This document will explain best practices of motorcycle electrification from around the world and what Greater Jakarta can learn from them.

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

Best Prac ces of Motorcycle Electrification Program Around the World

30/06/2021

Table of Contents

List of Figures

List of Tables

1. Best Practices of Motorcycle Electrification from Other Global Cities

This section will explain how motorcycle electrification was or is conducted in other cities around the world. As there are currently not many countries with a high motorcycle usage rate, let alone electric motorcycles, we will be looking at cities from three Asian countries which have higher rates of electric motorcycle usage than other cities. Those three countries are India, China, and Vietnam. To allow for more comprehensive understanding, a brief explanation on each country and city background will be provided, before going deeper into incentives scheme being applied and the overall government policies or programs to support electric motorcycle usage in each country and city.

1.1. India

In India, two-wheelers account for 70% of the 200 million plus registered (MOSPI, 2017). The government of India has committed to the goal of making 30% of the total vehicles to be electric by 2030. To make this transition happen the government of India launched the Phase 1 of the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME I) scheme in 2015, to accelerate electric vehicle (EV) adoption under the National Electric Mobility Mission Plan 2020 (MHIPE, 2012). Around 90% of the vehicles that availed FAME I incentives were electric two wheelers (CRISIL Research, 2019).

In 2019, the second phase of the FAME scheme was launched with a total budget outlay of USD 1.367 billion, of which USD $ 275 million was directed toward providing demand incentives for electric two wheelers (NAB, 2020). In FAME II, the electric two wheelers' subsidies are mainly targeted towards high-speed electric two wheelers with a minimum range of 80 km per charge, minimum top speed of 40 kmph and powered by advanced battery technology. It was estimated that there are currently around 7.35 million electric two wheelers registered in India (Statista, 2021). In the last five years, the electric two wheelers market in India has grown by a CAGR of 62%. However, the electric two wheelers market is projected to hit 3.4 million annual sales by 2025, an 87 percent CAGR over 2020 annual sales of 152,000 (JMK Research & Analytics, 2020).

In 2020, in an effort to reduce the high upfront purchase cost of electric two wheelers, the government of India has allowed the sale and registration of electric two wheelers without factory-fitted batteries. In addition to the efforts of the government of India, between 2017 and 2020, 15 Indian states have either notified or drafted state Electric Vehicle (EV) policies and are in the process of electrification of electric two wheelers. A summary of different policies or measures of different states are given in Table 4.

1.1.1. Government's Commitment on EV

While the central government has a stipulated budgetary outlay for promoting electric two wheelers usage, different state governments in India are yet to declare such allocations. However, it must be noted that almost all state governments have targets pertaining to electric two wheelers adoption.

At the national level, a number of government interventions have come into being since 2011, that are focused on EV adoption and have been already discussed in earlier sections.

Recently, the government of India approved the implementation of the Production Linked Incentive (PLI) scheme for 'National Programme on Advanced Chemistry Cell (ACC) Battery Storage'. This scheme aims to achieve a manufacturing capacity of 50-Gigawatt hour (GWh) of ACC and 5-GWh of 'Niche' ACC with an outlay of USD 2.4 Billion (MHIPE, 2021)

Each selected ACC battery Storage manufacturer would have to commit to set up an ACC manufacturing facility of minimum 5GWh capacity and ensure a minimum 60 percent domestic value addition at the project level within five years (MHIPE, 2021). This scheme will highly influence the supply side of electric two wheelers production in India.

1.1.2. Fiscal Incentives

Given the price parity between ICE and EV vehicles, fiscal incentives are essential to help defray the higher upfront costs of EVs, a key barrier to adoption. The most common purchase incentives in use are purchase subsidies and tax reductions. Besides, a couple of Indian states utilize favourable terms of financing and scrapping incentives to encourage EV adoption. Scrapping incentives are primarily targeted at commercial vehicle segments, in which vehicle owners may need additional financial assistance to switch to EVs. While widely used, the practical design of financial incentives is necessary to ensure their impact. To maximize impact, incentives should be offered upfront at the time of purchase, not afterward. And importantly, incentives should be designed with an extended timeframe in mind and should not be prematurely withdrawn before the market has adequately developed.

Purchase Subsidy

Purchase subsidy is an effective tool to make electric two wheelers more competitively priced to its conventional ICE counterparts. These can be offered as direct price reductions, tax rebates, depending how its structure has been designed for the buyer and other stakeholders.

- Some of the states have offered end-user subsidies for a defined number of vehicles, the incentive amount being dependent on the battery capacity. For example, Delhi offers purchase incentives of USD 67 per kWh (Delhi Transport Department, 2020).

- Additional incentive is also being offered for use of lithium-ion battery instead of conventional lead-acid battery.
- One of the states has also offered top-up subsidies to economically weaker sections of the society.
- On battery swapping EV models, Delhi offers 50% of the subsidy to the registered owner (without batteries on the EV) and the remaining 50% to the energy operators to defray deposit costs of the battery swapping service (Delhi Transport Department, 2020).

Tax Exemptions

The motor vehicle tax, or road tax as it is commonly called, is a tax levied at the state-level. The tax rate varies from one state to another. The tax structure varies for transport and non-transport vehicles- it is a periodic tax (half-yearly or annual) for transport vehicles and a one-time lifetime tax for non-transport vehicles. Most of the states that have rolled out the EV policy offer road tax exemption. The mechanisms used are:

- Several states are offering 100% road tax exemptions for defined periods of time including Delhi.
- Few other states are offering full exemption or partial exemption for a defined number of electric two wheelers.
- Some states have used localized manufacturing as a criterion for tax exemption for 5 years.
- Most states have offered an exemption on registration fees for EVs. Despite the road tax exemption mandated in EV policies, most states have yet to implement the tax waiver.

Access to Financing

Indian EV ecosystem still lacks the backing of a strong financing structure. The nascence of EV penetration, lack of historical data and hence predictability, has made it difficult for financing bodies to assess the risk attached with the EVs and, by extension, electric two wheelers' markets. The resulting inadequacy greatly contributes to the low traction of electric two wheelers. Governments need to step up to tackle this dearth by a slew of policy measures such as low-interest loans, interest subventions, subsidized down-payments, and extended repayment periods to make it attractive for EV buyers. Delhi is developing a subvention scheme and is in the process of rolling out this through Delhi Finance corporation.

Scrapping & Retrofit Incentives

Scrapping and retrofitting tend to bridge the gap between electric vehicles and its conventional ICE counterparts by putting more of the former on the road and reducing the latter's numbers. Financial incentives for retrofitting would make conversion of ICE two wheelers to EVs cheaper and for scrapping to eliminate ICE two wheelers and purchase EVs anew.

- Delhi offers a scrapping incentive of USD 67 to registered owners of electric two wheelers for scrapping and deregistering old ICE two wheelers in Delhi. The incentive is contingent on a matching contribution from the dealer or OEM.

- Additionally, some states allow registration of two wheelers retrofitted with an electric motor and an electric powertrain and certified by a government-recognized agency.
- Some states are making efforts to incentivize EV buyers through transition credits.

The total fiscal incentive in Delhi comes out to be about $ 365 which is approximately 20 % of the total cost of electric two wheelers.

Table 1 Fiscal Incentives for E-2W in Delhi

Type of Fiscal Incentive	Fiscal Incentives in Delhi	% Of Total Cost of E-2W
Subsidy	USD 160	8.9%
Road Tax Exemption	USD 72	4.0%
Scrapping Incentive	USD 133	7.4%
Total Incentive	**USD 365**	**20.2%**

1.1.3. Non-Fiscal Incentives

While purchase incentives are offered at the time of buying an electric vehicle, governments can also incentivize EV usage through recurring operational incentives. These may include perks such as zero-emission zones or open permit systems for EVs, or they may include usage benefits, such as parking incentives and usage fee waivers. Non-financial, operational incentives effectively promote EV adoption, but must be designed keeping in mind differences in traffic conditions, travel patterns, consumer preferences, and other local variations. Especially in congested metropolitan areas, operational incentives can prioritize road use for EVs and boost their usage.

Priority or Free Permits

State transport authorities are responsible for issuing permits to vehicles according to its policies and rules. The frameworks of issuing permits tend to be highly regulated, owing to city or state transport authorities monopolized services, or policies defining a fixed number of vehicles to be allowed on the road. Easing or exempting electric two wheelers from the regulatory barriers and prioritizing its permits' issuance can go a long way in incentivizing uptake of electric two wheelers.

Some states Kerala, Punjab, and Uttarakhand offer free permits for commercial electric two wheelers.

Green Zones

Green Zones are government-sanctioned areas where polluting vehicles are prohibited or penalized, encouraging the movement of electric vehicles in these zones. Several states have indicated that they plan to identify and designate areas as 'Green Zones' with entry limited to EVs. In addition, some states plan to demarcate special transport routes as 'Green Corridors' that shall encourage plying of electric vehicles or identify green zones.

Parking incentive

Parking incentives such as reserved EV slots and fee waiver and equipping these spaces with charging facilities can reduce the discomfort for electric two wheelers' users in accessing public parking spaces. Some states are offering 100% waiver on electric two wheelers (Kerala Transport Department, 2019; Madhya Pradesh Urban Development and Housing Department, 2019) and are also exploring providing reserved slots in all major public parking spaces across cities targeted for EV incentives and also designate street parking spots, equipped with street-pole charging facilities

Toll fee waivers

Toll fee waivers and incentives reduce the operational costs attached with electric two wheelers. Toll exemptions provided across entire states reduce toll costs incurred during long-distance trips. Some of the states have indicated toll waiver for electric two wheelers.

1.1.4. Local Component Usage on E-2W

a) Regulations by the Government for Minimum Level of Local Component Usage

In India, under the purview of FAME II, localised manufacturing of all EV segments, not just electric two wheelers, is a definite objective. This objective resonates with India's goals of localising Li-ion battery production in the country, as well. From 30th January 2019, targets for local component usage for electric two wheelers manufacturing were set by the Department of Heavy Industry (DHI), Ministry of Heavy Industries & Public Enterprises. These targets were revised in April 2020 and April 2021. These targets, along with the current localisation rates for electric two wheelers manufacturing, are explicated in Table 2.

Table 2 Local Content Requirement for EVs in India (MHIPE, 2019)

No.	Item Description	Local Content Requirement w.e.f. 01/2019	Local Content Requirement w.e.f. 04/2020 (Current)	Local Content Requirement w.e.f. 04/2021
1.	Completely Built Unit (E-2W)	0%	0%	0%
2.	Semi Knocked Down (E-2W)	15%	25%	25%
3.	Completely Knocked Down (E-2W)	10%	15%	15%
4.	Li-ion Cells for Use in Li-ion Accumulator for EVs	5%	5%	10%
5.	Battery Packs for Use in EV Manufacture	5%	5%	15%
6.	Other Parts for Use in EV Manufacture, like: • AC or DC Charger • AC or DC Motor • AC or DC Motor Controller • Energy Monitor • Electric Compressor	0%	0%	15%

The introduction of the Phased Manufacturing Programme (PMP) under the FAME II scheme was aimed at local component usage for EVs (MHIPE, 2019). The objective of the PMP is to foster indigenous production in all EV segments, through the support of localised manufacturing targets and a graded duty structure. The intention is to substantially increase EV manufacturing capacity and subsequent value addition in the country. The PMP is envisaged to enable manufacturers to plan their investments for a robust EV (including electric two wheelers) manufacturing base in India, which shall raise domestic value addition and generate employment opportunities in the country. The values listed in Table 2 are aligned with the ideas contained in the National Electric

Mobility Mission Plan 2020, which also suggests localisation of electric two wheelers manufacturing, to: uphold India's strong position in the automotive sector; adhere to India's capacities and natural resource reserves related to the EV value chain and; minimize India's dependence on imports for EVs.

When local component usage targets were put in place, the penetration rate of electric two wheelers in the Indian market was 0.3% in FY 2018. Also, the average cost of an electric two wheeler was ~50% higher than the average cost of a conventional two wheeler in FY 2018 (JMK Research & Analytics, 2020). The share of electric two wheelers among all two wheelers' sales in FY2020 was approximately 0.6%, which is expected to reach 13% by FY2025. Figure 1 below shows the increase in electric two wheelers sales in India over the last 5 years. Due to Covid-19, the percentage increase in sales of electric two wheelers in 2021 is less than the previous year's growth. Through a number of incentives and support from the government and business targets, the demand for electric two wheelers is expected to exponentially rise.

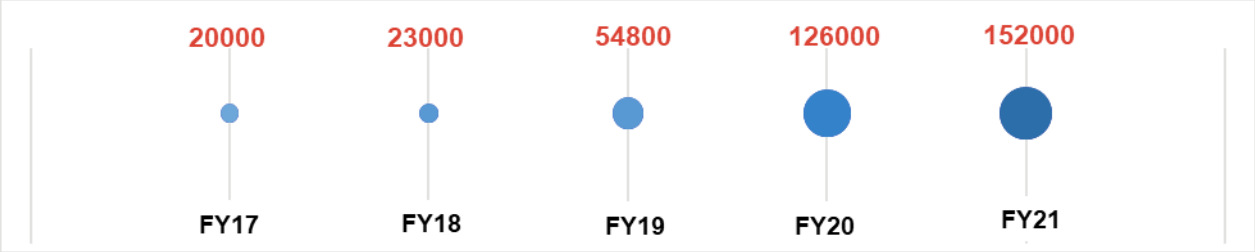

Figure 1 Increasing Sales of E-2Ws in India

b) Comparison of Local Component Rate Obligation Between e-2Ws and Conventional 2Ws Being Sold or Produced in India

In India, market leaders in the conventional two wheelers segment began manufacturing 100% indigenous two wheelers from 2018. This trend (of complete indigenous manufacturing of two wheelers) is slowly diffusing across the entire ecosystem in the country (Dhawan et al., 2018). Such localisation levels are far higher than those that are mandated for electric two wheelers. The current levels of localisation are around 20% for the electric two wheelers (Dhawan et al., 2018). Aside from the nascency of the electric two wheelers ecosystem, two major reasons for the low localisation rates required for electric two wheelers are: lack of lithium mining and Li-ion battery pack manufacturing capacities in India, which contribute to 50% of the value of an electric two wheelers and; low-cost manufacturing of electric two wheelers in China, owing to the economies of scale, which inhibit the growth of- and competition from an indigenous electric two wheelers market in India.

According to the US market research company, P&S Intelligence, India's EV component market is expected to grow at 22.1% by 2030, from a base of $ 536 Mn (INR 4K Cr) in 2020 (P&S Intelligence, 2020). Leading electric two wheelers companies like Ather, Okinawa have announced plans of increasing their localisation to 75%-100% in a year (Chaliawala, 2020).

1.1.5. Charging Infrastructure

Charging Infrastructure Incentives help build an eco-system for EV charging networks and easier adoption to EVs. The FAME scheme has allocated a budget to install 2,600 public charging stations across 62 cities in India. The government of India and several Indian states have taken various measures and policies such as capital subsidies, concessional tariff and planning and regulatory measures to support the development and access to charging infrastructure. Details of some measures by different states are given in Table 4.

- Delhi offers an unspecified capital subsidy for installing public charging infrastructure. It is the only state to offer financial incentives for private charging equipment, with a 100% grant up to USD 80 available per charging point for the first 30,000 private charging points (Delhi Transport Department, 2020). In addition, Delhi and Andhra Pradesh will also reimburse State GST levied on the purchase of advanced batteries for swapping stations.
- For charging infrastructure connection, Delhi is the only state to frame standard operating protocols (SOP) for private customers, including individuals and building associations. Customers can request the installation of private charging points through the state DISCOM's web portal. Installation expenses will be recovered through the customer's electricity bill.

Germane to Indian cities/states, there is – currently – a dearth of publicly available data on the numbers and densities of available electric two wheelers charging/swapping stations. However, there does exist limited state-wise data on the numbers of EV charging stations (not disaggregated by vehicle typology or charger type/technology) that have been established in India under the FAME scheme. These numbers are depicted, linked to their geographies, in Figure 2.

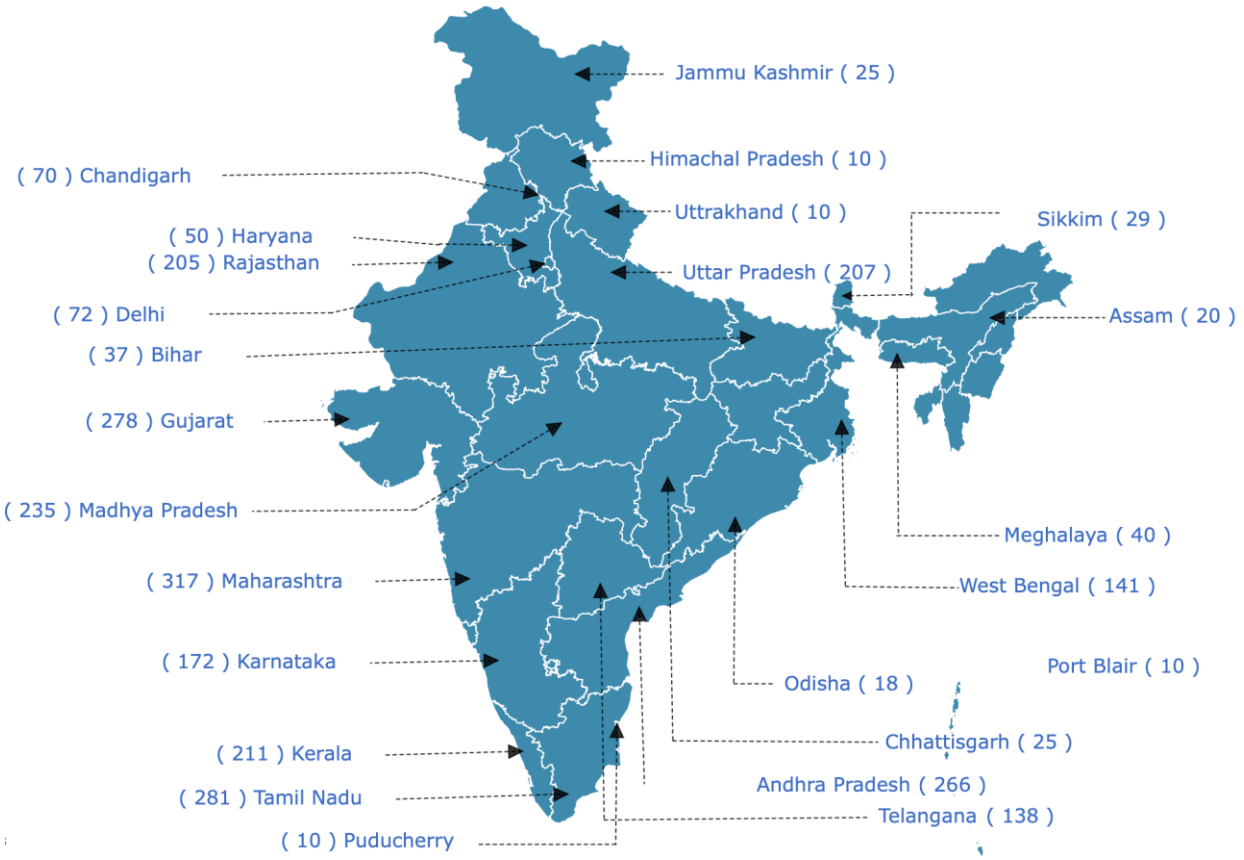

Figure 2 Public EV Charging Stations Established in India (MHIPE, 2021)

The data on electric two wheelers charging/swapping stations in Indian cities was collected from online information. Table 3 below shows the battery swapping stations deployed in some of the cities for electric two and three wheelers.

Table 3 Battery Swapping Stations in Different Cities (Various online sources)

Cities	Battery Swapping Stations
Delhi	55
Bengaluru	5
Chandigarh	8

Cities	Battery Swapping Stations
Kochi	5

Table 4 Summary of EV Policies State Wise in India

Demand incentives for promoting E-2W usage	Andhra Pradesh	• 100% reimbursement of road taxes, registration fees, and state's goods and services tax, on E-2W sales till 2024
	Bihar	• 100% exemption of road taxes and registration fees on the first 24,000 E-2W manufactured in Bihar • Demand incentive for the first 24,000 E-2W manufactured and purchased in Bihar – of ₹10,000 per kWh of battery capacity • Additional incentive of ₹7,000 per kWh for E-2W with Li-ion batteries • Interest rate subvention of 10% to buyers for E-2W manufactured in Bihar • Providing green registration plates for E-2W
	Delhi	• 100% exemption of road taxes and registration fees on all E-2W registered during the policy period (2020 – 2023) • Scrapping incentive of ₹5,000 per 2W can be availed on new E-2W purchase • Demand incentive for E-2W purchase – of ₹5,000 per kWh of battery capacity; maximum subsidy amount per E-2W is ₹30,000 • Providing green registration plates for E-2W • Financing support from state finance corporation for 100% electrification of logistics fleets • Congestion fee exemption for all E-2W taxis
	Kerala	-
	Maharashtra	• 100% exemption of road taxes and registration fees on all E-2W purchased during the policy period (2018 – 2023) • Demand incentive for first 70,000 E-2W purchased in the state – of 15% of purchase cost per E-2W; maximum subsidy amount per E-2W is ₹5,000
	Madhya Pradesh	• First 15,000 E-2W (or total E-2W in the state between 2019 – 2024; whichever is less) to be charged 1% Motor Vehicle tax • First 22,500 E-2W (or total E-2W in the state between 2019 – 2024; whichever is less) to be exempted from registration fees • Parking fees in urban areas to be waived for E-2W from 2019 – 2023

	Punjab	• 100% exemption of Motor Vehicle tax on all private and commercial E-2W purchased during 2019 – 2024; for E-2W manufactured in Punjab, the exemption is applicable from 2019 to 2029 • Fleet and delivery companies encouraged to achieve 100% transition to E-2W by 2024 • Providing green registration plates for E-2W • Reservations of parking and charging slots for E-2W in cities • Exemption from toll taxes on select state highways for E-2W
	Tamil Nadu	• 100% exemption of road taxes and registration fees on E-2W till 30.12.2022 • Providing green registration plates for E-2W
	Telangana	• 100% exemption of road taxes and registration fees for the first 200,000 E-2W • Incentivizing ride-hailing fleets to include E-2W
	Uttarakhand	• 100% exemption from Mortgage Tax to the first 100,000 EV buyers in the state (can include E-2W)
	Uttar Pradesh	• 100% exemption of road taxes and registration fees for the first 100,000 EVs manufactured and purchased in the state (can include E-2W) • State government to promote adoption of E-2W taxis for short distance mobility
Planning and regulatory measures for facilitating E-2W adoption	Andhra Pradesh	• Provision of land to private developers for E-2W charging stations • Modifications in development controls of master plans to incorporate public E-2W charging stations • New developments (above 5,000 m^2) to have EV charging facilities (may include E-2W) • Mandated conversion of 2W logistics fleets to 100% electric by 2024
	Bihar	-
	Delhi	• Modifications to building bye-laws and development control regulations, to make new homes and workplaces EV-ready, with 20% parking reserved for E-2W and 25% higher power load sanctions
	Kerala	• Limiting electricity tariffs to ₹5.5/unit at E-2W charging stations • Piloting E-2W for last-mile connectivity, and in e-mobility zones at tourist villages/hubs, technology hubs, and central business districts

	Maharashtra	• Fast-tracked approvals by planning authorities and electricity supply companies for E-2W charging stations • Modifications in development controls of master plans to incorporate public E-2W charging stations
	Madhya Pradesh	• Fast-tracked provision of land to urban development authorities and transport companies to set up E-2W charging stations • Amendments to building bye-laws and development control regulations to incorporate public E-2W charging stations
	Punjab	• Creation of green zones and corridors in cities, for exclusive access by EVs (including E-2W) and accelerated development of infrastructure • Modifications to building bye-laws and development control regulations to incorporate EV charging stations in new buildings • Limiting electricity tariffs to ₹6/unit at E-2W charging stations • 100% electricity duty exemption at charging points from 2019 to 2024
	Tamil Nadu	• Limiting E-2W charging tariffs, up to 15% above average cost of supply • Incorporating E-2W charging facilities in urban development regulations and building codes
	Telangana	-
	Uttarakhand	-
	Uttar Pradesh	• Amendments to building bye-laws and development control regulations for developing E-2W charging stations • Housing societies (above 5,000 m^2) to have EV charging facilities
Charging infrastructure development for E-2W	Andhra Pradesh	• Capital cost subsidy (of 25% charger cost) to EV charging stations (may include E-2W charging stations); 300 DC chargers (<100 V) will be subsidized (maximum subsidy about is ₹30,000); 100 DC chargers (>100 V) will be subsidized (maximum subsidy about is ₹1,000,000); • 100% state goods and services tax exemption on DC chargers (>100 V) and advanced batteries for battery swapping • State-owned power distribution companies to develop 100 DC charging stations (may include E-2W charging stations)
	Bihar	• First 500 commercial public EV (may include E-2W) charging stations to receive 25% capital cost subsidy on equipment/machinery (up to ₹500,000 per charging station) • E-2W charging points to be developed via public-private-partnerships • Facilitating provision of government land for E-2W charging stations

	Delhi	• First 30,000 EV charging points in residential areas (may include E-2W chargers) to receive 100% capital cost subsidy on equipment/machinery (upto ₹6,000 per charging point)
	Kerala	• State electricity board to develop and power EV charging infrastructure • Encouraging energy and oil companies to invest in charging networks
	Maharashtra	• First 250 public EV charging stations in the state (including public E-2W charging stations) to be eligible for 25% capital subsidy on machinery and equipment (upto ₹1,000,000 per station)
	Madhya Pradesh	• Public EV charging stations in the state (including public E-2W charging stations) to be eligible for 25% capital subsidy on machinery and equipment; Subsidy shall be provided to: ○ First 300 small EV charging stations (up to ₹50,000) ○ First 100 medium EV charging stations (up to ₹200,000) ○ 3. First 100 large EV charging stations (up to ₹1,000,000)
	Punjab	• -
	Tamil Nadu	• Allocating budgets for subsidization and development of E-2W charging infrastructure by private/public entities (budget amount not declared)
	Telangana	• Development of EV charging stations through public-private-partnerships
	Uttarakhand	• -
	Uttar Pradesh	• Prominent highways to be equipped with EV charging facilities per 50 km • First 100 EV public charging stations in the state (including public E-2W charging stations) to be eligible for 50% capital cost subsidy on machinery and equipment (up to ₹600,000 per station)

1.2. China

China currently is one of the countries with the highest number of electric vehicles in the world. In fact, it is estimated that there are more than 200 million electric two wheelers being used in China (IEA, 2021) with annual growth rate of around 20-30 million (Gu et al., 2020), which makes them the country with the most electric two wheelers (IEA, 2021). Even though it is known that China is quite early in adopting electric two wheelers, which started between late 1980s and early 1990s (Gu et al., 2020; Weinert et al., 2007), preferences towards electric two wheelers has not always

been the case in China. This section will elaborate further the way China managed to mainstream electric two wheelers usage in their country.

For a long time, China has been a huge two wheelers country. Bicycles were first introduced in China in the early 20th century, and its usage steadily increased until it reached its peak in mid 1990s (Gu et al., 2020). Based on a report by the China Academy of Transportation Sciences, cited by Gu et al. (2020), there were as much as 670 million bicycles being used in China in 1995. The high usage of bicycles also reflected on the mode share on Chinese cities, where it reached more than 40% in Beijing and Shanghai in 1995 (Gu et al., 2020). This huge number of bicycle usage in cities was actually resulted from the provision of bicycle infrastructures. In 2016, it is estimated that Beijing already had 3,200 km of bicycle lanes to accommodate and encourage bicycle usage (Zhao et al., 2018). This initial familiarity towards two wheelers was also one of the reasons why Chinese people were willing to use electric two wheelers in the future.

1.2.1. Government's Commitment on EV

Apart from motorcycle bans and the availability of affordable e-bikes which will be explained further below, there are also other reasons on why electric two wheelers gained huge popularity in China. The lack of decent public transports and the provision of bicycle infrastructure to be used by e-bikes, are among the other reasons affecting the high number of electric two wheelers in China (Weinert et al., 2008). Looking at these factors, many argue that the e-bike boom in China was driven by demand rather than supply pushed as there was not much support from the government to encourage e-bikes usage (Gu et al., 2020). Although, some would argue that this phenomenon was not entirely because of the high demand and actually triggered by the government's decision to ban motorcycle usage (Gu et al., 2020). This might be true, as Yang in his study (2010) concluded that, although seems unintentional, the motorcycle ban in Chinese cities actually brought greater effect towards e-bike adoptions rather than subsidies given in Taiwan to reduce electric two wheelers price, promote electric two wheelers research and development, and encourage more charging infrastructure constructions.

Chinese government also has the initiative to grow electric vehicles further, through the New Energy Vehicle program (Gong et al., 2013). It has been started since the 1990s, and the government has spent more than USD 1.79 billion between 2001 and 2011 on research and development, pilots and demonstrations, and promotional activities (Gong et al., 2013). In the following 8 years (2012 – 2020), the Chinese government allocated an even bigger budget of USD 15 billion to further promote NEV development (Heller, 2017). However, as mentioned briefly in the previous section, this program was intended to promote electric vehicle usage mainly on four wheelers. Therefore, apart from the improvement on public charging infrastructures, electric two wheelers would not get any significant benefit through this program.

1.2.2. Fiscal Incentives

Electric two wheelers were first introduced in China back in 1983 (ITDP China, 2017). In 1991, the government put electric bikes as one of the major technology projects to be developed during the next 5 year and started the investment towards electric bike research and development (Ruan, 2014; Weinert, 2007). Apart from this, there is no actual fiscal incentives given by the government to encourage electric two wheelers purchase (Gu et al., 2020; ITDP China, 2017), such as purchase subsidy or tax rebates, which commonly used in other countries such as Taiwan (Yang, 2010) and India (Delhi Transport Department, 2020).

Only recently, the government offered a subsidy of up to 30% on each electric vehicle under the New Energy Vehicles initiatives (ITDP China, 2017). However, it was intended to encourage electric four wheelers growth. Therefore, the subsidy was specifically being allocated for them, not to electric two wheelers. Nevertheless, due to the established ecosystem, electric two wheelers growth is still expected to be growing in the future years without the needs of government intervention (ITDP China, 2017).

1.2.3. Non-Fiscal Incentives

But it was not until around the mid-2000s that electric two wheelers started to grow rapidly (Gu et al., 2020). This was due to the fact that some cities started to ban motorcycles off the road. At first, there was a considerable growth of motorcycles (gasoline powered two wheelers) in the 1990s as shown by Figure 3 below. However, many cities started to ban motorcycle usage due to traffic congestion, environmental, and safety issues (Gu et al., 2020; Ruan et al., 2014; Yang, 2010). Tianjin, Guangzhou, Shenzhen, Shanghai are amongst the first to ban the motorcycle usage (Gu et al., 2020; Ruan, 2014), which then followed by many other cities and resulted in more than 150 cities in China ban motorcycles usage as of 2020 (Gu et al., 2020). Although unintended, this motorcycle ban would actually serve as an incentive towards electric two wheelers usage and eventually resulted in the increasing usage of electric two wheelers in mid 2000s as shown by Figure 3 below as well.

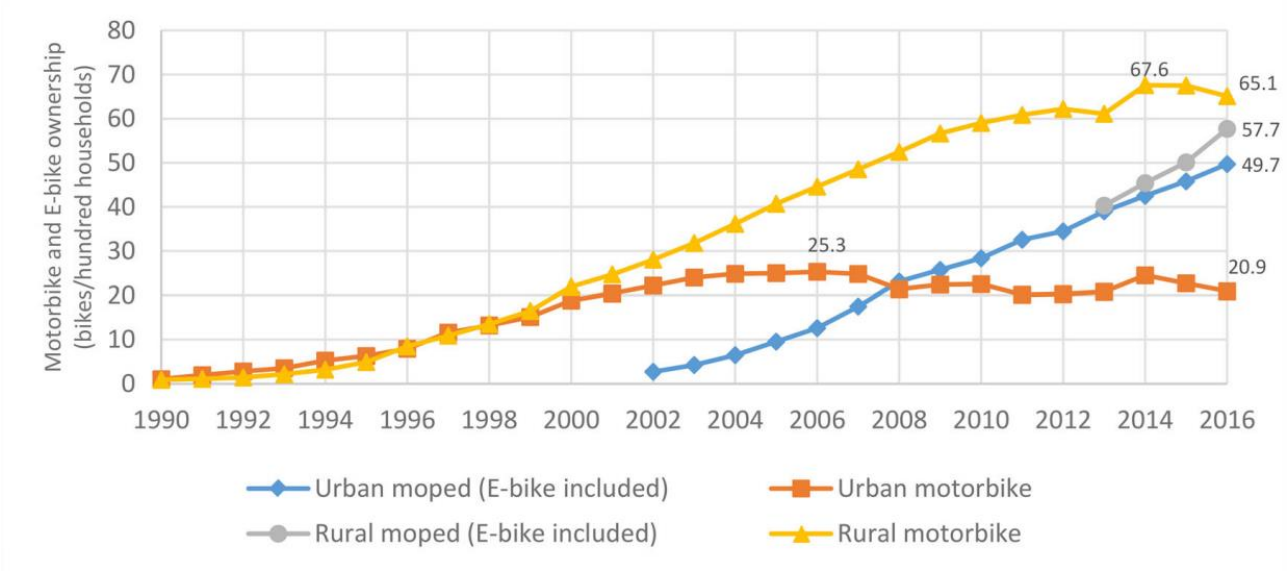

Figure 3 Electric Two Wheelers and Motorcycles Ownership in China (National Bureau of Statistics of China, 2018 as cited in Gu et al., 2020)

Another contributing factor to the widespread adoption of electric two wheelers is the fact that electric two wheelers proved to be more economically efficient (Weinert et al., 2007). Not only on its operational cost, its required capital cost was also lower than that of gasoline two wheelers. Based on a study by Weinert et al. (2007), the capital cost required for acquiring electric two wheelers in the form of E-bike (speed limit of under 25 kph, equipped with pedal) is almost half of that motorcycle price as shown on Table 5 below.

Table 5 Cost Comparison between E-Bike and Motorcycle (Weinert et al., 2007)

	E-Bike	Motorcycle (gasoline)	Motorcycle (LPG)
Total cost ($/year)	**120**	**360**	**380**
Assumptions			
Fuel price ($/fuel unit)	0.08/kWh	0.56/l	0.41/l
Fuel economy (fuel unit/km)	0.015 kWh	0.040 l	0.036 l
Vehicle cost ($)	310	560	750
Maintenance cost ($/year)	4	70	70

	E-Bike	Motorcycle (gasoline)	Motorcycle (LPG)
Battery cost ($)	33	1.3	1.3
License cost ($)	4	180	180
Average usage (km/day)	9.4	14	14
Vehicle lifetime (year)	5	5	5

The reason for this was because the initial e-bikes being sold had considerably lower performance than the available motorcycle models at that time, in particular on speed, load, and range aspects (Ruan, 2014; Weinert et al., 2007). This would mean that the quality of components being used on those e-bikes was not as good as those being used on motorcycles, thus cost less to build.

Moreover, its practicality and the absence of any sort of license to operate made e-bikes able to capture interests from non-motorcycle users, which are the elderly, children and women (Ruan, 2014). The existence of this niche market actually enabled the electric two wheeler industry to grow and increase their production which further reduced the production cost for each vehicle. This was shown by E-bikes price that kept decreasing from USD 310 in 1999 to only USD 125 in 2006, which already has better quality and performance (Weinert et al., 2007).

1.2.4. Local Component Usage on E-2W

Information on local content requirements for electric two wheelers in China are hard to come by. However, there is some information on local content requirements for the overall automobile industry in China.

Back in 1987, rather than setting the minimum local content requirement for manufacturers, Chinese government offered reduced import tariffs for as low as 20% on certain key parts if they could reach 80% of localization rate (Chu, 2011). Therefore, each manufacturer could analyse their own cost benefit analysis and come up with their own conclusion whether the localization rate was worth pursuing. However, in 2004 they abolished the local content requirement (Chu, 2011). This was done in coordination with the WTO to simplify the administrative procedures (Chu, 2011). Nowadays, despite not having any local content requirement, China still imposes an import tariff with an average of 13.8% for automotive vehicles and 6% for auto parts (KPMG, 2018).

1.2.5. Charging Infrastructure

Speaking of charging infrastructure, it is also worth noting that the e-bikes boom in China happened without the provision of sufficient public charging infrastructure. In 2019, it was estimated that the number of public charging stations in China is only around 330,000 (Ou et al., 2020), which is far below the number of electric vehicles in China which comprised at least 200 million electric two wheelers (IEA, 2021). Based on a study by Weinert et al. (2008), it was found that most e-bikes available in China have removable batteries, therefore almost all of the users charged their battery at home during night time to utilize the reduced off-peak electricity rate.

1.3. Vietnam

Vietnam is also one of the countries with considerably high electrification of two wheelers. Out of the 43 million registered two wheelers in 2014, 2.5 million of them are electric two wheelers (Nguyen and Nguyen, 2015). Vietnam's capital city of Hanoi is home to around eight million people with an area of about 3,358 km^2. With limited high-capacity public transit, motorcycles have long been the preferred transport mode in the city. There are more than six million motorbikes today, and it is estimated that by 2025, there could be about 11 million on Hanoi's streets (BBC, 2017).

Pollution from these vehicles contributes to poor air quality in the city--in 2019, Hanoi had only eight days with PM2.5 lower than the national standard of 50 µg/m3 (Huu and Ngoc, 2021). To reduce pollution and congestion, the Hanoi City government voted to ban motorcycles in sections of the city by 2030, and has already begun banning use in certain neighbourhoods. With only around ten percent of trips currently taken on public transport and up to 80 percent via motorcycles, some are sceptical about the feasibility of banning two-wheelers (Di and Long, 2019). Recent government initiatives led by the Ministry of Transport since 2017 have begun to look at the role electric vehicles--especially electric two wheelers--can play in reducing air and noise pollution, but the country currently lacks a comprehensive EV roadmap (Huu and Ngoc, 2021).

With this backdrop, electric motorcycles are catching on in Hanoi. While exact numbers are hard to come by, electric two wheelers are estimated to make up anywhere from 5-10 percent of the current Hanoi fleet (300-600 thousand electric vehicles). With vehicle manufacturers such as VinFast and MBI investing in charging stations and battery swapping technologies across the city, and costs reaching parity, that figure is expected to increase in the coming years.

1.3.1. Government's Commitment on EV

The Vietnamese government has committed to a reduction of its greenhouse gas (GHG) emissions by 25% by 2030 as part of the Paris Agreement (Cheung, 2021). Since transportation is a main contributor to GHGs, it is expected that the government will adopt a transition strategy to support

uptake of electric two-wheelers. Indeed, Prime Minister Directive No 03/CT-TTg dated 18 January 2021 called for the Ministry of Transport to urgently develop a national program to expand environmentally-friendly transport, including electric vehicles (Huu and Ngoc, 2021).

1.3.2. Fiscal Incentives

To date, there are no fiscal incentives in place specifically to promote local manufacture and use of electric two wheelers in Vietnam. As described in section 3.1, growth in electric two wheelers manufacturing has largely been spurred by companies with existing manufacturing presence in the country diversifying into the electric mobility space. Some of these companies are calling on the Vietnamese government to create new opportunities for local manufacturers through concessional loans, tax exemption, land use incentives, technology incentives, and/or support for product distribution (UNEP, 2020a).

Even without incentives in place to promote their use, consumers have been motivated to switch to electric through operational cost savings. Petrol in Vietnam currently includes an environmental tax of US $0.13 per litre, and costs around USD 3.50 for a full tank to travel around 100km. The same distance can be travelled via electric motorcycle for around US $0.22.

Hanoi is also advancing a congestion charging scheme, similar to those in place in Singapore and London. Under the proposal, motorbikes would be required to pay a fee to enter designated areas in the city centre. It is unclear whether or not electric two-wheelers will be exempted from the charge (Viet Nam News, 2018).

1.3.3. Non-Fiscal Incentives

While Vietnam's government has not yet implemented subsidies or other fiscal incentives for electric motorcycles, the federal Ministry of Transportation has proposed new regulations mandating electric infrastructure at parking lots and bike stations, which could help to overcome consumer range anxiety and boost sales of electric two wheelers (Shu, 2021).

Vietnam has a vehicle labelling program in place, which informs consumers about the annual or cost of energy consumed by the vehicle. Labelling programs have proven to be an effective approach to giving consumers greater insight into the long- term cost savings of electric vehicles (UNEP, 2020b).

1.3.4. Local Component Usage on E-2W

Vietnam does not have a specific requirement for using local components on electric two wheelers. However, import taxes for component parts range from 15-30 percent, creating an incentive for local manufacturers (Shu, 2021).

1.3.5. Charging Infrastructure

Currently, in Vietnam, most of the electric 2-wheeler users charge their vehicles at home or work (UNEP, 2020a). Public charging infrastructure and battery swapping kiosks are beginning to expand in Hanoi and elsewhere in the country, with manufacturers committing to major investments in the coming years. For example, VinFast has committed to opening more than 2,000 charging stations nationwide in 2021 at its VinMart convenience stores (Viet Nam News, 2021). These rapid charging stations can fully charge an electric motorcycle in about 20-30 minutes. The company also employs a team of technicians to supply an emergency charge for any stranded riders.

Companies are also looking into swappable battery kiosks. For example, MBI is investing in 15,000 battery swapping stations across Vietnam (Electropro, 2019).

2. Gaps in Indonesia

Unlike those three countries mentioned before, electric vehicle adoption is still in its early stage in Indonesia. Out of the registered 112 million two wheelers in Indonesia (BPS-Statistics Indonesia, 2019), only around 2,000 of them are electric (Sugiharto, 2020). Based on commitments from various public and private institutions gathered by the Ministry of Energy and Mineral Resources, it was estimated that there will be around 41,474 electric two wheelers by the end of 2021 (MEMR, 2021), which is only 0.04% of all two wheelers in Indonesia which further confirmed that Indonesia is still in its early stage of electrification. However, this early stage of electrification actually provides an opportunity for Indonesia to learn what gaps need to be covered to catch up and eventually reach the electrification rate of those three countries, or even higher.

This section of the report will analyse the electrification practice from those three countries explained in the previous section, and will also identify which practices should be applied in Indonesia to enable high electrification rate. Following the same structure as the previous section, this section will be divided into 5 different subsections and will be summarized in the other separate sub-section.

2.1.1. Government's Commitment on EV

In 2019, the Indonesian government issued a Presidential Regulation No. 55 of 2019 on Acceleration of BEV Adoption. There are several things addressed in this regulation, such as the application of various fiscal and non-fiscal incentives for EV, the development of the domestic EV industry, the provision of charging infrastructure, the regulation of electricity rate for EV, the technical specification requirements of EV, and the environmental protection measures. Even though these issues were mentioned, they were not addressed in detail as this regulation would only serve as the foundation for further regulations to be issued by other related stakeholders.

Up until now, some stakeholders assigned by the presidential regulation have produced their implementing regulations. Based on a report by CMMIA (2020), there are at least six regulations that have been produced to regulate the mandate given through the presidential government as shown on Table 6 below.

Table 6 Derivative Regulations for EV Acceleration Program in Indonesia (CMMIA, 2020)

No	Regulation	Title	Objective
1	Ministry of Home Affairs Regulation No. 8 of 2020	Calculation on Road Tax and Purchase Tax for Motorized Vehicle	Legal protection for local governments to provide fiscal incentives for EV
2	Ministry of Transportation Regulation No. 44 of 2020	Electric Vehicle Testing and Certification	EV roadworthiness test procedure
3	Ministry of Energy and Mineral Resources Regulation No. 13 of 2020	Provision of Charging Infrastructures for Battery Electric Vehicle	Provision of charging infrastructure and battery swap station, and safety aspect of charging infrastructures
4	Ministry of Industry Regulation No. 27 of 2020	EV Industry Road Map and Local Content Requirement Calculation	Regulate domestic EV industry road map and how to calculate local content rate on EV
5	Ministry of Industry Regulation No. 28 of 2020	BEV in Completely Knocked Down (CKD) State and Incompletely Knocked Down (IKD) State	Procedure of CKD and IKD manufacturing process
6	Traffic Corps of National Police Decree No. 5 of 2020	Vehicle Plate for BEV	Specification of BEV's vehicle registration plate

Furthermore, through the Coordinating Ministry of Maritime and Investment Affairs Regulation No. 8 of 2020, the government has also established the coordination team for the BEV acceleration program to facilitate coordination between numerous stakeholders related to BEV adoption led by CMMIA. The government through the Ministry of State-Owned Enterprises has also established the Indonesia Battery Corporation (IBC). This company would be the focal point of collaboration with other global corporations to develop the battery industry in Indonesia (Wareza, 2021) as Indonesia has the world's biggest reserve of nickel (Garside, 2021), one of the main components of battery production (MEMR, 2020).

Although the government seems really committed to accelerate EV adoption, currently there is still no clear budget allocation to develop domestic EV industries or to give subsidies for EVs. Unlike India or China, where they have stated the specific budget allocated to FAME I & II and New Energy Vehicle programs, in Indonesia there were only some records of the government saying that the national budget will be directed to support electric vehicles adoption (Hendartyo and Setiawan, 2019) without the specific budget. This unclear budget allocation might lead to industry players becoming unsure of the government's commitment towards EV development and might discourage them from making any major investment to develop the EV ecosystem.

2.1.2. Fiscal Incentives

Currently, Indonesia provides several fiscal incentives for electric vehicles. The first one is the reduction of road tax (PKB) and purchase tax (BBN-KB) as stated in Ministry of Home Affairs Regulation No. 8 of 2020. PKB is an annual tax while BBN-KB is a one-off tax up front. Their rate differs between regions, where in Jakarta the PKB is up to 10% of vehicle cost and BBN-KB is up to 12.5% of vehicle's price (Nugrahadi and Maulana, 2021). The Ministry of Home Affairs Regulation No. 8 of 2020 states that electric vehicles will only be subjected to 20-30% of what they are supposed to be. Moreover, some local governments give further incentives to PKB and BBN-KB. For example, Jakarta Provincial Government through Jakarta's Governor Regulation No. 3 of 2020 completely eliminate the BBN-KB for electric vehicles, whereas Bali Provincial Government through its Governor Regulation No. 9 of 2021 further reduces the PKB and BBN-KB of electric vehicles to only 10% of what they are supposed to be. The next incentive is on luxury tax (PPnBM) based on Government Regulation No. 74 of 2021, where electric vehicles are exempted from this tax starting from October 2021. Last but not least, the government through the state utility company (PLN) gives a 30% discount on off-peak (10 pm to 5 am) electricity rate for electric vehicle owners (Umah, 2021).

Although there are other incentives planned to be imposed to electric vehicles based on the Presidential Regulation No. 55 of 2019, such as import duty exemption, they have not been implemented yet and believed to be still under discussion with all related stakeholders.

Higher acquisition price is one of the identified barriers for massive EV adoption in the previous report. Therefore, effort should be made on how to reduce EV's acquisition price. Unlike EV's operational cost that have been proven to be lower than conventional vehicles (Ainurrofiq, 2020), their acquisition price is still higher in Indonesia as briefly explained in the previous report. Although there seems to be a lot of fiscal incentives being given to EV, they are actually not reducing the capital cost required so that it is cheaper to buy EV than conventional vehicles and further incentives are needed (Dinda et al., 2021).

To break it down briefly, out of those 3 types of tax subsidy or exemption explained above, only BBN-KB and PPnBM are paid up front and related to capital cost needed. For two wheelers with

small engines (< 250 cc) which are mainly used by ride hailing services, they are not subjected to PPnBM. Unlike PPnBM, BBN-KB is subjected to all kinds of vehicles. One of the components used to calculate BBN-KB is vehicle price. Therefore, as electric vehicle prices are still high and reaching 3 times of that conventional vehicle price (Ainurrofiq, 2020) a 70% discount on BBN-KB would still result in the similar amount of money needed to be paid as tax between EV and conventional vehicles. As EVs' prices are higher, the same amount of taxes would not reduce the price parity between EV and conventional vehicles, thus further incentives are needed.

Looking at other countries mentioned in the previous section, India offered a purchase subsidy that actually reduces EVs price. This kind of direct subsidy could actually bridge the price parity between EV and conventional vehicles, thus might increase EV adoption in the future. Subsidies given on battery deposit that is applicable in India (Delhi Transport Department, 2020) should also be assessed further, as battery seems to be one of the most expensive parts on electric vehicles.

However, it should be noted that bridging the price gap might not be the most efficient way to accelerate EV adoption. Lessons should be learned from Taiwan that has allocated USD 10 million dollars of subsidy to reduce 50% of EV's price, but failed to increase the actual sales of electric two wheelers back in early 2000s (Yang, 2010).

2.1.3. Non-Fiscal Incentives

Based on the Presidential Regulation No. 55 of 2019, there are 3 non-fiscal incentives to be given to electric vehicles. Out of those 3, 2 incentives are given to manufacturers which might not impact EVS price significantly, while the other one is given to electric vehicle users in the form of exemption to any Transport Demand Management (TDM) measures. In Jakarta, there was an odd-even policy being implemented before the pandemic, where vehicles with odd numbered vehicle plates could only be used on selected road corridors on odd dated days, and vice versa. In Governor Regulation No. 80 of 2020, it was stated that this policy would be implemented to four wheelers as well as two wheelers. However, as the pandemic struck, odd-even policy has never been implemented anymore as there is less traffic on the street.

Looking at other countries, non-fiscal incentives proved to be one of the most powerful tools to increase EV adoption in a country. In China where the government did not give any fiscal incentives, and where there was not much public charging infrastructure, a strict motorcycle ban on cities actually managed to improve electric two wheelers' sales by multiple times as explained in the previous section. However, it should be noted that Chinese local governments started to ban motorcycle usage when there were less motorcycle users, therefore they did not meet any major resistance. Some takeaways that could be learned from China are: 1) the usage of environmental issues to perform restrictions on conventional vehicles and promote EV usage, and 2) significant restrictions on conventional vehicles could definitely accelerate EV usage.

Indonesia could also learn from India and Vietnam to gain references on what types of non-fiscal incentives that might be useful to improve EV adoption. From the explanation in the previous section, the application of Green Zones and Vehicle Label are examples of non-fiscal incentives used in both of those countries. Green zones that are planned to be implemented in some areas in India are actually similar in some degree to what China did and could be replicated in Indonesia as well. Last but not least, vehicle efficiency labels that are used in Vietnam could also be adopted in Indonesia to increase people's knowledge on potential savings from using EVs.

2.1.4. Local Component Usage on E-2W

One of the government's objectives of promoting electric vehicles usage in Indonesia is to maximise the utilisation of nickel in Indonesia (MEMR, 2020), which is one of the components for batteries used in EVs where Indonesia has the biggest nickel reserve in the world (Garside, 2021). This motivation has led to the implementation of Local Content Requirement on EV production in Indonesia. Based on Presidential Regulation No. 55 of 2019, the local content requirement for electric two wheelers is 40%. This local content requirement would be gradually increased, with 60% in 2024 and eventually 80% in 2026.

Although it is understandable that the government would want to leverage local industry as well by accelerating EV adoptions, early local content requirement implementation could potentially dissuade people further in adopting EV. EV is a new thing in Indonesia, so only a few manufacturers have some sort of familiarity with EV's components. EV's prices could be further increased with the implementation of local content requirement as local industries still have some limitations in producing EVs.

In India, the local content requirement of 10% was implemented in 2018 (MHIPE, 2019) when the penetration rate of electric two wheelers is 0.3% (JMK Research & Analytics, 2020) of all two wheelers. Compared to Indonesia where the local content requirement is 40% and the penetration rate is still below 0.04% (BPS-Statistics Indonesia, 2019; MEMR, 2021), this might suggest that the local content requirement implemented in Indonesia is too high and too early. Therefore, this might result in more effort and resources required to promote massive EV adoption in Indonesia.

2.1.5. Charging Infrastructure

As explained in the previous chapter, one of the barriers of electrification is the limited range of EV which led to range anxiety (Evarts, 2013; Bonges et al., 2016). One way to reduce this range anxiety is by providing public charging infrastructure (Tran et al., 2012). In Indonesia, the provision of public charging infrastructure is one of the issues being addressed by the Presidential Regulation No. 55 of 2019. PLN has also provided the road map of public charging infrastructure provision in Indonesia, where they have projected that there should be almost 4,000 public

charging stations built by the end of 2024 (PLN, 2020). However, up until May 2021, there were only 147 units available (Meilanova, 2021) out of the 572 units that should have been built based on the road map. Compared to the 2,000 electric two wheelers that have been registered in Indonesia (Sugiharto, 2020), it could be concluded that currently each charging station would serve 13 electric two wheelers on average.

Comparison on the proportion of the available charging station to the registered electric two wheelers with other countries with high two wheelers penetration rate should be made. Table 7 below calculates the average number of electric two wheelers served by a single charging station in each country to analyse whether Indonesia already has a sufficient number of charging stations available. The lower the number of electric two wheelers per charging station means the better the country in providing public charging infrastructure. As detailed data of registered two wheelers and available public charging stations in city level are hard to come by, the national figures will be used instead to give rough estimation of charging availability condition of each country.

Table 7 Comparison of Available Charging Stations and Registered Electric Two Wheelers from India, China, and Indonesia

Country	Available Charging Stations	Registered E-2W	E-2W/Charging Stations
India	3,000 (MHIPE, 2021)	7,350,000 (Statista, 2021)	2,450
China	330,000 (Ou et al., 2020)	200,000,000 (IEA, 2021)	606.06
Indonesia	147 (Meilanova, 2021)	2,000 (Sugiharto, 2020)	13.61

Looking at the Table 7 above, we could see that Indonesia actually performs best out of the three countries mentioned. Looking at how India and China have more penetration rate of electric two wheelers, this might suggest that charging infrastructure availability might not be the major obstacle in electric two wheelers adoption. Although many Indonesian drivers stated that "lack of electric vehicle charging infrastructure" as their main concern for EV adoption (Deloitte, 2021), few studies from countries with high electric two wheelers penetration rate stated that most of electric two wheelers users charge their vehicles at home or work (Weinert et al., 2008; UNEP, 2020). It should also be noted that these other countries could reach high electric two wheelers adoption rate despite of comparatively low public charging infrastructure availability due to strict policies, such as motorcycle ban in China (Gu et al., 2020; Ruan et al., 2014; Yang, 2010), or preferred fiscal incentives found in India (Delhi Transport Department, 2020).

2.1.6. Summary

Upon looking at the comparison between Indonesia and three other countries, here is the summary of electric two wheelers adoption in each country and their respective supporting policy or programs:

Table 8 Summary of Best Practices for Two Wheelers Electrification

No	Indicators	India	China	Vietnam	Indonesia
1	Number of registered electric two wheelers/overall two wheelers	(7,350/154,000*) = 4.8%	(200,000/350,00 0*) = 57.1%	(2,500/43,000) = 5.8%	(2/112,000) = 0.002%
2	Government program to electrify two wheelers	Starts from 2015	Starts from 1991	Starts from 2017	Starts from 2019
3	Fiscal incentives	Up to 20% cut on EV price + tax	-	-	Up to 12.5% cut on EV price + tax
4	Non-fiscal incentives	1. Permit and parking priority; 2. Green Zone exemption; 3. Toll Fee Waiver	Gasoline two wheelers ban on numerous cities	Vehicles' energy efficiency labelling program	Exemption to TDM measures
5	Local content requirement	Up to 10% after the third year of EV acceleration program	-	-	40% since the first year of EV acceleration program
6	Charging infrastructure availability	1 for every 2,450 E-2W	1 for every 606.06 E-2W	-	1 for every 13.61 E-2W

*Estimated figures from available sources

From Table 8 above, it can be concluded that charging infrastructure availability in Indonesia is currently sufficient to enable massive adoption of electric two wheelers. However, it should be supported with more restrictions towards electric vehicles alternatives as it was proven to give the best result as could be seen by gasoline two wheelers ban in China and congestion pricing in London (Yang, 2010). A lower local content requirement should also be assessed further as India managed to grow their electric two wheelers intake while also imposing local content requirements to leverage domestic EV industries.

3. References

Ainurrofiq, U. 2020. Kolaborasi mewujudkan ekosistem kendaraan listrik untuk masa depan. *Grab Indonesia*.

BBC. 2017. Hanoi plan to ban motorbikes by 2030 to combat pollution. *BBC*. [Online]. 4 July 2017. [Accessed on June 2021]. Available from: https://www.bbc.com/news/world-asia-40498052

Bonges, H. A., Lusk, A. C. 2016. Addressing Electric Vehicle (EV) Sales and Range Anxiety through Parking Layout, Policy and Regulation. *Transportation Research Part A: Policy and Practice*. **83**, pp.63-73.

BPS-Statistics Indonesia. 2019. *Land Transportation Statistics 2019*. [Online]. [Accessed 21 April 2021]. Available from: https://www.bps.go.id/publication/2020/11/20/ddce434c92536777bf07605d/statistik-transportasi-darat-2019.html

Chaliawala, N. 2020. Localisation of electric vehicles gathers steam amidst call for "Atmanirbhar" and China face-off. *The Economic Times*. [Online]. 10 September 2020. [Accessed on June 2021]. Available from: https://economictimes.indiatimes.com/industry/auto/auto-news/localisation-of-electric-vehicles-gathers-steam-amidst-call-for-atmanirbhar-and-china-face-off/articleshow/78041280.cms?from=mdr

Cheung, J. 2021. Accelerating e-mobility in Vietnam. *Arup*. [Online]. 2 March 2021. [Accessed on June 2021]. Available from: https://www.arup.com/news-and-events/accelerating-e-mobility-in-vietnam

Chu, W.W. 2011. How the Chinese government promoted a global automobile industry. *Industrial and Corporate Change*.**20**(5), pp.1235-1276.

Coordinating Ministry for Maritime and Investment Affairs (CMMIA). 2020. Strategi Percepatan Kendaraan Bermotor Listrik Berbasis Baterai/KBLBB (BEV). *Coordinating Ministry for Maritime and Investment Affairs*. [Online]. [Accessed on June 2021]. Available from: http://b2tke.bppt.go.id/images/Event/Materi_Webinar_KBLBB/3.%20Kemenkomarvest_Strategi%20Percepatan%20KBLBB.pdf

CRISIL Research. 2019. Unplugged! Subsidy ends for ~95% of electric scooters. *CRISIL Research*. [Online]. [Accessed on June 2021]. Available from: https://www.crisil.com/content/dam/crisil/our-analysis/views-and-commentaries/impact-note/2019/apr/crisil-research-impact-note-unplugged-subsidy-ends-for-~95percent-of-electric-scooters.pdf

Delhi Transport Department. 2020. Delhi Electric Vehicles Policy, 2020. *Transport Department Government of National Capital Territory of Delhi*. Available from: https://transport.delhi.gov.in/sites/default/files/All-PDF/Delhi_Electric_Vehicles_Policy_2020.pdf

Deloitte. 2021. *Full speed ahead: Supercharging electric mobility in Southeast Asia*. [Online]. [Accessed on April 2021]. Available from: https://www2.deloitte.com/content/dam/Deloitte/sg/Documents/strategy/sea-strategy-operations-full-speed-ahead-report.pdf

Dhawan, R., Gupta, S., Huddar, N., Iyer, B., Mangaleswaran, R., and Padhi, A. 2018. The Auto Component Industry in India: Preparing for the Future. *McKinsey & Company*. Available from: https://www.mckinsey.com/featured-insights/asia-pacific/the-auto-component-industry-in-india-preparing-for-the-future#

Di, W. and Long, B. 2019. Feature: Motorbike banning scheme in Hanoi sees debates rev up, sparks mixed feelings. *Xinhuanet*. [Online]. 27 March 2019. [Accessed on June 2021]. Available from: http://www.xinhuanet.com/english/2019-03/27/c_137927910.htm

Dinda, S., Cahyoputra, L.A., and Kurniawan, H. 2021. Mobil Listrik Butuh Tambahan Insentif. *Investor Daily*. [Online]. 29 March 2021. [Accessed on June 2021]. Available from: https://investor.id/business/mobil-listrik-butuh-tambahan-insentif

Electropro. 2019. Korean MBI electric motorbike in Vietnam. *Electropro*. [Online]. October 2019. [Accessed on June 2021]. Available from: https://electrodealpro.com/korean-mbi-electric-motorbike-is-wide-in-vietnam/

Evarts, E. 2013. Many Americans are Just a Plug away from Owning an Electric Car. *Yahoo Autos*. [Online]. 11 December 2013. [Accessed on 24 April 2021]. Available from: https://autos.yahoo.com/news/many-americans-just-plug-away-owning-electric-car-160000286.html

Garside, M. 2021. Nickel reserves worldwide by country 2020. *Statista*. [Online]. 18 February 2021. [Accessed on June 2021]. Available from: https://www.statista.com/statistics/273634/nickel-reserves-worldwide-by-country/

Gong, H., Wang, M.Q., and Wang, H. 2013. New energy vehicles in China: policies, demonstration, and progress. *Mitigation and Adaptation Strategies for Global Change*. **18**, pp.207-228.

Gu, T., Kim, I., and Currie, G. 2020. The two-wheeled renaissance in China—an empirical review of bicycle, E-bike, and motorbike development. *International Journal of Sustainable Transportation*. **15**(4), pp.239-258.

Heller, M. 2017. Chinese Government Support for New Energy Vehicles as a Trade Battleground. *The National Bureau of Asian Research*. [Online]. 27 September 2017. [Accessed on June 2021]. Available from: https://www.nbr.org/publication/chinese-government-support-for-new-energy-vehicles-as-a-trade-battleground/

Hendartyo, M and Setiawan, K. 2019. Luhut Pandjaitan: APBN 2021 Diarahkan Dukung Kendaraan Listrik. *Tempo*. [Online]. 31 August 2019. [Accessed on June 2021]. Available from:

https://bisnis.tempo.co/read/1242288/luhut-pandjaitan-apbn-2021-diarahkan-dukung-kendaraan-listrik/full&view=ok

Huu, D.N. and Ngoc, V.N. 2021. Analysis Study of Current Transportation Status in Vietnam's Urban Traffic and the Transition to Electric Two-Wheelers Mobility. *Sustainability*. **13**(10), article no: 5577.

IEA. 2021. Global EV Outlook 2021. *International Energy Agency (IEA)*. [Online]. [Accessed on June 2021]. Available from: https://www.iea.org/reports/global-ev-outlook-2021

ITDP-China. 2017. The Development and Future Prospects of Electric Bicycles in China. *Guangzhou Modern BRT & Sustainable Transport Institute (ITDP-China)*. [Online]. [Accessed on June 2021]. Available from: http://www.itdp-china.org/media/publications/pdfs/ebike.pdf

JMK Research & Analytics. 2020. E-Two Wheeler India Market Outlook: May, 2020. *JMK Research & Analytics*. [Online]. [Accessed on June 2021]. Available from: https://www.iamrenew.com/wp-content/uploads/2020/05/Electric-Two-Wheeler-India-Market-Outlook_JMK-Research.pdf

Kerala Transport Department. 2019. Policy on Electric Vehicles for the State of Kerala. *Transport Department Government of Kerala*. Available from: https://anert.gov.in/sites/default/files/inline-files/go20190310_Trans-24-Ms_e_vehicle_policy_.pdf

KPMG. 2018. Significant reduction of Import Tariffs on Automotive Vehicles and Parts. *KPMG*. [Online]. [Accessed on June 2021]. Available from: https://home.kpmg/cn/en/home/insights/2018/05/china-tax-alert-12.html

Madhya Pradesh Urban Development and Housing Department. 2019. Madhya Pradesh Electric Vehicle (EV) Policy 2019. *Urban Development and Housing Department Government of Madhya Pradesh*. Available from: http://mpurban.gov.in/Uploaded%20Document/guidelines/1-MPEVP2019.pdf

Meilanova, D.R. 2021. Hingga Mei 2021, Baru Terbangun 147 Stasiun Pengisian Kendaraan Listrik. *Bisnis*. [Online]. 16 June 2021. [Accessed on June 2021]. Available from: https://ekonomi.bisnis.com/read/20210616/44/1406216/hingga-mei-2021-baru-terbangun-147-stasiun-pengisian-kendaraan-listrik

Ministry of Energy and Mineral Resources (MEMR). 2020. Peluang Investasi Nikel Indonesia. *Ministry of Energy and Mineral Resources Republic of Indonesia*.

Ministry of Energy and Mineral Resources (MEMR). 2021. Dashboard Percepatan Program KBLBB (Kendaraan Bermotor Listrik Berbasis Baterai). *Ministry of Energy and Mineral Resources Republic of Indonesia*. [Online]. [Accessed March 2021]. Available from: https://www.esdm.go.id/kblbb/

Ministry of Heavy Industries and Public Enterprises (MHIPE). 2012. National Electric Mobility Mission Plan 2020. *Ministry of Heavy Industries and Public Enterprises Government of India*. Available from: https://dhi.nic.in/writereaddata/content/nemmp2020.pdf

Ministry of Heavy Industries and Public Enterprises (MHIPE). 2019. Phased Manufacturing Programme (PMP) to promote indigenous manufacturing of Electric Vehicle. *Ministry of Heavy Industries and Public Enterprises Government of India*. Available from: https://dhi.nic.in/writereaddata/fame/famedepository/1-pmp.pdf

Ministry of Heavy Industries and Public Enterprises (MHIPE). 2021. Production Linked Incentive (PLI) scheme notification. *Ministry of Heavy Industries and Public Enterprises Government of India*. Available from: https://dhi.nic.in/writereaddata/UploadFile/ACC%20Scheme%20Notification%209June21.pdf

Ministry of Statistics and Programme Implementation (MOSPI). 2017. MOTOR VEHICLES – Statistical Year Book India 2017. *Ministry of Statistics and Programme Implementation Government of India*. Available from: http://mospi.nic.in/statistical-year-book-india/2017/189

National Automotive Board (NAB). 2020. FAME India Scheme Phase II (National Mission on Electric Mobility). *Ministry of Heavy Industries*. [Online]. 25 September 2020. [Accessed on June 2021]. Available from: https://fame2.heavyindustry.gov.in/

Nguyen, X. T. and Nguyen, Q. H. 2015. Service Issues: Overview of Electric Vehicles use in Vietnam. *Armand Peugeot Chair International Conference: 3rd Electromobility Challenging Issues*.

Nugrahadi, A. and Maulana, A. 2021. Ini Biaya Resmi Urus Balik Nama Kendaraan di Jakarta. *Kompas*. [Online]. 29 March 2021. [Accessed on June 2021]. Available from: https://otomotif.kompas.com/read/2021/03/29/151200415/ini-biaya-resmi-urus-balik-nama-kendaraan-di-jakarta

Ou, S., Lin, Z., He, X., Przesmitzki, S., and Bouchard, J. 2020. Modeling charging infrastructure impact on the electric vehicle market in China. *Transportation Research Part D: Transport and Environment*. **81**, article no: 102248.

P&S Intelligence. 2020. Indian Electric Vehicle Component Market Research Report: Two-Wheeler (Scooters, Motorcycle), Three-Wheeler (E-Rickshaw, E-Auto, Retrofitted Rickshaw), Passenger Car, Commercial Vehicle – Industry Analysis and Growth Forecast to 2030. *P&S Intelligence*. Available from: https://www.psmarketresearch.com/market-analysis/indian-electric-vehicle-component-market/report-sample

Perusahaan Listrik Negara (PLN). 2020. Road Map Pengembangan Infrastruktur Kendaraan Listrik 2020-2024. *PLN*. Available from: https://gatrik.esdm.go.id/assets/uploads/download_index/files/ab04d-road-map-pengembangan-infrastruktur-kendaraan-listrik-pln-.pdf

Ruan, Y., Hang, C.C., and Wang, Y.M. 2014. Government's role in disruptive innovation and industry emergence: The case of the electric bike in China. *Technovation*. **34**, pp.785-796.

Shu, C. 2021. Vietnamese electric motorbike startup Dat Bike raises $2.6M led by Jungle Ventures. *Techcrunch*. [Online]. 13 April 2021. [Accessed on June 2021]. Available from: https://techcrunch.com/2021/04/12/vietnamese-electric-motorbike-startup-dat-bike-raises-2-6m-led-by-jungle-ventures/

Statista. 2021. Projected number of electric two-wheelers India 2020-2030. *Statista*. [Online]. 15 March 2021. [Accessed on June 2021]. Available from: https://www.statista.com/statistics/1029838/india-projected-electric-two-wheeler-market-size/

Sugiharto, J. 2020. Jumlah Motor Listrik di Indonesia Tak Sampai 2.000 Unit. *Tempo*. [Online]. 10 September 2020. [Accessed on June 2021]. Available from: https://otomotif.tempo.co/read/1384968/jumlah-motor-listrik-di-indonesia-tak-sampai-2-000-unit/full&view=ok

Tran, M., Banister, D., Bishop, J., and McCulloch, M. D. 2012. Realizing the electric-vehicle revolution. *Nature Climate Change*. **2**(5), pp.328-333.

Umah, A. 2021. PLN Beberkan Insentif Isi Daya Mobil Listrik di Rumah. *CNBC Indonesia*. [Online]. 1 February 2021. [Accessed on June 2021]. Available from: https://www.cnbcindonesia.com/news/20210201185957-4-220283/pln-beberkan-insentif-isi-daya-mobil-listrik-di-rumah

United Nations Environment Programme (UNEP). 2020a. Mainstreaming Electric Mobility in Vietnam. *United Nations Environment Programme*.

United Nations Environment Programme (UNEP). 2020b. Policy Guidelines for Electric 2- & 3-wheelers for Southeast Asia. *United Nations Environment Programme*.

Viet Nam News. 2018. Hanoi hopes imposing fees will reduce congestion. *China Daily*. [Online]. 29 September 2018. [Accessed on June 2021]. Available from: https://www.chinadailyhk.com/articles/99/109/249/1538185014284.html

Viet Nam News. 2021. Vinfast announces launch of two new electric motorcycle models and O2O shopping experience. *Viet Nam News*. [Online]. 21 January 2021. [Accessed on June 2021]. Available from: https://vietnamnews.vn/brand-info/859659/vinfast-announces-launch-of-two-new-electric-motorcycle-models-and-o2o-shopping-experience.html

Wareza, M. 2021. Diumumkan Hari Ini, Cek 8 Fakta Indonesia Battery Corporation. *CNBC Indonesia*. [Online]. 26 March 2021. [Accessed on June 2021]. Available from: https://www.cnbcindonesia.com/market/20210326070718-17-232976/diumumkan-hari-ini-cek-8-fakta-indonesia-battery-corporation

Weinert, J., Ma, C., and Cherry, C. 2007. The transition to electric bikes in China: history and key reason for rapid growth. *Transportation*. **34**, pp.301-318.

Weinert, J., Ogden, J., Sperling, D., and Burke, A. 2008. The future of electric two-wheelers and electric vehicles in China. *Energy Policy*. **36**, pp.2544-2555.

Yang, C. 2010. Launching strategy for electric vehicles: Lessons from China and Taiwan. *Technological Forecasting & Social Change*. **77**, pp.831-834.

Zhao, C., Carstensen, T.A., Nielsen, T.A.S., and Olafsson, A.S. 2018. Bicycle-friendly infrastructure planning in Beijing and Copenhagen - between adapting design solutions and learning local planning cultures. *Journal of Transport Geography*. **68**, pp.149-159.

UK PACT

www.ukpact.co.uk

For any enquiries, please get in touch via email at communications@ukpact.co.uk