Electric Vehicles Adoption Scenario in Malaysia

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In the roadmaps of the automotive industry, the electric vehicle (EV) is regarded as a crucial technology for the future of automotive power systems. The EV has become a top priority of major global car manufacturers and is expected to disrupt the road transportation sector. In Malaysia and Indonesia, EVs just started as an important force. However, in Malaysia, the lack of EV infrastructure, along with its strong dependency on fossil fuels, poses an enormous challenge.

electric vehicles | battery electric vehicle | Malaysia | Indonesia

1. Introduction

In efforts to reduce greenhouse gases (GHGs) generated by air pollution, gases which can cause climate change, green technology was introduced [1][2]. The electric vehicle (EV) is a product in development that is expected to contribute to pollution reduction [3]. Together with sustainable power plants such as hydro, wind, nuclear, and solar power plants, EV deployment can effectively keep clean air on the road, directly increasing air quality.

In the global market, the technologies of EVs have been established, as indicated by the availability of commercial EVs. However, two major concerns must be handled. The first is the formation of a supply chain for EV components, especially drive train components such as batteries, inverters, and electric motors. The second is the safety issues that may arise due to EV implementation. In the supply chain, even though the number of EVs in the global market has increased drastically, the mass production of batteries and electric motors remains the biggest problem. The manufacturers supplying batteries are considerably small compared to the high demand for EV products. Thus, the battery is still the most expensive component in an EV. On average, the battery makes up about 40% of the total EV manufacturing cost [4]. It is problematic if the EV wants to compete with conventional vehicles running with internal combustion engines (ICEs). Another concern of EVs is the safety issues. The EV technology needs enormous data to collect, analyse, and improve the technology to ensure that the EVs are safe to be implemented. The more data obtained from simulation, testing, and actual incidents/accident, the better, assuring the safety of the EVs.

As one of the fastest developing nations in Southeast Asia, Malaysia has a population of 32.7 million in the first quarter of 2021 [5] and is expected to reach 41.5 million by 2040 [6]. Statistics from ASEAN Statistics Division for 2020 revealed that Malaysia had 29.96 million registered motor vehicles in 2019. In the same year, Malaysia recorded 925 registered motor vehicles per 1000 population which depicts that nine out of every ten Malaysians have a road vehicle [7]. With no restrictions on vehicle ownership, roads in Malaysia are being dominated by passenger vehicles (46.0%) and motorcycles (48.4%) [8][9]. The Road Transport Department Malaysia revealed that there were 16.8 million licensed drivers in 2019, an increase of 10.5% from 2018 [10]. As for the total industry volume (TIV) for the automotive industry in Malaysia, both registered passenger and commercial vehicles in 2020 have dropped by 12.4% [11], believed to be caused by the COVID-19 pandemic. The sales distribution in the year showed 66.7% was from passenger vehicles and 17.6% was from 4 × 4/SUVs. However, Malaysia Automotive Association (MAA) has forecasted the TIV growth to increase by 6.0% in 2022, followed by an average growth of 3.1% from 2023 to 2025 [11].

2. EV Adoption Scenario in Malaysia

The Malaysian automotive industry is being driven by several government agencies under different ministries. Government agencies and ministries are working together with the Ministry of Transport Malaysia to spearhead the Malaysian automotive industry. Malaysia Automotive Robotics and IoT Institute (MARii) is an agency established under the purview of the Ministry of International Trade and Industry Malaysia (MITI) that serves as the coordinating centre and think tank towards enhancing the automotive industry and overall mobility in Malaysia. In collaboration with MARii, MITI released the latest National Automotive Policy 2020 (NAP 2020) [12]. Among others, NAP 2020 highlights the development of the Next Generation Vehicle (NxGV) in

the areas of charging, energy management, and safety. Meanwhile, Malaysian Green Technology and Climate Change Centre (MGTC), an agency of the Ministry of Environment and Water (KASA), drives the scope of green growth, climate change mitigation, and green lifestyle, which is also highly involved in the areas related to clean and efficient transport in Malaysia. In collaboration with MGTC, KASA is proposing the Low Carbon Mobility Blueprint 2021–2030 that involves vehicle fuel economy and emission improvement, EVs and low emission vehicle adoption, alternative fuel adoption, and GHG emission and energy reduction via mode shifts [13]. Both the NAP 2020 and the Low Carbon Mobility Blueprint 2021–2030 are expected to be a catalyst in further propelling the Malaysian automotive industry to be more competitive in the upcoming years.

In Malaysia, there are two national vehicle manufacturers: Perodua and Proton. In 2019, Perodua had the largest market share of 38%, while Honda had the second-largest market share of 17%, followed by Toyota and Proton [14]. From the consumer's perspective in Malaysia, a survey conducted by the Malaysian Electric Vehicle Owners Club (MyEVOC) [15] revealed that fuelling infrastructure is the biggest concern at the moment, followed by the cost. Regardless of the infrastructure concern, most of the MyEVOC members have been using their EVs for daily usage because the average driving range of 50 to 70 km is sufficient for home charging. Port specification is also not a concern for them as they are using a common UK/EU/SG, which are Type-2 for AC and CCS Combo Type-2 for DC rapid charging. The main concern lies in travelling out of the urban area where DC rapid chargers are only located in the North–South Expressway of West Malaysia.

3. Types of EV and Battery Capacities Available in the Malaysian Market

In September 2020, there were only four new battery EV (BEV) models available in the Malaysian market: Nissan LEAF, Mini Cooper Electric, BMW i3s, and Porsche Taycan; the rest of the EVs available in the market mostly consist of hybrid EV (HEV) and plug-in hybrid EV (PHEV). Table 1 lists some of the popular EV models available on Malaysian roads today [16]. The batteries from the available EV models in Malaysia are mostly the lithium-ion type, while a few models are the nickel-metal hydride type. The battery capacities of these models for HEV ranges from 0.86 kWh (Honda Jazz) to 1.6 kWh (Lexus IS), PHEV ranges from 11.6 kWh (BMW i8 Roadster) to 24.0 kWh (BMW X5), and BEV ranges from 28.9 kWh (Mini Electric) to 93.4 kWh (Porsche Taycan). The travelling distance for electric mode in the PHEV model may reach 77 km (BMW X5) before shifting into the gasoline-powered mode, while the BEV model may reach 385 km (Porsche Taycan). Alternatively, there are also other used EV models brought into the market.

4. Adoption Rate of EVs in Malaysia

Toyota introduced HEV in the Malaysian market as early as 2009 [17], followed by Honda in 2010 [18], then in 2013, both Mitsubishi and Nissan introduced BEVs [19][20]. While the national vehicle manufacturers are still using ICEs in all their existing models, foreign manufacturers in Malaysia, such as Toyota, Honda, Nissan, Hyundai, BMW, Mercedes-Benz, and Volvo, have started to include a range of EV types as part of their product line-ups. As a result, the volume of EVs in Malaysia peaked in 2017 and 2018, with close to 9000 units on the annual registration [21]. More than 95% of the registered EVs are PHEV, but recently, in the year 2021, the share of the BEV segment has increased from 5% to 8% [21]. As of today, there are more than 31,000 units of registered EVs on Malaysian road, whereby 5% are BEV [21]. Even with such an increase, the existing adoption rate in Malaysia is considerably low.

5. Readiness of Malaysian EVs Charging Infrastructure

Apart from the price, the availability of public DC chargers is among the concern of Malaysian consumers. Sufficient DC charging infrastructure would relieve their anxiety on travelling using EV, and at the same time, increase the adoption and accessibility of electrification transport in Malaysia. While AC chargers are useful for overnight charging, DC chargers are the most important necessity for consumers when travelling with EV. This concern has been addressed to the government, related agencies, and related industries. In 2021, several efforts were put forward to address the concern. Among the recent efforts, MARii and the Malay Vehicle Importers and Traders Association of Malaysia (PEKEMA) have signed a collaboration to set up a network of 1000 DC rapid charging stations around the country by 2025 [22]. The collaboration will also look at the infrastructure ecosystem that, in turn, will create opportunities in other businesses and job opportunities in the country. In parallel, Tenaga Nasional Berhad (TNB), as the largest electricity utility company in Malaysia, has also focused on providing the necessary infrastructure by collaborating with various stakeholders in Malaysia [22]. To support Malaysia's transition into

low carbon mobility, TNB is also willing to work with the private sectors that intend the transition; an example of this can be seen when TNB recently collaborated with DHL Express Malaysia to install charging stations along DHL's service routes as the initial step for the future transition [23].

6. Charging Stations Distribution in Malaysia

Where are the EV charging stations in Malaysia? As reported by [24], there are about 500 public AC chargers and 9 public DC chargers in Malaysia today. Currently, chargEV has the largest AC charger network in Malaysia [25]. The chargEV network was established by MGTC to provide public EV charging infrastructure in Malaysia for free. The chargEV network has 303 units of AC chargers in-operation across the states of Johor, Kedah, Kuala Lumpur, Melaka, Negeri Sembilan, Pahang, Perak, Penang, Putrajaya, Sarawak, and Selangor. The power output of the AC chargers ranges from 3.7 to 22.0 kW. To further support and facilitate EV users, chargEV also provides its own mobile apps to locate charging stations in Malaysia conveniently. Based on the chargeEV platform, MGTC also collaborated with BMW in mobility services, dedicated for BMW EV users in Malaysia to locate the charging stations. Besides chargEV, Shell, in collaboration with ParkEasy, also provides a free EV charging service called Shell Recharge [26]. AC charging stations were in smart parking bays at seven locations across Kuala Lumpur and Selangor.

As for DC chargers, an EV charging specialist company, EV Connection Sdn Bhd, has provided EV charging solutions in Malaysia since 2016 and aims to expand its installation in the next three to five years [27]. The company currently has the largest DC charger network in Malaysia, located along the North–South Expressway, passing through states of Perak, Kuala Lumpur, Melaka, and Johor. Meanwhile, Shell, in collaboration with Porsche, is planning to install 180 kW DC chargers in six Shell stations across Malaysia, including Singapore, by 2022 [28].

7. Are Malaysian EV Charging Stations Standardised?

Most of the available public EV charging stations in Malaysia use Level 2 type AC chargers that meet International Electrotechnical Commission (IEC) standards. Availability of Level 3 DC chargers is still at the minimum but increasing at a low pace. The power output of the available AC chargers ranges from 3.7 to 22.0 kW, depending on the location of the charging station. In comparison, available DC chargers are as high as 50.0 kW [29], with higher output chargers in development [28].

As for the ports, the public AC charging stations within the chargEV network in Malaysia are fitted with a Type 2 charging outlet as per IEC standards, which is compatible with all PHEV and BEV sold in Malaysia. In addition, the DC charging stations are fitted with Combined Charging System (CCS) Combo Type 2 port for rapid charging.

Home charging is convenient due to the availability of local suppliers/distributors for purchase and installation. Furthermore, new housing developments in Malaysia have already started to include EV charging infrastructure as standard amenities in respective houses or residential areas [30].

8. EV Tax Credit in Malaysia and How It Works

On top of the sales tax, foreign vehicles in Malaysia are also charged with excise and import duties. The excise duty for locally assembled and imported vehicles may vary between 60% to 105%, depending on the vehicle model and engine capacity [31]. The import duty may reach up to 30%, based on which country the vehicle was manufactured [31]. With the combination of these tax charges, the price of foreign vehicles in Malaysia can be substantial for local consumers. In 2009, the Malaysian government introduced 100% import duty exemption and 50% excise duty exemption for HEVs with 2.0 L engines and below [32]. In the following year, the Malaysian government extended the exemption to the end of 2011 with a 100% exemption for both import and excise duties [32]. This exemption has brought down the local price of Toyota Prius from RM175,000 to RM139,900 [33]. The exemption has helped the sales of HEVs in Malaysia to rise to 614 units by 2010 [34]. When the exemption was supposed to end in December 2011, the Malaysian government then further extended the exemption to December 2013 [34]. After 2013, there were no such exemptions nor incentives introduced by the Malaysian government for HEVs and EVs until May 2021. MARii, under the purview of MITI, announced they would soon release an accelerated policy on EVs under the existing NAP 2020, which will comprise incentives regarding sales, excise, and import duties for EVs [35]. Such incentives provide affordability to Malaysian consumers and are expected to elevate the existing adoption rate.

9. Opportunities and Challenges of EV in Malaysia

Comparing the latest progress of EV adoption with the neighbouring countries, Malaysia is left behind, even though Malaysia started its initiatives in 2016. While Malaysia is currently revising its policy (at the time of writing) to boost EV adoption, the neighbouring countries are constantly taking drastic simultaneous actions in many areas involving manufacturing, policy, incentives, and public awareness. Despite being slow, this allows Malaysia to learn and benchmark the adoption by the other countries, thus allowing adaptation and improvisation.

Among many initiatives, infrastructure accessibility and consumer's incentive are the biggest contributors to any EV adoption. The quantity of EV charging stations in Malaysia is still considerably low, and the rate of establishment of the stations since 2016 is sluggish. This can be associated with the sluggish conversion of consumers from combustion engines to electrification, which correlates to a survey conducted by a BFM radio station Twitter poll where 40% of respondents would not consider an EV, due to the insufficient charging infrastructure in Malaysia. Malaysia's biggest challenge, for now, is to increase the number of EV charging stations at strategic locations. With sufficient charging infrastructure, higher EV adoption is expected to cause an increase in electricity usage and load in Malaysia. It provides an opportunity for TNB to increase their revenue and further upgrade their infrastructure and resources while at the same time allowing them to introduce new services for the consumers and expand outside their conventional scope of just being a utility provider. Apart from TNB, local agencies and companies, such as MARii and PEKEMA, in their recent collaboration to provide EV infrastructure [22], should also take the opportunity to venture into the e-mobility ecosystem by providing EV-related solutions and services such as battery maintenance and battery swapping services. Establishing a management system capability over the infrastructure allows the providers to collect valuable energy consumption data from parties such as the government, agencies, city councils, housing developers, and vehicle manufacturers.

Another challenge for EV adoption in Malaysia is the consumers. The range anxiety, or the consumer's fear of the EV running out of electricity, is a common challenge that a country must address. Among the main contributor to range anxieties are insufficient charging infrastructure and lack of awareness. In reality, a BEV with a full charge battery can travel more than 200 km, which is sufficient for daily urban driving in Malaysia. Certainly, the number of EV charging stations in Malaysia is still low. With the existing efforts to increase the number of EV charging stations and provide sufficient awareness, Malaysia would be able to address the range anxiety to the consumers. Besides the range anxiety, increasing the consumers' willingness to convert from fully combustion engine vehicles to EVs is a challenge that the government, agencies and related industries must work together to tackle through incentives, awareness and education. This will provide opportunities for the OEM in Malaysia to increase their sales and revenue, and at the same time, bring new investors into Malaysia. Consistent awareness programmes will eventually shift the existing consumer's perspectives. In parallel, the education sector will be able to take the opportunity to revise and update their teaching content in emphasising low carbon mobility, which includes EV in their subjects or course to cultivate future consumers.

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