

Promoting the development of electric vehicles in Vietnam

Authors: Huong Le, Francisco Posada

INTRODUCTION

Vietnam aims to reduce its greenhouse gas emissions (GHG) and air pollution and is embracing international and national commitments to achieve this. In September 2020, the country submitted its updated Nationally Determined Contribution (NDC)¹ to the United Nations Framework Convention on Climate Change (UNFCCC) with a goal of reducing GHG emissions by 9% (using domestic resources only) and 27% (with international support) by 2030, compared to 2014.² During the UN Climate Change Conference in Glasgow in November 2021 (COP26), Vietnam also committed to a target of net-zero emissions by 2050. To achieve these goals, actions to reduce fossil fuel use in the transport sector are urgently needed.

The road transport sector is a major contributor of GHGs and air pollution in Vietnam, being responsible for 18% of total national GHG emissions.³ In large cities such as the capital, Hanoi, and Ho Chi Minh City—the two largest cities in Vietnam with 8 and 9 million inhabitants, respectively—road transport is a major contributor to local air pollution, especially particulate matter 2.5 (PM2.5), transport-related pollutants that cause many adverse health effects.⁴ In 2015, Ho Chi Minh City and Hanoi were ranked 35th and 85th in transport-attributed deaths, globally.⁵ The road transport sector is responsible for 40% of PM2.5 concentrations in Ho Chi Minh City, and 60% of this road transport PM2.5 is generated by two-wheelers (2Ws) (including mopeds and

1 NDC is a climate action plan to cut emissions and adapt to climate impacts.

2 The previous NDC target would have reduced GHG emissions by 8% (using domestic resources only), and by 25% (with international support) by 2030 compared to 2010.

3 Jung Eun Oh, Maria Cordeiro, John Allen Rogers, Khanh Nguyen, Daniel Bongardt, Ly Tuyet Dang, and Vu Anh Tuan, *Addressing Climate Change in Transport-Volume 1: Pathway to Low-Carbon Transport* (World Bank: Hanoi, 2019), <https://openknowledge.worldbank.org/handle/10986/32411>.

4 Health Effects Institute, "Systematic review and meta-analysis of selected health effects of long-term exposure to traffic-related air pollution," Special Report 23, 2022, <https://www.healtheffects.org/publication/systematic-review-and-meta-analysis-selected-health-effects-long-term-exposure-traffic>.

5 Susan Anenberg, Joshua Miller, Daven Henze, and Ray Minjares, *A global snapshot of the air pollution-related health impacts of transportation sector emissions in 2010 and 2015* (ICCT: Washington, DC, 2019), <https://theicct.org/publication/a-global-snapshot-of-the-air-pollution-related-health-impacts-of-transportation-sector-emissions-in-2010-and-2015/>.

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motorcycles).⁶ 2Ws are major transport modes in the country, meeting 72.6% and 82% of travel demand in Hanoi and Ho Chi Minh City, respectively.⁷ The government is taking various actions to address transport issues, including developing fuel economy standards for passenger vehicles (PVs) and 2Ws, developing public transport systems, and promoting public transport use. Among these actions, promoting electric vehicles (EVs) is a key strategy for cutting GHG emissions, reducing traffic-related air and noise pollution, enhancing the living environment, mitigating climate change effects, meeting the net-zero emission target by 2050, and building a more sustainable transport system in Vietnam.

In July 2022, the Vietnamese government announced Decision No. 876/QĐ-TTg⁸ approving the *Action Program on Green Energy Transition and Reducing Carbon and Methane Emissions in the Transport Sector*, which aims to achieve net-zero emissions in the transport sector by 2050. The decision sets specific national objectives related to promoting electric vehicle development, including:

- » In the first period, from 2022 to 2030, promoting production, assembly, import, and use of electric vehicles (EVs), and developing charging infrastructure;
- » In the second period, from 2031 to 2050, ending, by 2040, the production, assembly, and import of fossil-fueled cars, motorcycles, and mopeds for domestic use; and by 2050, requiring that 100% of road motorized vehicles be powered by electric and green energy, and developing a charging infrastructure system across the country to meet the demand of people and businesses.

Vietnam has the potential to become the leader in EV demand and EV production in the Association of Southeast Asian Nations (ASEAN)⁹ especially in the electric two-wheeler (E2W) market.¹⁰ The country's E2W market is the second largest in the world (after China's) and the largest and fastest growing in the ASEAN region, and the market for electric passenger cars (EPVs) is increasing significantly. Local manufacturers dominate the EPV and E2W markets in the country. However, more actions are needed for the country to fully realize its potential capacity in the EV market and EV production. This paper reviews current EV production and its supply chain, EV demand, and EV charging infrastructure in the country to provide recommendations for accelerating EV development. Accelerating EV development not only contributes to achieving the country's climate goals, reducing GHG emissions, and improving air quality, but also supports the country's economic development. The paper will focus mainly on E2Ws and EPVs.

6 C40 Cities, "Ho Chi Minh City," Benefits of Urban Climate Action, C40 Cities Technical Assistance report, <https://www.c40.org/wp-content/uploads/2022/02/Ho-Chi-Minh-City-%E2%80%93-Upgrading-the-Bus-Fleet-from-Diesel-to-CNG-Promoting-the-Uptake-of-E-bikes.pdf>.

7 An Minh Ngoc, Hiroaki Nishiuchi, Nguyen Van Truong, and Le Thu Huyen, "A comparative study on travel mode share, emission, and safety in five Vietnamese cities," *International Journal of Intelligent Transportation Systems Research*, <https://link.springer.com/content/pdf/10.1007/s13177-021-00283-0.pdf>.

8 Prime Minister of Vietnam, "Phê duyệt chương trình hành động về chuyển đổi năng lượng xanh, giảm phát thải khí cac-bon và khí mê-tan của ngành giao thông vận tải", 2022, <https://thuvienphapluat.vn/van-ban/Giao-thong-Van-tai/Quyết-dinh-876-QĐ-TTg-2022-chuyen-doi-nang-luong-xanh-giam-khi-cac-bon-nganh-giao-thong-523057.aspx>. (In Vietnamese).

9 ASEAN member states include Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

10 Huong Le, Francisco Posada, Zifei Yang, *Electric two-wheeler market growth in Vietnam: An overview* (ICCT: Washington, DC, 2022), <https://theicct.org/publication/asia-pacific-lvs-ndc-tia-e2w-mkt-growth-vietnam-nov22/>.

PROMOTING EV PRODUCTION AND ITS SUPPLY CHAIN

OVERVIEW OF EV PRODUCTION AND BATTERY PRODUCTION CAPACITY

Regarding E2Ws, production capacity has exceeded 1 million vehicles per year,¹¹ while demand for E2Ws in 2020 was around one-fourth of production capacity. Seven E2W manufacturers produce E2Ws in Vietnam, and six are Vietnamese enterprises, including VinFast, Pega, Anbico, Detech, DK bike, and Datbike. VinFast is the largest E2W manufacturer in the country, with a manufacturing capacity of 250,000 E2Ws annually, which can be expanded to 1,000,000 vehicles annually.¹² As of 2022, these seven manufacturers offered more than 60 E2W models to the market. Details of the production capacity and characteristics of E2W models of these manufacturers can be found in the ICCT paper, “Electric two-wheeler market growth in Vietnam: An overview.”¹³

The 2W industry in Vietnam has had substantial experience producing internal combustion engine (ICE) 2Ws for decades, with a high rate of local production. The country can effectively use this ICE 2W supply chain to produce E2Ws because many vehicle components of E2Ws and ICE 2Ws are similar.

Regarding electric passenger vehicles (EPVs), VinFast is the only manufacturer of EPVs in the country. The VinFast automobile manufacturing factory began operation in June 2019. The design capacity of Phase 1 is 250,000 vehicles/year, and Phase 2 is 500,000 vehicles/year; production speed is 38 vehicles/hour.¹⁴ In 2020, VinFast announced that it would stop producing vehicles with internal combustion engines (ICE) by the end of 2022.¹⁵ The first batch of VinFast EPVs was delivered to customers in December, 2021. VinFast also plans to start delivering two new EV models (VF8 and VF9) on a global scale in the second half of 2022.¹⁶ Other foreign car makers in Vietnam, such as KIA and Hyundai, are also planning to introduce their EPVs to the Vietnam market. However, their plans to produce and assemble or import EPVs in the country are largely unknown as of 2022. The number of EPV models offered to the market is limited, with only two models from VinFast (VF e34 and VF8, both are SUV models) on offer. Unlike the 2W industry, the automobile industry in Vietnam is still underdeveloped and highly dependent on imported spare parts.¹⁷ The localization rate (in terms of vehicle value) for PVs remains low, at around 7-10%.¹⁸ Most of the automobile parts produced in the country are low technology, including tires, seats, mirrors, and plastic products. As a result, the cost of producing a passenger vehicle in Vietnam is often higher than in other ASEAN countries (e.g., Thailand and Indonesia), and higher than the cost of a similar imported vehicle.¹⁹

Regarding battery production, several companies are producing electric batteries for E2Ws, such as Dry Cell and Storage Battery Joint Stock company (Pinaco) and 365 Creative Technology Joint Stock company. They are local enterprises and still focusing

11 Le, Posada, and Yang, *Electric two-wheeler market growth in Vietnam*.

12 “Bên trong nhà máy sản xuất xe máy VinFast,” vnexpress, November 6, 2018, <https://vnexpress.net/ben-trong-nha-may-san-xuat-xe-may-VinFast-3834786.html> (in Vietnamese).

13 Le, Posada, and Yang, *Electric two-wheeler market growth in Vietnam*.

14 “VinFast khánh thành nhà máy sản xuất ô tô”, Vingroup, June 14, 2019, <https://www.vingroup.net/tin-tuc-su-kien/bai-viet/304> (in Vietnamese).

15 “VinFast announces its all electric strategy and full electric vehicle lineup at CES 2022”, Vingroup, January 6, 2022, <https://vingroup.net/en/news/detail/2466/vinfast-announces-its-all-electric-strategy-and-full-electric-vehicle-lineup-at-ces-2022>.

16 “VinFast công bố kết quả kinh doanh ô tô tháng 4/2022”, VinFast, May 10, 2022, https://vinfastauto.com/vn_vi/vinfast-cong-bo-ket-qua-kinh-doanh-o-to-thang-42022 (in Vietnamese)

17 VIRAC, Vietnam automobiles and auto part industry report.

18 “Overview of Vietnam’s automobile market in 2022,” Vietnamcredit, May 14, 2022, https://vietnamcredit.com.vn/news/overview-of-vietnams-automobile-market-in-2022_14713.

19 VIRAC, Vietnam automobiles and auto part industry report.

on producing traditional lead-acid batteries. Two other large foreign brands that have also established battery production plants in Vietnam are GS battery Vietnam Co., Ltd. (a Japanese brand, focused mainly on lead-acid batteries) and Samsung SDI Co., Ltd. (a Korean brand, focused mainly on advanced chemistry batteries). Compared to advanced chemistry batteries, lead-acid batteries have lower durability, higher weight, and require more frequent replacement, which generates more negative effects on the environment. In 2021, Vingroup started constructing the VinES Battery Manufacturing Factory in the Vung Ang Economic Zone (Ha Tinh), with an area of 8 ha and an investment of 4,000 billion VND (nearly 173.7 million USD) in the first phase. The establishment of this factory represents an important milestone in VinFast's strategy of self-production and supply of batteries with global standards for its electric vehicles. The VinES Battery Manufacturing Factory will provide lithium batteries for VinFast's electric cars and buses; the factory capacity is 100,000 battery packs per year. Phase 2 of the factory will expand production to include battery cell manufacturing and will increase capacity to one million battery packs annually.

Raw material to produce electric vehicle batteries. Key materials in vehicle batteries are nickel and lithium, and Vietnam is potentially a source of nickel and lithium. Vietnam's total nickel and lithium reserves are estimated at 3.6 million tons²⁰ and 1 million tons,²¹ respectively. However, the research, experience, and technology needed to exploit these minerals in Vietnam are still very limited. Until 2022, there was only one company studying the feasibility of nickel extraction in Son La province, Ban Phuc Nickel Mine, Ltd. Ninety percent of this company's shares are owned by Blackstone Minerals, an Australian company, and 10% are owned by Son La Engineering and Mechanical Joint Stock company.²²

EXISTING POLICIES SUPPORTING EV PRODUCTION AND BATTERY PRODUCTION CAPACITY

Generally, policies supporting EV and battery production and EV supply chains in Vietnam are limited. There is no indication of manufacturing incentives for the production of batteries for E2Ws in Vietnam. Regarding PVs, based on Vietnam's national automobile development strategy for 2025 and orientation towards 2035,²³ investment in projects that produce environmentally friendly vehicles (including electric vehicles, hybrid vehicles, biofuel vehicles, etc.) will be encouraged. However, specific policies to support this investment are still limited. Recently, the National Assembly agreed to reduce the excise tax on domestically manufactured, assembled, and imported electric cars,²⁴ starting March 1, 2022. The excise tax is paid by the manufacturers or importers and then transferred to the customer. The detail of the reduction is presented in Table 1. The excise tax rate applied to electric cars is significantly lower than the tax rate applied to gasoline or diesel cars. The tax rate for gasoline or diesel PVs with fewer than nine seats ranges from 35% to 150%, depending

20 "Đánh thức tiềm năng niken ở Việt Nam," vnexpress, March 20, 2022, <https://vietnam.vn/kinh-te/danh-thuc-tiem-nang-niken-o-viet-nam-20220316141155158.html> (in Vietnamese).

21 "Tinh nào ở Việt Nam nắm giữ loại tài nguyên mà VinFast và cả thế giới đang rất cần," Vietnamnet, May 12, 2022, <https://vietnamnet.vn/tinh-nao-o-viet-nam-nam-giu-loai-tai-nguyen-ma-vinfast-va-ca-the-gioi-dang-rat-can-2018559.html> (in Vietnamese).

22 "Đại sứ Úc thăm và làm việc tại mỏ Niken Bản Phúc," Công thương, April 16, 2022, <https://congthuong.vn/dai-su-uc-tham-va-lam-viec-tai-mo-niken-ban-phuc-175328.html> (in Vietnamese).

23 Prime Minister of Vietnam, Decision No. 1168/QĐ-TTg: Approval for strategy to develop automotive industry in Vietnam by 2025, orientation towards 2035, July 16, 2014, <https://thuvienphapluat.vn/van-ban/Thuong-mai/Quyết-dinh-1168-QĐ-TTg-2014-phat-trien-nganh-cong-nghiep-o-to-Viet-Nam-den-2025-tam-nhin-2035-239843.aspx> (in Vietnamese).

24 The National Assembly of Vietnam, Law number: 03/2022/QH15, Luật sửa đổi, bổ sung một số điều luật đầu tư công, luật đầu tư theo phương thức đối tác công tư, luật đầu tư, luật nhà ở, luật đầu thầu, luật điện lực, luật doanh nghiệp, luật thuế tiêu thụ đặc biệt và luật thi hành án dân sự, January 1, 2022, <https://thuvienphapluat.vn/van-ban/Dau-tu/Luat-sua-doi-Luat-Dau-tu-cong-Luat-Dau-tu-theo-phuong-thuc-doi-tac-cong-tu-486653.aspx> (in Vietnamese).

on the engine displacement. This policy helps to reduce EPV production costs resulting in lower purchase costs for customers.

Table 1. Excise tax rate on passenger vehicles in Vietnam

Vehicle type	Tax rate		
	Before 1/3/2022	1/3/2022 - 28/2/2027	From 1/3/2027
Battery-powered electric cars, fewer than nine seats	15%	3%	11%
Gasoline or diesel-powered cars, fewer than nine seats	35% to 150%, depending on vehicle engine displacement		

In addition, the Vietnamese government is focusing on development of the country's automobile industry. To support the industry, 0% preferential import tax rates will be levied on raw materials and components used for automobile manufacturing and assembly that has not yet been domestically made, started in 2020 to 2024 (Decree No. 57/2020/ND-CP).²⁵ Depending on the locations of automobile factories, each industry zone has offered specific incentives such as reducing income taxes or renting land to attract the investment of automobile companies.

Regarding technical regulations²⁶ and technical standards²⁷ related to EPVs and E2Ws, there are several standards available. However, there are still big gaps in the technical regulations and technical standards across the lifecycle of EVs. For example, new imported, manufactured, and assembled EVs must comply with national technical regulations on safety and environmental protection that were designed primarily for ICE vehicles; differences between EVs and ICE vehicles could mean that the safety and environmental protection for EVs is not assured. Some issues that may affect the safety of EV users and other road users include vehicle safety specifications, vehicle operational safety, and electric safety. However, none of these technical standards are mandatory in the legal regulations that may cause safety issues. In addition, the technical regulations and standards related to charging infrastructures for EVs, battery swapping systems, and EVs vehicle disposal and recycling of expired batteries are also not available. The lack of standards could potentially affect the vehicles manufacturers' willingness to invest in EV production since they are waiting for a complete set of technical regulations and technical standards.

RECOMMENDATIONS TO PROMOTE EV AND BATTERY PRODUCTION CAPACITY

Vietnam is potentially the leader in manufacturing and exporting E2Ws and EPVs in the ASEAN region and the world. The EV production capacity is promising, especially for E2Ws, and local enterprises are major players in the domestic EV market. The opportunity is significant; however, promoting EV and production capacity in the country requires strong support from the government, especially at this early stage of market development. To encourage EV and battery production in Vietnam the government should:

25 The Government of Vietnam, Decree No. 57/2020/ND-CP, Nghị định sửa đổi, bổ sung một số điều của nghị định số 122/2016/ND-CP ngày 01 tháng 9 năm 2016 của chính phủ về biểu thuế xuất nhập khẩu, biểu thuế nhập khẩu ưu đãi, danh mục hàng hoá và mức thuế tuyệt đối, thuế hỗn hợp, thuế nhập khẩu ngoài hạn ngạch thuế quan và nghị định số 125/2017/ND-CP ngày 16 tháng 11 năm 2017 sửa đổi, bổ sung một số điều của nghị định số 122/2016/ND-CP, May 25, 2020, <https://thuvienphapluat.vn/van-ban/Xuat-nhap-khau/Nghi-dinh-57-2020-ND-CP-sua-doi-Nghi-dinh-122-2016-ND-CP-Bieu-thue-xuat-nhap-khau-uu-dai-443599.aspx> (in Vietnamese).

26 Technical regulations are mandatory, and new vehicles have to comply with these regulations to ensure vehicle quality, safety, and protection of the environment.

27 Technical standards are voluntarily applied. All or parts of a specific standard becomes mandatory only when it is referred to in the legal documents or technical regulations. Vehicles that do not comply with the technical standards are still allowed to be traded in the market.

- » **Introduce a mandate for EV production/sales programs.** A mandated program would require manufacturers to meet increasing annual levels of EV sales. The highest target is that 100% of new vehicle sales will be electric. Globally, many countries have announced an EV mandate of a 100% electric share by 2050 to achieve the net-zero emissions goal. The list of governments with targets for phasing out new sales of ICE PVs is updated regularly by ICCT.²⁸ Vietnam should set mandatory targets for EV production or sales for both E2Ws and EPVs that align with Decision No. 876/QĐ-TTg.²⁹ These targets could serve as a guideline for manufacturers to plan their scaling up of EV production, building infrastructure, and gradually phasing out new sales of ICE vehicles. The country should set targets over a specific timeframe (e.g., interim targets and long-term targets) to allow manufacturers time to adjust their production capacity and plan for EV production.
- » **Develop mandatory regulations on fuel consumption, CO2 emissions, or fuel economy standards for ICE 2Ws and ICE PVs.** These regulations signal 2W and automobile industries to adopt more efficient and lower-emission technologies and investment in EV transition. Several legal documents have signaled the government's intention to strengthen fuel consumption standards in the coming years. For example, Law No. 72/2020/QH14 on environmental protection has mentioned development of a roadmap that gradually eliminates fossil fuel vehicles in Vietnam. Decision 452/QĐ-BGTVT on Ministry of Transport (MOT) action plan responding to climate change, enhance resource management, and protect the environment in the 2021-2025 period has also established the objective of developing fuel consumption standards for PVs and 2Ws. Vietnam has already adopted voluntary fuel consumption standards since 2013, but the current fuel consumption levels of PVs and 2Ws are already lower than these standards. Mandatory fuel consumption or CO2 emission standards are still unavailable. In addition, the country also implemented mandatory vehicle energy labeling programs for PVs starting from 2015 and 2Ws starting from 2020.
- » **Develop comprehensive technical regulations and technical standards related to EVs, charging infrastructure, battery swapping systems, and vehicle disposal and recycling of expired batteries.** This would show vehicle manufactures that the Vietnamese government is taking full consideration of all aspects related to EVs and that firms can invest confidently in EV development in the country.
- » **Tighten vehicle emission standards for ICE 2Ws and ICE PVs.** Euro 3 and Euro 5 emission standards are applied to 2Ws and PVs in the country, respectively. These standards are not yet world-class. Therefore, the country should develop a clear roadmap for strengthening 2W and PV emission standards and quickly move toward Euro VI-equivalent standards. Stringent vehicle emission standards could reduce the gap in production cost between ICE vehicles and EVs because compliance costs for ICE vehicles increase as standards get stricter. This could encourage manufacturers to shift to investment in manufacturing EVs.
- » **Provide fiscal incentives to promote investment in EV and battery production and development of their supply chains.** Support from the government plays a crucial role in the early stage of EV transition in the country when EV production costs are significantly higher than those of ICE vehicles. The incentives should be designed to support the local EV manufacturing industry and attract foreign investment in the EV industry. Many countries in the ASEAN region, such as Thailand and Indonesia are also providing supply-based incentives. Examples of these incentives include

²⁸ Sandra Wappelhorst, *Update on government targets for phasing out new sales of internal combustion engine vehicles*, (ICCT: Washington, DC, 2021) <https://theicct.org/ice-phase-outs/>.

²⁹ Prime Minister of Vietnam, Decision No.876/QĐ-TTg, Quyết định phê duyệt chương trình hành động về chuyển đổi năng lượng xanh, giảm phát thải khí các-bon và khí mê-tan của ngành giao thông vận tải, July 22, 2022, <https://thuvienphapluat.vn/van-ban/Giao-thong-Van-tai/Quyết-dinh-876-QĐ-TTg-2022-chuyen-doi-nang-luong-xanh-giam-phai-thai-ki-cac-bon-va-ki-me-tan-cua-nganh-giao-thong-van-tai-523057.aspx> (in Vietnamese).

waived or reduced corporate income tax and tax holidays for manufacturers over a specified timeframe; investment tax allowances; waived or reduced duties and VAT (Value Added Tax) for imported production-related raw materials and EV/battery components; allowance for greenfield investments involving foreign direct investment (FDI) by international companies for EV manufacturing; reduced-rate financing for EV manufacturers; and government land grants for developing assembly plants. In parallel, Vietnam could consider applying higher tax rates for components used solely for manufacturing and assembling ICE PVs (e.g., gasoline and diesel engines). Currently, the import taxes for raw materials and components used for manufacturing and assembling ICE PVs and EPVs are similar, at 0%. These incentives may be helpful in the very early stage of market development, but they may need to be restructured to favor EVs over ICE vehicles and gradually replaced by supply-side regulations.³⁰

- » **Establish a dedicated committee to support the development of the EV industry and supply chains.** Vietnam is still in the early stage of EV development. However, it has great potential to become a leader in EV manufacturing in the country and the region. Establishing a dedicated committee that leads the government to support EV deployment could rapidly boost the EV industry to more advanced stages. The committee members should include public authorities, manufacturers, research institutes, citizens, etc. Furthermore, the committee should be given certain powers in developing policies and regulations related to EV development. In particular, technical regulations and standards of EVs are still insufficient and need to be improved quickly to ensure the safety and quality of users and vehicles. The committee's mission should include facilitating collaboration among stakeholders in research and development (R&D) projects, setting the roadmap for EV deployment, and developing EV policy programs and promotional strategies.
- » **Establish research and development (R&D) centers to explore and develop the technical capabilities for EV and battery production.** These centers should encourage and facilitate collaboration among manufacturers nationally, regionally, and internationally in the development of EVs and battery production and its supply chains through cooperation, sharing of knowledge and experiences, and setting technical standards and certification procedures for EV and EV component production. The country has potential sources of raw materials to produce electric batteries; increasing the value of these raw materials through production of higher-end products like batteries should be considered. For example, since 2020 Indonesia has prohibited the export of nickel ore, an important raw material for producing electric batteries, in an effort to leverage the value of this strategically important raw material.³¹
- » **Take advantage of trade agreements to encourage EV exports to other countries in the ASEAN region and the world, focusing on exporting E2Ws first.** To address climate change and air pollution, several ASEAN countries are taking action to promote electric mobility, including E2Ws. Therefore, the demand for E2Ws in the region is predicted to increase significantly in the coming years. Meanwhile, Vietnam's local E2W production capacity has already exceeded 1 million units per year. With strong support from the government, Vietnam could become the leader in E2W production in the ASEAN region and worldwide.

30 Tanzila Khan, Zifei Yang, Sumati Kohli, Josh Miller, *A critical review of ZEV deployment in emerging markets* (ICCT: Washington DC, 2022), <https://theicct.org/wp-content/uploads/2022/02/ZEV-EMDE-white-paper-A4-v3.pdf>.

31 "Turning nickel into EV batteries: Indonesia wants to take its mining industry to the next level," CNBC, April 13, 2022, <https://www.cnbc.com/2022/04/14/indonesia-wants-to-stop-exporting-minerals-make-value-added-products.html>.

PROMOTING EV DEMAND

OVERVIEW OF EV DEMAND

Regarding E2W demand, Vietnam is the largest E2W market in the ASEAN region and the second largest market worldwide, after China.³² The market share of E2Ws has increased significantly in recent years, from 5.14% in 2019 to 8.54% in 2020³³ and 10% in 2021,³⁴ demonstrating the momentum for electrification of the 2W fleet in the country. In the ASEAN region, Vietnam is the leading country in the electrification transition process of the 2W fleet.³⁵ Figure 1 shows the change in E2W market share in key ASEAN countries including Vietnam, the Philippines, Indonesia, and Thailand, in 2019 and 2020.

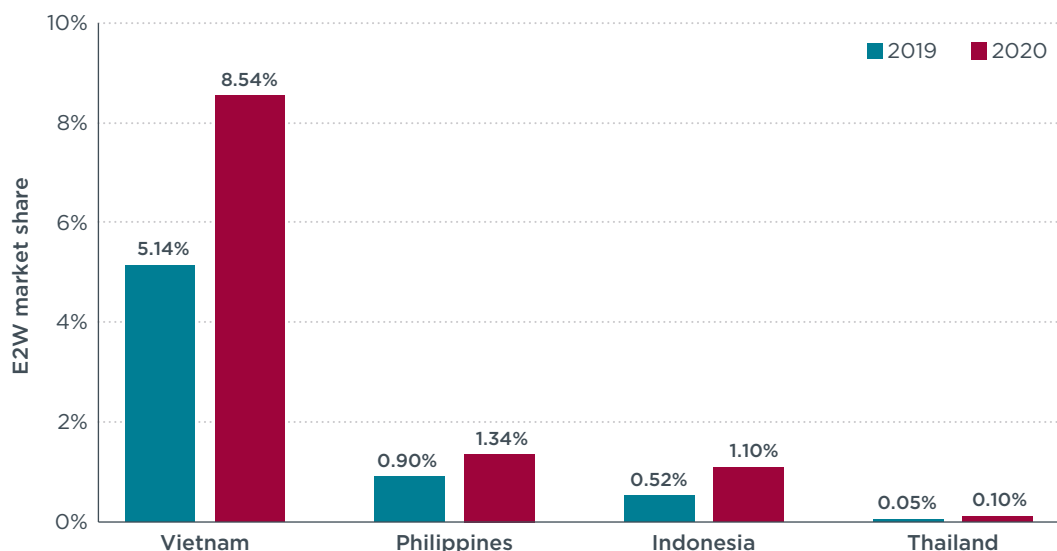


Figure 1. Change in E2W market share in key ASEAN countries in 2019 and 2020

Regarding demand for EPVs, in 2020 the number of EPVs in the country was relatively small, with 900 vehicles sold; the majority were hybrid and plug-in hybrid, with the number of battery electric vehicles (BEVs) remaining very small.³⁶ However, the number of BEVs increased significantly in the first half of 2022, when VinFast, a local automobile company, delivered its first EPV model to customers at the end of 2021. Based on the sales report of VinFast, sales of VinFast EPVs in the first five months of 2022 totaled 1,359 vehicles.³⁷ Meanwhile, VinFast dominates sales of EPVs and E2Ws in the country. Several brands, such as Kia and Mercedes-Benz, plan to offer EPVs in Vietnam; however, the detailed plan is still unclear.

EXISTING POLICIES TO PROMOTE EV UPTAKE

Several policies have been adopted to support EV uptake in the country, such as reducing registration fees, but these apply only to electric cars. Policies promoting

³² MCD team, "Vietnam 2022. VinFast is Fast (+32%) while motorcycles market recovers slow (+5.3%)", motorcyclessdata, October 14, 2022, <https://www.motorcyclessdata.com/2022/10/14/vietnam-motorcycles/>

³³ Huong Le and, Zifei Yang, *Market analysis of two-and three-wheeler vehicles in key ASEAN member states* (ICCT: Washington DC, 2022), <https://theicct.org/publication/asia-pacific-lvs-ndc-tia-23w-market-asean-countries-jun22/>.

³⁴ MCD team, "Vietnam 2022. VinFast is Fast (+32%) while motorcycles market recovers slow (+5.3%)", motorcyclessdata, October 14, 2022, <https://www.motorcyclessdata.com/2022/10/14/vietnam-motorcycles/>

³⁵ Le and Yang, *Market analysis of two-and three-wheeler vehicles*.

³⁶ "Phương tiện xanh: thế giới "nhảy vọt" và thực trạng tại Việt Nam", Vietnamplus, February 18, 2022, <https://www.vietnamplus.vn/phuong-tien-xanh-the-gioi-nhay-vot-va-thuc-trang-tai-viet-nam/773596.vnp> (in Vietnamese).

³⁷ "VinFast công bố kết quả kinh doanh ô tô tháng 5/2022", VinFast, June 14, 2022, https://vinfastauto.com/vn_vi/vinfast-cong-bo-ket-qua-kinh-doanh-o-to-thang-52022 (in Vietnamese).

E2W demand do not exist. From the demand side, E2Ws are still subject to the same taxes and fees as ICE 2Ws. The high price of vehicles is one of the leading reasons that Vietnamese people are not buying E2Ws.³⁸

Regarding EVPs, the government recently issued Decree 10/2022/ND-CP³⁹ on Registration Fees, which exempts battery electric cars from registration fees for three years starting March 1, 2022. After this period, the registration fee shall be paid at a rate equal to 50% of the fee for petrol and diesel cars with the same number of seats over the next two years. Meanwhile, the registration fee for PVs powered by gasoline and diesel is 10%. The registration fee is calculated based on vehicle price or on the registration price (regulated by the Ministry of Finance), whichever is higher.

RECOMMENDATIONS TO PROMOTE EV DEMAND

Electrifying vehicle fleets is a promising approach for reducing air pollution and meeting Vietnam's climate goals. At this early stage, the upfront cost of EVs is still higher than that of ICE vehicles. Thus, support from the government is necessary to accelerate EV uptake in the country. To increase EV uptake the government should:

- » **Provide fiscal incentives for owning and operating EVs.** Policies should aim to reduce the cost of owning and operating EVs.⁴⁰ Examples of financial incentives such as vehicle purchase subsidies, tax exemption or tax reduction, free parking, and lower electricity prices could potentially increase EV uptake. Experiences from countries such as China, the Netherlands, Denmark, the United Kingdom, and the United States have shown a positive correlation between fiscal incentives and EV uptake.⁴¹ The Vietnamese government can learn from these countries and adapt their lessons to the local context to facilitate EV uptake.
- » **Provide non-fiscal incentives that offer preferential treatment to EVs over ICE vehicles.** These policies aim to increase convenience and comfort when using EVs while making ICE vehicle use less convenient and less comfortable. Examples of non-fiscal incentives include priority lanes, priority parking places, free parking, low-emission zones, and exclusion from traffic restrictions. Hanoi and Ho Chi Minh City are planning to restrict private motorized transport, such as implementing road charging systems and limiting the operation of motorized vehicles in specific areas or at certain time periods.
- » **Mandate EV purchase.** Starting with its own vehicle fleet, the government could mandate a minimum volume of EV purchases per year and gradually replace the ICE fleet with the EV fleet. After that, the program can be evaluated and designed to apply to other organizations (e.g., ride-hailing companies, universities, schools, etc.).
- » **Discourage ownership and use of ICE vehicles.** Measures discouraging ICE vehicle ownership and use, such as low- or zero-emission zones, environmental zones, vehicle registration quotas, environmental taxes, spatial access restrictions, and increased fuel prices, could indirectly increase EVs' attractiveness. Many developed countries have implemented these measures to encourage people to buy cleaner vehicles. However, these measures are not yet implemented in Vietnam.

38 V. Kiem, T. Nguyen, and T. Chan, "Mainstreaming Electric Mobility in Vietnam-Focusing on 2-wheelers," PowerPoint presentation, March 2022.

39 The Government of Vietnam, Decree No. 10/2022/ND-CP, Nghị định quy định về lệ phí trước bạ, January 15, 2022, <https://thuvienphapluat.vn/van-ban/Thue-Phi-Le-Phi/Nghi-dinh-10-2022-ND-CP-quy-dinh-ve-le-phi-truoc-ba-484768.aspx> (in Vietnamese)

40 Le Anh Tuan, "Study on the criteria development of pilot city selection for e-mobility adoption in Vietnam," presentation at NDC-TIA kick-off Meeting 15 March 2021, Hanoi, Vietnam https://www.changing-transport.org/wp-content/uploads/3.-210312-NDC-TIA-kick-off-Vietnam_Le-Anh-Tuan_Consultant-team-leader.pdf

41 Zifei Yang, Peter Slowik, Nic Lutsey, and Stephanie Searle, *Principals for effective electric vehicle incentive design* (ICCT: Washington DC, 2016), https://theicct.org/sites/default/files/publications/ICCT_IZEV-incentives-comp_201606.pdf.

» **Educate and raise awareness of the population on EVs.** Although the number of EVs is increasing, the transport mode share of EVs remains low in Vietnam. Safety issues, travel distance, and vehicle price are the top 3 consumer concerns and reasons for not buying EVs.⁴² EV educational programs and awareness campaigns can help address consumer concerns and build people's trust in EV technology, which is also important for increasing EV uptake in the country.

PROMOTING THE DEVELOPMENT OF CHARGING INFRASTRUCTURE AND BATTERY SWAPPING

OVERVIEW OF EV CHARGING INFRASTRUCTURE AND BATTERY SWAPPING

Meanwhile, the EV charging network and E2W battery swapping system are still limited in Vietnam, and EV users mainly charge their vehicles at home. Government targets for developing EV charging infrastructure are not available. VinFast is the leading actor providing charging infrastructure and battery swapping services in the country. Figure 2 shows VinFast EV charging stations in the basement of a high-rise building in Hanoi.

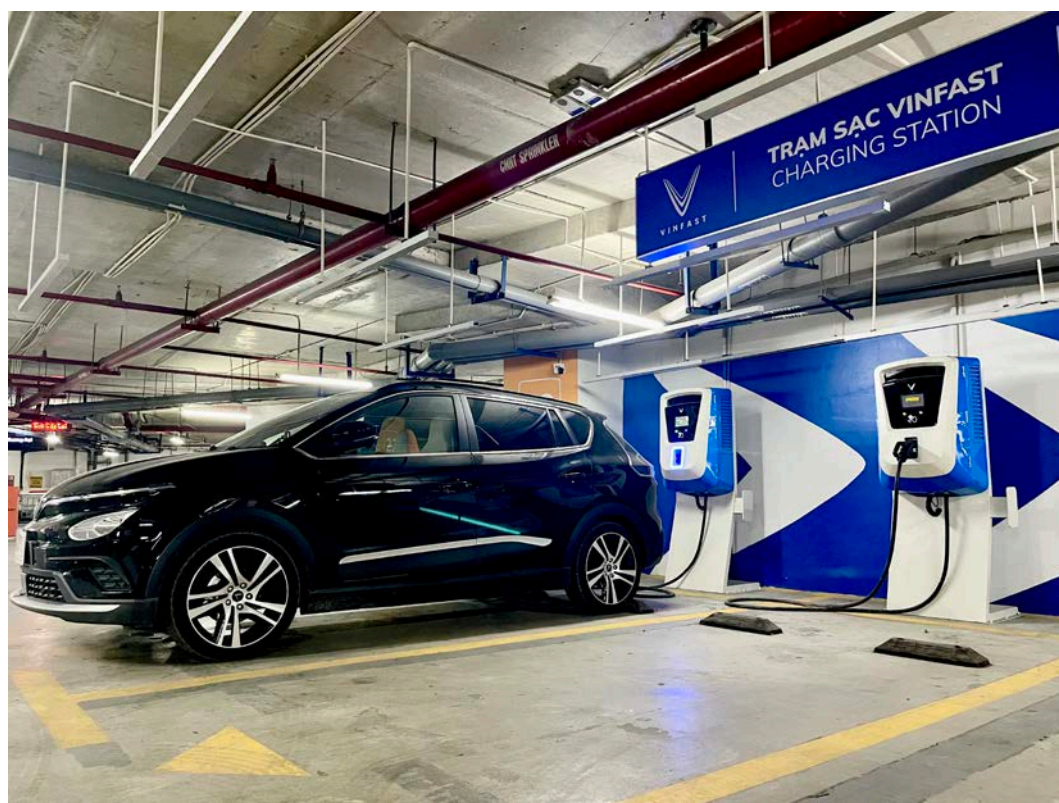


Figure 2. VinFast EV charging station in the basement of a high-rise building in Hanoi
Photo credit: Dinh-Son Tran

In 2021, VinFast implemented 2,000 charging stations with more than 40,000 charging ports for E2Ws and electric cars across the country. This is the largest project providing charging infrastructure for EVs in Vietnam.⁴³ Locations of these charging stations include commercial centers, gas stations, supermarkets, bus stations, public parking spaces, apartment buildings, offices, universities, etc. Currently, VinFast invites partners who provide charging station sites to cooperate with VinFast in installing and

⁴² Le Anh Tuan, "Study on the criteria development of pilot city selection."

⁴³ "Quy hoạch trạm sạc VinFast," VinFast, accessed October 1, 2022, https://vinfastauto.com/vn_vi/tram-sac (in Vietnamese).

operating charging stations. In such a partnership, VinFast is responsible for installing, maintaining, and repairing charging infrastructure and taking care of customer services. Partners provide spaces and operate charging stations. VinFast is also offering battery swapping services for E2Ws at around 300 VinFast showrooms, called Vin3S (for Sales, Service, and Support), across the country.⁴⁴ Charging stations and swapping services apply only to VinFast EVs. VinFast currently adopts international standards (IEC, ISO) in designing their charging and swapping system because of the lack of national technical regulations for charging infrastructure and battery swapping systems. To promote EV deployment in the future, VinFast plans to expand its charging network to more than 150,000 charging ports across the country for E2Ws and EPVs.⁴⁵

VinFast offers different types of chargers at charging stations; the key technical characteristics of these chargers are presented in the Table 2 below.

Table 2. Characteristics of VinFast charging stations

Charger	Electric car				E2Ws
	Super fast charging DC 250kW	Fast charging DC 60kW	Fast charging DC 30kW	Fast charging DC 11kW	
Operating voltage (V)	400 VAC ± 10%, 3-phase	304-456 VAC, 3-phase	304-456 VAC, 3-phase	304-456 VAC, 3-phase	220 VAC ± 5%, 1-phase
Output voltage	200 - 1000 VDC	200-1000 VDC			
Capacity per charging port	≥ 250kW	≥ 60kW	≥ 20kW	≥ 11kW	≥ 1.2kW
Charging time	n/a	30 - 90 minutes (80% of battery capacity)	40 - 120 minutes (80% of battery capacity)	40- 120 minutes (80% of battery capacity)	4 hours (full standard charging)

EXISTING POLICIES TO PROMOTE EV CHARGING INFRASTRUCTURE AND BATTERY SWAPPING

This policy overview found no policies supporting EV charging infrastructure development in Vietnam as of 2022.

RECOMMENDATIONS TO PROMOTE THE DEVELOPMENT OF EV CHARGING INFRASTRUCTURE AND BATTERY SWAPPING

A major reason Vietnamese consumers are discouraged from buying EVs is concern about their range.⁴⁶ Therefore, providing a widely accessible charging network and battery swapping system is necessary for reducing customer concerns and for facilitating EV adoption. In particular, the rapid development of battery swapping services could attract people to use E2Ws because of their convenience and their reduced charging time.

Two major barriers that may hinder the deployment of EV charging infrastructure in Vietnam include (1) lack of investment and incentives from the government in providing and operating charging infrastructures and (2) lack of technical regulations and technical standards for the E2W and EPV charging network and battery swapping systems. To address this situation policymakers should:

- » **Set clear targets and draft plans for developing an EV charging network and an E2W battery swapping system.** A well-developed, nationwide charging and

⁴⁴ “Quy hoạch trạm sạc,” VinFast, accessed October 1, 2022, https://VinFastauto.com/vn_vi/he-thong-tram-sac-doi-pin (in Vietnamese).

⁴⁵ “Quy hoạch trạm sạc,” VinFast, accessed October 3, 2022, https://VinFastauto.com/vn_vi/he-thong-tram-sac-va-thiet-bi-sac (in Vietnamese).

⁴⁶ Le Anh Tuan, “Study on the criteria development of pilot city selection.”

swapping network will increase the confidence of customers and facilitate EV usage. At the early stage of electrification, the government should provide funding for developing public charging stations. The best practices and approaches for developing an efficient publicly accessible charging infrastructure and implementation process that Vietnam can learn from and adapt to the local context can be found in the ICCT working paper, “Efficient planning and implementation of public chargers: Lessons learned from European cities.”⁴⁷

- » **Mandate or regulate installation of EV charging stations and E2W battery swapping services at various places** (e.g., parking lots, gas stations, residential areas, etc.). These regulations can apply to new construction initially and provide a longer timeframe for refurbishing current buildings and spaces to meet these demands. It can also include tax incentives for constructing these types of EV chargers.
- » **Provide incentives for developing a charging network and battery swapping system.** Incentives can be direct subsidies for providers and operators of charging facilities. Examples of incentives include providing land or reducing rental costs for installing charging infrastructures, tax exemptions for importing EV charging-related equipment and components, etc. Canada, for example, provides the Zero Emission Vehicle Infrastructure Program (ZEVIP) with \$680 million to address a lack of charging infrastructure in the country.⁴⁸
- » **Develop harmonized technical regulations and technical standards on charging infrastructure and battery swapping systems, and operate these facilities to ensure their safety and interoperability.** Currently, the technical standard for charging infrastructure has been defined by the market, specifically, by VinFast. This standard could be made official or included as one temporary option until a final technical standard is adopted. In the long term, the interoperability across charging station providers would allow EV users to have seamless access to charging facilities regardless of their vehicle models.
- » **Develop the power grid with due consideration for the increase in electric demand created by a growing EV fleet.** The increase in EV uptake will affect grid capacity and stability considerably. The government should carefully consider how to power its growing EV fleet sustainably because the environmental impacts of EVs strongly depend on clean sources of electricity. The current goals of electrifying the vehicle fleet and transitioning to EVs would require a localized analysis of power grid demands. To maximize the environmental potential of a transition to EVs, the government could increase the contribution of renewable sources and phase out fossil fuel-based power generation. In addition, the coordination between charging providers and energy companies should also be encouraged to design and develop charging infrastructure and operational policies that could reduce investment costs and optimize the power grid.

47 Marie Rajon Bernard and Dale Hall, *Efficient planning and implementation of public chargers: Lessons learned from European cities* (ICCT: Washington DC, 2021), <https://theicct.org/publication/efficient-planning-and-implementation-of-public-chargers-lessons-learned-from-european-cities/>.

48 “Zero emission vehicle infrastructure program,” Government of Canada, accessed October 5, 2022 <https://www.nrcan.gc.ca/energy-efficiency/transportation-alternative-fuels/zero-emission-vehicle-infrastructure-program/21876>.

PHASING OUT DIRTY VEHICLES AND LOW-EFFICIENCY VEHICLES

OVERVIEW OF THE IN-USE VEHICLE FLEET

Previous sections focused mainly on new vehicles, specifically on shifting production and sales toward electric vehicles or highly efficient vehicles. This section focuses on the in-use vehicle fleet, a major contributor to Vietnam's air pollution and GHG emissions. In 2018, around 3.9 million PVs and 58.2 million 2Ws were operating on Vietnam's roads.⁴⁹ Compared to other countries in the ASEAN region, the PV ownership rate is still low, around 30 vehicles/1,000 inhabitants (by comparison, Thailand's rate is 226; Indonesia's is 87; and Malaysia's is 443).⁵⁰

Government regulations require that PVs undergo regular vehicle inspections regarding Technical Safety and Environmental Protection.⁵¹ The inspection periods depend on the vehicle production year and range from 6 to 18 months. In contrast, 2Ws, which are responsible for more than 80% of travel demand, are not subject to inspection and maintenance regulations. This results in a large number of unchecked and poorly maintained motorcycles. In addition, the average vehicle age of in-use 2Ws in Vietnam is 8-12 years.⁵² Without regular maintenance, these vehicles could contribute significantly to air pollution and GHG in the country; for example, in a study from Iran, one year of aging for a 125cc motorcycle caused a 6% increase in the CO emission rate and a 2% increase in fuel consumption.⁵³ Another study from Ho Chi Minh City showed that 2Ws contributed 90% of the VOC (Volatile Organic Compounds) emissions and 70% of the CO from traffic.⁵⁴ Thus, PVs are not the main source of air pollution in the country, except in big cities like Hanoi and Ho Chi Minh City, where the number of PVs is large.

Low-emission standards applied to in-use vehicles also cause higher levels of air pollution. Euro 3 emission standards are in place for 2Ws starting from 2017, and Euro 5 emission standards are applied for PVs beginning in 2022.⁵⁵ Therefore, the majority of vehicles in use today were introduced under lower emission standards. A 2012 study reported that a large number of 2Ws were not equipped with exhaust control devices, 47% of the 2W fleet complied with EURO 2, 18% complied with EURO 3, and 35% did not comply with any EURO standards.⁵⁶

49 N. Duc, T. Michimasa, B. Long, et al., Báo cáo cuối kì-tập 2: Chiến lược phát triển an toàn giao thông xe máy đến năm 2025, tầm nhìn 2030. (in Vietnamese).

50 "Việt Nam đứng áp chót bảng tỷ lệ sở hữu xe hơi ở Đông Nam Á", kinhtemoitruong, September 27, 2019, <https://kinhtemoitruong.vn/viet-nam-dung-ap-chot-bang-ty-le-so-huu-xe-hoi-o-dong-nam-a-9764.html> (in Vietnamese).

51 Circular No. 16/2021/TT-BGTVT, Thông tư quy định về kiểm định an toàn kỹ thuật và bảo vệ môi trường phương tiện giao thông cơ giới đường bộ, <https://thuvienphapluat.vn/van-ban/Giao-thong-Van-tai/Thong-tu-16-2021-TT-BGTVT-bao-ve-moi-truong-phuong-tien-giao-thong-co-gioi-duong-bo-484636.aspx> (in Vietnamese).

52 Duc, Michimasa, Long, et al., Báo cáo cuối kì-tập 2: Chiến lược phát triển an toàn giao thông xe máy đến năm 2025, tầm nhìn 2030. (in Vietnamese).

53 A. Hassani and V. Hoseini, An assessment of gasoline motorcycle emissions performance and understanding their contribution to Tehran air pollution, 2016, <https://www.sciencedirect.com/science/article/abs/pii/S1361920916302504>.

54 Dan Meszler, Air Emissions Issues Related to Two- and Three-Wheeled Motor Vehicles, 2007, https://theicct.org/sites/default/files/publications/twothree_wheelers_2007.pdf.

55 The Prime Minister of Vietnam, Decision No. 49/2011/QĐ-TTg, Quyết định về việc quy định lộ trình áp dụng tiêu chuẩn khí thải đối với xe ô tô, xe mô tô hai bánh sản xuất, lắp ráp và nhập khẩu mới, September 1, 2011, <https://vanbanphapluat.co/quyet-dinh-49-2011-qd-ttg-quy-dinh-lo-trinh-ap-dung-tieu-chuan-khi-thai>.

56 Nguyen Thi Kim Oanh, Mai Thi Thuy Phuong, and Didin Augustian Permadi, "Analysis of motorcycle fleet in Hanoi for estimation of air pollution emission and climate mitigation co-benefit of technology implementation, 2012," <https://www.sciencedirect.com/science/article/abs/pii/S1352231012004293>.

EXISTING POLICIES TO PHASE OUT DIRTY AND LOW-EFFICIENT VEHICLES

Currently there are no standing regulations to limit high emitters in cities or to retire older vehicles. The recent government Decision No. 876/QĐ-TTg on approving the *Action Program on Green Energy Transition and Reducing Carbon and Methane Emissions in the Transport Sector* provides for an ICE phaseout by 2040, but this has not been codified in a regulation that can be enforced.

RECOMMENDATIONS TO PHASE OUT DIRTY AND LOW-EFFICIENT VEHICLES

To obtain better air quality and achieve climate goals, actions to phase out dirty and less efficient vehicles are essential in Vietnam. To eliminate old and high-emitting vehicles the government should:

- » **Implement vehicle replacement programs (or scrappage programs) that seek to replace old and high-polluting vehicles completely.** Although older, high-polluting vehicles may account for a small share of the overall in-use vehicle fleet, these vehicles could contribute a disproportionately large share of total emissions. Globally, many countries and cities have implemented vehicle replacement programs, including the United States, Germany, China, Mexico, and India. The Vietnamese government can learn from these policies and adapt them to the local context to encourage vehicle owners to replace their vehicles with cleaner ones. Providing fiscal incentives could be a promising approach for encouraging people to replace their dirty vehicles with cleaner ones. A number of replacement programs and best practices for developing vehicle replacement programs can be found in the report “Survey of best practices in reducing emissions through vehicle replacement programs.”⁵⁷
- » **At the city level, implement low/zero emission zones (LEZ/ZEZ) (or environmental zones) that restrict access of high-polluting vehicles within a defined area.** The vehicles must meet certain emission standards to enter LEZs, and other vehicles are either prohibited or must pay to enter LEZ, with more-polluting vehicles paying more. Implementing LEZs contributes to reducing air pollution in defined areas and facilitates the transition to cleaner vehicles. Large Vietnamese cities such as Ho Chi Minh City and Hanoi, facing high levels of air pollution, should consider establishing LEZs. In these cities, motorized vehicles are prohibited from entering some areas in the city center at certain periods during the weekends; the major purpose is to provide safe, public, open spaces for citizens. To improve air quality and accelerate the transition to EVs, the boundary and restricted access time in these areas should be expanded, and creation of new LEZs should also be considered. In addition, vehicle emission standards should be made more stringent over time so that LEZs become ZEZs, which allows only zero-emission vehicles, pedestrians, and cyclists to access the area freely. Therefore, having a clear timeline is important to signal customers to shift their purchasing decisions. With high demand for E2Ws and E2W production capacity, the LEZ or ZEZ can directly prohibit ICE 2Ws and apply the high emission standards for PVs (e.g., starting with requiring vehicles to comply with the Euro 4 emission standard).
- » **Design and implement a regular vehicle inspection and maintenance regulation for 2Ws.** Vehicles that do not meet emission requirements must be upgraded to allow them to operate again. By integrating with the vehicle replacement program, highly polluting vehicles should be replaced with cleaner vehicles.

⁵⁷ Francisco Posada, David Vance Wagner, Gaurav Bansal, and Rocio Fernandez, *Survey of best practices in reducing emissions through vehicle replacement programs* (ICCT: Washington, DC, 2015), <https://theicct.org/publication/survey-of-best-practices-in-reducing-emissions-through-vehicle-replacement-programs/>.

- » **Implement a vehicle remote sensing program to measure real-world vehicle emissions without interrupting traffic.** Understanding current real-world vehicle emissions is crucial to developing effective policies to reduce in-use vehicles. However, data on real-world emissions of in-use vehicles do not exist in Vietnam. Thus, the data collected using vehicle remote sensing technology can support development of better policies to reduce emissions from in-use vehicles and provide evidence-based information on a vehicle's actual emissions that could affect consumers' vehicle purchasing decisions.⁵⁸ In addition, the program can help identify the most polluting vehicles that should be replaced by cleaner vehicles.

SUMMARY

This paper has reviewed the current EV production and its supply chain, EV demand, EV charging infrastructure, and the phasing out of high-emitting vehicles in Vietnam, focusing on E2Ws and EPVs. Recommendations are provided to facilitate the development of EVs in the country using policies such as exempting EVs from registration fees and reducing their excise taxes. The uptake of EPVs is still limited, but it is increasing. Although policies to support E2W development are not yet in place, Vietnam is the largest E2W market in the ASEAN region and the second largest market worldwide after China, and the market share of E2W has increased significantly in recent years.

Transport is a major contributor to air pollution and GHG emissions in Vietnam; accelerating EV development is an important strategy for addressing these transport problems and helping Vietnam to achieve its net-zero emission target by 2050. In general, the country has the potential to become the leader in EV demand and EV production. However, policies supporting EV development that could strongly affect progress in the country's electrification are largely unavailable, and most existing policies focus on EPVs only. In the paper, we have provided recommendations to facilitate EV deployment in Vietnam. Key recommendations are summarized below.

Recommendations to promote EV and battery production capacity

- » Mandate EV production/sales
- » Develop the mandatory regulation on fuel consumption, CO2 emissions, or fuel consumption standards on ICE 2Ws and ICE PVs
- » Develop comprehensive technical regulations and technical standards related to EVs, charging infrastructure, a battery swapping system, and vehicle disposal and recycling of expired batteries
- » Tighten vehicle emission standards for ICE 2Ws and ICE PVs
- » Provide fiscal incentives to promote investment in EV and battery production and development of their supply chains
- » Establish a dedicated committee to support the development of the EV industry and supply chains
- » Establish research and development (R&D) centers to explore and develop the technical capabilities for production of EVs and batteries
- » Take advantage of trade agreements to encourage the export of EVs to other countries in the ASEAN region and the world, focusing first on exporting E2Ws.

⁵⁸ Tim Dallmann, Yoann Bernard, Uwe Tietge, Rachel Muncrief, "Remote sensing of motor vehicle emissions in Paris," 2019, https://www.trueinitiative.org/media/790750/true_paris_rs_report_0905019-1.pdf.

Recommendations to promote EV demand

- » Provide fiscal incentives for owning and operating EVs
- » Provide non-fiscal incentives that offer preferential treatments to EVs over ICE vehicles
- » Mandate EV purchases
- » Discourage ownership and usage of ICE vehicles
- » Educate and raise awareness of the population regarding EVs.

Recommendations to promote the development of EV charging infrastructure and battery swapping systems

- » Set clear targets and develop specific plans for developing an EV charging network and a E2W battery swapping system
- » Mandate or regulate the installation of EV charging stations and E2W battery swapping services in various places
- » Provide incentives for developing a charging network and a battery swapping system
- » Develop harmonized technical regulations and technical standards on charging infrastructure and battery swapping systems, and operate these facilities to ensure the safety and interoperability of the systems
- » Encourage collaboration among providers to save installation costs and increase the convenience of customers
- » Develop the power grid with due consideration for increased electric demand from the growing fleet of EV vehicles. Increase the share of renewables generation to maximize EV decarbonization potential.

Recommendations to phase out dirty and low-efficient vehicles

- » Implement vehicle replacement programs (or scrappage programs) that seek to phase out old and high-polluting vehicles entirely
- » Implement low/zero emission zones (LEZ/ZEZ) (or environmental zones) that restrict the accessibility of high-polluting vehicles within a defined area
- » Develop and implement a regular vehicle inspection and maintenance regulation for 2Ws
- » Implement vehicle remote sensing programs to measure real-world vehicle emissions without interrupting traffic.