test Readiness

In preparation for entering the era of electric vehicles in Indonesia, the government said it would establish a new type of test facility center. This type of test is to determine whether an electric vehicle model is sold on the market or not. Broadly speaking, there are three important aspects in the test of types of electric vehicles, namely those related to batteries, speed, and charging. currently being explored various kinds of electric vehicle technology that is being developed at this time to determine the technology that will be used in a new type of test facility. Testing standards will adopt international standards, so that all brands can adjust. Construction of the type test facility will begin in 2019 and the target is 2021 completed.

Regulations related to electric vehicle type tests, have been summarized in Transportation Minister Regulation (Permenhub) No. 33 of 2018 concerning Testing of Motorized Vehicle Types. However, it still needs to be done in-depth related to what parameters will be tested. One of the parameters tested was the sound of electric vehicles. The rules governing the sound of electric vehicles are listed in Article 23 paragraphs 3, 4, and 5. This new regulation will also become a reference for controlling the sound of electric cars. Here are the details of Permenhub No. 33 of 2018 about the sound of electric vehicles:

(1) Electric motorized vehicles to meet safety aspects must be equipped with sound with certain noise levels and types of noise.

(2) The noise level as referred to in paragraph (3) is at least 31 (thirty one) decibels and the highest does not exceed the threshold of a Motorized Vehicle that uses an ordinary combustion motor.

(3) The noise level as referred to in paragraph (3) must be as follows:

a) at a speed of 10 (ten) km / h a minimum of 50 (fifty) decibels;

b) at a speed of 20 (twenty) km / h a minimum of 65 (sixty five) decibels;

c) to retreat a minimum of 47 (forty seven) decibels.

In addition, the regulation also includes provisions that sounds produced by electric vehicles do not resemble music, animal sounds, sirens or horns

IV. CONCLUSION

From the discussion above it can be seen that the level of readiness of Indonesia in welcoming the electric motor vehicle is still in the position of preparation. The issuance of Perpres 55/2019 is expected to accelerate the readiness of its ecosystem, mainly in terms of providing electricity, SPKLU, KBL feasibility testing facilities and the KBL industry.

In terms of electricity supply, with a 30% reserve at peak load, gradually need to be added. Likewise, the number of SPKLU fast charging needs to be added immediately, especially for potential areas. KBL eligibility test facilities also need to be developed immediately.

For the KBL industry, KBL research and development needs to be immediately pushed into the industrial scale, by cooperating with potential industries both in terms of the main component industry, as well as the vehicle manufacturing industry.

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