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Fuel consumption baseline analysis for two-wheelers in Vietnam, 2017–2021

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EXECUTIVE SUMMARY

Two-wheelers, including motorcycles and mopeds, are major modes of transport in Vietnam. In 2023, over 74 million two-wheelers were registered in the country, accounting for more than 90% of the motorized vehicle fleet. Vietnam's two-wheeler market in terms of new sales is ranked second in the ASEAN region, after Indonesia. The country's reliance on fossil fuel-powered vehicles has severely degraded air quality, leading to an increase in respiratory illnesses and other health problems.

Vietnam has committed to reducing its greenhouse gas (GHG) emissions and improving air quality to align with global and national targets. In Vietnam's updated Nationally Determined Contribution (NDC) under the Paris Agreement, the country committed to regulating fuel consumption for newly manufactured, assembled, and imported motor vehicles to reduce GHG emissions from the transport sector. Given the dominance of motorcycles and mopeds, such measures are crucial to helping Vietnam meet its climate goals and improve air quality.

This study collects and analyzes the characteristics and baseline fuel consumption of two-wheelers sold in Vietnam from 2017 to 2021. This activity is a part of the NDC Transport Initiative for Asia (NDC-TIA), which aims to facilitate a shift to zero-emission transport across Asia. The results of this study will serve as a foundation for further development of mandatory fuel consumption standards for two-wheelers to reduce the overall CO_2 emissions in Vietnam's transport sector. The key findings of this work are:

- **The two-wheeler market in Vietnam is dominated by manufacturers headquartered in Japan.** In 2021, the Vietnamese two-wheeler market dropped to 2.89 million, the lowest level in 15 years. More than 250 two-wheeler models from more than 60 brands are offered in the country each year, but the top-selling models accounted for over 90% of the market share. Honda and Yamaha dominated the two-wheeler market in the country in the years studied, with more than 80% of two-wheelers sold in the country annually. Motorcycles accounted for more than 85% of annual two-wheeler sales, and the remaining sales were mopeds with a maximum speed below 50 km/h.
- **Despite the overall decline in the two-wheeler market, the electric two-wheeler segment has grown rapidly.** Its market share increased from 1.2% in 2017 to 10.4% in 2021. Electric two-wheeler sales rose from 39,700 units in 2017 to 152,000 in 2019, reaching 288,000 by 2021, a 78% increase compared to 2019. The majority of these electric vehicles were e-mopeds.
- **Unlike the internal combustion two-wheeler market, the electric two-wheeler market is led by domestic brands** such as VinFast, Pega, and Anbico. Domestic brands account for over 70% of new electric two-wheeler sales each year, with VinFast responsible for the majority of these sales. Most electric two-wheelers sold in Vietnam are equipped with lead-acid batteries, which hold over 70% market share annually.
- **The penetration of electric two-wheelers has contributed to a significant reduction in the average fuel consumption of the two-wheeler fleet.** The average fuel consumption for the conventional internal combustion engine two-wheeler fleet increased from 1.86 L/100 km in 2019 to 1.88 L/100 km in 2020 and 1.92 L/100 km in 2021. However, when including electric two-wheelers, the fleet's average fuel consumption decreased, dropping from 1.77 L/100 km in 2019 to 1.73 L/100 km in 2020, and to 1.72 L/100 km in 2021—a 10.4% reduction compared with the fleet average excluding electric two-wheelers.

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INTRODUCTION

Transport is one of the major sources of air pollution and greenhouse gas (GHG) emissions in Vietnam, and is responsible for 18% of total GHG emissions in the country (Oh et al., 2019). In its 2022 updated Nationally Determined Contribution to the United Nations Framework Convention on Climate Change, Vietnam committed to regulating fuel consumption limits for newly manufactured, assembled, and imported motor vehicles to reduce GHG emissions from the transport sector (Socialist Republic of Vietnam, 2022).

Two-wheelers, including motorcycles and mopeds, are major modes of transportation in Vietnam. The country's two-wheeler market is ranked second in the region encompassed by the Association of Southeast Asian Nations (ASEAN), after Indonesia, with 74.3 million two-wheelers registered in 2023 (Lam, 2024). The country's reliance on fossil fuel-powered vehicles has severely degraded air quality, leading to an increase in respiratory illnesses and other health problems. Air pollution has emerged as a critical environmental and public health issue in Vietnam, responsible for 99,700 deaths in 2021 (Health Effects Institute, 2024). Implementing mandatory fuel consumption or efficiency standards for motorcycles and mopeds is a promising approach to decarbonize the transport sector, helping the country to meet climate goals and improve air quality.

China has implemented mandatory fuel economy or greenhouse gas emission standards for motorcycles. India has set a target to electrify its two- and three-wheeler fleet (Institute for Transportation & Development Policy, 2023), and may consider adopting fuel economy standards in the near future. Vietnam has the potential to become a pioneer in the ASEAN region to establish mandatory fuel efficiency standards for two-wheelers and to utilize these standards as a policy tool to accelerate two-wheeler electrification.

This study presents an overview of the two-wheeler market and assesses the baseline fuel consumption of motorcycles and mopeds in Vietnam over a 5-year period, from 2017 to 2021. This analysis will serve as a foundation for further development of mandatory fuel consumption (FC) or fuel economy (FE) standards for motorcycles and mopeds to reduce CO_2 emissions in the transport sector.

This study was performed for the Nationally Determined Contributions Transport Initiative for Asia (NDC-TIA), a joint project of seven organizations, which aims to promote a comprehensive approach to decarbonizing transport in China, India, and Vietnam. The project provides technical support for the Vietnam Register (VR), a government entity which is under the lead executing agency, the Ministry of Transport.

DATA SOURCES AND VEHICLE CLASSIFICATIONS

The data collecting and processing methods used in this study are presented in Figure 1. Motorcycle and moped sales data for the years 2017 to 2021 were obtained from MotorCycles Data, a commercial vehicle data vendor, and VR. New vehicle sales data for Honda, Yamaha, Suzuki, SYM, and Piaggio—the five companies constituting the Vietnam Association of Motorcycle Manufacturers (VAMM)—were compared and checked with data provided by VAMM. Vehicle fuel consumption and specifications data were verified with data from manufacturers' websites and VR for the years 2017 to 2021.

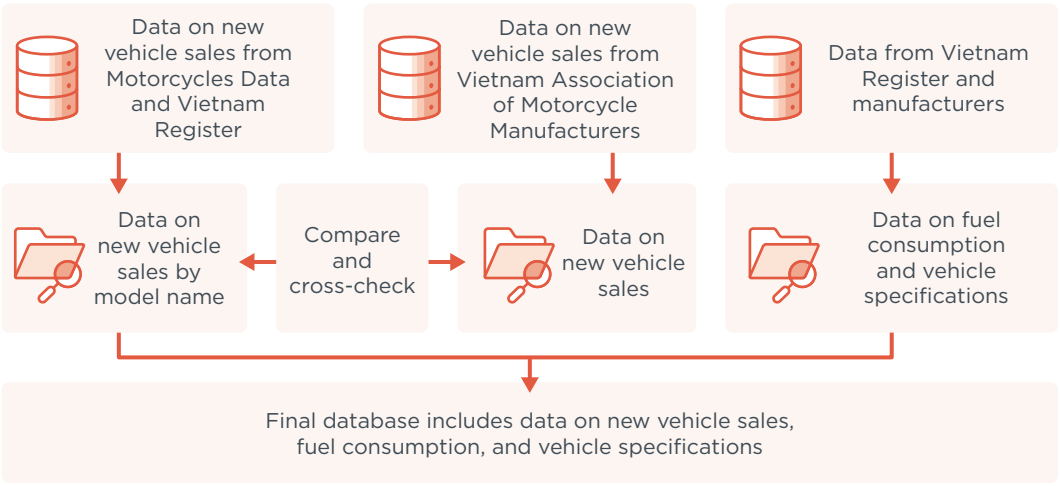
Data from 2021 will be used as the baseline for developing FC standards for two-wheelers. For this study, additional 2021 sales data from VR was collected to provide a more comprehensive view of Vietnam's two-wheeler market. This data covered smaller domestic manufacturing, assembly, and import companies not listed in MotorCycles Data. The VR data included the model name and the total number of vehicles produced, assembled, and imported by these smaller companies. For this analysis, we assumed that the number of vehicles produced, assembled, and imported by these companies in 2021 equaled their new vehicle sales, as there was no significant difference between these values.

Because the database from MotorCycles Data focuses on electric two-wheeler manufacturers and members of VAMM, there are differences between MotorCycles Data and VR. For the analysis of the 5-year period from 2017 to 2021, we used data from MotorCycles Data, which covers more than 85% of two-wheeler market in Vietnam, to provide a more complete overview of the market over time.

The detailed analysis of fleet characteristics and FC of the new two-wheeler fleet in 2021 used data from both MotorCycles Data and VR, which represents more than 95% of the 2021 sales.

Key vehicle specifications, including FC, vehicle weight, transmission type, engine displacement, fuel supply system, and engine power, were collected and checked from manufacturer websites and the VR website. The data collection form can be found in the appendix.

Figure 1
Data collection process



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In this paper, the term two-wheelers refer to motorized motorcycles and mopeds, as defined by the Ministry of Transport (2015). Motorcycles are defined as having engine displacement of 50 cc or larger, a maximum speed of more than 50 km/h, and vehicle weight not exceeding 400 kg. Mopeds are defined as having a maximum speed not exceeding 50 km/h, internal combustion engine (ICE) displacement not more than 50 cc or electric motor power of not more than 4 kW. The same definition of electric mopeds is also given in Decree No. 100/2019/ND-CP (Socialist Republic of Vietnam, 2019). There is no clear definition for electric two-wheelers with motor power of more than 4 kW and maximum speed higher than 50 km/h in existing regulations and standards. In this paper, this type of vehicle is defined as an electric motorcycle.

The classification of two-wheelers used in this paper is presented in Table 1. As shown, ICE motorcycles and mopeds are differentiated by transmission type.

Table 1
Specifications of motorcycles and mopeds in Vietnam

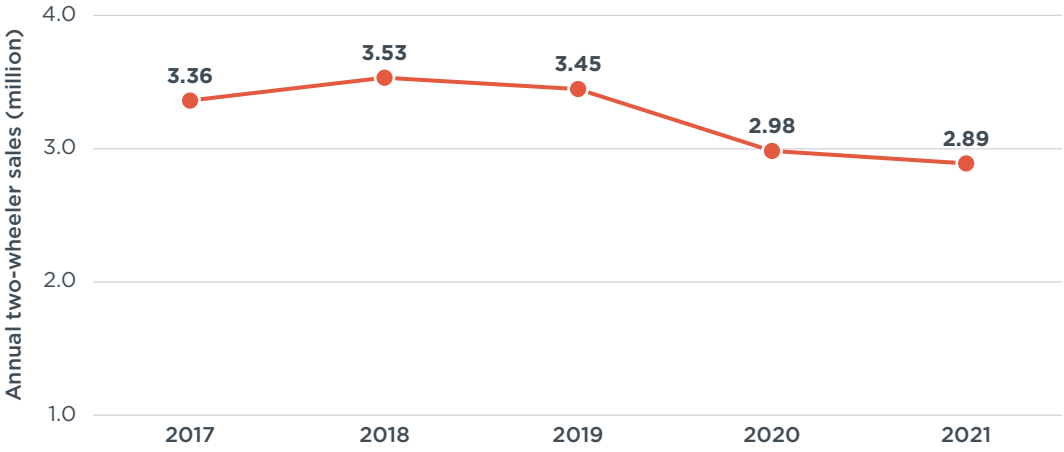
Class	Vehicle types	Engine displacement (cc)/Motor power (kW)	Maximum speed (km/h)	Transmission
Moped	Moped	≤ 50	≤ 50	Manual
	Moped	≤ 50	≤ 50	Automatic
	E-moped	≤ 4	≤ 50	
Motorcycle	Motorcycle	> 50	> 50	Manual
	Motorcycle	> 50	> 50	Automatic
	E-motorcycle	> 4	> 50	

OVERVIEW OF THE TWO-WHEELER MARKET

Vietnam's two-wheeler market ranks second in the ASEAN region and fourth in the world in terms of new sales (Nguyen, 2020). Figure 2 shows the number of new ICE and electric two-wheeler sales in the country from 2017 to 2021. Sales of two-wheelers reached a peak in 2018, with more than 3.5 million vehicles. Sales dropped in 2020 during the COVID-19 pandemic to 2.98 million units, marking the first time sales dropped below 3 million over the last decade. In 2021, two-wheeler sales continued to drop to 2.89 million, the lowest level in 15 years.

Figure 2

New two-wheeler sales in Vietnam from 2017 to 2021



Data sources: MotorCycles Data and Vietnam Association of Motorcycle Manufacturers

TWO-WHEELER MARKET TRENDS, 2017–2021

This section provides an overview of the characteristics of the two-wheeler fleet in Vietnam over a 5-year period, from 2017 to 2019, using data from MotorCycles Data and focusing on the 50 top-selling electric and ICE two-wheeler models. The ICE vehicles in this section were from the five major manufacturers represented by VAMM. Data related to vehicle type and engine displacement were available for the entire 5-year period from 2017 to 2021. Data related to FC and other vehicle specifications for 2017 and 2018 were not available from VR or manufacturer websites; thus, the FC trends analysis covers only the years from 2019 to 2021.

Every year, more than 250 two-wheeler models from more than 60 brands are sold in Vietnam. Table 2 presents sales of two-wheelers and the total sales and sales share of the 50 top-selling models by year.

Table 2

Two-wheeler sales and sales of the top-selling models in Vietnam

	All two-wheelers	50 top-selling models	
Year	Sales	Sales	Share of all sales
2017	3,362,305	3,322,668	98.8%
2018	3,533,435	3,465,621	98.1%
2019	3,446,588	3,376,551	98.0%
2020	2,984,218	2,903,680	97.3%
2021	2,889,318	2,734,941	94.7%

Note: Sales figures are based on data from MotorCycles Data and the Vietnam Association of Motorcycle Manufacturers. Sales numbers for ICE vehicles are from VAMM members only.

The total sales and market share of the 50 top-selling two-wheeler models (ICE and electric) by company are shown in Figure 3 and Figure 4. The total sales of the top-selling companies decreased since 2019. Honda dominated the two-wheeler market each year, with more than 65% of two-wheelers sold in the country. Yamaha is the second-highest seller of two-wheelers in Vietnam, but its market share decreased from 24.5% in 2017 to 13.9% in 2021. The sales share of the remaining companies was relatively small compared with Honda and Yamaha. However, the market share of these brands increased steadily from 4.9% in 2017 to 12.1% in 2021.

Figure 3

Two-wheeler sales by company

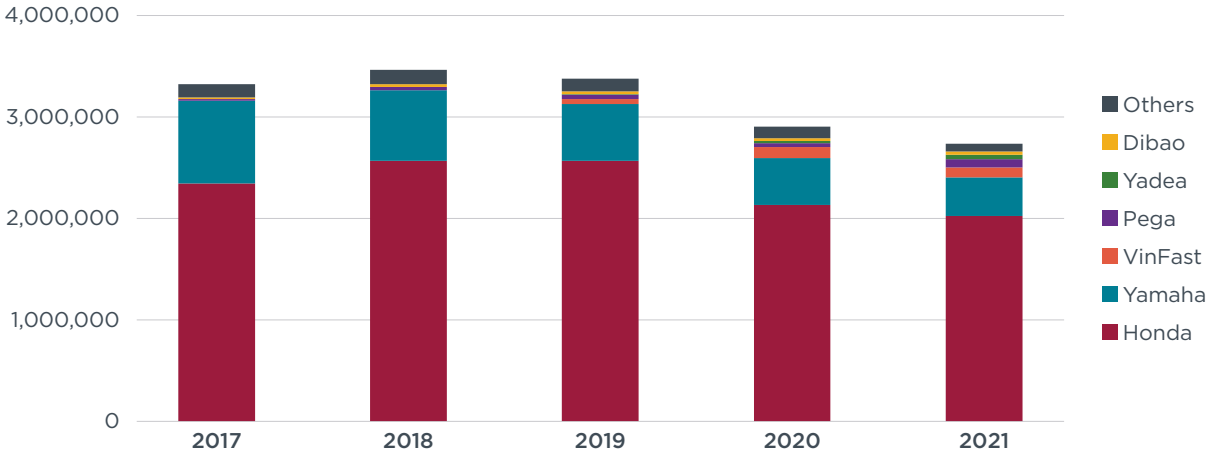
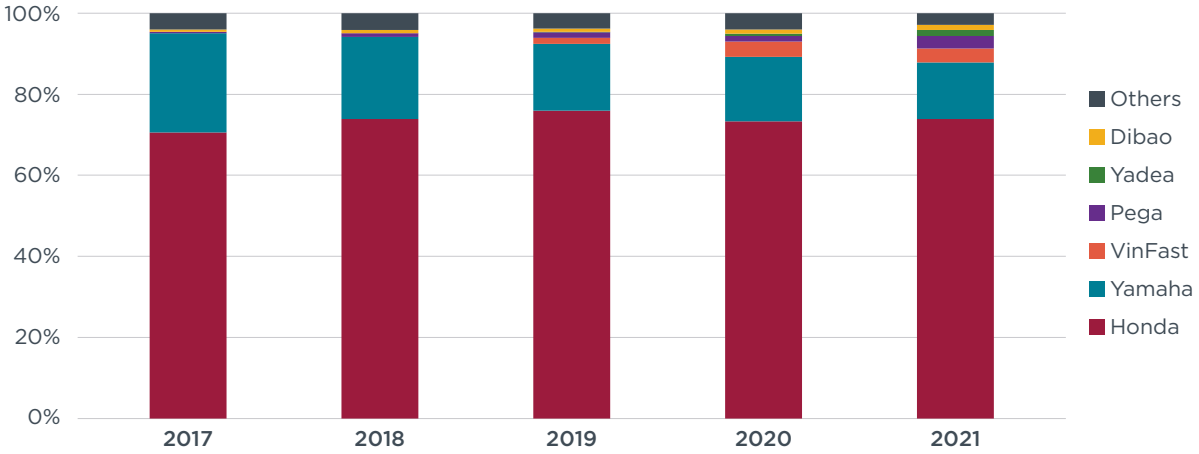


Figure 4

Two-wheeler market share by company



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CHARACTERISTICS OF TWO-WHEELER FLEET

Figure 5 and Figure 6 present the two-wheeler market shares of vehicle types by sales and sales share in Vietnam from 2017 to 2021. ICE motorcycles dominated two-wheeler sales in the country during this 5-year period. More than 88% of two-wheelers sold each year were ICE motorcycles with manual or automatic transmissions. ICE two-wheelers with automatic transmission, also referred to as continuous variable transmission, accounted for an average of 46.8% of sales during the 5-year period while those with manual transmission accounted for 41.9%. E-mopeds, e-motorcycles, and ICE mopeds accounted for a smaller market share, but this share increased from 3.1% In 2017 to 11.4% in 2021.

Figure 5

Two-wheeler sales by vehicle type

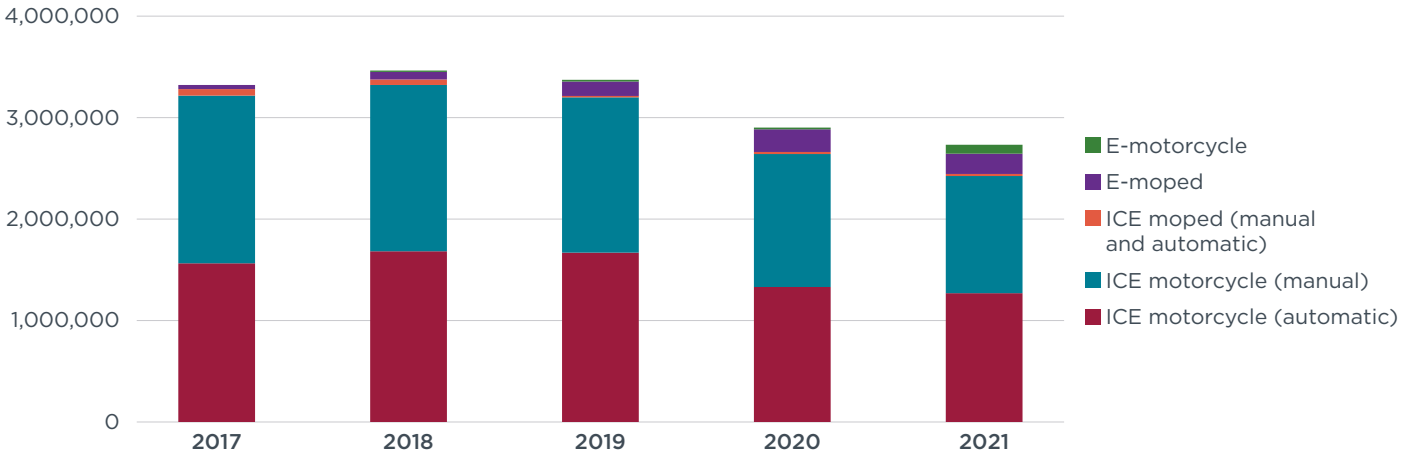

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Figure 6

Two-wheeler market share by vehicle type

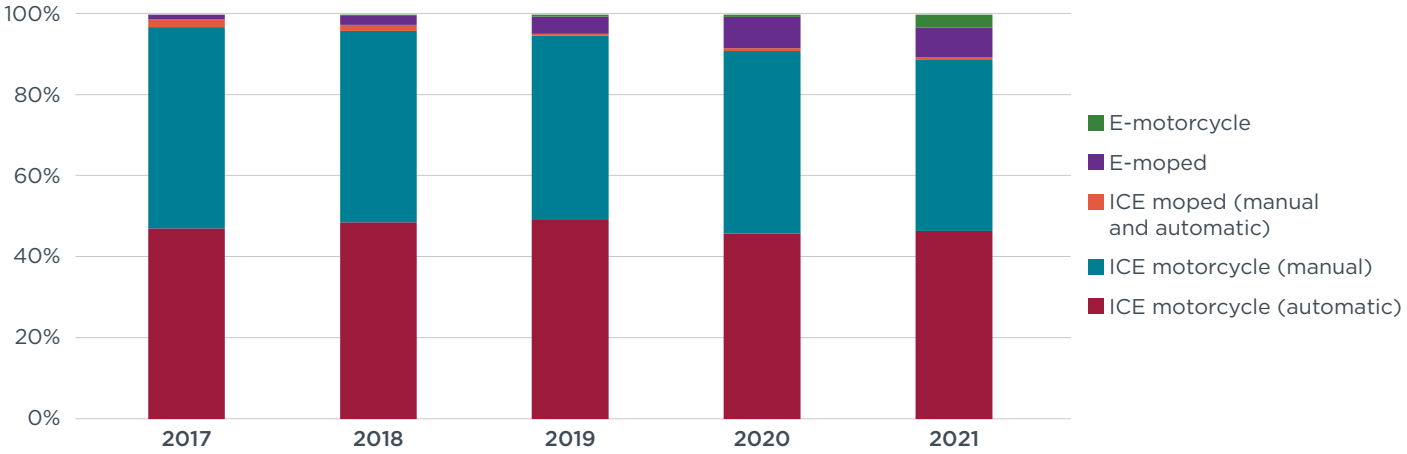

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Figure 7 shows the two-wheeler market share by engine displacement from 2017 to 2021. The engine displacement of the 50 top-selling models ranged from less than 50 cc to 278 cc. Two-wheelers with engine displacement of 100–125 cc were the most common in Vietnam, accounting for more than 70% of the market each year. Two-wheelers with engine displacement of 125–150 cc accounted for more than 8% of vehicles sold each year. In 2017 and 2018, motorcycles with engine displacement of 50–100 cc were also common, however, the market share of these two-wheelers decreased after 2018.

Figure 7

Market share by engine displacement of ICE two-wheelers and the market share of electric two-wheelers

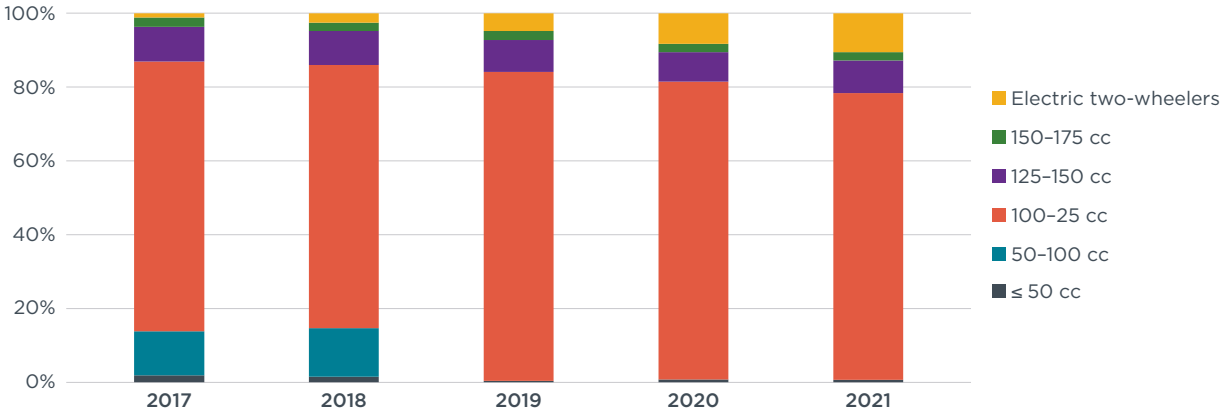

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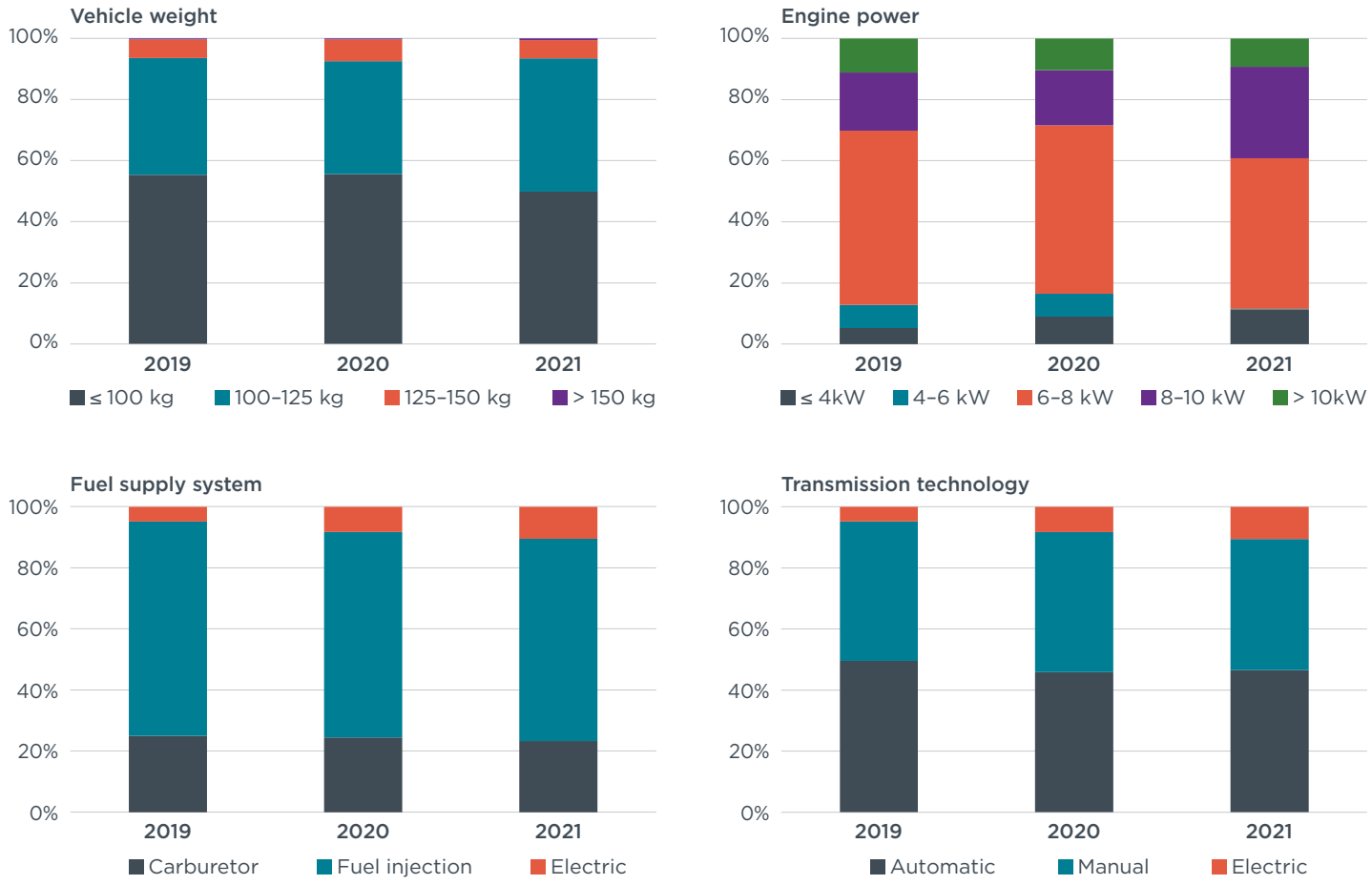
Figure 8 shows two-wheeler market shares between 2019 and 2021 by weight, rated power, type of fuel supply, and type of transmission. The data for these vehicle specifications are not available for 2017 and 2018. Vehicles lighter than 100 kg and those weighing 100–125 kg accounted for 49.7% and 43.3% of the two-wheeler market in 2021, respectively. Vehicles with power ranging between 6 kW and 8 kW were the most popular in the country, accounting for nearly 50% of two-wheelers sold each year.

Regarding fuel supply system, 66.3% of two-wheelers sold in 2021 used fuel injection technology, and 23.3% used carburetor technology.[1] Two-wheelers with automatic transmissions had a slightly higher market share (46.8%) than those with manual transmissions (42.7%) in 2021.

Figure 8
Two-wheeler market share by key features



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CHARACTERISTICS OF TWO-WHEELER FLEET BY VEHICLE TYPE

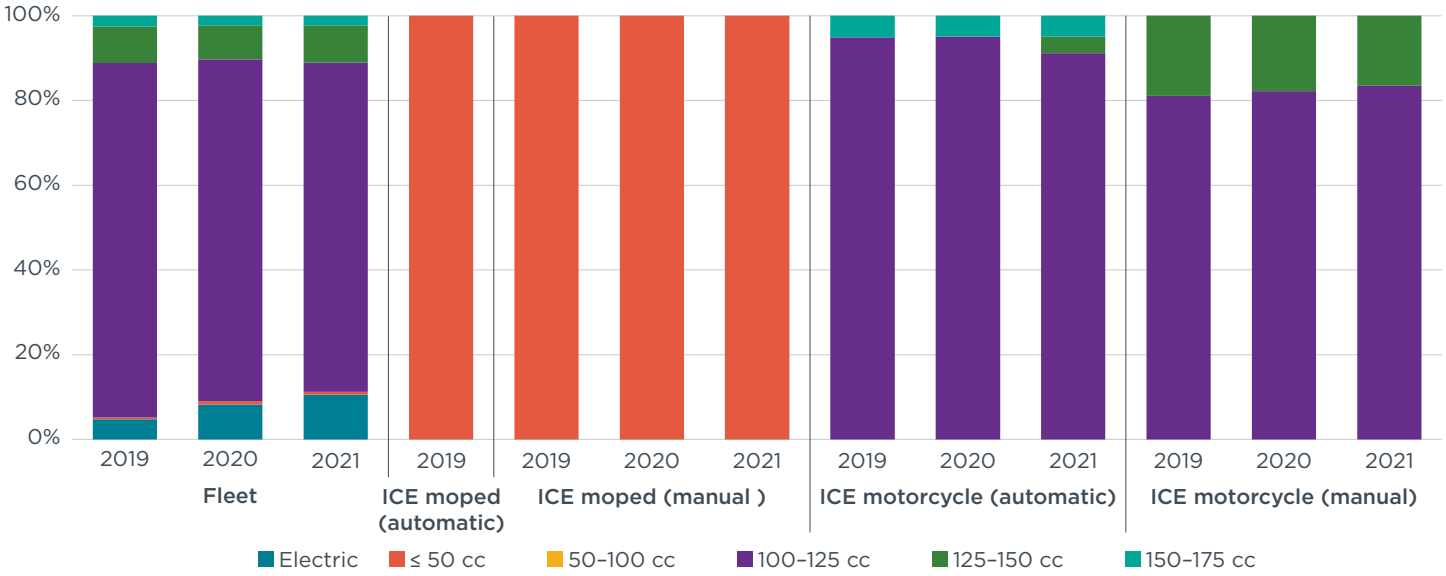
This section presents two-wheeler characteristics by vehicle type. Characteristics included in this section are vehicle weight, engine displacement, engine power, fuel supply system, and transmission technology. Data of fleet characteristics are not available for 2017 and 2018; this section analyzes data from 2019 through 2021.

Figure 9 shows the two-wheeler market by vehicle type and engine displacement. Per their classification, all ICE mopeds had an engine displacement volume below 50 cc. For both ICE motorcycles with automatic transmission and manual motorcycles and mopeds, 100–125 cc was the most common engine displacement. Engine displacement of 125–150 cc was more common for ICE motorcycles with manual transmission than for other two-wheeler types, while displacement of 150–175 cc was more common for ICE motorcycles with automatic transmission.

1 Compared to carburetor technology, fuel injection technology consists of a complex set of electronics and sensors, which provides more precise control over the air-to-fuel ratio, leading to more efficient fuel use, reduced consumption, and lower emissions.

Figure 9

Two-wheeler market share by engine displacement and share of sales for each vehicle type by engine displacement



Note: Among the top 50 selling models from 2019 to 2021, no sales of mopeds with automatic transmission were recorded in 2020 and 2021.

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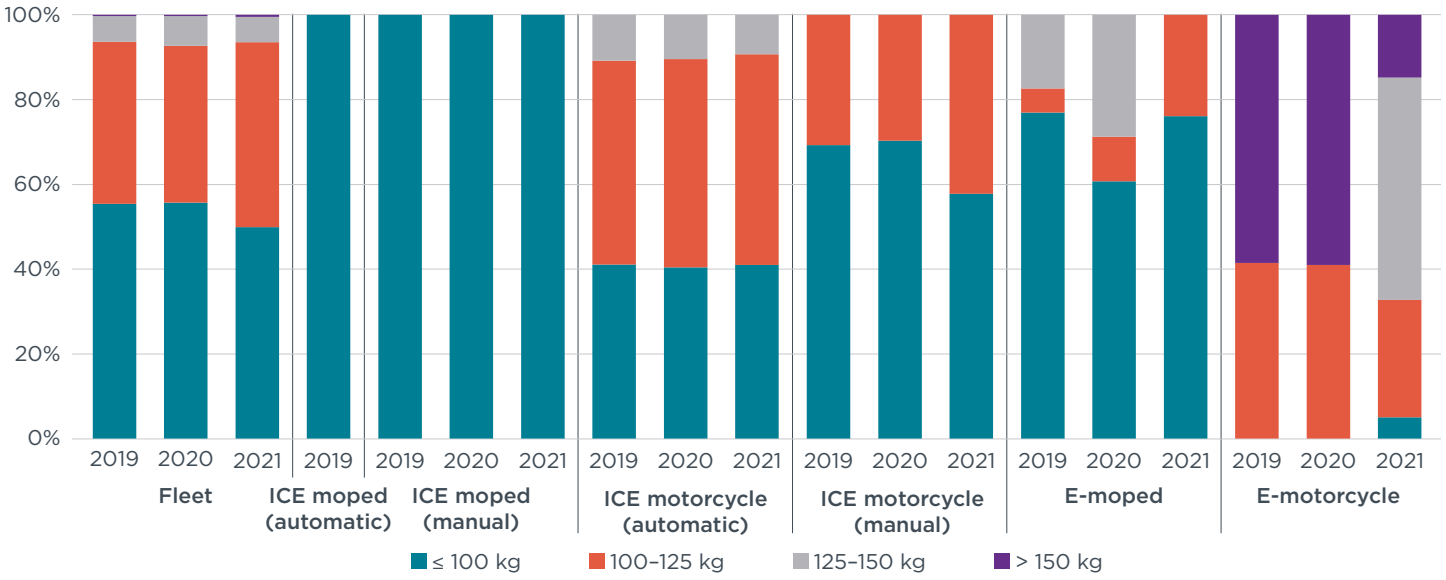
Figure 10 shows the two-wheeler market by vehicle type and by vehicle weight from 2019 to 2021. ICE mopeds had the lowest weight compared to other vehicle types, weighing less than 100 kg, while 58.6% and 59% of e-motorcycles sold in 2019 and 2020, respectively, were heavier than 150 kg. E-motorcycles sold in 2021 were lighter than those sold in 2019 and 2020. The majority of ICE motorcycles with manual transmissions and e-mopeds weighed less than 100 kg. ICE motorcycles with manual transmission were lighter than those with automatic transmission.

Figure 10

Two-wheeler market share by vehicle weight, and share of sales for each vehicle type by vehicle weight



Note: Among the top 50 selling models from 2019 to 2021, no sales of mopeds with automatic transmission were recorded in 2020 and 2021.

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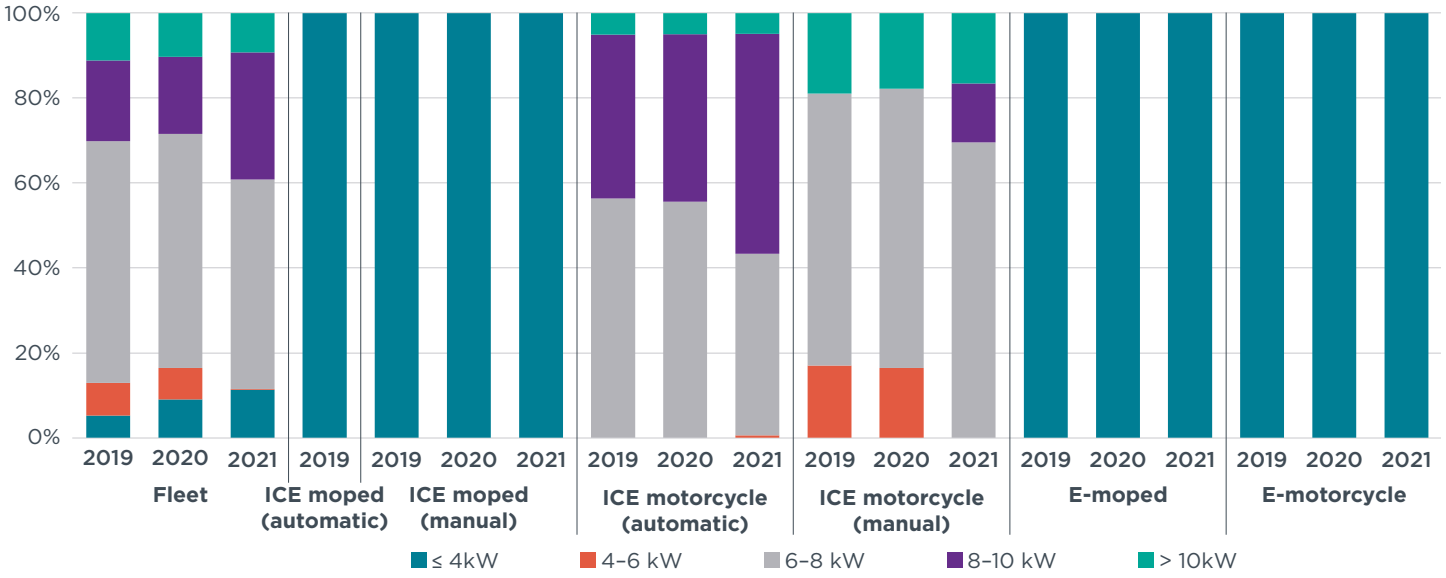
Figure 11 shows the two-wheeler market by vehicle type and engine power. All ICE mopeds, e-mopeds, and e-motorcycles sold had an engine power below 4 kW. Engine

power of 6–8 kW and greater than 10 kW were the most common for ICE motorcycles with manual transmission. Engine power of 8–10 kW was the most common for ICE motorcycles with automatic transmission.

Figure 11

Two-wheeler market share by engine power and share of sales for each vehicle type by engine power

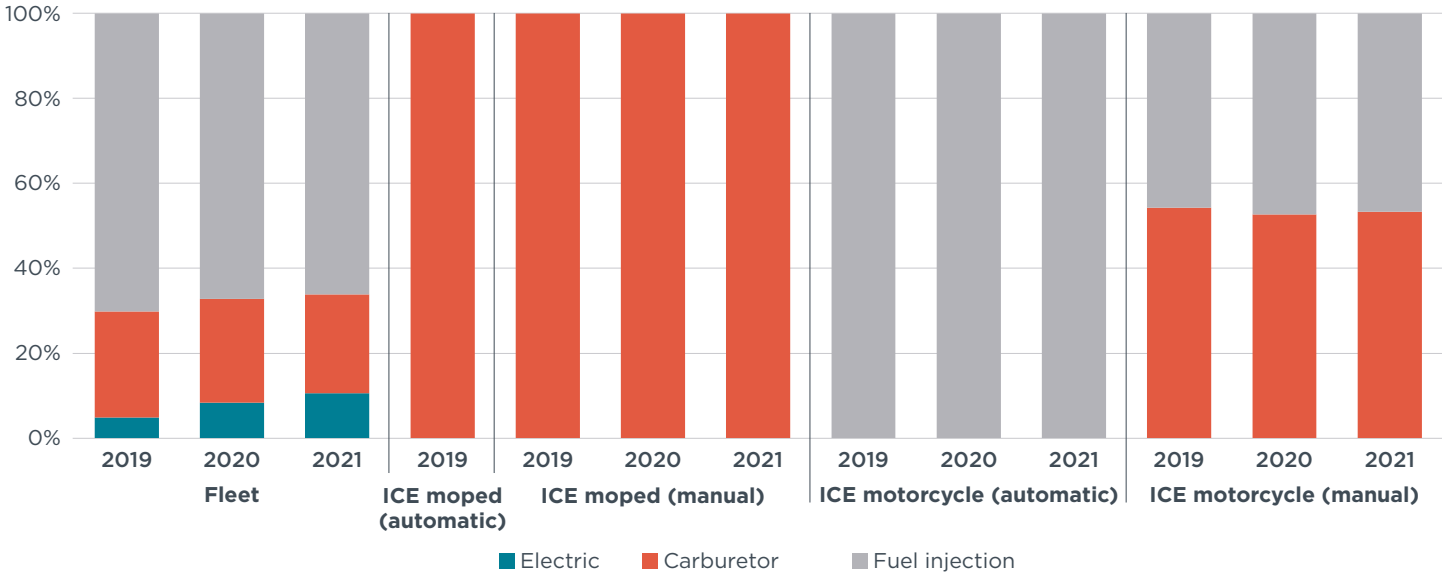


Note: Among the top 50 selling models from 2019 to 2021, no sales of mopeds with automatic transmission were recorded in 2020 and 2021

The ICE two-wheeler market by vehicle type and fuel supply system is described in Figure 12. All ICE mopeds used carburetor technology, while all ICE motorcycles with automatic transmission used fuel injection technology. The distribution of two-wheelers equipped with a carburetor and fuel injection technology was relatively similar for ICE motorcycles with manual transmission. Overall, vehicles equipped with fuel injection dominated the two-wheeler fleet in all 3 years.

Figure 12

Two-wheeler market share by fuel supply system and share of sales for each vehicle type by fuel supply system

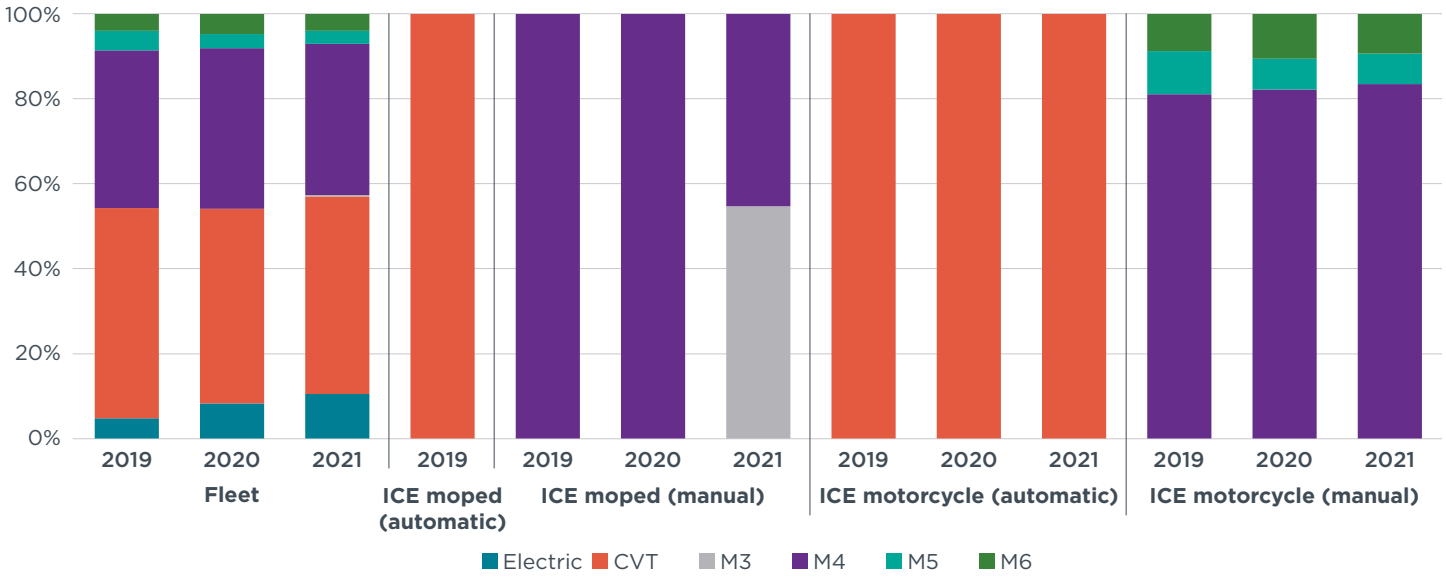


Note: Among the top 50 selling models from 2019 to 2021, no sales of mopeds with automatic transmission were recorded in 2020 and 2021.

Figure 13 presents the two-wheeler market by vehicle type and transmission technology. In 2019 and 2020, all ICE mopeds with manual transmission had four gears. In 2021, 53.4% of these vehicles had four gears, and 46.6% had three gears. For ICE motorcycles with manual transmission, more than 80% were equipped with four gears, with the remaining vehicles having five or six gears.

Figure 13

Two-wheeler market share by transmission technology and share of sales for each vehicle type by transmission technology



Notes: CVT is continuous variable transmission (automatic transmission). Motorcycles with manual transmisison have three gears (M3), four gears (M4), five gears (M5), or six gears (M6). Among the top 50 selling models from 2019 to 2021, no sales of mopeds with automatic transmission were recorded in 2020 and 2021.

CHARACTERISTICS OF ICE TWO-WHEELER FLEET BY MANUFACTURER

Among the 50 top-selling models in Vietnam, five manufacturers were responsible for all sales of ICE two-wheelers: Honda, Yamaha, SYM, Suzuki, and Piaggio. However, the number of ICE two-wheelers sold by these companies has declined since 2019. Honda is the largest ICE two-wheeler company in Vietnam, with more than 70% of ICE two-wheeler sales; its market share increased from 72% in 2017 to 81.8% in 2021. The second largest ICE two-wheeler company in the country, Yamaha, sold 15.5% of ICE two-wheelers in 2021. SYM, Suzuki, and Piaggio were also ranked in the top five ICE two-wheeler companies in terms of sales, however, their market share was very limited compared to Honda and Yamaha. Figure 14 and Figure 15 show the ICE two-wheeler sales and market share by manufacturer from 2017 to 2021.

Figure 14
ICE two-wheeler sales by manufacturer

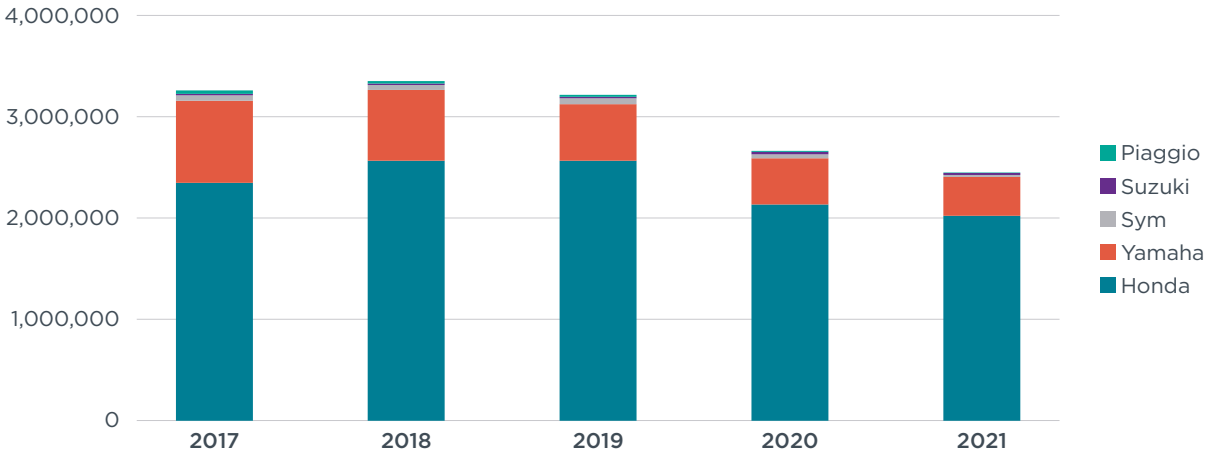


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Figure 15
ICE two-wheeler market share by manufacturer

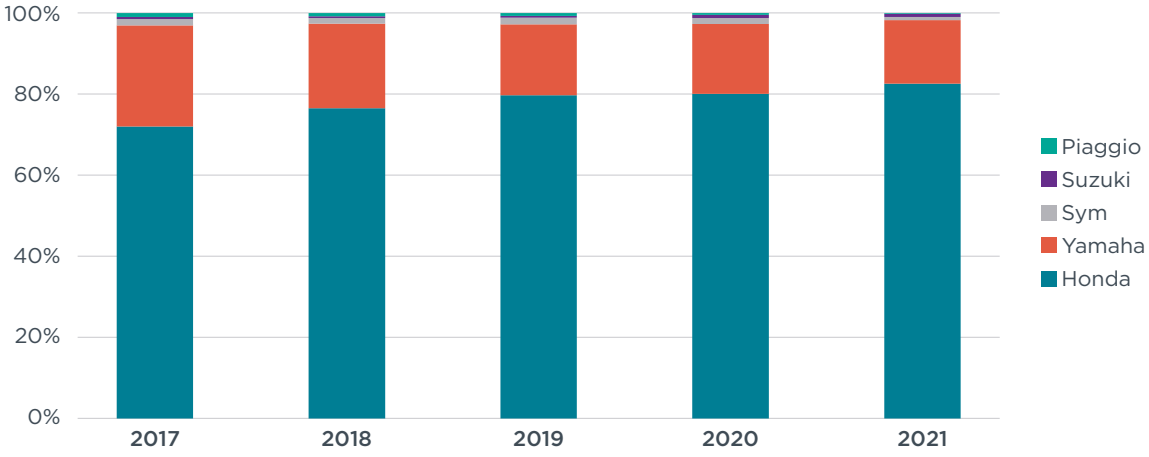

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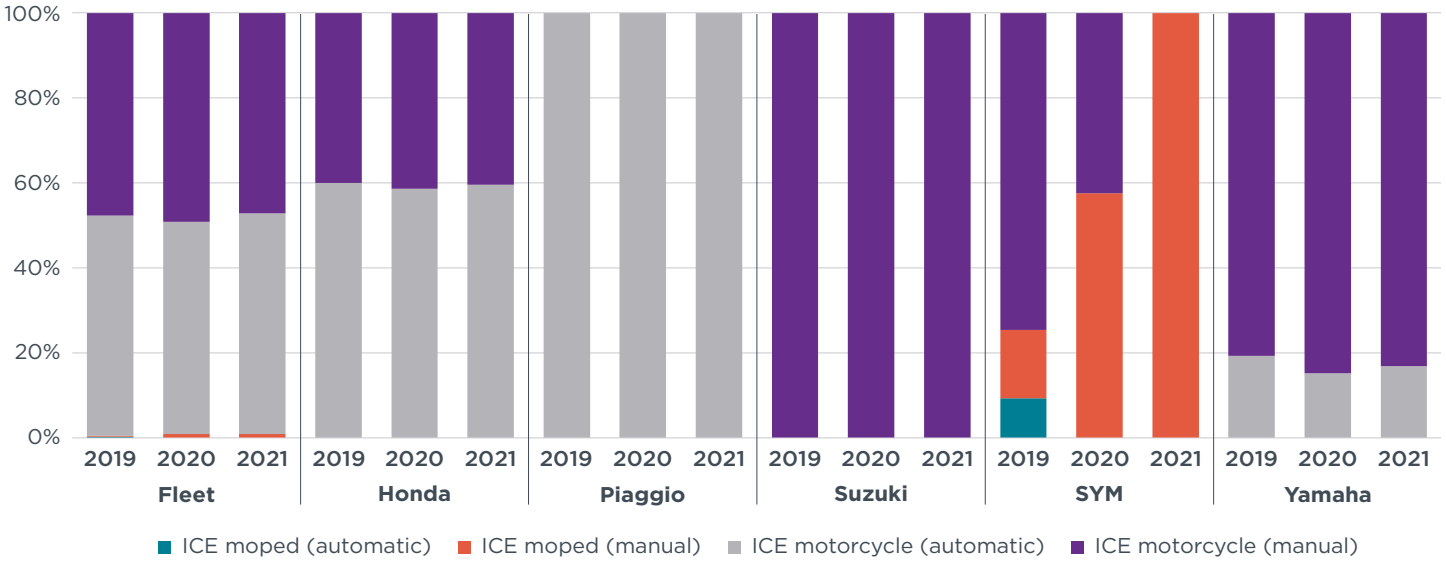
Figure 16 presents the ICE two-wheeler market by manufacturer and vehicle type. Over the 3 years, Honda and Yamaha sold both manual and automatic transmission ICE motorcycles each year. In contrast, Suzuki sold only motorcycles with manual transmissions, and Piaggio sold only motorcycles with automatic transmissions. SYM was the only company that offered both mopeds and motorcycles in 2019 and 2020, but SYM seemed to shift focus to moped sales in 2021.

Figure 16

ICE two-wheeler market share by vehicle type and share of each manufacturer's sales by vehicle type



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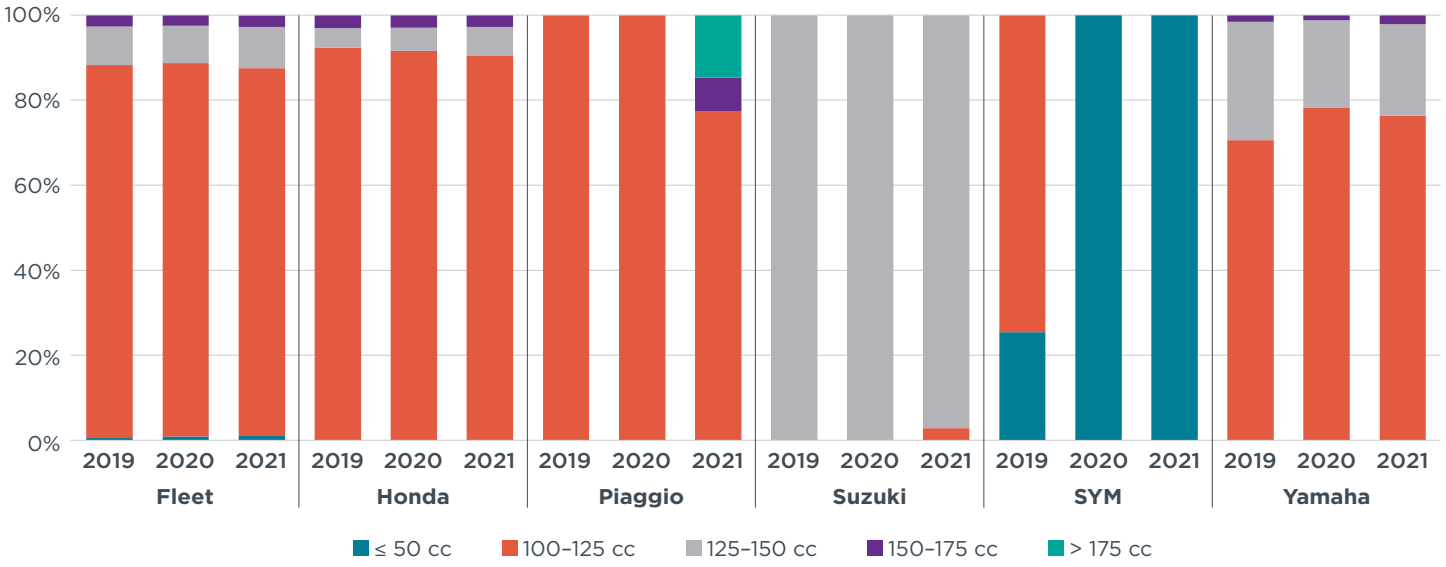
The ICE two-wheeler market segmented by manufacturer and engine displacement is shown in Figure 17. The Vietnamese ICE-two-wheeler fleet is characterized by motorcycles with an engine displacement of 100–125 cc. The engine displacement of Honda's and Yamaha's two-wheeler fleets ranged from 100 cc to 175 cc. However, engine displacement of 100–125 cc was more common in Honda's two-wheeler fleet, and displacement of 125–150 cc was more common in Yamaha's two-wheeler fleet. SYM's focus on smaller engine displacement is reflective of their shift toward moped sales. In 2019 and 2020, Piaggio offered only vehicles with engine displacement of 100–125 cc, while Suzuki offered only vehicles with engine displacement of 125–150 cc.

Figure 17

ICE two-wheeler market share by engine displacement and share of each manufacturer's sales by engine displacement



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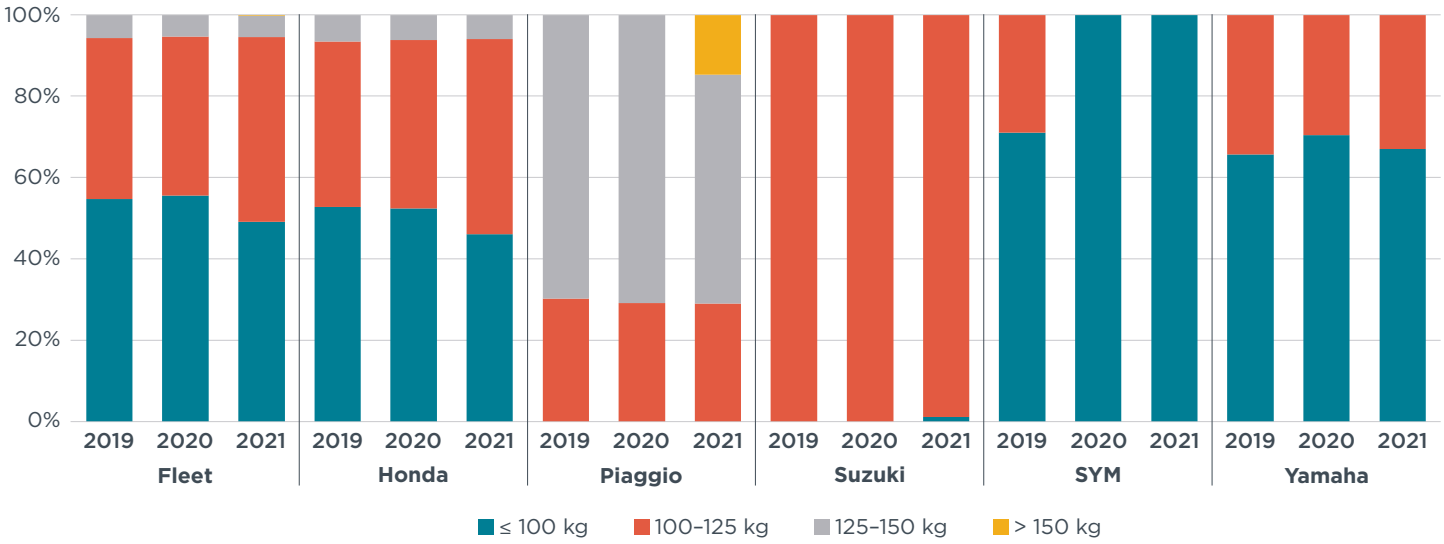
ICE two-wheelers in Vietnam tend to weigh less than 125 kg in the 3 years studied. Piaggio's two-wheelers were heavier than two-wheelers from other four companies assessed, whereas SYM's two-wheelers were the lightest. Almost all of Suzuki's two-wheelers weighed 100–125 kg. Vehicles from Honda had a wider range of weight, from

less than 100 kg to 150 kg, while Yamaha's two-wheelers weighed less than 125 kg. The two-wheeler market segmented by company and by vehicle curb weight is presented in Figure 18.

Figure 18

ICE two-wheeler market share by vehicle weight and share of each manufacturer's sales by vehicle weight



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The two-wheeler market by company and vehicle engine power is shown in Figure 19. Most ICE two-wheelers in Vietnam present a rated power of 6–8 kW. Among five the companies, two-wheelers from Suzuki presented the highest engine power over the years studied. SYM's two-wheelers had the lowest range of engine power of the group; in 2021, SYM only sold vehicles with engine power lower than 4 kW. Piaggio only offered two-wheelers with engine power of 6–8 kW in 2019 and 2020, while in 2021, Piaggio also offered vehicles with engine power larger than 8 kW. Two-wheelers from Honda and Yamaha had a wider range of engine power. Vehicles with engine power of 8–10 kW were more common in Honda's fleet, while vehicles with engine power greater than 10 kW were more common in Yamaha's fleet.

Figure 19

ICE two-wheeler market share by engine power and share of each manufacturer's sales by engine power

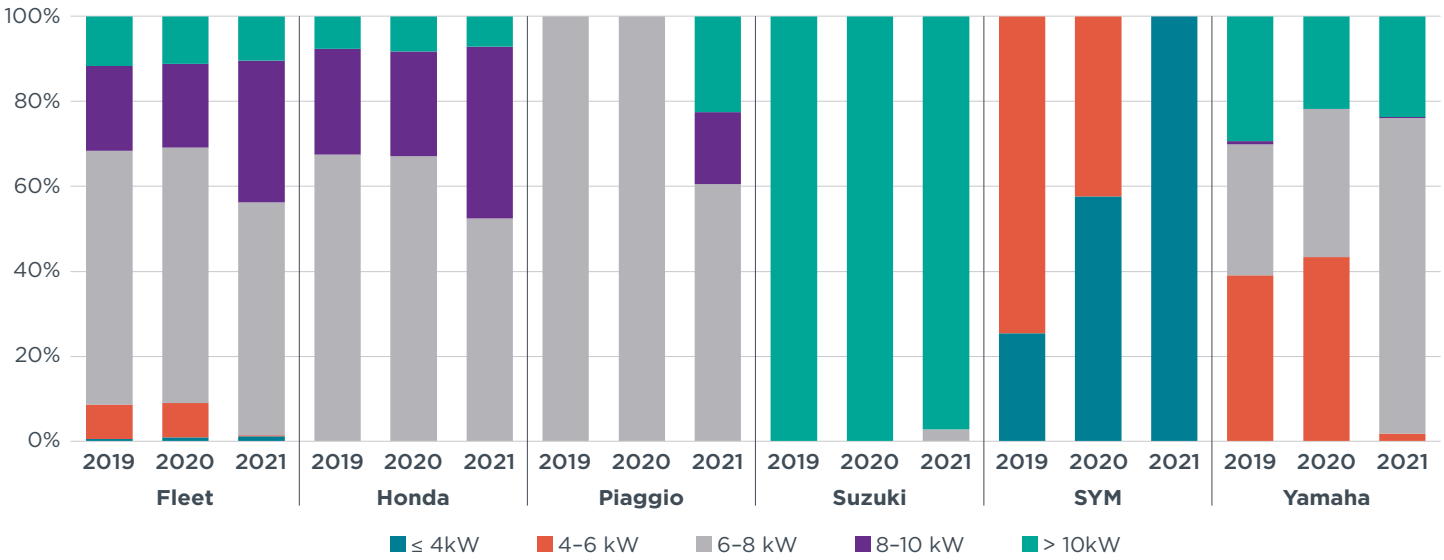

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Figure 20 describes the ICE two-wheeler market segmented by manufacturer and fuel supply system. Fuel injection is the preferred technology among Vietnamese two-wheelers. Among the five manufacturers, only Honda and Yamaha offered both types of vehicles with carburetor and fuel injection technology, but vehicles equipped with fuel injection were more common in Honda's fleet. More than 77% of Honda's two-wheelers used fuel injection technology in each year studied. Over the 3 years, Piaggio only offered vehicles equipped with fuel injection technologies. Most vehicles from SYM and Suzuki were equipped with carburetor technology.

Figure 20

ICE two-wheeler market share by fuel supply system and share of each manufacturer's sales by fuel supply system

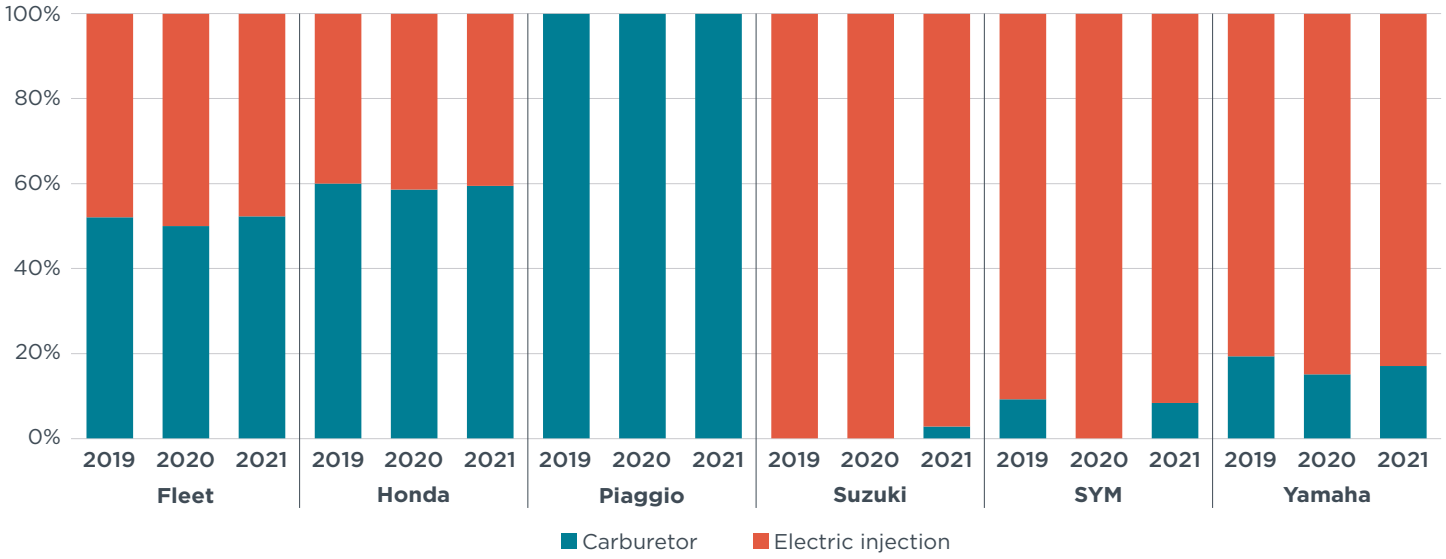

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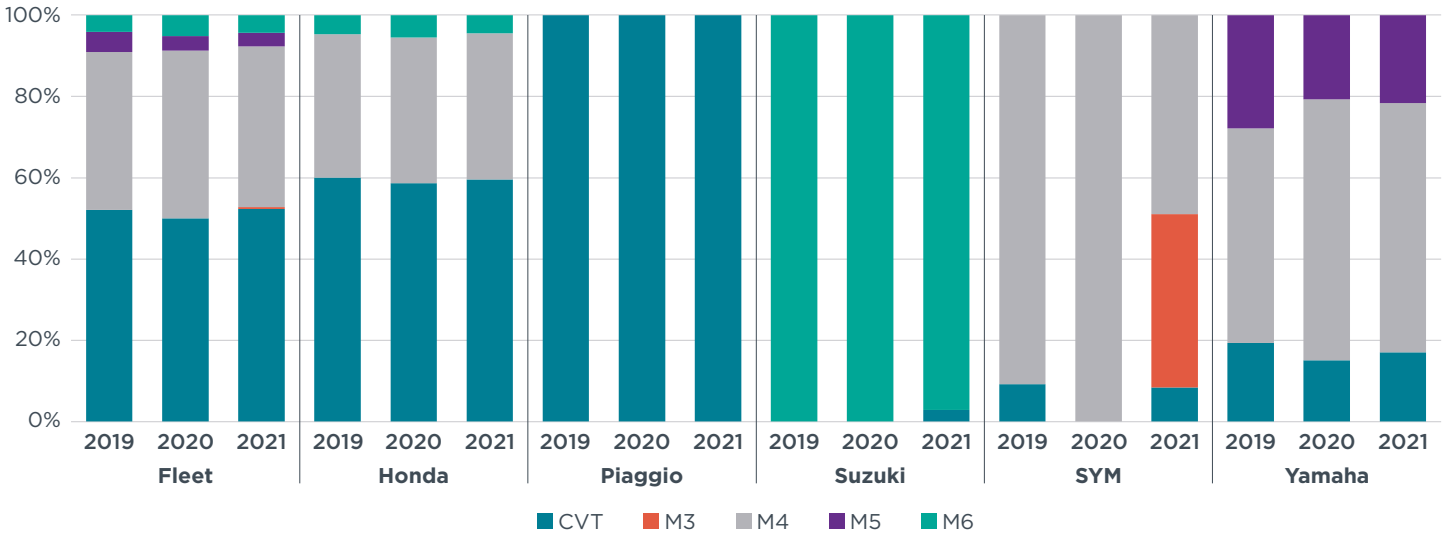
Figure 21 presents the ICE two-wheeler market by company and transmission technology. The fleet presents a slight technology preference towards modern automatic transmissions. Piaggio principally sold vehicles with automatic transmission technology, while Suzuki sold vehicles with 6-gear manual transmissions. Honda and Yamaha offered two-wheelers with both automatic and manual transmission. Two-wheelers with automatic transmissions were more common in Honda's fleet, while two-wheelers with 4-gear manual transmissions were more common in Yamaha's fleet. SYM is the only company still offering 3- manual transmissions, along with 4-gear manual transmission.

Figure 21

ICE two-wheeler market share by transmission technology and share of each manufacturer's sales by transmission technology



Notes: CVT is continuous variable transmission (automatic transmission). Motorcycles with manual transmission have three gears (M3), four gears (M4), five gears (M5), or six gears (M6).

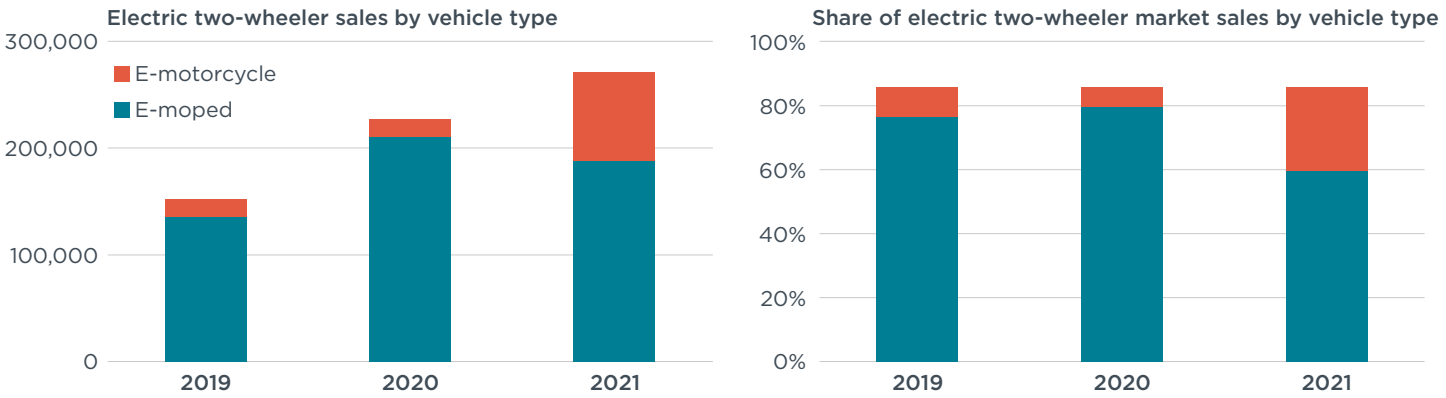
CHARACTERISTICS OF ELECTRIC TWO-WHEELER FLEET

The electric two-wheeler market in Vietnam grew from 1.2% of all two-wheelers in 2017 to 10.4% in 2021. This section provides more detail about the characteristics of electric two-wheeler fleet in the country for 3 years, from 2019 to 2021, as data is unavailable for 2017 and 2018. The major features of electric two-wheeler fleet covered in this section are vehicle type, range, motor power, maximum speed, vehicle weight, battery capacity, and battery type.

Figure 22 presents electric two-wheeler sales and the share of sales by vehicle type. The total number of electric two-wheeler sales increased 78% over the 3 years, from 39,700 vehicles in 2017, to 152,000 vehicles in 2019, and to 288,000 vehicles in 2021. The majority of electric two-wheelers sold were e-mopeds, which made up 89.2% of sales in 2019 and 92.7% of sales in 2020. E-motorcycles accounted for a small market share in 2019 and 2020 but increased to 30.6% in 2021.

Figure 22

Number of electric two-wheeler sales and share of electric two-wheeler sales by vehicle type



An overview of electric two-wheeler fleet characteristics is presented in Figure 23. The majority of electric two-wheelers sold in all 3 years were equipped with lead-acid batteries, accounting for more than 70% of the market share each year. Electric two-wheelers with battery capacity of 1.0–1.2 kWh were the most popular in the electric two-wheeler fleet, accounting for almost a half of the market share each year, followed by vehicles with battery capacities of 1.4–1.6 kWh and 1.2 –1.4 kWh. Vehicles with battery capacities of 1.4–.6 kWh were more common in the 2020 electric two-wheeler fleet, while vehicles with battery capacities of 1.2–1.4 kWh were more common in the 2021 electric two-wheeler fleet. All electric two-wheelers had a range—the distance a vehicle can travel on a single charge—greater than 60 km. In 2021, 33% of electric two-wheelers had a range of 80–90 km, and 18.7% had a range of 90–100 km. On average, the range of the 2021 electric two-wheeler fleet tended to be higher than the 2019 and 2020 fleets, which can be explained by the higher share of e-motorcycles in the 2021 fleet.

Figure 23

Electric two-wheeler fleet characteristics by battery type, capacity, and range

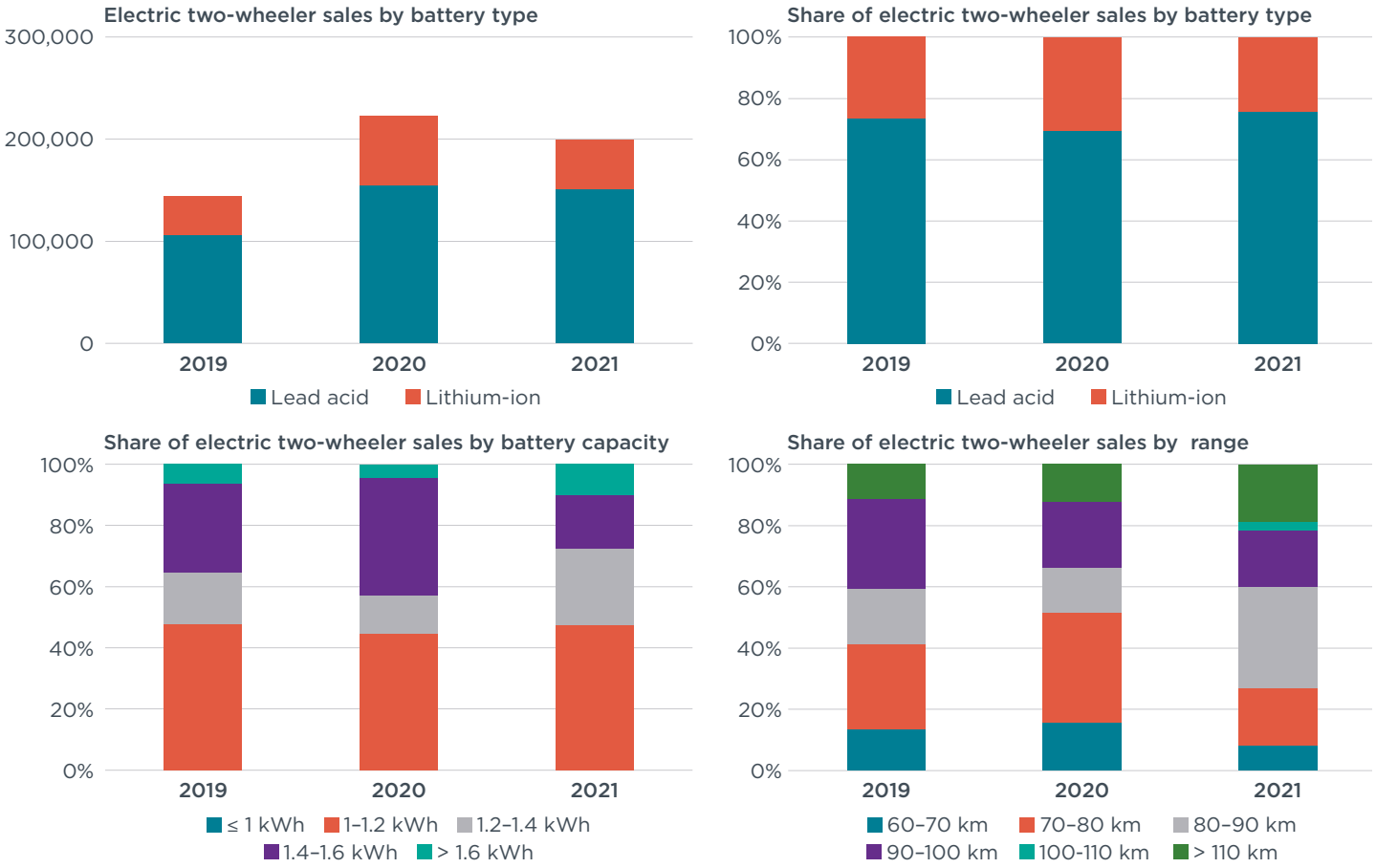
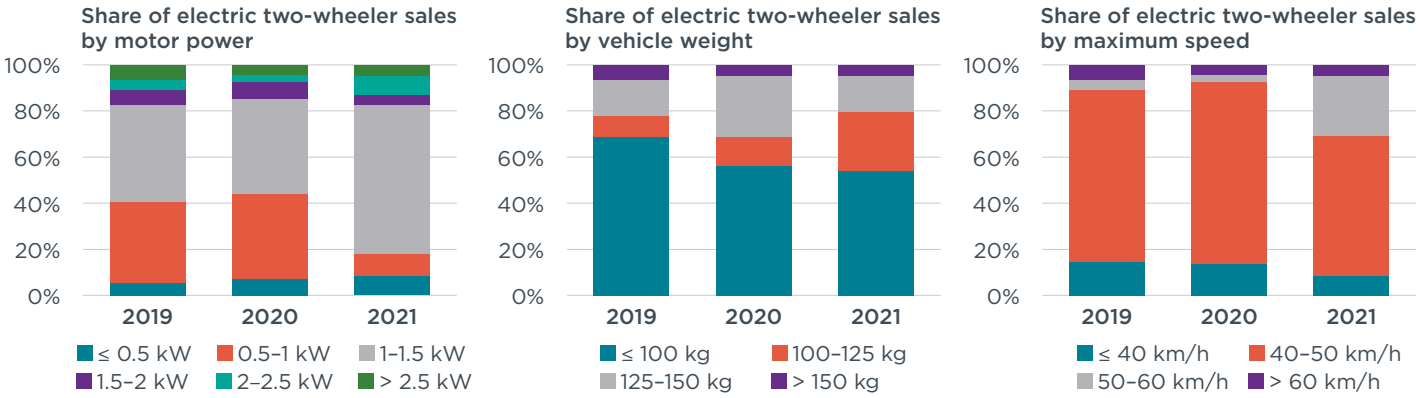


Figure 24 presents the electric two-wheeler market by engine power, vehicle weight, and maximum speed. Over the 3 years assessed, the majority of electric two-wheelers sold in the country had engine power of 1–1.5 kW, followed by vehicles with power of 0.5–1.0 kW. Two-wheelers with engine power greater than 1.5 kW accounted for a small market share. Electric two-wheelers weighing less than 100 kg, mainly e-mopeds, dominated the electric two-wheeler fleet, accounting for 68.7% of sales in 2019, 56.2% in 2020, and 54.35% in 2021. Following were vehicles weighing 100–150 kg; vehicles heavier than 150 kg accounted for a 4.5% market share in 2021. The majority of electric two-wheelers sold in the 3 years had a maximum speed of 40–50 km/h. In 2021, the

number of electric two-wheelers sold with a maximum speed of 50–60 km increased, accounting for 26.1% of the 2021 electric two-wheeler fleet.

Figure 24

Electric two-wheeler fleet characteristics by engine power, vehicle weight, and maximum speed



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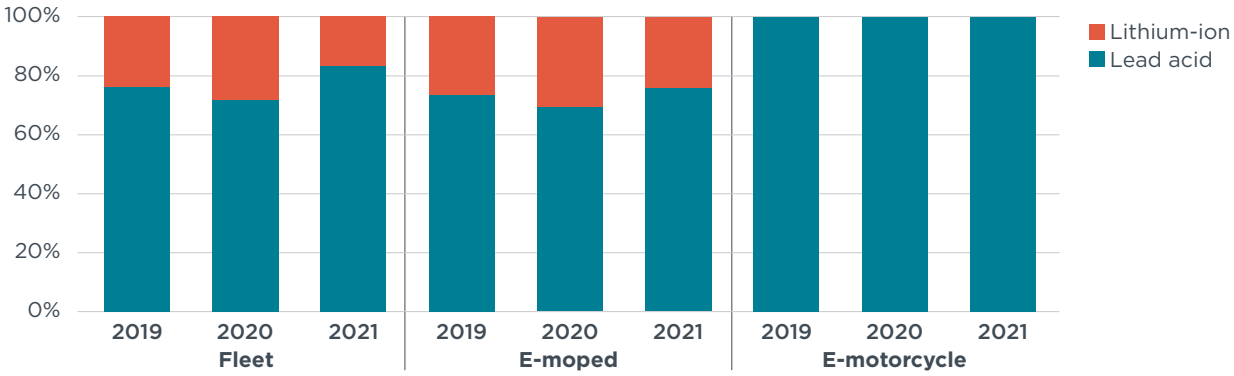
CHARACTERISTICS OF ELECTRIC TWO-WHEELER FLEET BY VEHICLE TYPE

The electric two-wheeler market segmented by vehicle type and battery type is shown in Figure 25. All e-motorcycles sold in the market were equipped with lead-acid batteries. E-mopeds with lead-acid batteries also dominated the market, at 70% of sales. E-mopeds powered by lithium-ion batteries accounted for a smaller market share, with 26.6% in 2019, 30.4% in 2020, and 24.1% in 2021.

Figure 25

Electric two-wheeler market share by battery type and share of sales for e-mopeds and e-motorcycles by battery type



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The electric two-wheeler market by vehicle type and battery capacity is shown in Figure 26. E-motorcycles had higher battery capacity than e-mopeds. In 2019 and 2020, all e-motorcycles sold in the market had a battery capacity greater than 1.4 kWh, and a battery capacity greater than 1.6 kWh was most common. In 2021, e-motorcycles with a battery range of 1.2–1.4 kWh had the largest sales share of the e-motorcycle fleet, at 57.5%, driven by the introduction of the VinFast Klara A2. E-motorcycles with a battery capacity of 1.4–1.6 kWh had a 27.7% market share in 2021, followed by those with a capacity greater than 1.6 kWh with 14.8%. E-mopeds with a battery capacity of 1–1.2 kWh were the most popular in the market over the 3 years and accounted for 68.1% of all e-mopeds sold in 2021.

Figure 26

Electric two-wheeler market share by battery capacity and share of sales for each vehicle type by battery capacity

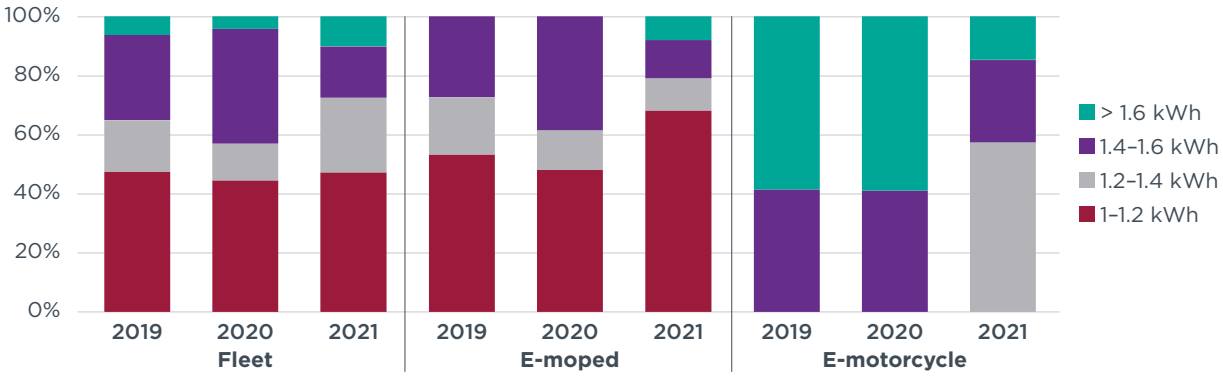

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Figure 27 shows the electric two-wheeler market segmented by vehicle type and travel range. On average, e-mopeds had a lower range than e-motorcycles, which may be related to the lower battery capacity of e-mopeds. In each year studied, e-mopeds with ranges of 70–80 km and 90–100 km accounted for more than 50% of the e-moped fleet. E-mopeds with a range greater than 110 km accounted for only a small share of sales.

All e-motorcycles sold in 2019 and 2020 offered a travel range above 80 km. The average battery capacity of e-motorcycles in 2021 was lower than that in 2019 and 2020, resulting in a lower range for the 2021 e-motorcycle feet. In 2021, 42.5% of e-motorcycles sold on the market had a travel range greater than 110 km, 52.5% had a travel range of 80–90 km, and 4.9% offered a range of 70–80 km.

Figure 27

Electric two-wheeler market share by battery range and share of sales for each vehicle type by battery range

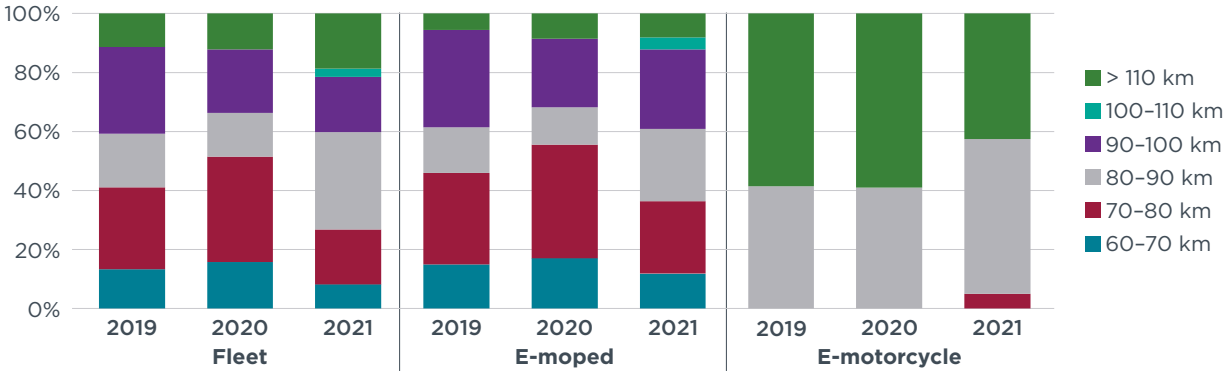

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Figure 28 shows the electric two-wheeler market by vehicle type and motor power. As expected, e-mopeds had a lower power rating than e-motorcycles. All of the e-mopeds offered had a motor power of less than 2 kW; e-mopeds with motor power of 0.5–1.5 kW were the most popular. In 2019 and 2020, all e-motorcycles sold had motor power greater than 2 kW. In 2021, e-motorcycles with motor power of 1–1.5 kW were the most common, accounting for 57.5% of sales, driven by the introduction of the popular VinFast Klara A2.

Figure 28

Electric two-wheeler market share by motor power and share of sales for each vehicle type by motor power

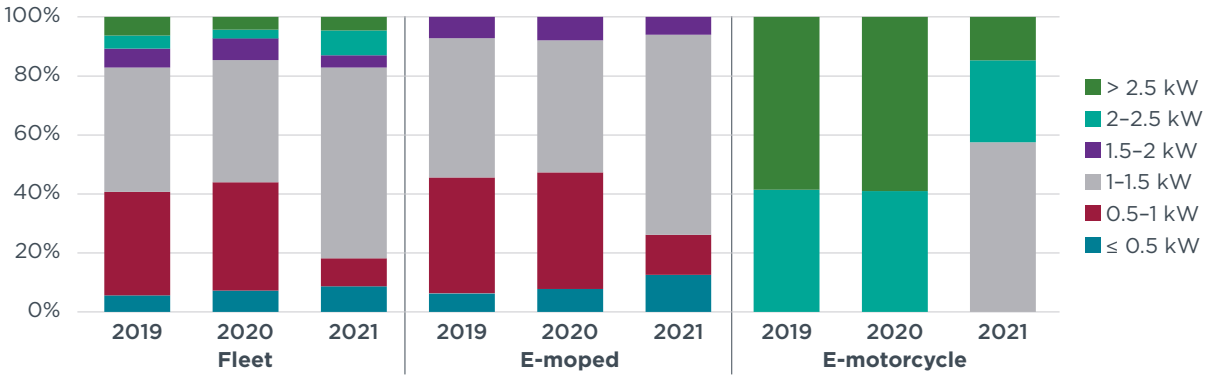

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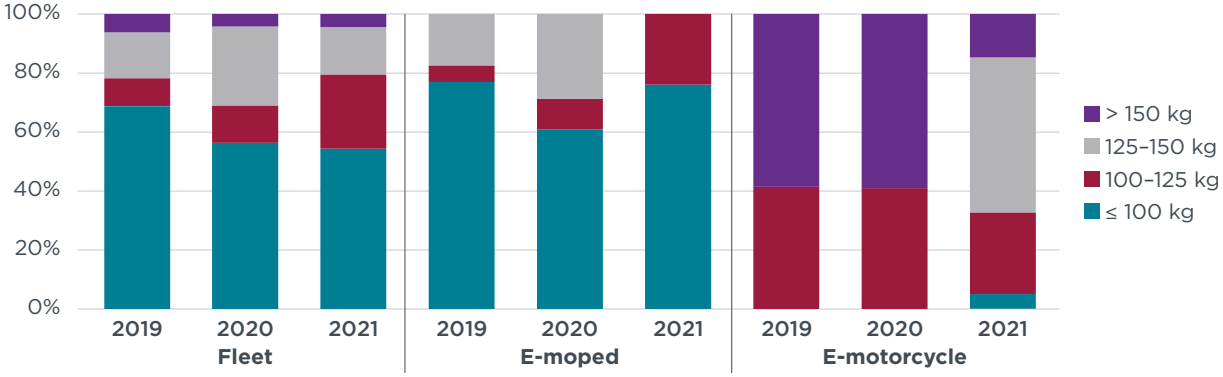
Figure 29 presents the electric two-wheeler market by vehicle type and vehicle weight. E-mopeds are, by definition, lighter than e-motorcycles; most e-mopeds sold each year weighed less than 100 kg. In 2019 and 2020, e-mopeds weighing 125–150 kg were also offered for sale. In 2019 and 2020, e-motorcycles heavier than 150 kg dominated the e-motorcycle fleet, with nearly 60% of e-motorcycle sales. In 2021, e-motorcycles weighing 125–150 kg were more common.

Figure 29

Electric two-wheeler market share by vehicle weight and share of sales for each vehicle type by vehicle weight



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The electric two-wheeler market segmented by vehicle type and maximum travel speed is shown in Figure 30. As expected, all mopeds had a maximum speed below 50 km/h, while all e-motorcycles had a maximum speed of over 50 km/h. Over the 3 years studied, most e-mopeds sold had a maximum travel speed of 40–50 km/h, and those with a maximum speed of less than 40 km/h accounted for only a small share. E-motorcycles with a maximum speed greater than 60 km/h were more common in 2019 and 2020. However, in 2021, e-motorcycles with a maximum travel speed of 50–60 km/h accounted for 85.2% of sales.

Figure 30

Electric two-wheeler market share by maximum speed and share of sales for each vehicle type by maximum speed

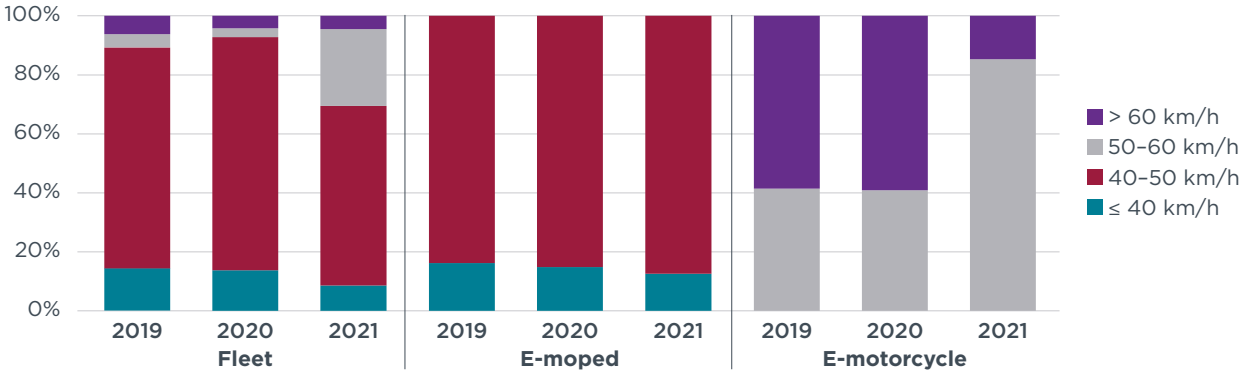

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Table 3 summarizes the sales-weighted averages of electric two-wheeler specifications by vehicle type in 2021. On average, e-motorcycles had higher battery capacity, range, engine power, curb weight, and speed than e-mopeds. All e-motorcycles sold in 2021 were equipped with lead-acid batteries, while 24.1% of e-mopeds were powered by lithium-ion batteries.

Table 3

Sales-weighted averages of electric two-wheeler specifications by vehicle type in 2021

Parameters		All electric two-wheelers	E-moped	E-motorcycle
Share of all two-wheeler sales		**10.4%**	**7.2%**	**3.2%**
Battery capacity (kWh)	Min	1.1	1.1	1.3
	Max	3.2	3.2	2.3
	Average	1.4	1.4	1.5
Battery type	Lead-acid	83.3%	75.9%	100%
	Lithium-ion	16.7%	24.1%	0.0%
Range (km)	Min	70	70	80
	Max	140	120	140
	Average	95.6	90.2	107.8
Engine power (kW)	Min	0.5	0.5	1.2
	Max	4.0	1.6	4.0
	Average	1.4	1.2	1.9
Vehicle weight (kg)	Min	75.0	75.0	93.0
	Max	155.0	115.0	155.0
	Average	103.3	92.3	128.4
Speed (km/h)	Min	35.0	35.0	55.0
	Max	65.0	50.0	65.0
	Average	51.6	47.6	60.5

CHARACTERISTICS OF ELECTRIC TWO-WHEELER FLEET BY MANUFACTURER

The number of electric two-wheelers sold in the country increased over the 3 years studied, from 161,500 vehicles in 2019, to 240,500 vehicles in 2020, and 287,700 vehicles in 2021. The electric two-wheeler market and total sales by manufacturer are presented in Figure 31. Eight manufacturers sold electric two-wheelers in Vietnam during this 3-year period: Anbico, Dibao, Gogoro, JVC, Niu, Pega, VinFast, and Yadea. VinFast dominated the electric two-wheeler market in the country, reaching its highest share of electric two-wheeler sales in 2020 at 45.9%. Pega was the second-largest electric two-wheeler manufacturer in 2021, with 29.3% of sales. In 2021, the market share of VinFast decreased to 32.8%, while Pega and Yadea gained market share.

Figure 31

Electric two-wheeler sales by manufacturer and share of electric two-wheeler sales by manufacturer

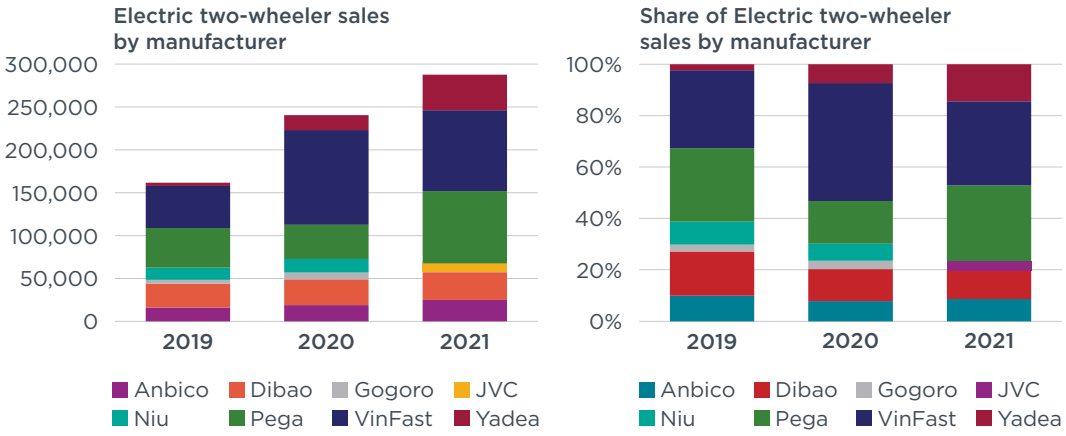

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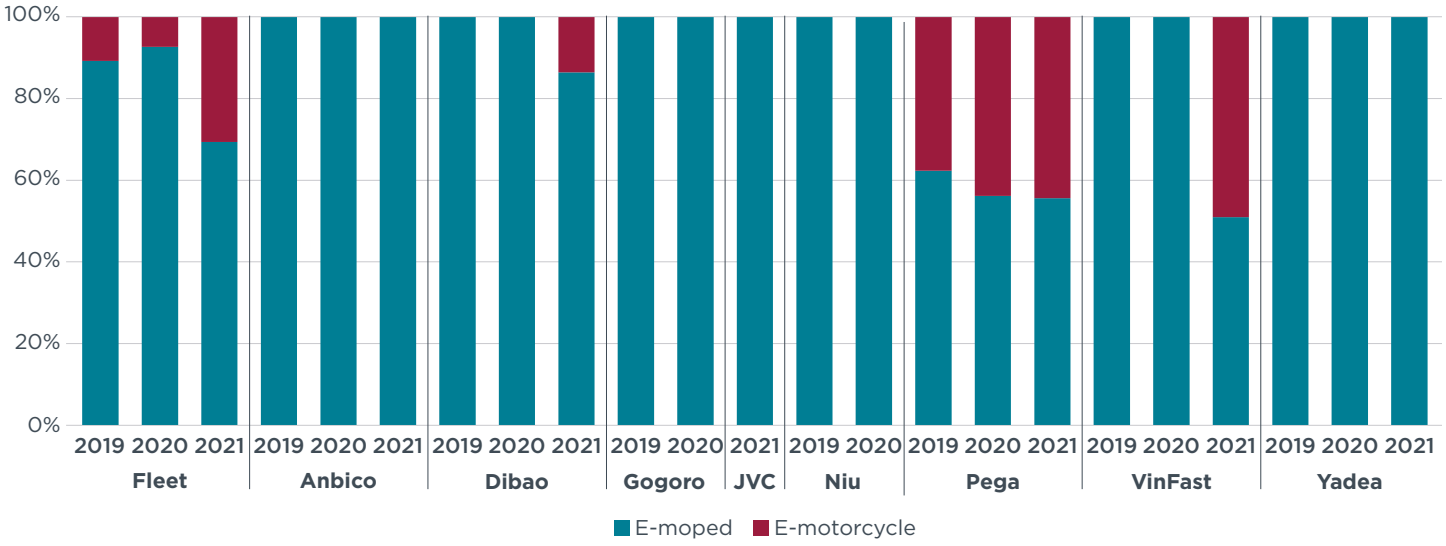
Figure 32 shows the electric two-wheeler market segmented by manufacturer and vehicle type. All brands offered e-mopeds; Anbico, Gogoro, Yadea, Niu, and JVC sold e-mopeds exclusively. In 2019 and 2020, Dibao, Niu, and VinFast offered only e-mopeds, but all three brands started offering e-motorcycles in 2021. Although VinFast only began selling e-motorcycles in 2021, they made up 49% of their sales that year. Pega is the only brand that sold e-motorcycles over all 3 years.

Figure 32

Electric two-wheeler market share by vehicle type and share of each manufacturer's electric two-wheeler sales by vehicle type



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he electric two-wheeler market share by manufacturer and battery type is shown in Figure 33. Niu, the sole manufacturer to exclusively use lithium-ion batteries, did not sell any vehicles in 2021. In 2020, the company sold 15,800 vehicles, accounting for 6.6% of the electric two-wheeler market. Among the eight manufacturers, Anbico, Dibao, Gogoro, JVC and Pega only sold electric two-wheelers equipped with lead-acid batteries. VinFast, and Yadea to some extent, offered both battery types in their electric two-wheelers. For VinFast, 51% of sales in 2021 were vehicles with lithium-ion batteries.

Figure 33

Electric two-wheeler market share by battery type and share of each manufacturer's electric two-wheeler sales by battery type

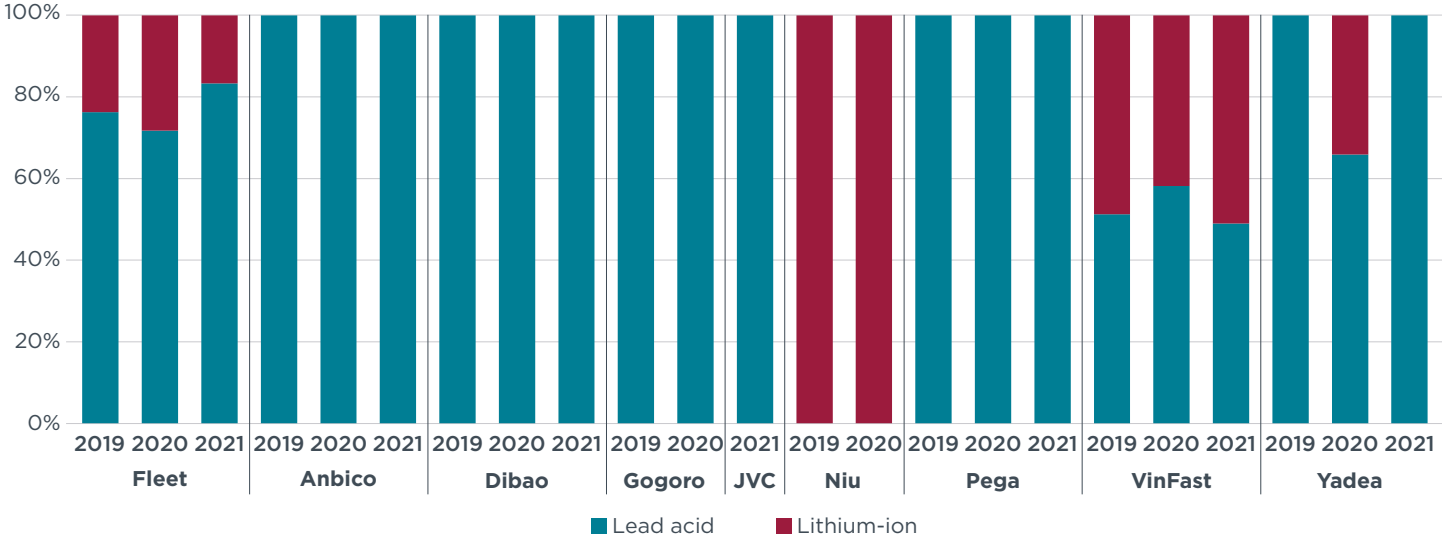

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Figure 34 shows the electric two-wheeler market share by manufacturer and battery capacity. Anbico, Gogoro, and JVC only sell vehicles with battery capacity of 1.0–1.2 kWh, while Niu only offered vehicles with a battery capacity of between 1.4 to 1.6 kWh. Electric two-wheelers with a battery capacity of 1.2 to 1.4 kWh also dominated Dibao's fleet. Pega and VinFast were the only manufacturers selling electric two-wheelers with battery capacities greater than 1.6 kWh.

Figure 34

Electric two-wheeler market share by battery capacity and share each manufacturer's sales by battery capacity

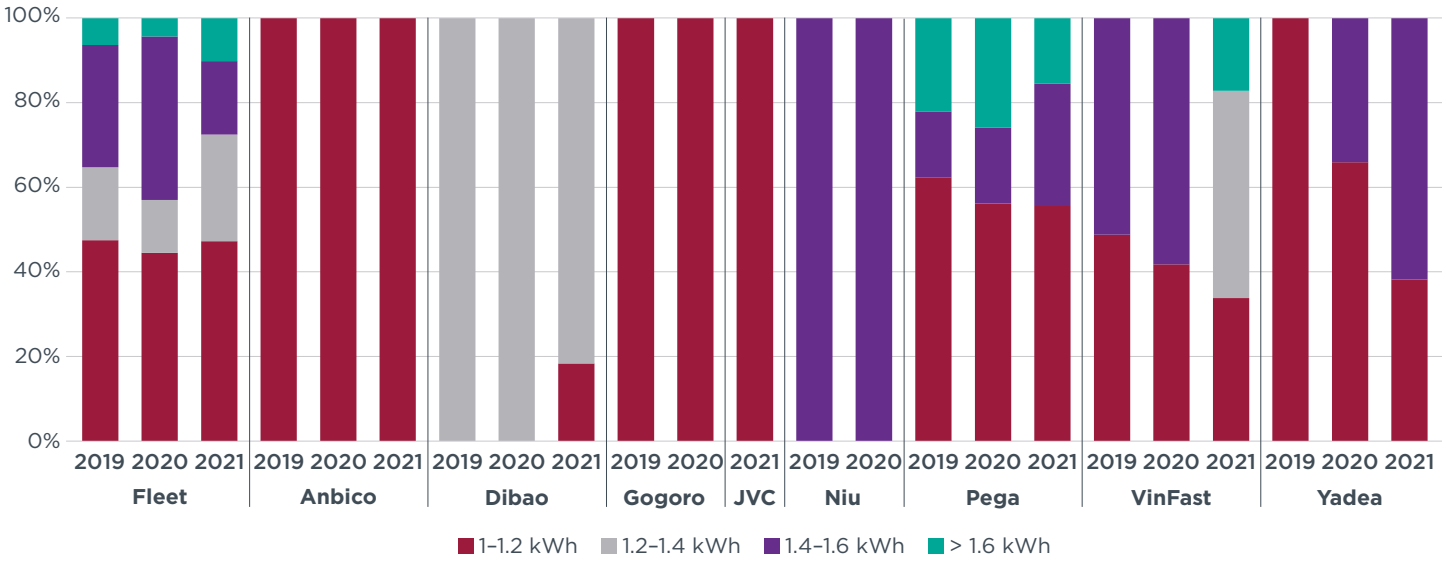

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Figure 35 shows the electric two-wheeler market by manufacturer and range. Pega and VinFast offer electric two-wheelers with the longest range, above 110 km per charge. On average, the electric two-wheeler fleets of VinFast and Pega had a higher average travel range compared with other companies' fleets because of their higher battery capacity. Pega had the largest share of electric two-wheelers with a range greater than 110 km, at 44.4% in 2021. All vehicles from Gogoro and Niu had ranges of 90–100 km, while JVC offered only vehicles with a range of 70–80 km. Electric two- wheelers with ranges of 60–70 km were more common in the Anbico and VinFast fleets.

Figure 35

Electric two-wheeler market share by battery range and share of each manufacturer's sales by battery range

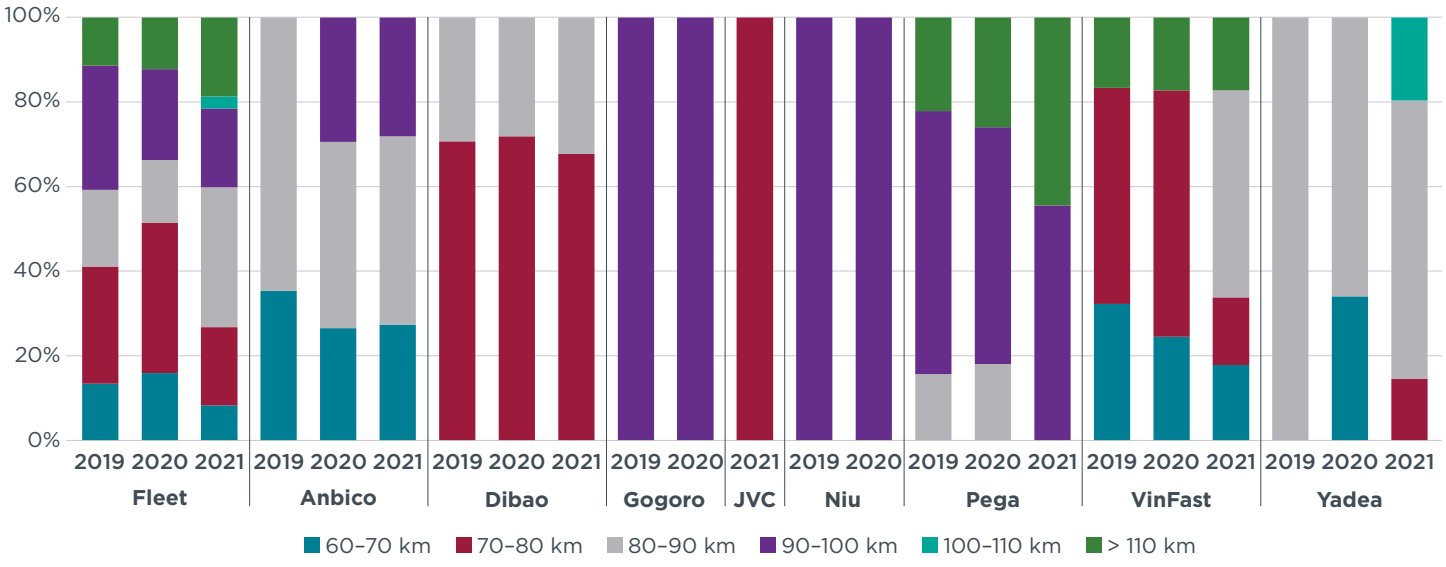

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Figure 36 presents the electric two-wheeler market share by company and motor power. Pega offered vehicles with a wide range of motor power, ranging from 0.5 kW to greater than 2.5 kW. Electric two-wheelers with power greater than 2 kW were the

most common in Pega's fleet, at 34.4%. Dibao and Niu offered only vehicles with 1–1.5 kW of power, and Gogoro offered only vehicles with motor power of 1.5–2 kW. Vehicles with power of less than 0.5 kW were most common in the Yadea and VinFast fleets.

Figure 36

Electric two-wheeler market share by motor power and share of each manufacturer's sales by motor power

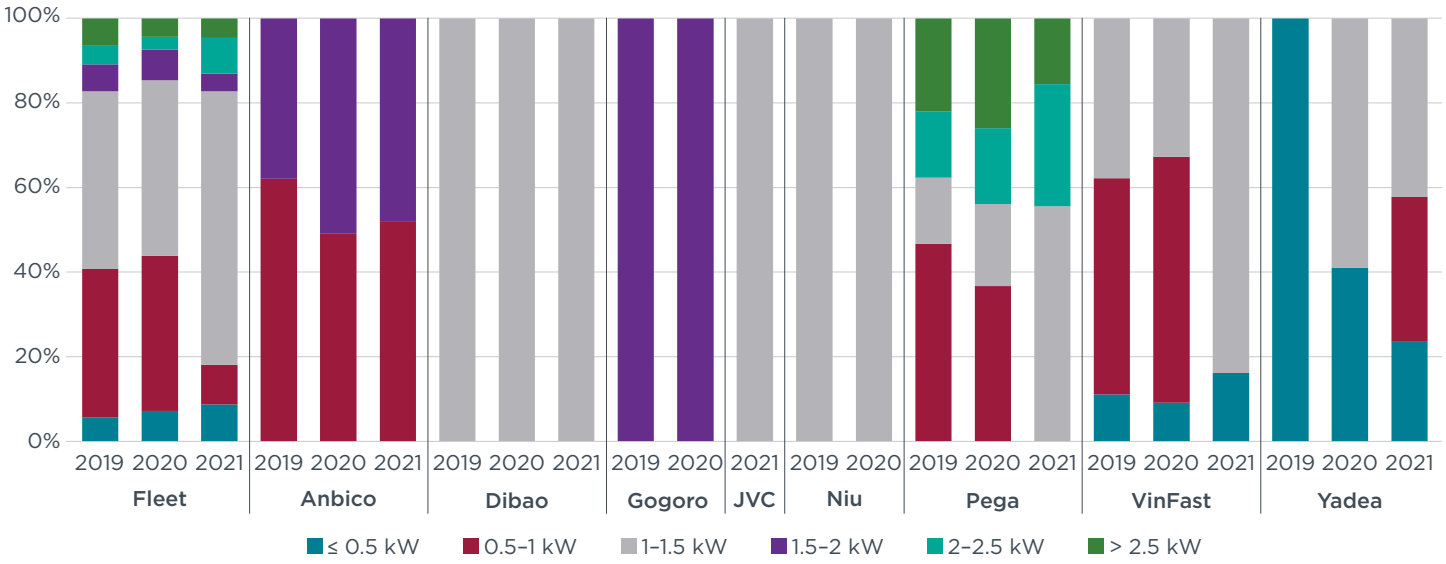

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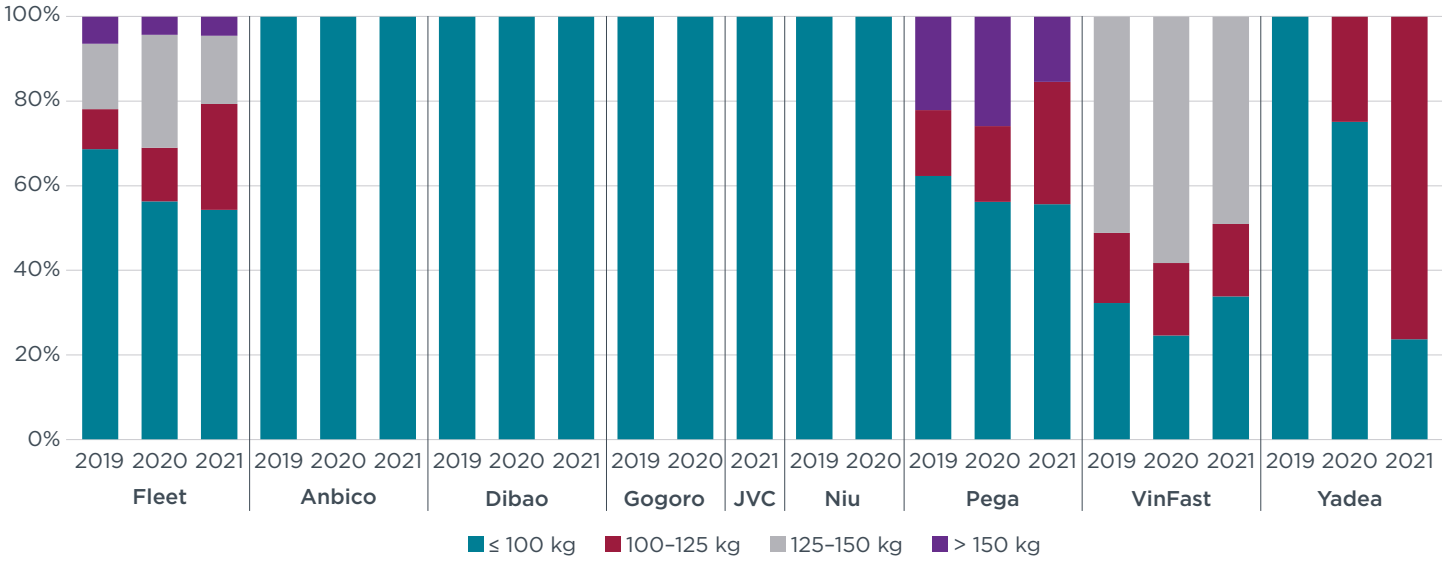
Figure 37 presents the electric two-wheeler market by vehicle weight, which includes battery weight. Anbico, Dibao, Gogoro, JVC, Niu exclusively sold electric two-wheelers of less than 100 kg. This type of electric two-wheeler was also common in the Pega and Yadea fleets. Because Pega and VinFast offered e-motorcycles, which tend to be heavier than e-mopeds, the fleets of these two manufacturers were heavier than those of other companies. Pega was the only manufacturer that sold electric two-wheelers weighing more than 150 kg, while VinFast was the only manufacturer that offered electric two-wheelers weighing 125–150 kg.

Figure 37

Electric two-wheeler market share by vehicle weight and share of each manufacturer's sales by vehicle weight



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The electric two-wheeler market segmented by manufacturer and maximum speed is shown in Figure 38. By definition, e-mopeds have a maximum speed of 50 km/h. Vehicles with a maximum speed of 40–50 km/h were dominant in all manufacturer fleets except for Niu, which offered only vehicles with a maximum speed below 40 km/h. Pega was the only manufacturer to sell electric two-wheelers with a maximum speed of higher than 60 km/h. Vehicles with a maximum speed range of 50–60 km/h were the most popular in VinFast's fleet in 2021. The year VinFast began to offer e-motorcycles. In 2019 and 2020, VinFast only offered e-mopeds; therefore, the maximum speed of the VinFast fleet in these 2 years was lower than 50 km/h.

Figure 38

Electric two-wheeler market share by maximum speed and share of each manufacturer's sales by maximum speed

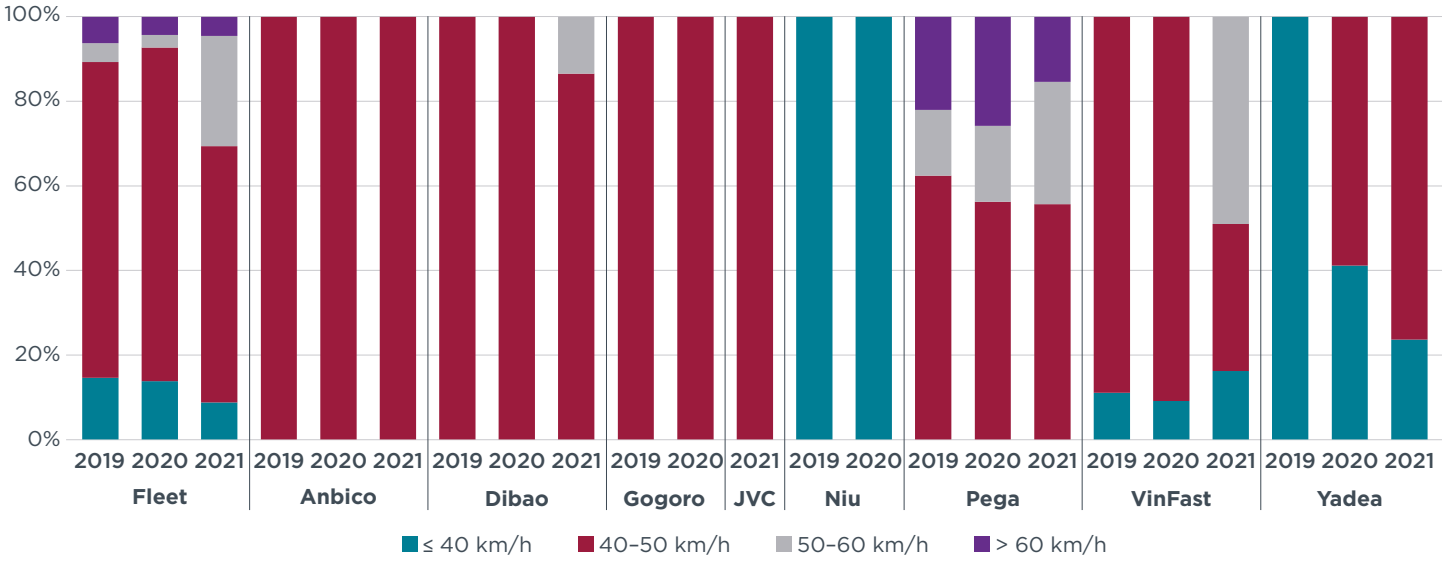

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Table 4 summarizes the sales-weighted averages of electric two-wheeler specifications by manufacturer in 2021. VinFast had the highest-average battery capacity power (1.6 kWh) among the six companies. However, Pega's fleet had the highest-average travel range (114.7 km), engine power (1.9 kW), vehicle weight (109.6 kg), and speed (55.2 km/h). Yadea's fleet had the lowest average engine power and speed, while Anbico's fleet was lightest, and JVC's fleet had the lowest travel range.

Table 4

Sales-weighted averages of electric two-wheeler specifications by manufacturer in 2021

Parameters		All electric two-wheelers	VinFast	Pega	Yadea	Dibao	Anbico	JVC
		100%	32.8%	29.3%	14.4%	11.2%	8.7%	3.6%
Vehicle type	E-moped	69.4%	51.0%	55.6%	100%	86.5%	100%	100%
	E-motorcycle	30.6%	49.0%	44.4%	0%	13.5%	0%	0%
Battery capacity (kWh)	Min	1.1	1.1	1.2	1.2	1.2	1.2	1.2
	Max	3.2	3.2	2.3	1.4	1.3	1.2	1.2
	Average	1.4	1.6	1.4	1.3	1.3	1.2	1.2
Battery type	Lead-acid	83.3%	49.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	Lithium-ion	16.7%	51.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Range (km)	Min	70	70	100	80	80	70	80
	Max	140	120	140	109	90	100	80
	Average	95.6	89.2	114.7	90.4	83.2	86.4	80.0
Engine power (kW)	Min	0.5	0.5	1.2	0.5	1.5	0.8	1.5
	Max	4.0	1.2	4.0	1.2	1.5	1.6	1.5
	Average	1.4	1.1	1.9	1.0	1.5	1.2	1.5
Vehicle weight (kg)	Min	68.0	68.0	90.0	94.0	92.0	85.0	95.0
	Max	150.0	127.0	150.0	115.0	93.0	95.0	95.0
	Average	103.3	105.0	109.6	105.3	92.8	89.6	95.0
Speed (km/h)	Min	35.0	35.0	50.0	37.0	50.0	50.0	50.0
	Max	65.0	60.0	65.0	50.0	55.0	50.0	50.0
	Average	51.6	52.0	55.2	45.3	50.7	50.0	50.0

TWO-WHEELER MARKET DEEP DIVE ANALYSIS FOR 2021

Data from 2021 will be used to determine the baseline for developing fuel consumption standards for two-wheelers in Vietnam. This section presents an overview of the two-wheeler market in 2021, including information on vehicle characteristics at the fleetwide and company levels. Data is used from two sources, MotorCycles Data and VR, to cover a boarder range of two-wheeler companies and reflect a comprehensive picture of the country's two-wheeler market.

In total, 28 companies are included in this analysis. The classification of these companies and their market shares are presented in Table 5. Honda, Yamaha, Suzuki, Piaggio, and Savina produced vehicles locally and also imported vehicles into Vietnam. These five companies dominated the 2021 two-wheeler market, with a total market share of 79.7%. Six electric two-wheeler companies had a combined market share of 9.4%. The number of domestic producing/assembling companies included in this analysis was 13, but their combined market share was small at 7.6%. Four companies imported vehicles to Vietnam, including GPX Vietnam, Ly Nghia, Hung Thinh Vuong, and Tran Phuong, with a share of 3.3%. These companies imported two-wheelers mainly produced by Honda, Yamaha, Suzuki, and GPX outside of Vietnam.

Table 5

Two-wheeler company classifications and market share in 2021

Type of company	Company	Market share (%)	Vehicle type
Producer/assembler and importer	Honda, Yamaha, Suzuki, Piaggio, Savina	79.7%	ICE motorcycles
Domestic producer/ assembler	Detech, Honlei Duc Ha, SYM, Victoria, Nam Anh, Sumotor, Lifan, Cong Thuong Dong Minh, Kwang Yang, DK Viet Nhat, Phuong Dong, Saki Vietnam, Motor Thai	7.6%	ICE mopeds
Importer	GPX Vietnam, Ly Nghia, Hung Thinh Vuong, Tran Phuong	3.3%	ICE motorcycles
Electric two-wheeler producer/assembler	VinFast, Pega, Yadea, Dibao, Anbico, JVC	9.4%	Electric motorcycles and electric mopeds

The 2021 two-wheeler market share by sales and percentage of sales is presented in Table 6. Honda had the largest share of the market, with a share of 65.6%, followed by Yamaha with a market share of 12.5%. The remaining 26 companies accounted for 21.9% of all sales. The market share of domestic manufacturers that produced ICE two-wheelers was relatively small, ranging from 1.1% (Honlei Duc Ha) to 0.2%. The market shares of Honda, Yamaha, SYM, Suzuki, Piaggio, and electric two-wheeler companies in this section are slightly lower than those mentioned in section 2.4 because the database used for this section covers ICE companies that are members of VAMM as well as nonmembers.

Table 6

Two-wheeler market share by company sales and percentage of sales in 2021

Company	Vehicle sale	Percentage of sales
Honda	2,020,962	65.6%
Yamaha	383,971	12.5%
VinFast	94,300	3.1%
Pega	84,292	2.7%
Detech	76,339	2.5%
GPX Vietnam	63,870	2.1%
Yadea	41,445	1.3%
Honlei Duc Ha	33,011	1.1%
Dibao	32,168	1.0%
SYM	25,740	0.8%
Anbico	25,081	0.8%
Victoria	22,304	0.7%
Piaggio	21,332	0.7%
Nam Anh	20,297	0.7%
Suzuki	19,638	0.6%
Ly Nghia	17,829	0.6%
Hung Thinh Vuong	13,438	0.4%
Savina	10,652	0.3%
Sumotor	10,558	0.3%
JVC	10,413	0.3%
Lifan	7,968	0.3%
Dong Minh	7,664	0.2%
Kwang Yang	7,598	0.2%
DK Viet Nhat	7,271	0.2%
Phuong Dong	6,521	0.2%
Tran Phuong	6,160	0.2%
Saki Vietnam	5,518	0.2%
Motor Thai	4,656	0.2%

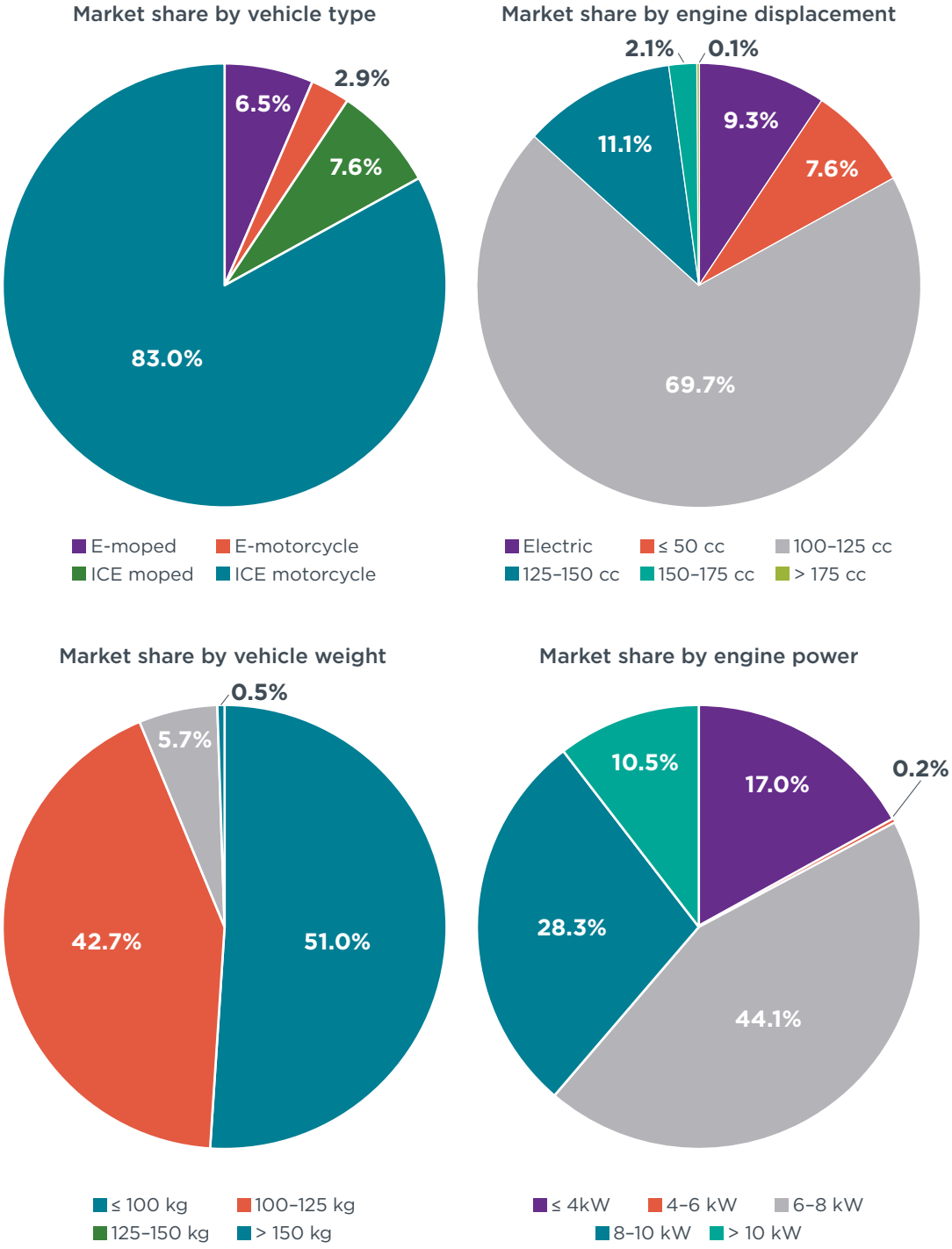
CHARACTERISTICS OF 2021 TWO-WHEELER FLEET

Figure 39 presents an overview of 2021 two-wheeler fleet characteristics. ICE motorcycles dominated the fleet, with a market share of 83%, followed by ICE mopeds with a share of 7.6%. Electric two-wheelers accounted for 9.4% of the total market share; 6.5% of all two-wheeler sales were e-mopeds and 2.9% were e-motorcycles.

Regarding engine displacement, the majority of 2021 fleet consisted of two-wheelers with engine sizes of 100–125 cc (69.7%). Vehicles with engine sizes of 125–150 cc had a market share of 11.1%, and ICE mopeds with engine sizes of less than 50 cc had a market share of 7.6%. Vehicles with engine sizes greater than 150 cc accounted for a small share, with only 2.2%.

Two-wheelers weighing less than 100 kg and between 100 kg and 125 kg were the most popular in 2021 fleet, with market shares of 51% and 42.7%, respectively. Vehicles heavier than 150 kg were the least common, with a market share of only 0.5%. Two-wheelers in 2021 had a wide range of engine power, ranging from less than 4 kW to higher than 10 kW. Vehicles with engine power of 6–8 kW were the most common, with a market share of 44.1%, and vehicles with engine power of 4–6 kW were the least common, with a share of only 0.2%.

Figure 39
2021 two-wheeler market share by characteristic



CHARACTERISTICS OF 2021 TWO-WHEELER FLEET BY VEHICLE TYPE

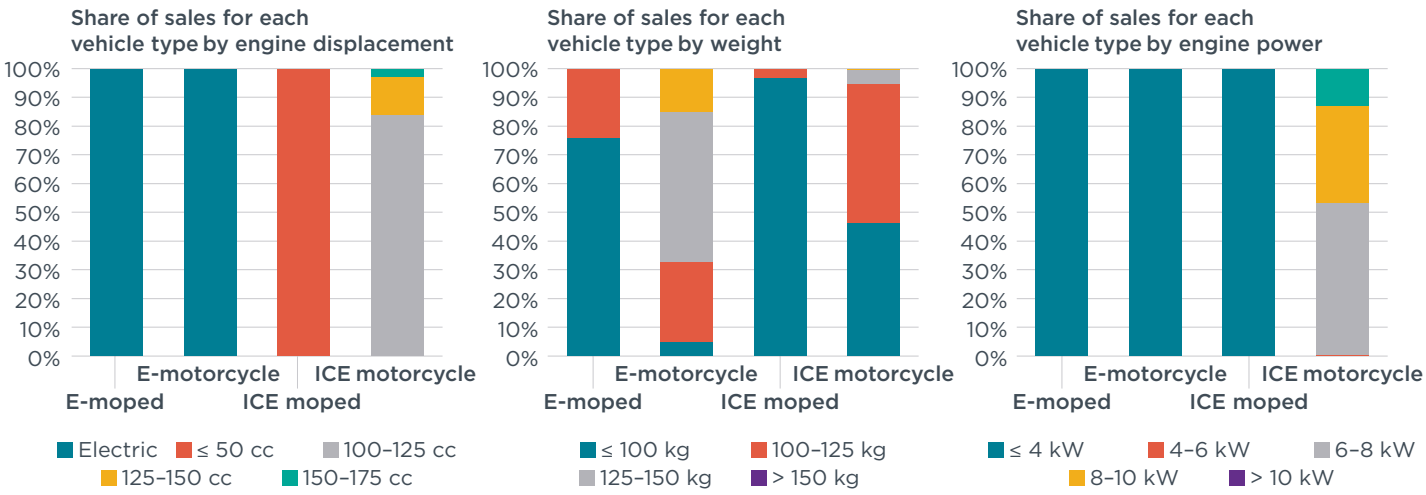
Figure 40 describes the characteristics of the 2021 fleet by vehicle type. By definition, all ICE mopeds have an engine size below 50 cc. Regarding ICE motorcycles, those with engine sizes of 100–125 cc accounted for 84% of the market for this vehicle type. ICE motorcycles with engine sizes greater than 150 cc were not common in the 2021 fleet, with a share of only 2.6%.

The majority of e-mopeds and ICE mopeds weighed less than 100 kg, with 76% of e-mopeds and 96.8% of ICE mopeds lighter than 100 kg. E-motorcycles were the heaviest among vehicle types, with the majority weighing more than 125 kg and accounting for a 67.3% share of the market. Vehicles weighing less than 125 kg were the most common in the ICE motorcycle fleet, with 48.3% weighing 100–125 kg and 46.5% weighing less than 100 kg.

All e-mopeds, e-motorcycles, and ICE mopeds sold in 2021 had engine power less than 4 kW, and all ICE-motorcycles had engine power greater than 4 kW. More than half of ICE motorcycles had engine power of 6–8 kW (53.1%). Motorcycles with engine power of 8–10 kW had a 31.4% market share.

Figure 40

Characteristics of 2021 two-wheeler fleet by vehicle type



CHARACTERISTICS OF 2021 TWO-WHEELER FLEET BY COMPANY

Figure 41 presents the two-wheeler market share by company and vehicle type in 2021. Honda, Yamaha, GPX Vietnam, Piaggio, Suzuki, Ly Nghia, Hung Thinh Vuong, Savina, and Tran Phuong sold exclusively ICE motorcycles. All four import companies, including GPX Vietnam, Ly Nghia, Hung Thinh Vuong, and Tran Phuong, sell ICE vehicles. Six companies offered only electric two-wheelers; three pf these companies (VinFast, Pega, Dibao) sell both e-mopeds and e-motorcycles, while the other three companies (Yadea, Anbico, and JVC) sell only e-mopeds. The remaining 13 companies offered only ICE mopeds.

Figure 41

Share of two-wheeler sales for each company by vehicle type in 2021

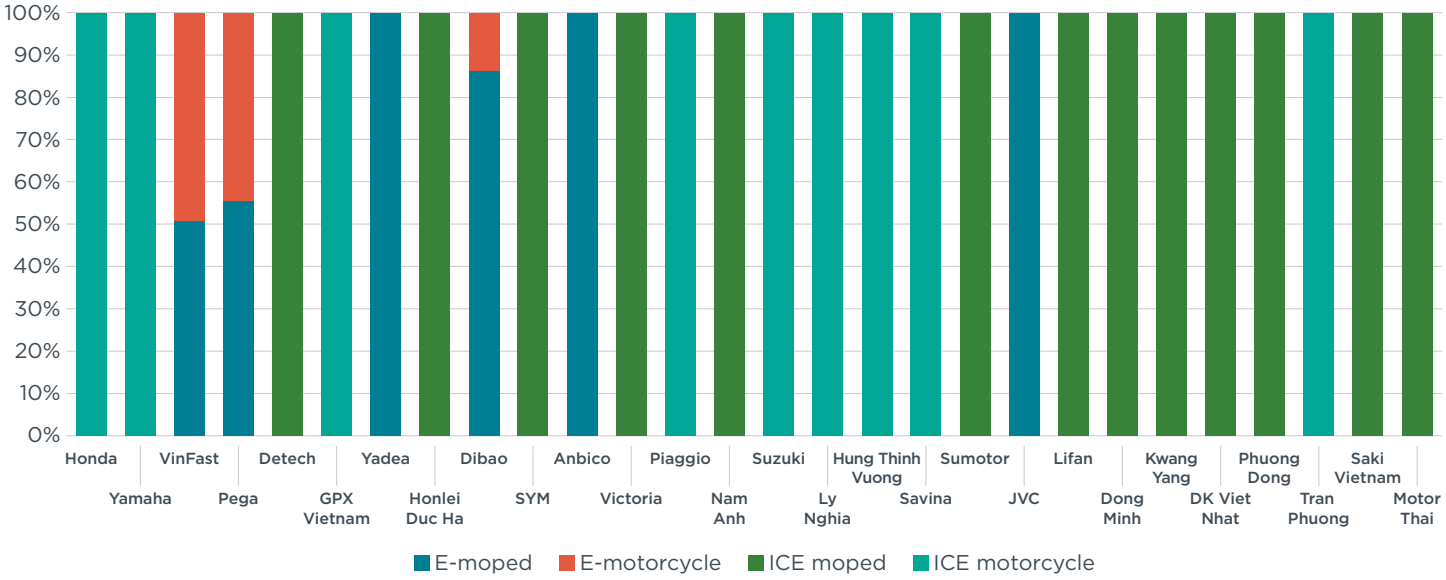
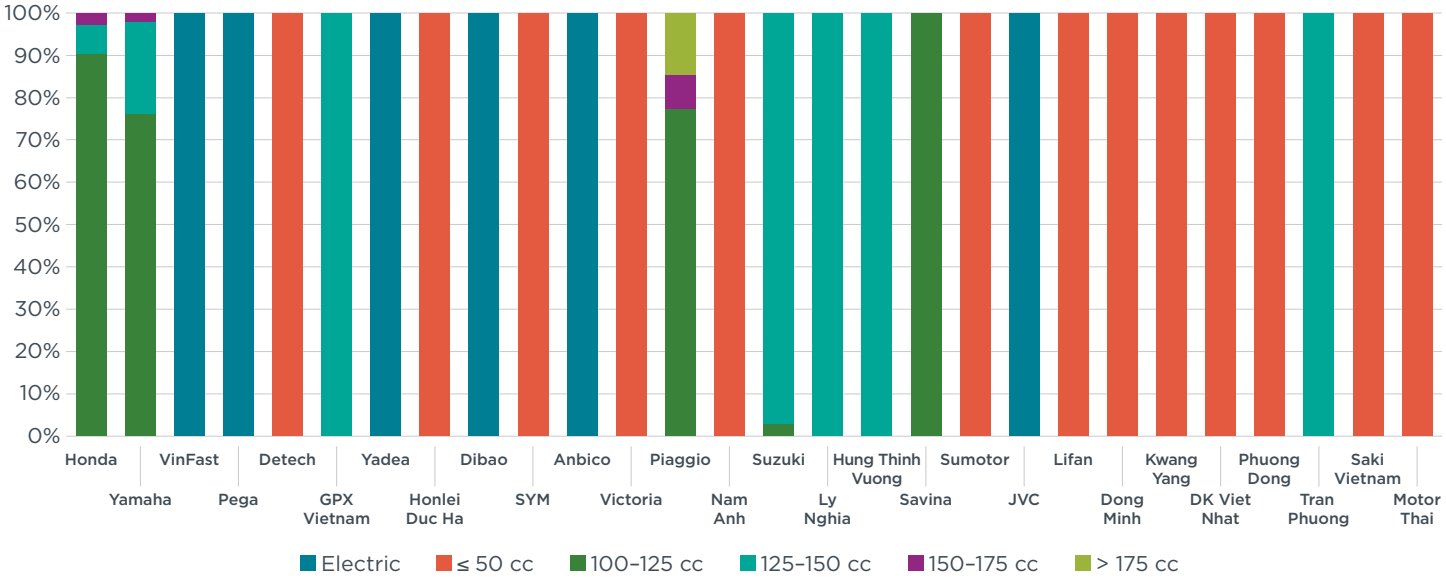


Figure 42 shows the two-wheeler market by company and engine displacement. All 13 domestic assembly/production companies only offered ICE mopeds (engine size < 50 cc). Four import companies—including GPX Vietnam, Ly Nghia, Hung Thinh Vuong, and Tran Phuong—only offered vehicles with engine displacement from 125 cc to 150 cc. Honda, Yamaha, Piaggio, and Suzuki offered two-wheelers with a wider range of engine sizes. Two-wheelers with engine sizes between 100 cc to 125 cc dominated the two-wheeler fleets of Honda, Yamaha, and Piaggio, while vehicles with engine sizes between 125 cc to 150 cc accounted for 97.2% of Suzuki's fleet.

Figure 42

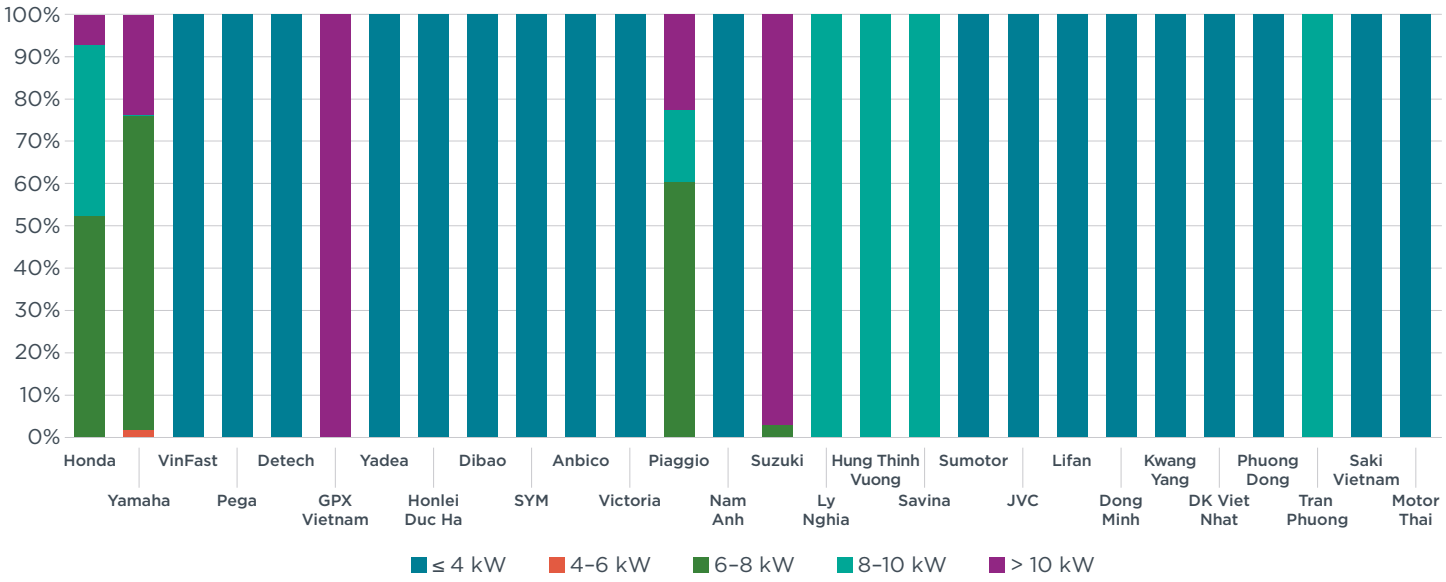
Share of two-wheeler sales for each company in 2021 by engine displacement



The 2021 two-wheeler market by company and engine power is presented in Figure 43. All vehicles offered by domestic ICE companies and electric two-wheeler companies had an engine power of less than 4 kW. An import company, GPX Vietnam, offered only vehicles with an engine power greater than 10 kW. This high-powered vehicle type accounted for 97.2% of Suzuki's fleet. Honda, Yamaha, and Piaggio offered vehicles with a broader range of engine power, ranging from less than 4 kW to larger than 10 kW. Vehicles with an engine power of 6–8 kW were more common in Yamaha and Piaggio's fleets than in Honda's fleet. Four companies, including Ly Nghia, Hung Thinh Vuong, Savina, and Tran Phuong, sold only two-wheelers with an engine power of 8–10 kW.

Figure 43

Share of two-wheeler sales for each company in 2021 by engine power



FUEL CONSUMPTION BASELINE ANALYSIS OF TWO-WHEELERS

Fuel consumption and fuel economy are common metrics referring to a vehicle's efficiency in consuming fuel to travel a certain distance. The definitions for this paper are:

- Fuel consumption (FC): The amount of fuel consumed, in liters, of a vehicle traveling 100 km, written as L/100 km.
- Fuel economy or fuel efficiency (FE): The distance traveled, in kilometers, when a vehicle consumes 1 liter of fuel, written as km/L.

Within this study, the unit used to measure fuel consumption is L/100 km. The term "fuel economy" is used interchangeably with "fuel consumption" or "fuel efficiency" without intending a change of the underlying units. This terminology accounts for the fact that policies to reduce the fuel consumption of vehicles are most often referred to as "fuel economy policies" without necessarily implying the respective unit of measurement. Note that because virtually all two-wheelers powered by internal combustion engines use gasoline, liters in this case refer to liters of gasoline.

Based on the final database, the weighted average fuel consumption of motorcycles and mopeds for 2019–2021 is calculated using the following equation.

$$FC = \frac{\sum_i^n Reg_i \times FC_i}{\sum_i^n Reg_i}$$

Where:

FC is the weighted average fuel consumption;

Reg_i is the number of newly sales vehicles of type i; and

FC_i is the fuel consumption of a vehicle of type i.

Weighted average fuel consumption is analyzed based on vehicle type (motorcycles and mopeds), engine displacement, vehicle weight, and engine power. In the case of electric two-wheelers, the sales number is input into the equation and fuel consumption is assigned a value of zero to those sales.

FUEL CONSUMPTION TRENDS FOR TWO-WHEELERS, 2019–2021

This section describes the FC trends of the two-wheeler fleet in Vietnam, focusing on 3 years: 2019, 2020, and 2021. Fuel consumption data from previous years were not available from the consulted sources. The analysis used data from MotorCycles Data, which includes electric two-wheeler companies and the five ICE two-wheeler companies that are VAMM members.

A more detailed analysis is provided for 2021, as this will be the baseline year for developing FC standards for two-wheelers. This analysis uses data from MotorCycles Data and VR to cover a wider range of ICE two-wheeler companies, including VAMM members and nonmembers.

The trends in FC of two-wheeler fleets by vehicle type and by engine displacement, vehicle weight, engine power, fuel supply system, and transmission technology are analyzed here for 2019, 2020, and 2021. Because the inclusion of EV sales in the calculation of a company-average FC is a recommended best practice, our 2021 baseline analysis presents company fleet averages with and without EV sales. This baseline analysis shows those values, noted as:

(1) Fleet average FC (Fleet AVG): The fleet average FC including electric two-wheelers.

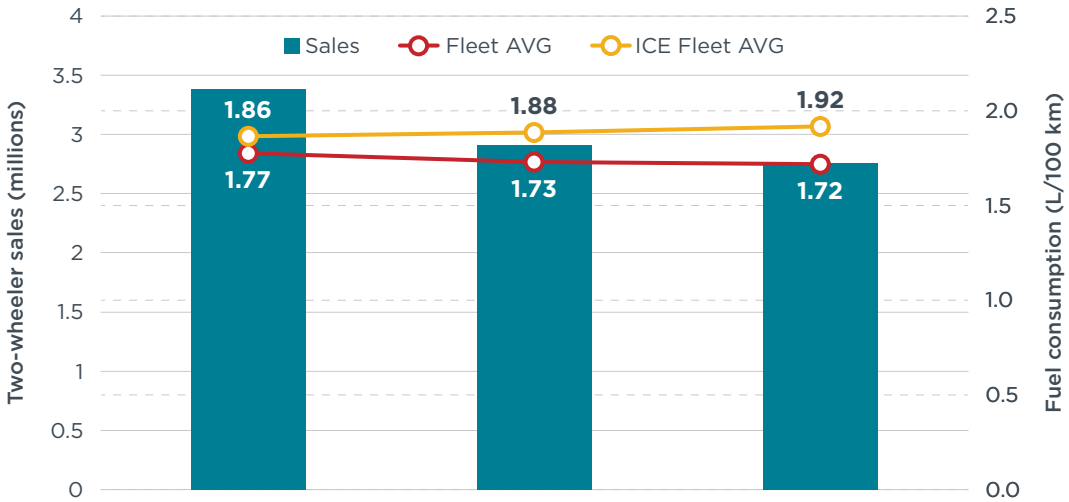
(2) ICE-only average FC (ICE Fleet AVG): The fleet average FC excluding electric two-wheelers.

FUEL CONSUMPTION TRENDS FOR THE TWO-WHEELER FLEET BY SALES

Figure 44 presents the average FC of the two-wheeler fleet each year, including and excluding electric two-wheelers. As would be expected, the average FC of the fleet when electric two-wheelers are included in the calculation is lower than the average when only ICE vehicles are considered. In 2021, the average FC of the fleet including electric two-wheelers was 10.4% lower than the average FC of the ICE two-wheeler fleet. The average FC of gasoline two-wheelers has increased from 1.86 L/100 km in 2019 to 1.88 L/100 km in 2020, and to 1.92 L/100 km in 2021. The average FC of the total fleet, including electric two-wheelers, decreased 2.3%, from 1.77 L/100 km in 2019 to 1.72 L/100 km in 2021.

Figure 44

Two-wheeler sales and sales-weighted fleet average fuel consumption

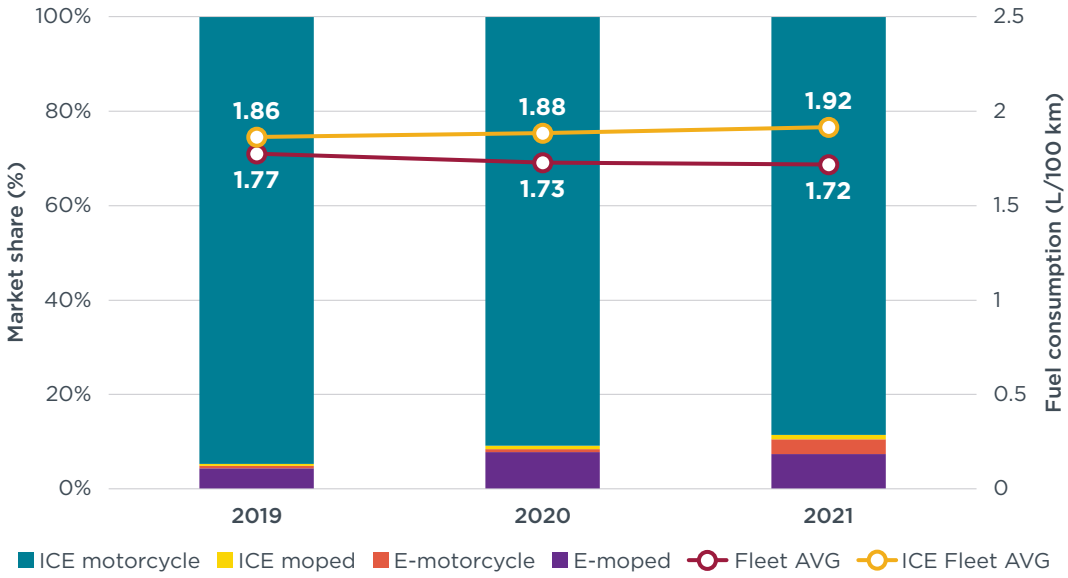


IMPACT OF ELECTRIC TWO-WHEELERS ON FLEET-AVERAGE FUEL CONSUMPTION TRENDS

Figure 45 presents the 2019–2021 sales-weighted fleet average FC of two-wheelers, including and excluding electric two-wheelers. As shown, the increase in electric two-wheeler market share from 4.8% in 2019 to 10.4% in 2021 contributed to the reduction in the sales weighted average FC of the two-wheeler fleet in Vietnam. In 2021, the fleet-average FC was 1.72 L/100 km, which is 10.4% lower than the fleet-average FC of 1.92 L/100 km when only ICE two-wheelers are considered.

Figure 45

Two-wheeler market share by vehicle type and sales-weighted fleet average fuel consumption



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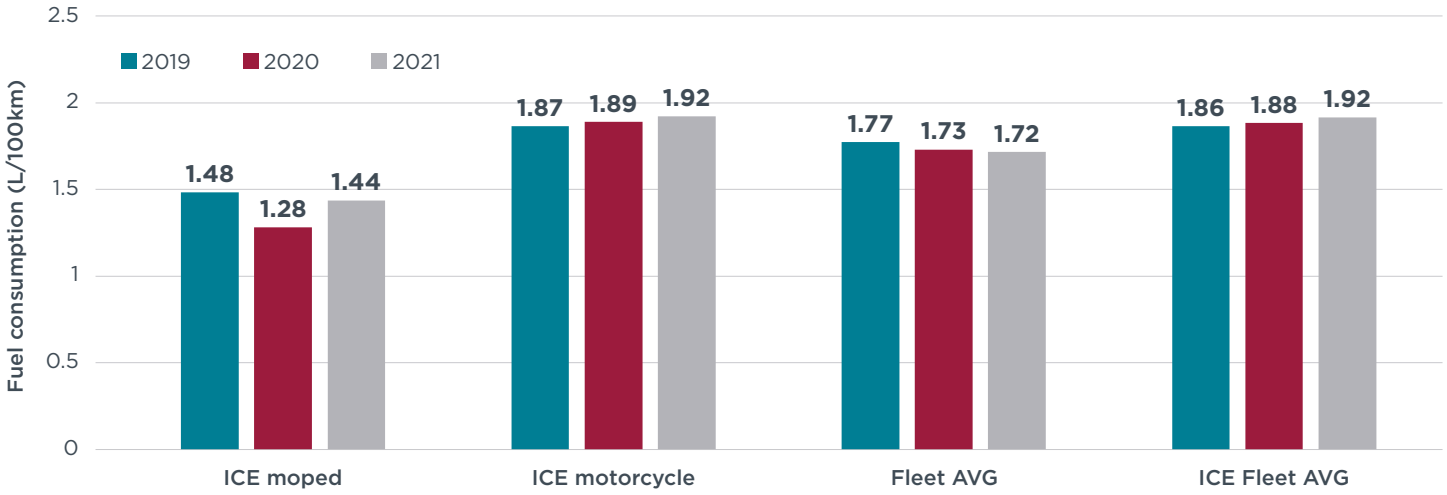
FUEL CONSUMPTION TRENDS BY ICE VEHICLE TYPE

Figure 46 shows the average FC of the two-wheeler fleet by vehicle type for 2019–2021. As shown, ICE motorcycles had a higher average FC than ICE mopeds. In 2021, the average FC of ICE motorcycles was 1.92 L/100 km, 33.3% higher than average FC of 1.44 L/100 km for ICE mopeds. The market share of ICE mopeds was small; thus, the average FC of ICE motorcycles from 2019 to 2021 was similar to the average FC of the entire ICE two-wheeler fleet.

Figure 46

Sales-weighted fleet average fuel consumption by vehicle type



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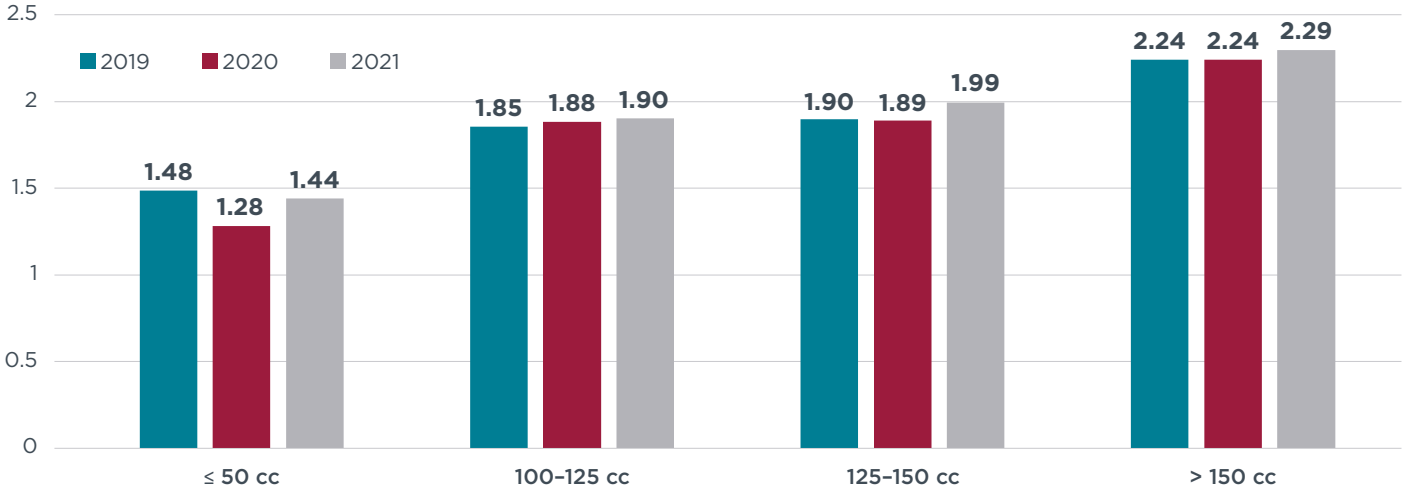
FUEL CONSUMPTION TRENDS BY ENGINE DISPLACEMENT, VEHICLE WEIGHT, ENGINE POWER, AND FUEL INJECTION TECHNOLOGY

The average FC of the two-wheeler fleet by engine displacement is presented in Figure 45. The data shows that the higher the engine displacement, the higher the average FC level. Two-wheelers with engine displacement greater than 150 cc had the highest average FC among the groups, at 2.29 L/100 km in 2021, which is 59% higher than the average FC of mopeds with engine displacement of less than 50 cc (1.44 L/100 km in 2021). Two-wheelers with engine displacement of 100–125 cc dominated the two-wheeler fleet over the study period, with the average FC of this group increasing from 1.85 L/100 km in 2019, to 1.88 L/100 km in 2020, and to 1.90 L/100 km in 2021. The average FC of two-wheelers with engine displacement of 125–150 cc in 2021 (1.99 L/100 km) was 4.7% higher than in 2019 (1.90 L/100 km).

Figure 47

Weighted fleet-average fuel consumption by engine displacement



Note: Vehicles with engine displacement less than 50 cc are mopeds

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Table 7 displays the average FC by vehicle type and engine displacement from 2019 to 2021, excluding electric two-wheelers. The average FC of ICE mopeds was significantly lower than the average FC of ICE motorcycles. The average FC of ICE motorcycles varied by engine displacement and year; ICE motorcycles with an engine displacement of 100–125 cc showed the largest change in average FC, decreasing from 1.97 L/100 km in 2019 to 1.82 L/100 km in 2021. The average FC of motorcycles with engine displacement of 125–150 cc increased 7.3% over the 3 years, from 1.79 L/100 km in 2019 to 1.92 L/100 km in 2021.

Table 7

Average fuel consumption (L/100 km) by vehicle type and engine displacement, excluding electric two-wheelers

Engine displacement	2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021
	≤ 50cc			100–125 cc			125–150 cc			> 150 cc		
ICE mopeds	1.48	1.28	1.42									
ICE motorcycles				1.97	1.84	1.82	1.79	1.81	1.92	2.24	2.24	2.24

Figure 46 shows the average FC by vehicle weight class, including electric two-wheelers. Vehicles with weights greater than 125 kg had the highest average FC in 2019, at 1.98 L/100 km. However, the average FC of this vehicle group was significantly less in 2020 and 2021, mainly because of the increased market penetration of e-motorcycles in these years. In 2019 and 2021, vehicles weighing less than 100 kg had the lowest average FC compared to other groups, at 1.67 L/100 km in 2019 and 1.66 L/100 km in 2021. The average FC of vehicles with weights of 100–125 kg decreased 5.3% from 1.89 L/100 km in 2019 to 1.79 L/100 km in 2021.

Figure 48

Weighted fleet-average fuel consumption by vehicle weight, including electric two-wheelers

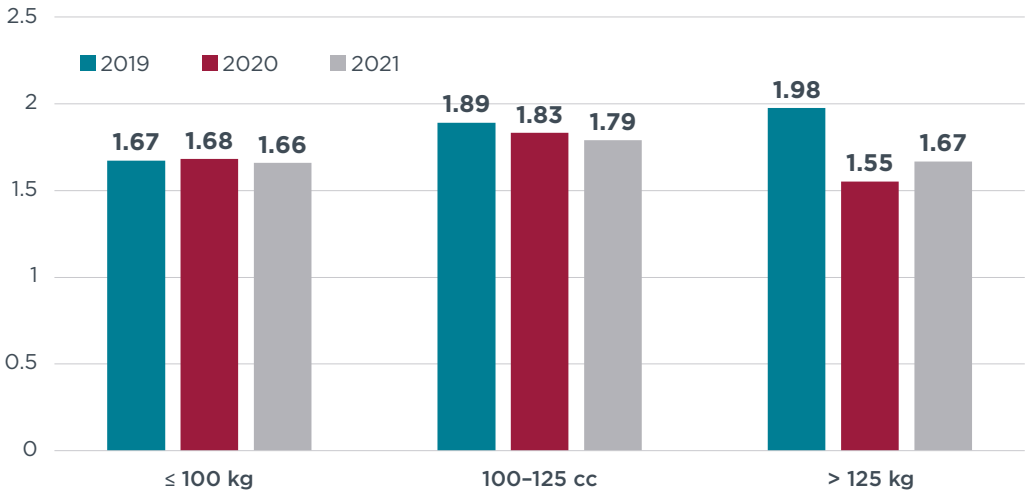

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Figure 47 shows the weighted fleet-average FC by vehicle weight, not including electric two-wheelers. The average FC values of the vehicle groups weighing less than 100 kg and higher than 125 kg are significantly higher than the same vehicles groups with electric two-wheelers, as shown in Figure 46.

Figure 49

Weighted fleet-average fuel consumption by vehicle weight, excluding electric two-wheelers

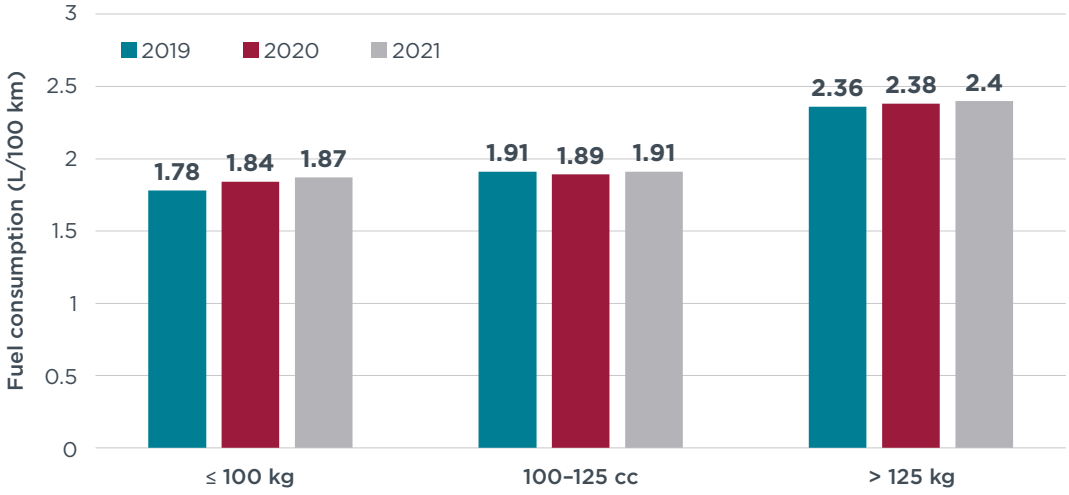

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Table 8 shows the average FC of ICE two-wheelers by vehicle type and vehicle weight. As shown, the heavier a vehicle is, the higher its fuel consumption level. All ICE mopeds weighed less than 100 kg, and this vehicle group experienced the largest changes in average FC. In 2019 the average FC of ICE mopeds was 1.48 L/100 km, declining to 1.28 L/100 km in 2020, but then increased to 1.42 L/100 km in 2021. The average FC of motorcycles weighing less than 100 kg has increased over the 3 years, from 1.78 L/100 km in 2019, to 1.84 L/100 km in 2020, and to 1.88 L/100 km in 2021 (increased by 5.6% compared to 2019). The average FC of motorcycles weighing between 100 and 125 kg changed slightly over the 3 years, staying about 1.9 L/100 km.

Table 8

Average fuel consumption (L/100 km) by vehicle type and weight, excluding electric two-wheelers

	2019	2020	2021	2019	2020	2021	2019	2020	2021
Weight class	**< 100 kg**			**100–125 kg**			**> 125 kg**		
ICE moped	1.48	1.28	1.42						
ICE motorcycle	1.78	1.84	1.88	1.91	1.89	1.90	2.36	2.38	2.36

Figure 48 presents the two-wheeler fleet-average FC by engine power, including electric two-wheelers. In 2019 and 2020, vehicles with an engine power of 8–10 kW had a higher average FC than vehicles with engine power greater than 10 kW. Vehicle with engine power of less than 4 kW had the lowest average FC, at 0.12 L/100 km in 2021, mainly because of the high share of electric two-wheelers in this vehicle group. The average FC of vehicles with engine power of 6–8 kW increased from 1.78 L/100 km in 2019 to 1.87 L/100 km in 2021.

Figure 50

Weighted fleet-average fuel consumption by engine power, including electric two-wheelers

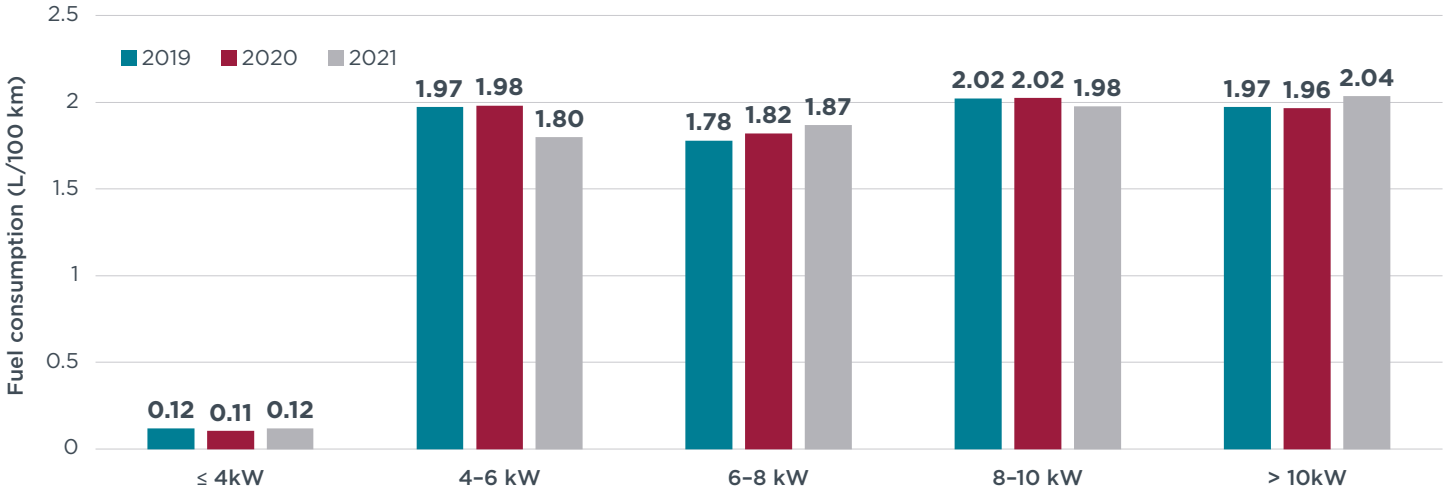

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Figure 49 shows the weighted fleet-average FC by engine power, excluding electric two-wheelers. All electric two-wheelers have engine power less than 4 kW, so excluding electric two-wheelers for vehicles with engine power below 4 kW results in a significantly higher FC. The average FC of other groups remains unchanged with or without electric two-wheelers because these groups do not have electric two-wheelers.

Figure 51

Weighted fleet average fuel consumption by engine power, excluding electric two-wheelers

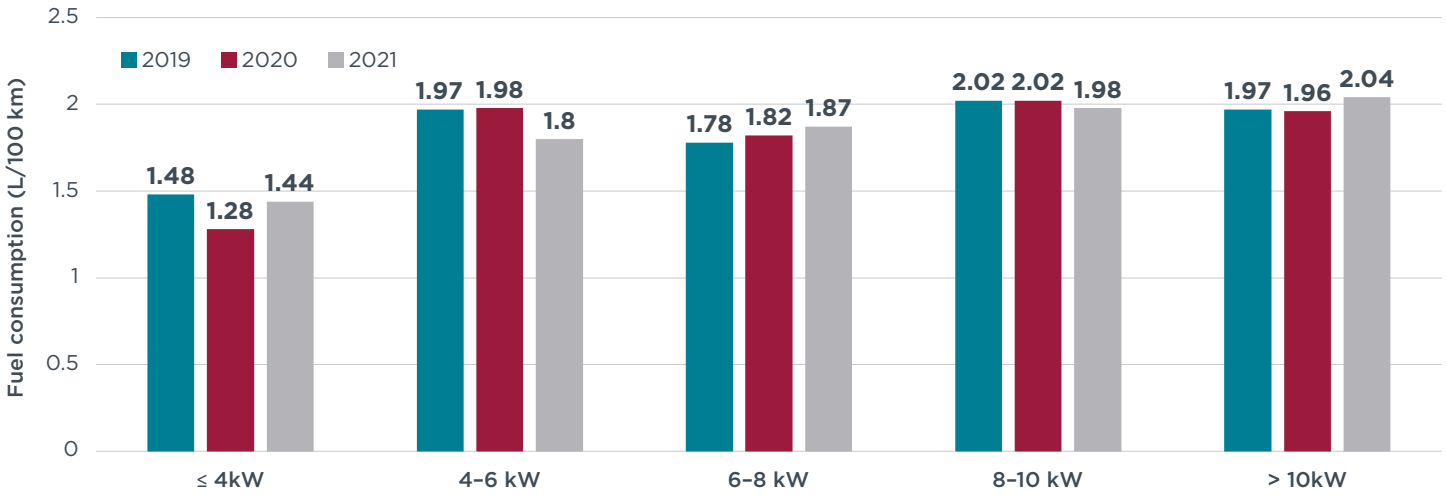

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Table 9 shows the average FC of two-wheelers by vehicle type and engine power, excluding electric two-wheelers. Motorcycles with engine power of 4–6 kW experienced the largest reduction in average FC over the 3 years, decreasing 8.6% from 1.97 L/100 km in 2019 to 1.8 L/100 km in 2021. The average FC of motorcycles with engine power of 6–8 kW shows the opposite trend, increasing 4.5%, from 1.78 L/100 km in 2019 to 1.86 L/100 km in 2021.

Table 9

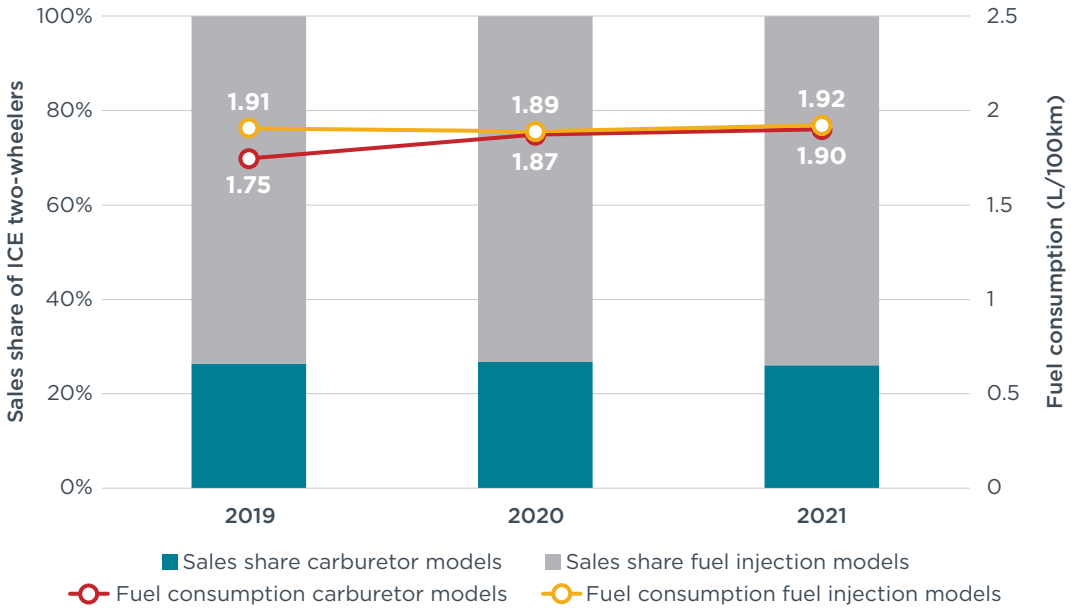
Average fuel consumption (L/100 km) by vehicle type and engine power, excluding electric two-wheelers

	2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021
Engine power	≤ 4 kW			4–6 kW			6–8 kW			8–10 kW			> 10 kW		
ICE moped	1.48	1.28	1.42												
ICE motorcycle				1.97	1.98	1.80	1.78	1.82	1.86	2.02	2.02	1.97	1.97	1.96	2.02

Although fuel injection technology is typically more efficient, the average FC for two-wheelers with fuel injection remains higher than for two-wheelers with carburetor technology. This is because carburetors are typically equipped in vehicles with lower engine displacement. Figure 50 shows that from 2019 to 2021, the FC of vehicles with carburetors increased from 1.75 L/100 km to 1.9 L/100 km. In contrast, the FC of vehicles with fuel injection technology changed slightly from 1.89 L/100 km in 2019 to 1.90 L/100 km in 2021.

Figure 52

Fuel consumption of ICE two-wheelers by fuel delivery technology



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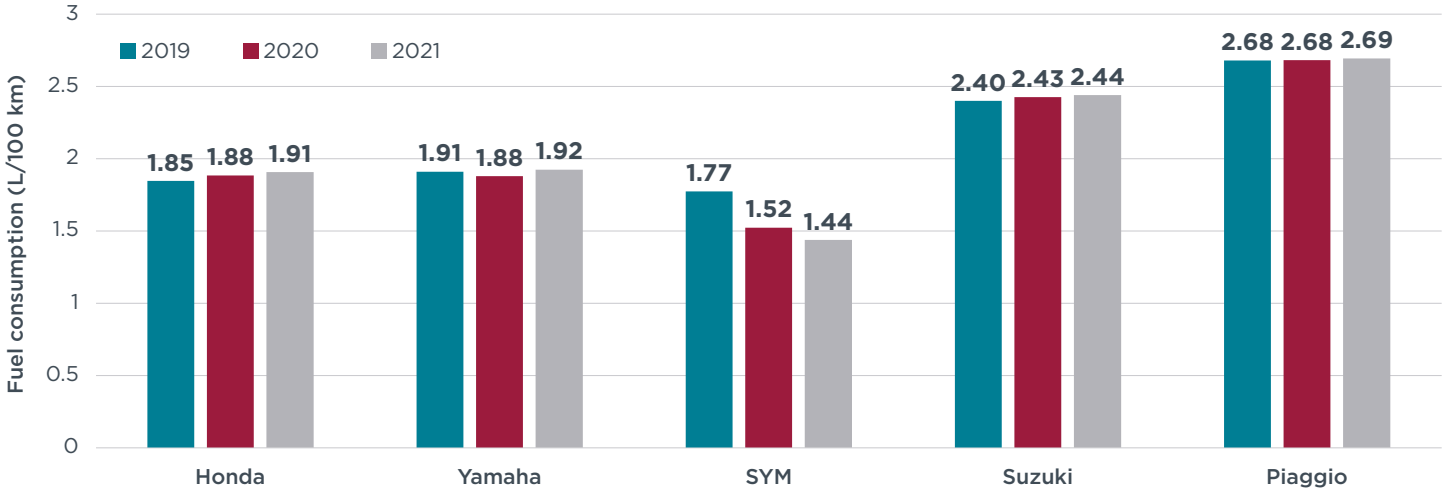
FUEL CONSUMPTION TRENDS BY COMPANY

Figure 51 shows the sales-weighted average FC of the two-wheeler fleet of companies that offer only gasoline two-wheelers. Piaggio's two-wheeler fleet had the highest average FC in all 3 years. In 2021, the average FC of Piaggio's two-wheeler fleet was 2.69 L/100 km, 56.4% higher than the two-wheeler fleet-average FC including electric two-wheelers (1.72 L/100 km). Suzuki's fleet had the second-highest FC, with 2.44 L/100 km in 2021, 41.8% higher than the two-wheeler fleet-average FC including electric two-wheelers.

Figure 53

Weighted fleet-average fuel consumption by companies selling only gasoline two-wheelers



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The average FC of different two-wheeler types by company over 3 years is presented in Table 10. The average FC of Piaggio's fleet was the highest among the five companies, followed by Suzuki. The average FC of Honda's fleet (1.91 L/100 km) and Yamaha's fleet (1.92 L/100 km) were similar.

Table 10

Average fuel consumption of ICE two-wheelers types by company

	2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021	2019	2020	2021
Company	**SYM**			**Honda**			**Yamaha**			**Piaggio**			**Suzuki**		
ICE moped	1.89	1.28	1.42												
ICE motorcycle				1.85	1.88	1.91	1.91	1.88	1.92	2.68	2.68	2.69	2.40	2.43	2.44

FUEL CONSUMPTION ANALYSIS FOR TWO-WHEELERS IN 2021

This section provides a detailed analysis of fleet-average FC in 2021 by vehicle type, engine displacement, engine power, vehicle weight, and company. The database used for the analysis in this section combines two sources, MotorCycles Data and VR, to cover a broarder range of two-wheeler companies (including smaller companies) to reflect a comprehensive picture of the two-wheeler market in the country for 2021. Thus, the analyzed results for 2021 are slightly different compared to the previous section.

AVERAGE FUEL CONSUMPTION OF THE 2021 TWO-WHEELER FLEET AS A FUNCTION OF ENGINE DISPLACEMENT, VEHICLE WEIGHT, AND ENGINE POWER

Table 11 summarizes the average values of key parameters for the two-wheeler fleet in 2021. Overall, the average FC of the fleet including electric two-wheelers was 9% lower than the average FC excluding electric two-wheelers. The average weight of the fleet including electric two-wheelers was similar to the fleet excluding electric two-wheelers. The average engine power of the two-wheeler fleet including electric two-wheelers was also lower than the two-wheeler fleet excluding electric two-wheelers because the majority of electric two-wheelers had engine power of less than 4 kW.

Table 11

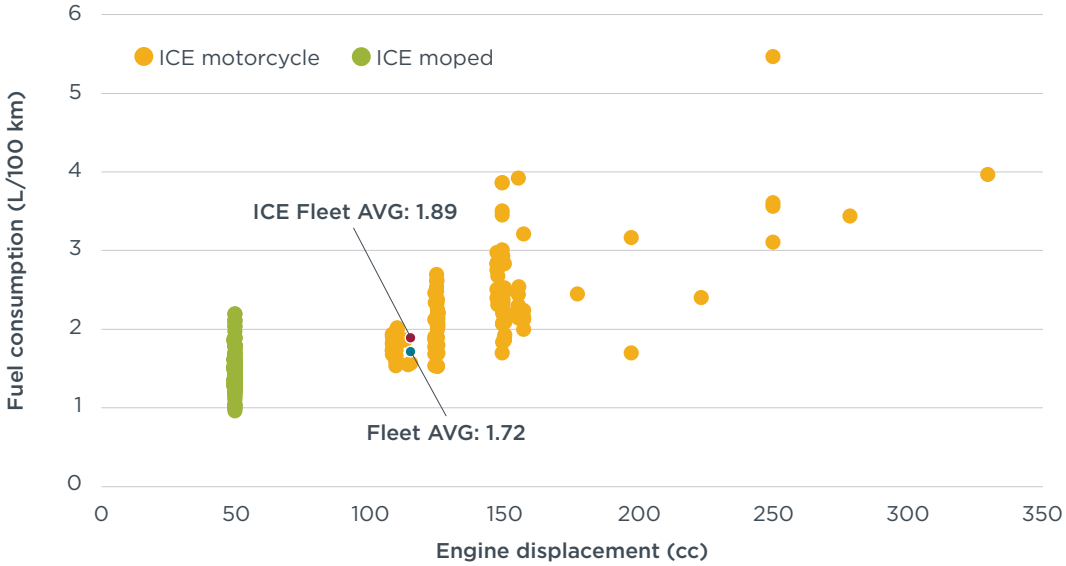
Average values for key parameters of the two-wheeler fleet in 2021

	Market share	Fuel consumption (L/100 km)	Vehicle weight (kg)	Engine displacement (cc)	Engine power (kW)
ICE two-wheeler fleet	89.5%	1.89	105.2	115	7.4
ICE and electric two-wheeler fleet	100%	1.72	105		6.8

Figure 54**,** Figure 55**,** and Figure 56 describe the average FC of the 2021 two-wheeler fleet plotted as a function of engine displacement, vehicle weight, and engine power. The FC values tend to group around engine displacement values common across companies. Most models offered in 2021 had engine displacements of 50 cc, 125 cc, and 150 cc, as reflected here. FC tends to increase proportionally to engine displacement or size. Many models had the same engine displacement, but the FC varied greatly. For example, many models had a smaller engine displacement of around 50 cc, but the FC of these models ranged from less than 1 L/100 km to more than 2 L/100 km, showing opportunities for FC improvement. The FC values as a function of vehicle weight tend to show a more linear distribution as higher weights tend to require additional energy per kilometer traveled to accelerate the mass of the vehicle. FC is also proportional to the power rating, showing greater distribution than for engine size but less than for vehicle weight. In all three figures, the models with the bigger engine, mass, and power present a higher FC value. However, the opposite does not apply to the model with the lowest power.

Figure 54

Average fuel consumption of the 2021 two-wheeler fleet as a function of engine displacement



Note: Each dot represents a single two-wheeler model

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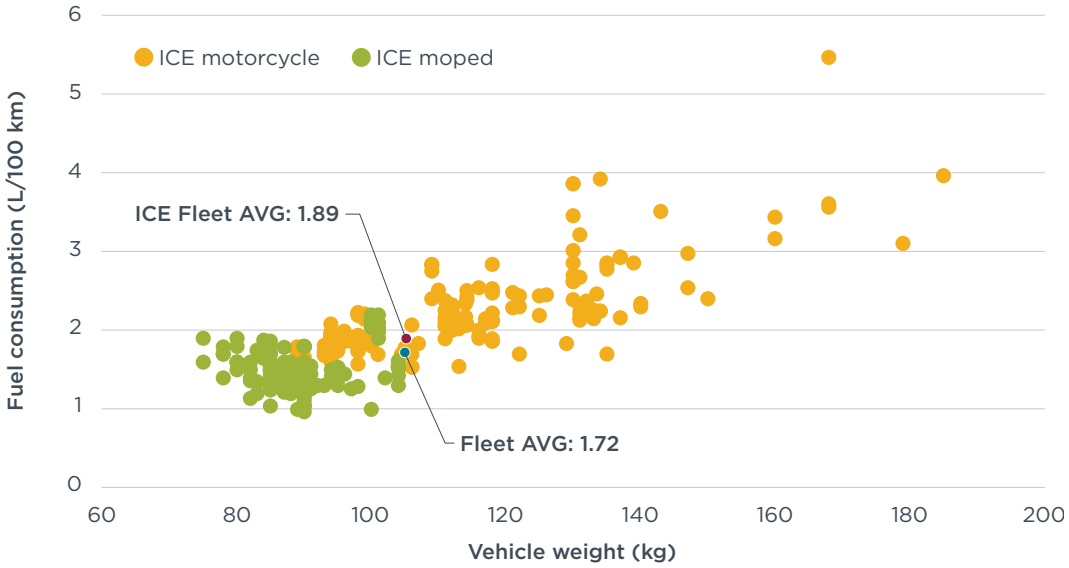
Figure 55

Average fuel consumption of the 2021 two-wheeler fleet as a function of vehicle weight



Note: Each dot represents a single two-wheeler model

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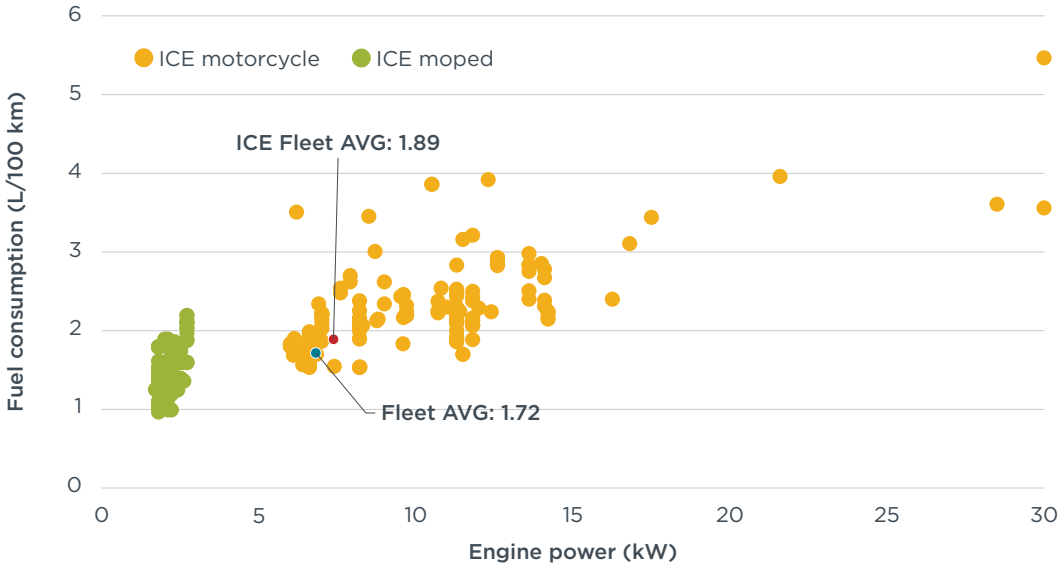
Figure 56

Average fuel consumption of the 2021 two-wheeler fleet as a function of engine power



Note: Each dot represents a single two-wheeler model

AVERAGE FUEL CONSUMPTION OF VEHICLE TYPES AS A FUNCTION OF ENGINE DISPLACEMENT, VEHICLE WEIGHT, AND ENGINE POWER

Average values of key parameters for two-wheeler types are shown in Table 12. ICE mopeds had a significantly smaller market share compared to ICE motorcycles. The average FC, vehicle weight, engine displacement, and engine power of ICE mopeds were also substantially lower than ICE motorcycles. The average FC of ICE mopeds in 2021 was 1.44 L/100 km, 25.8% lower than the average FC of ICE motorcycles of 1.94 L/100 km.

Table 12

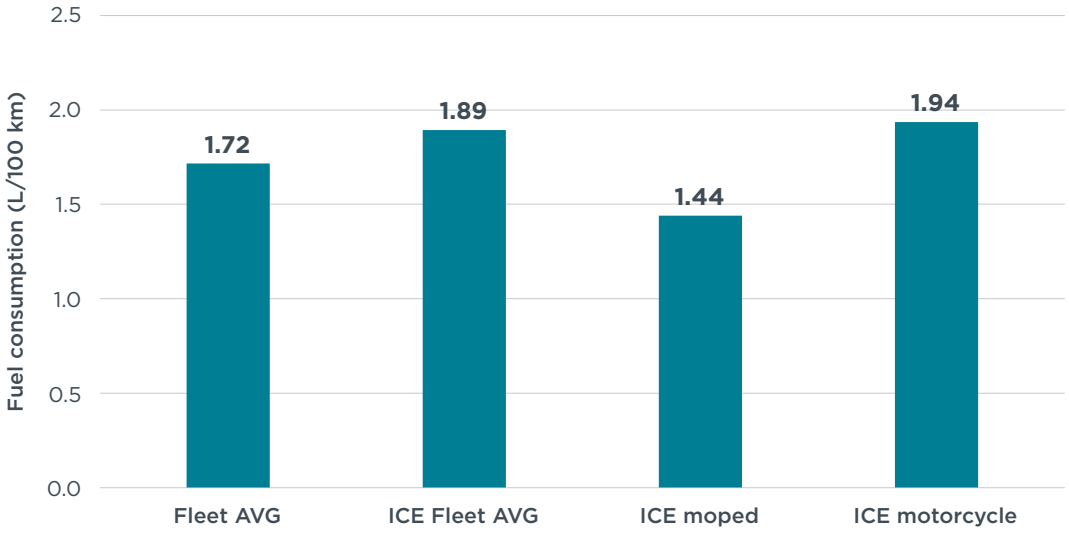
Average values for key parameters of two-wheelers by vehicle type, 2021

Vehicle type	Market share	Fuel consumption (L/100 km)	Vehicle weight (kg)	Engine displacement (cc)	Engine power (kW)
ICE moped	6.5%	1.44	49.5	49.1	2.1
ICE motorcycle	83.0%	1.94	106.3	106.7	7.9

Figure 55 shows the average FC of mopeds and motorcycles compared with the average FC of the fleet. ICE mopeds had lower FC (1.44 L/100km) compared with the fleet-average FC that includes electric two-wheelers, (1.72 L/100 km). The average FC of ICE motorcycles was 12.8% higher than the fleet-average fleet FC that includes electric two-wheelers.

Figure 57

Average fuel consumption of two-wheelers by vehicle type in 2021



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AVERAGE FUEL CONSUMPTION OF MAJOR TWO-WHEELER COMPANIES AS A FUNCTION OF ENGINE DISPLACEMENT, VEHICLE WEIGHT, AND ENGINE POWER

Table 13 summarizes the average values for key parameters of the fleets of 22 major ICE two-wheeler companies in 2021. These companies offered only gasoline two-wheelers. Piaggio had only 0.69% of the market share in 2021, but Piaggio's fleet had the highest average FC (2.69 L/100 km), vehicle weight (132.4 kg), and engine displacement (149.5 cc). Sumotor, a domestic company, had the lowest average FC compared with other companies at only 1.22 L/100 km. Suzuki's fleet had the highest average engine power (13.4 kW) among the companies, following by GPX Vietnam with a fleet-average engine power of 11.15 kW. Honda and Yamaha, the two biggest players in Vietnam's two-wheeler market, had a relatively similar fleet-average FC, at 1.9L/100 km and 1.92 L/100 km, respectively. The average engine power of Honda's and Yamaha's fleet were similar, but the average weight of Honda's fleet (106.8 kg) was slightly heavier than Yamaha's fleet (102.2 kg), and the average engine displacement of Honda's fleet (119 cc) was lower than Yamahas' fleet (122.5 cc).

Table 13

Average values for key parameters of ICE two-wheelers by company in 2021

Company	Market share			Fuel consumption (L/100 km)	Engine displacement (cc)	Engine power (kW)	Vehicle weight (kg)
	Fleet	ICE moped	ICE motorcycle				
Honda	65.59%	0%	65.59%	1.90	119.0	7.67	106.8
Yamaha	12.46%	0%	12.46%	1.92	122.5	7.70	102.2
Detech	2.48%	2.48%	0%	1.37	49.5	2.20	88.4
GPX Vietnam	2.07%	0%	2.07%	2.46	149.8	11.15	121.8
Honlei Duc Ha	1.07%	1.07%	0%	1.59	49.5	2.14	83.1
SYM	0.84%	0.84%	0%	1.44	49.1	2.06	95.4
Victoria	0.72%	0.72%	0%	1.50	49.5	2.20	87.5
Piaggio	0.69%	0%	0.69%	2.69	149.5	9.65	132.4
Nam Anh	0.66%	0.66%	0.00%	1.48	49.5	2.10	86.1
Suzuki	0.64%	0%	0.64%	2.44	146.3	13.42	109.4
Ly Nghia	0.58%	0%	0.58%	2.20	136.6	9.74	111.1
Hung Thinh Vuong	0.44%	0%	0.44%	2.17	128.7	9.00	108.9
Savina	0.35%	0%	0.35%	1.93	124.2	8.50	106.3
Sumotor	0.34%	0.34%	0%	1.22	49.5	2.10	87.3
Lifan	0.26%	0.26%	0%	1.27	49.5	1.85	87.5
Dong Minh	0.25%	0.25%	0%	1.48	49.5	2.16	84.6
Kwang Yang	0.25%	0.25%	0%	1.36	49.4	2.28	99.8
DK Viet Nhat	0.24%	0.24%	0%	1.52	49.4	2.26	87.8
Phuong Dong	0.21%	0.21%	0%	1.80	49.5	1.80	88.3
Tran Phuong	0.20%	0%	0.20%	2.08	128.7	9.00	104.1
Saki Vietnam	0.18%	0.18%	0%	1.28	49.5	2.03	86.3
Motor Thai	0.15%	0.15%	0%	1.45	49.5	2.00	86.8

Table 14 summarizes average key parameters for the two-wheeler fleet by company type. Vehicle fleets from import companies had the lowest market share but the highest average FC, engine displacement, engine power, and vehicle weight. The average FC of the two-wheeler fleet from importing companies was 2.35 L/100 km, which is 36.6% higher than the fleet-average FC for all two-wheelers of 1.72 L/100 km. Domestic production/assembly companies had the lowest average FC, engine displacement, engine power, and vehicle weight of the two-wheeler fleet.

Table 14

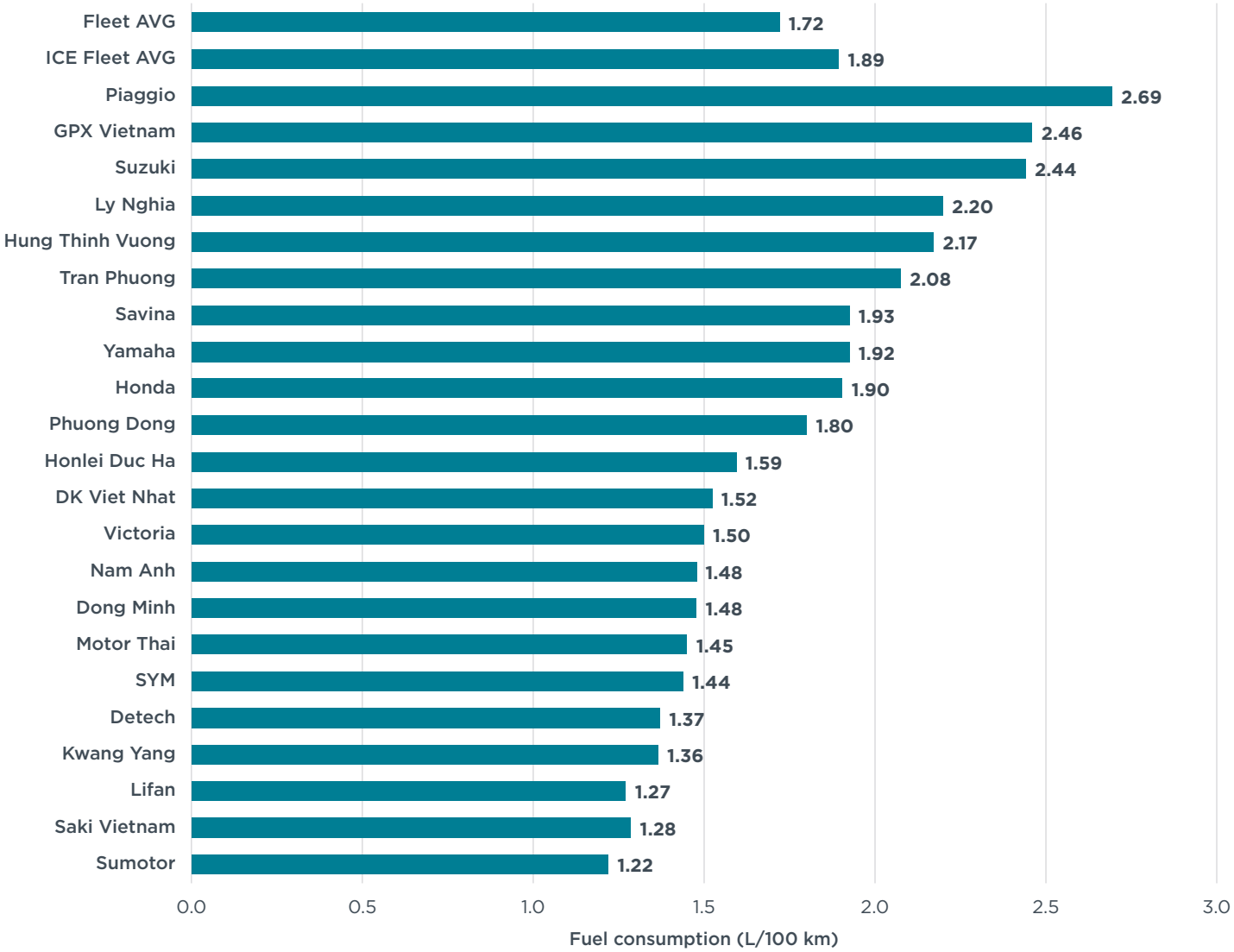
Average key parameters for the two-wheeler fleet by company type

Company type	Market share	Fuel consumption (L/100 km)	Engine displacement (cc)	Engine power (kW)	Vehicle weight (kg)
Producer/assembler and importer (ICE motorcycles)	79.7%	1.92	120.1	7.7	106.3
Domestic producer/assembler (ICE mopeds)	7.6%	1.43	49.5	2.1	88.3
Importer (ICE motorcycles)	3.3%	2.35	143.4	10.5	117.1
Electric two-wheeler producer/assembler	9.4%	—	—	1.9	128.4

Figure 58 displays the average FC of two-wheeler fleet by company. The fleet FC varied greatly across companies, ranging from 1.22 L/100 km to 2.69 L/100 km. Piaggio, GPX Vietnam, and Suzuki had the highest average fleet FC, which is significantly higher than the fleet-average FC (including electric two-wheelers). Sumotor, Lifan, and Saki Vietnam had the lowest average fleet FC, with fleet-average FC of 1.22 L/100 km, 1.27L/100 km, and 1.28 L/100 km, respectively.

Figure 58

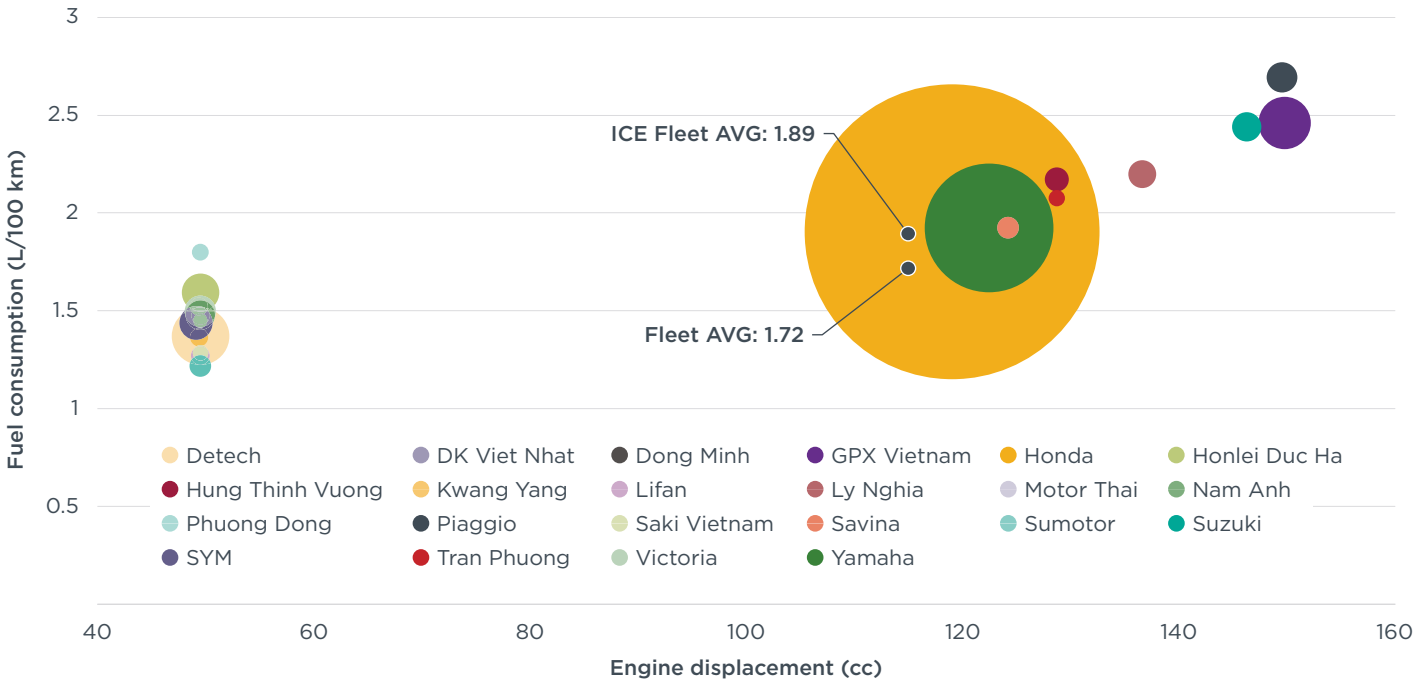
Average fuel consumption of the two-wheeler fleet by company in 2021



The average FC of two-wheelers sold by 22 companies are compared in Figure 57, Figure 58, and Figure 59. Piaggio's fleet had the highest average vehicle weight, engine displacement, and highest average FC at 2.69 L/100 km. This was followed by GPX Vietnam, which had a fleet-average FC of 2.46 L/100 km. Suzuki's fleet had the largest average engine power. The majority of domestic two-wheeler companies had vehicles with engine sizes below 50 cc and fleet-average FCs of less than 1.5 L/100 km because these companies offered only ICE mopeds. The average FC of Honda's and Yamaha's fleets were similar, at 1.90 L/100 km and 1.92 L/100 km, respectively.

Figure 59

Average fuel consumption as a function of engine displacement of major two-wheeler companies in 2021



Note: Bubble sizes represent the sales volume in 2021 of companies that only offer ICE two-wheelers.

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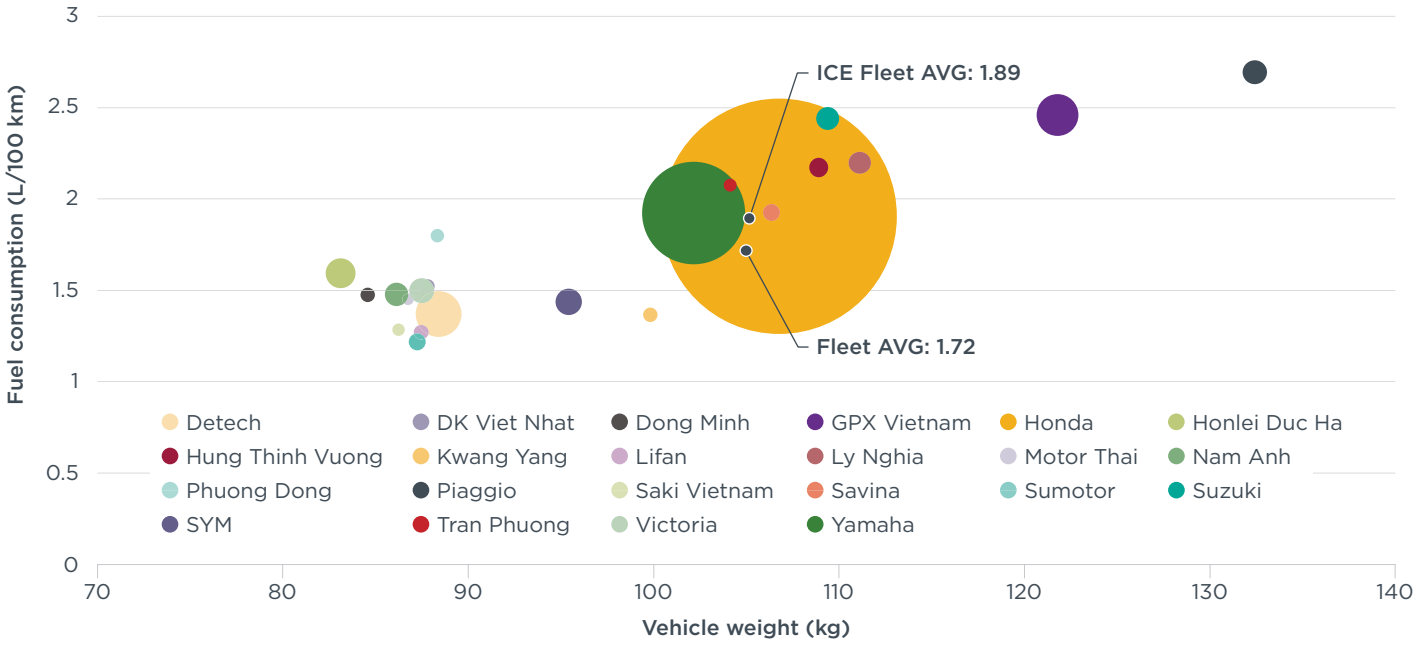
Figure 60

Average fuel consumption as a function of vehicle weight of major two-wheeler companies in 2021



*Note:*Bubble sizes represent the sales volume in 2021 of companies that only offer ICE two-wheelers.

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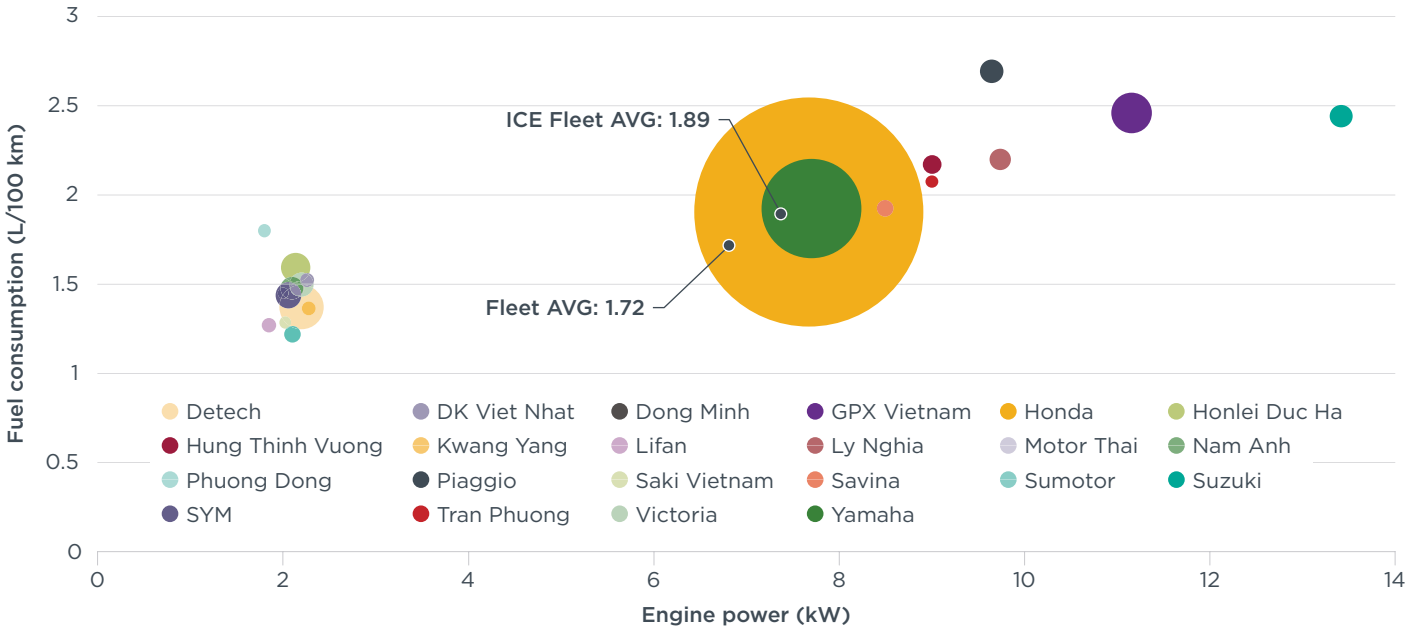
Figure 61

Average fuel consumption as a function of engine power of major two-wheeler companies in 2021



*Note:*Bubble sizes represent the sales volume in 2021 of companies that only offer ICE two-wheelers.

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COMPARISON OF FUEL CONSUMPTION BASELINE OF VIETNAM WITH FUEL CONSUMPTION STANDARDS IN CHINA

Table 15 compares the Vietnam FC baseline of two-wheelers in 2021 with FC standards in China. Fuel consumption standards have been in effect in China since 2018 (Yang, 2017). In general, the average FC of two-wheelers classified by engine displacement group in Vietnam is 8.3% to 23.5% lower than the standards in China. Regarding mopeds (vehicles with engine displacement smaller than 50 cc), the average FC in Vietnam is 1.44 L/100 km, while the FC standard for this vehicle type is 1.8 L/100 km in China. For vehicles with engine displacement of 125–150 cc, the FC value of Vietnam is 1.99 L/100 km, which is already 23.5% lower than China's FC target. The FC values of the vehicle types beyond 300 cc are not available for comparison.

Table 15

Comparison of Vietnam baseline with fuel consumption standards in Mainland China and Taiwan province

	China standard (from 2018)		Vietnam baseline 2021	
	Sales weighted average FC limits (L/100 km)		Sales weighted average FC (L/ 100 km)	
	Manual	Automatic	Compared with China standard	
≤ 50 (moped)	1.8	1.8	1.44	-20.0%
> 50–100	2	2.1	—	—
≥ 100–125	2.3	2.5	1.9	-20.8%
≥ 125–150	2.5	2.7	1.99	-23.5%
≥ 150–200	2.8	3	2.44	-15.9%
≥ 200–250	3.6	3.9	—	—
≥ 250–300	3.6	3.9	3.44	-8.3%
≥ 300–400	4.3	4.6	—	—
≥ 400–500	4.8	5.1	—	—
≥ 500–650	5.3	5.6	—	—
≥ 650–750	5.6	5.9	—	—
≥ 750–800			—	—
≥ 800–1000	5.8	6.1	—	—
≥ 1,000–1,250	6	6.3	—	—
≥ 1,250–1,500	6.3	6.6	—	—
≥ 1,500	6.5	6.8	—	—

Note: The far-right column compares a) the sales-weighted average FC limits for vehicles with both automatic and manual transmissions under the 2018 China standard, with b) the sales-weighted average FC baseline in 2021 for two-wheelers in Vietnam.

CONCLUSION

This study collected and analyzed the fuel consumption and characteristics of motorcycles and mopeds sold in Vietnam over a 5-year period, from 2017 to 2021. The results of this analysis provide important inputs for developing fuel consumption standards of motorcycles and mopeds in Vietnam. Our findings are presented below.

Overview of the two-wheeler market

- Sales of two-wheelers reached a peak in 2018 with more than 3.5 million vehicles but started decreasing 2019. In 2021, two-wheeler sales in Vietnam dropped to 2.89 million, a reduction of 17.4% compared with 2017 and the lowest level in 15 years.
- More than 250 two-wheeler models from more than 60 brands are sold in Vietnam each year. However, the top-selling models account for more than 95% of Vietnam's two-wheeler market. Honda dominated the two-wheeler market in the country each year, with more than 65% of two-wheelers sold in the country. Yamaha was the second-highest seller of two-wheelers in Vietnam.
- ICE motorcycles dominated the two-wheeler fleet in the country during these 5 years, making up more than 80% of sales in each year studied.

Two-wheeler characteristics by vehicle type

- Motorcycles accounted for more than 85% of all two-wheeler sales for each year studied. Mopeds accounted for less than 15% of sales each year, but the market share grew over the 5 years, mainly from increasing e-moped sales.
- The majority of ICE mopeds sold weighed less than 100 kg, whereas 58.6% of e-motorcycles sold in 2019 and 59% sold in 2020 were heavier than 150 kg.
- All ICE mopeds had engine displacements below 50 cc. Motorcycles with engine displacement between 100 and 125 cc were the most common in two-wheeler fleet, accounting for more than 70% of the two-wheeler market each year.
- All ICE mopeds, e-mopeds, and e-motorcycles sold had engine power below 4 kW, while ICE motorcycles had a wide range of engine power.

ICE two-wheeler characteristics by manufacturer

- More than 50 manufacturers sold ICE two-wheelers in Vietnam in 2017–2021. Honda and Yamaha were the market leaders, selling 2.02 million and 0.38 million vehicles in 2021, respectively. The market share of these two companies was relatively constant over the study period.
- In 2019 and 2020, Piaggio offered only vehicles with engine displacement of 100–125 cc, while Suzuki offered only vehicles with engine displacements of 125–150 cc. The engine displacement of the Honda and Yamaha two-wheeler fleets ranged from 100 cc to 175 cc.
- Of the five major manufacturers that are members of the Vietnam Association of Motorcycle Manufacturers, Piaggio's two-wheelers were heavier, at an average of 132.4 kg, than two-wheelers from other companies; SYM's two-wheelers were the lightest at an average of 95.4 kg.
- In 2021, all 13 domestic production and assembly manufacturers only offered ICE mopeds. Four importing companies—GPX Vietnam, Ly Nghia, Hung Thinh Vuong, and Tran Phuong—only offered ICE motorcycles with engine displacements of 125–150 cc. Honda, Yamaha, and Suzuki offered vehicles with a wider range of engine sizes.

Electric two-wheeler fleet characteristics

- Nearly 700,000 electric two-wheelers were sold in Vietnam between 2019 and 2021. The majority of electric two-wheelers sold were e-mopeds. E-motorcycles accounted for a small market share in 2019 and 2020 but increased in 2021 to 30.6% of all electric two-wheelers.
- More than 12 companies sold electric two-wheelers in Vietnam in 2019–2021, but three domestic brands (Anbico, JVC, Pega, and VinFast) and five foreign brands (Dibao, Gogoro, Niu, Pega, and YADEA) produced the top-selling models. Over the 3 years, VinFast dominated the electric two-wheeler market in the country, with the highest market share in 2020 at 45.9%. Pega was the second-largest seller of electric two-wheelers in the country.
- More than 70% of the electric two-wheelers sold in 2019–2021 were equipped with lead-acid batteries, including all e-motorcycles. Lithium-ion batteries were only used in e-mopeds; 24.1% of e-mopeds were equipped with lithium-ion batteries in 2021.
- Electric two-wheelers with the highest market share had battery capacities of 1–1.2 kWh, and the majority of these had engine power of between 1 kW and 1.5 kW. In 2021, e-mopeds had an average battery capacity of 1.16 kW while e-motorcycles had an average capacity of 1.92 kW.

Average fuel consumption of the two-wheeler fleet

- The average fuel consumption for conventional ICE two-wheelers increased from 1.86 L/100 km in 2019, to 1.88 L/100 km in 2020, and 1.92 L/100 km in 2021. However, when electric two-wheelers are included in the FC calculation, the two-wheeler fleet's average FC decreased from 1.77 L/100 km in 2019, to 1.73 L/100 km in 2020, and 1.72 L/100 km in 2021. The average FC of the two-wheeler fleet, including electric two-wheelers in 2021, was 9% lower than the average FC of just the ICE two-wheeler fleet.
- ICE motorcycles had a higher average FC than ICE mopeds. In 2021, the average FC of ICE motorcycles was 1.94 L/100 km, 34.7% higher than the average ICE moped FC of 1.44 L/100 km. Two-wheelers with higher engine displacement had a higher average FC level. Heavier ICE motorcycles also had a higher average FC.
- In 2021, Piaggio's two-wheeler fleet had the highest average FC compared with other companies, followed by GPX Vietnam and Suzuki. These three companies also have the highest average fleet weight, engine displacement, and engine power. Sumotor, Lifan, and Saki Vietnam had the lowest average fleet FC.
- The FC baseline shows that two-wheelers in Vietnam are already meeting FC standards in China. The average FC of two-wheelers in Vietnam in the 2021 baseline is 8.3% to 23.5% lower than the limits in China's regulations. More ambitious standards would be required to incentivize future sales in Vietnam of two-wheelers with lower FC.

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APPENDIX

Table A1

Framework of collected data with sample entries

No.	Company	Model	Vehicle type	Fuel use (gasoline/ electric)	Transmission technology	Company type (importer/ domestic manufacturer and assembler)	Actual engine displacement (cc)	Engine displacement group (cc)
1	Honda	Vision 110	Motorcycle	Gasoline	CVT[a]	Domestic assembled	110	100–125
2	Honda	Wave 100	Motorcycle	Gasoline	Manual	Imported	97	50–100
3	SYM	Elegant	Moped	Gasoline	Manual	Imported	49	0–50

No.	Fuel supply system	Wet weight (kg)	Engine power (kW)	Number of gears	Fuel consumption (L/100 km)	Number of vehicle sales	Data source
1	Electronic fuel injection	102	6.6		1.88	498,170	MotorCycles Data, Honda website
2	Carburetor	97	6.1	4	1.90	396,940	MotorCycles Data, Honda website
3	Carburetor	90	4	3	1.2	10,000	MotorCycles Data, SYM website

[a] CVT is continuously variable transmission, a type of automatic transmission.
[b] The wet weight of an ICE vehicle is the vehicle weight plus the weight of liquids, such as gasoline, lubricant, coolant, and brake fluid. The wet weight of an electric vehicle is the vehicle weight plus the battery weight.

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