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Market analysis of the new two-wheeler fleet in India for fiscal year 2020–21

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Keywords: Two-wheelers, fleet characteristics, fuel consumption, star labeling

Introduction

Prior to the April 1, 2020 implementation of Bharat Stage (BS) VI vehicle emission standards in India, many two-wheeler manufacturers launched BS VI two-wheeler models in quick succession in the last quarter of fiscal year (FY) 2019–20.[1] However, the Supreme Court did allow limited and conditional sale and registration of not more than 10% of remaining BS IV stock after the deadline, to compensate for lost sales during the nationwide lockdown due to COVID-19.[2] This means that the new vehicle stock for FY 2020–21 includes those BS IV models along with the new BS VI two-wheeler models; the BS IV models had carburetors and the more fuel-economical fuel injection appears in the new BS VI models.

Based on a variety of sources containing details of new two-wheelers sold in India, including data from the Society of Indian Automobile Manufacturers (SIAM), this paper analyzes the fleet characteristics and compares the vehicle characteristics of major two-wheeler classes and manufacturers. This is an update of an earlier ICCT study of FY 2017–18[3] and compares the two-wheeler models sold in FY 2019–20 with those sold in FY 2020–21. Additionally, we use the database we compiled to estimate how two-wheeler manufacturers would perform if feasible fuel consumption standards were adopted.

1 The fiscal year for the Government of India runs from April 1 to March 31.

2 Government of India, Ministry of Road Transport and Highways, "Limited registration of BS-IV vehicles to be allowed as per Apex Court order dated 27.3.2020," April 1, 2020, https://pib.gov.in/PressReleseDetailm.aspx?PRID=1609869

3 The working paper prepared for FY 2017–18 used the declared fuel consumption values of FY 2018–19 by SIAM. Sunitha Anup, Zifei Yang, *New two-wheeler vehicle fleet in India for fiscal year 2017–18*, (ICCT: Washington, DC, 2020), https://theicct.org/publications/new-two-wheeler-fleet-india-2017-18

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Market overview

Sales of new two-wheelers decreased by nearly 14% in FY 2020–21 compared to FY 2019–20, according to the Society of Indian Automobile Manufacturers (SIAM).[4] The composition of sales as seen in Figure 1 shows that, motorcycles were approximately 66% of new two-wheeler sales in FY 2020–21. The next largest segment was scooters, with nearly 29%, and mopeds were 4% of sales. The market share of electric two-wheelers was just 0.3% in FY 2020–21.

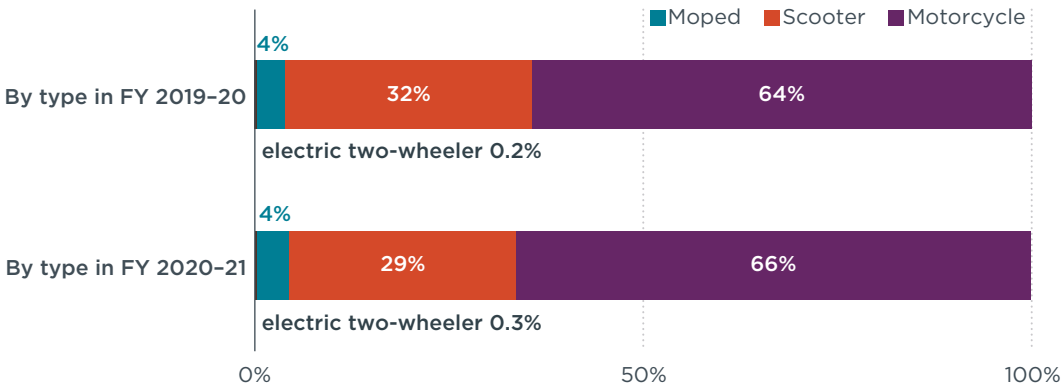

Figure 1. Market share of new two-wheelers by type

This paper analyzes the following two-wheeler parameters: engine displacement, engine power, curb weight, transmission, fuel type, fuel consumption under the World Motorcycle Test Cycle (WMTC), and carbon dioxide (CO_2) emissions. The fuel consumption values of the two-wheeler models after FY 2018–19 have not yet been declared by the SIAM. Hence, for that parameter, the data used here was compiled from a variety of sources, including Segment Y's India two-wheeler database for FY 2019–20 and FY 2020–21 and the websites carandbike.com, bikedekho.com, and bikewale.com.

As depicted in Figure 2 (a), two-wheeler models with engine size less than 150 cc were approximately 88% of sales in FY 2020–21. As compared to the market share in FY 2019–20, the sales of motorcycles larger than 150 cc increased by 2% in FY 2020–21. Additionally, in both years, 85% of the two-wheelers sold had engines smaller than 125 cc.

4 SIAM, "Automobile Domestic Sales Trends," accessed April 2021, https://www.siam.in/statistics.aspx?mpgid=8&pgidtrail=14

Figure 2. Select key parameters of the two-wheeler fleet for the analyzed years, (a) engine displacement, (b) curb weight, and (c) maximum engine power

Nearly 82% of the two-wheelers sold in FY 2020–21 weighed less than 125 kg and around 11% weighed between 125 kg and 150 kg. In the case of the parameter of maximum engine power, shown in Figure 2(c), 51% of the models had engines in the range 4 kW to 6 kW, and 26% were in the range of 6 kW to 8 kW.

With respect to transmission technologies, Figure 3 shows that nearly 70% of two-wheelers sold in FY 2020–21 were equipped with a manual transmission; of these, 40% of the models had 4-speed gears and 23% used 5-speed gears. The type of transmission on the scooters in FY 2019–20 was the same as those in FY 2020–21 and they used continuously variable transmission (CVT). As compared to FY 2019–20, the market share of 5-speed gear-equipped motorcycles was almost 10% greater in FY 2020–21.

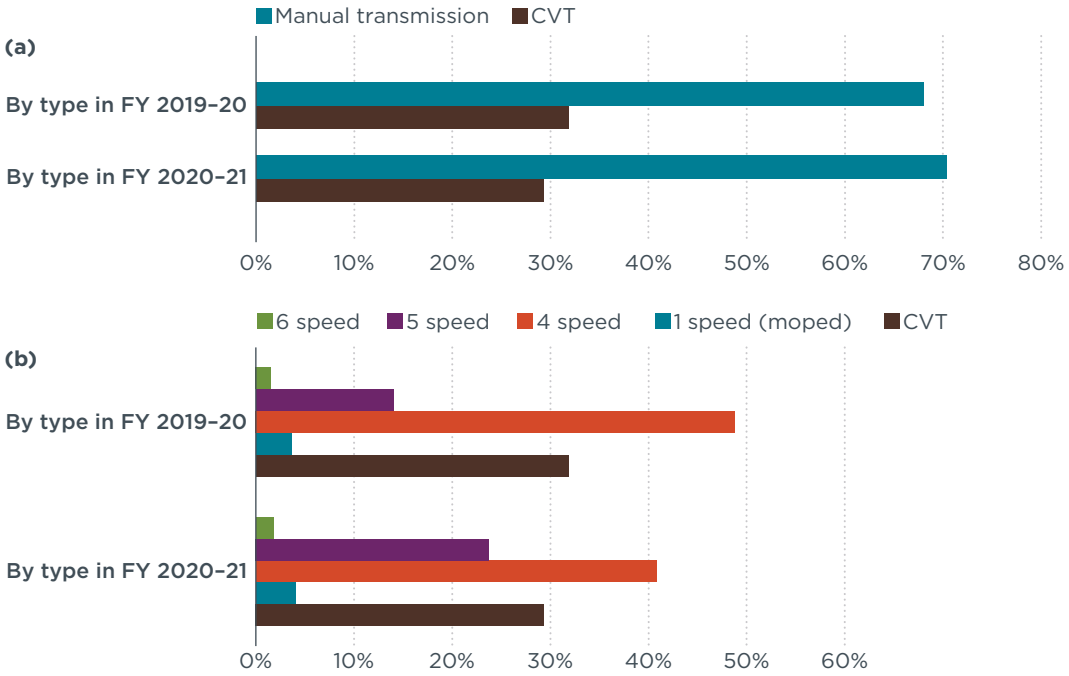

Figure 3. Transmission technologies of the two-wheeler fleet by (a) transmission type and (b) gear count

Top-selling models

The top 10 best-selling two-wheeler models in FY 2020–21 accounted for 59.4% of the market, and Table 1 shows the parameters of those models. In FY 2019–20, the share of the top 10 best sellers had dipped to 49.7%, and the parameters of those models are in Table 2. Observe that Hero MotoCorp's HF Deluxe, a BS VI model with fuel injection, was also in the top-selling list in FY 2019–20. This reflects sales in the last quarter of FY 2019–20 which means that the sale of BS VI models was already picking up. The Hero MotoCorp Splendor+ continues to be the top-selling model and its market share increased from 9.8% in FY 2017–18 to 10.6% in FY 2019–20 and to 12.8% in FY 2020–21. Eight of the top-selling models that were among the top 10 from FY 2017–18 were also on the list in FY 2020–21.

The top-selling scooter in FY 2020–21 was the Honda Activa 6G, with a market share of 10.9%. As seen in Table 2, all models were already equipped with fuel injection technology. The number of Class 2 two-wheelers in the top-selling models increased to three in FY 2020–21 from just one in FY 2019–20. With an increased maximum speed of 100 km/h, the Honda Shine is in the Class 2 WMTC category.[5]

5 The range of maximum speed in the vehicle Class 2 is 100 ≤ maximum speed in km/hour < 115

Table 1. Key parameters of top 10 best-selling models of FY 2019–20

Rank	Manufacturer	Model	Market share (%)	Class	Type	Engine size (cc)	Curb weight (kg)	Max engine power (kW)	Max speed (km/h)	Transmission type (gear count)	Fuel consumption (liter/100 km)	CO_2 (g/km)
1	Hero MotoCorp	Splendor+	10.6	1	Motorcycle	97	109	6	87	Manual, 4 speed	1.5	35.6
2	Hero MotoCorp	HF Deluxe	9.3	1	Motorcycle	97	109	6	90	Manual, 4 speed	1.5	35.6
3	Honda	Activa 6G	8.1	1	Scooter	109	109	6	85	CVT	1.8	42.7
4	Honda	CB Shine	4.0	1	Motorcycle	125	123	7	93	Manual, 4 speed	1.6	37.9
5	TVS	XL100	3.5	1	Moped	100	75	3	60	Manual, 1 speed	1.7	40.3
6	Honda	Activa i110	3.5	1	Scooter	109	103	6	83	CVT	1.9	45.1
7	Suzuki	Access 125	2.9	1	Scooter	124	101	7	90	CVT	1.8	42.7
8	Hero MotoCorp	Glamour	2.9	2	Motorcycle	125	125	7	100	Manual, 4 speed	1.7	40.3
9	TVS	Jupiter	2.5	1	Scooter	110	108	6	85	CVT	1.8	42.7
10	Hero MotoCorp	HF Deluxe(FI)	2.4	1	Motorcycle	97	109	6	90	Manual, 4 speed	1.4	33.9

Table 2. Key parameters of the top 10 best-selling models of FY 2020–21

Rank	Manufacturer	Model	Market share (%)	Class	Type	Engine size (cc)	Curb weight (kg)	Max engine power (kW)	Max speed (km/h)	Transmission type, gear count	Fuel consumption (liter/100 km)	CO_2 (g/km)
1	Hero MotoCorp	Splendor+(FI)	12.8	1	Motorcycle	97	100	6	87	Manual, 4 speed	1.4	33.9
2	Hero MotoCorp	HF Deluxe(FI)	10.9	1	Motorcycle	97	100	6	90	Manual, 4 speed	1.4	33.9
3	Honda	Activa 6G(FI)	10.9	1	Scooter	110	107	6	85	CVT	1.7	39.5
4	Honda	Shine 125(FI)	5.0	2	Motorcycle	124	115	8	100	Manual, 5 speed	1.5	36.5
5	TVS	XL100(FI)	4.1	1	Moped	100	86	3	60	Manual, 1 speed	1.5	35.4
6	TVS	Jupiter(FI)	3.6	1	Scooter	110	107	6	85	CVT	1.6	38.2
7	Hero MotoCorp	Passion Pro 115(FI)	3.2	1	Motorcycle	113	117	7	90	Manual, 4 speed	1.5	34.7
8	Hero MotoCorp	Splendor iSmart(FI)	3.2	1	Motorcycle	113	117	7	87	Manual, 4 speed	1.3	31.6
9	Bajaj	Pulsar 125 Neon(FI)	3.0	2	Motorcycle	124	140	9	105	Manual, 4 speed	1.6	38.2
10	Hero MotoCorp	Glamour 125(FI)	2.8	2	Motorcycle	125	122	8	100	Manual, 5 speed	1.6	38.2

Even though the engine size of the majority of the top-selling models remained the same, the engine size of Hero MotoCorp's Passion Pro increased from 97 cc in FY 2017–18 to 113 cc in FY 2020–21. In terms of curb weight, the top-selling models in FY 2020–21 weighed less than the top sellers in FY 2017–18. Similarly, there is a decreasing trend of maximum engine power and the highest value in FY 2020–21, 9 kW, was in the Bajaj Pulsar 125 Neon. With the adoption of fuel injection technology for the BS VI models, the top-selling motorcycle, the Hero Splendor+, saw a nearly 4% reduction of CO_2 emissions from FY 2017–18 to FY 2020–21. Similarly, for the top-selling scooter, the Honda Activa 6G, a nearly 13% reduction of CO_2 emissions was seen from FY 2017–18 to FY 2020–21.

Breakdown by class

Two-wheelers in India are classified using the Automotive Industry Standard, Draft AIS-017 Part 5, which is based on engine size and maximum speed.[6] Class 1 has smaller engines up to 150 cc and the maximum speed is less than 100 km/h. If the maximum speed is increased to 100 km/h, these engines of less than 150 cc are part of Class 2 and belong to subclass Class 2-1. All engines more than 150 cc are categorized in Class 2 or Class 3, depending on the maximum speed. Engines with maximum speed of up to 115 km/h are in subclass 2-1 and if the engine speed is increased to less than or equal to 130 km/h, the engines belong to subclass 2-2. If the maximum speed is greater than 130 km/h, the engines are classified under Class 3; between 130 and 140 km/h is subclass 3-1, and for those with maximum speed of more than 140 km/h, the category of the engine is subclass 3-2. As seen in Figure 4, the market is dominated by Class 1 two-wheelers with engine displacement below 150 cc and maximum speed below 100 km/h. However, the trend shows that the market share of Class 1 models has decreased in recent years from 85% in FY 2017–18 to 80.3% in FY 2019–20 and 72.8% in FY 2020–21.

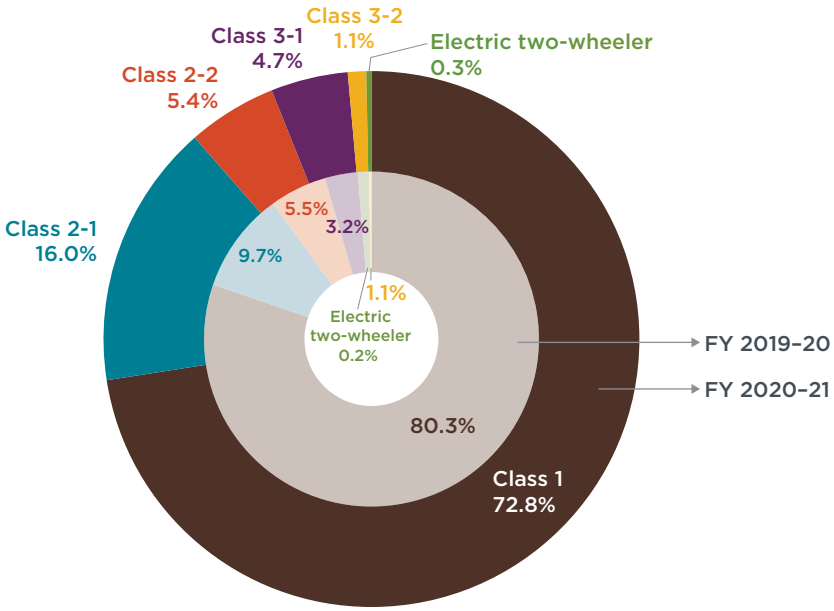

Figure 4. Sales share of new two-wheelers by class for FY 2019–20 and FY 2020–21

Table 3 details the fleet average values of the key parameters of the new two-wheeler fleet for FY 2019–20 and FY 2020–21. Fleet average engine size was bigger in FY 2020–21 than in FY 2019–20, and the fleet average engine size in FY 2017–18 was 123.5 cc. The trend of fleet average maximum engine power shows that engines were more powerful in FY 2020–21 than in FY 2019–20. Fleet average CO_2 emissions reduced from 41.2 g/km in FY 2017–18 to 40.5 g/km in FY 2019–20 and then to 38.2 in FY 2020–21. The adoption of the fuel injection technology is one reason for this decrease in CO_2 by FY 2020–21.

Table 3. Value range and sales-weighted average of the key parameters of two-wheelers by class

Type	Engine size (cc)		Curb weight (kg)		Max engine power (kW)		Fuel consumption (liter/100 km)		CO_2 emissions (g/km)	
	2019–20	2020–21	2019–20	2020–21	2019–20	2020–21	2019–20	2020–21	2019–20	2020–21
Fleet	124.5	125.6	116.6	116.4	7.2	7.3	1.7	1.6	40.5	38.2
Class 1	107.6	107.2	108.6	106.9	6.1	6.1	1.6	1.5	38.4	35.9
Class 2	163.2	142.3	141.9	132.3	10.4	9.4	1.9	1.7	46.0	41.1
Class 3	311.6	301.2	177.3	178.0	17.1	16.0	2.6	2.4	61.5	57.7

6 Government of India, Ministry of Road Transport and Highways, "Automotive industry standard: Criteria for vehicle types, variants and versions," (2015), https://morth.gov.in/sites/default/files/ASI/810201552915PMAIS-017_Part_5_Rev_1_D1_Aug_15.pdf

Figure 5 illustrates the vehicle parameters sold in FY 2020–21 by class. Figure 6 compares the transmission types and gears of the models.

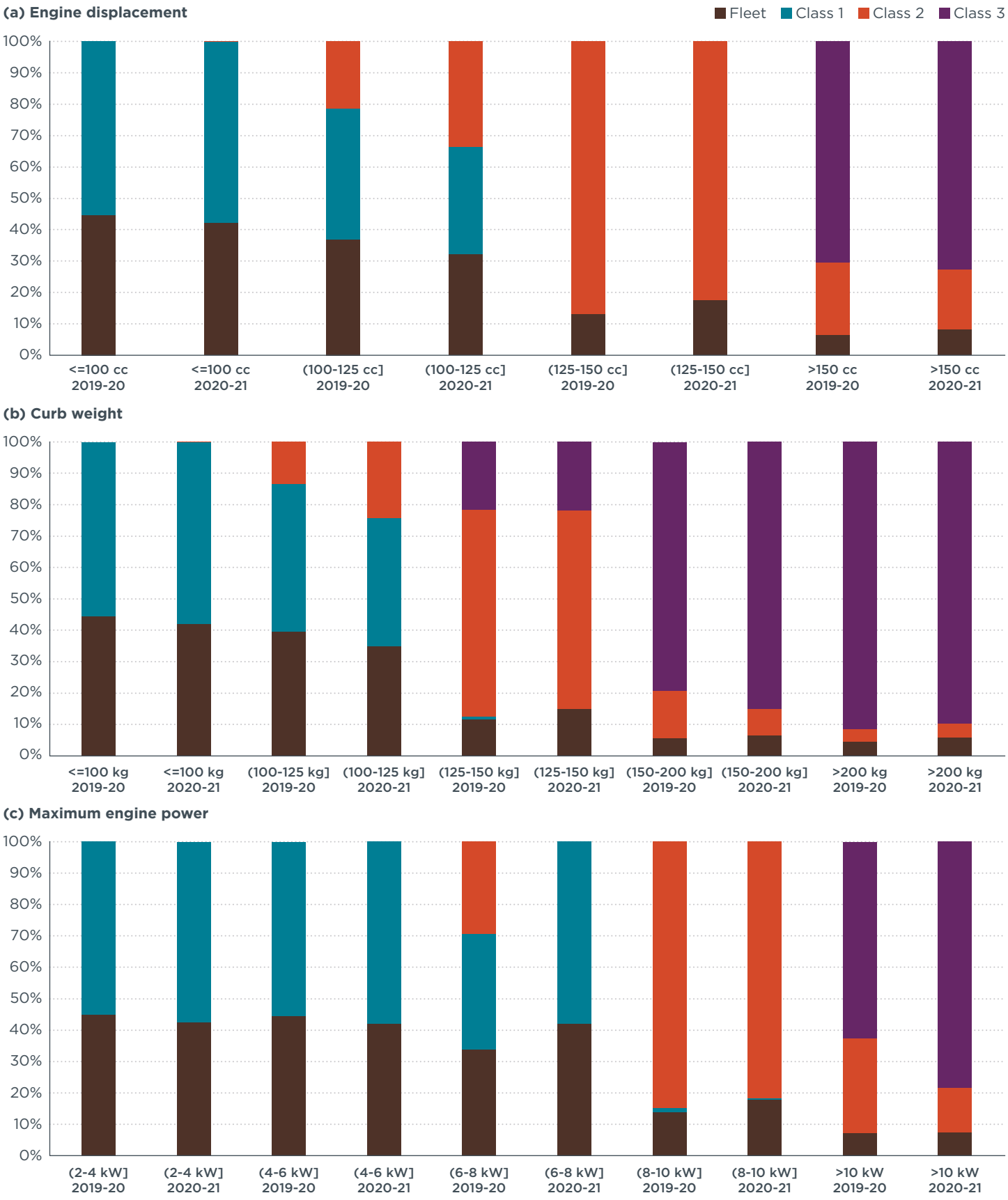

Figure 5. Key parameters by class

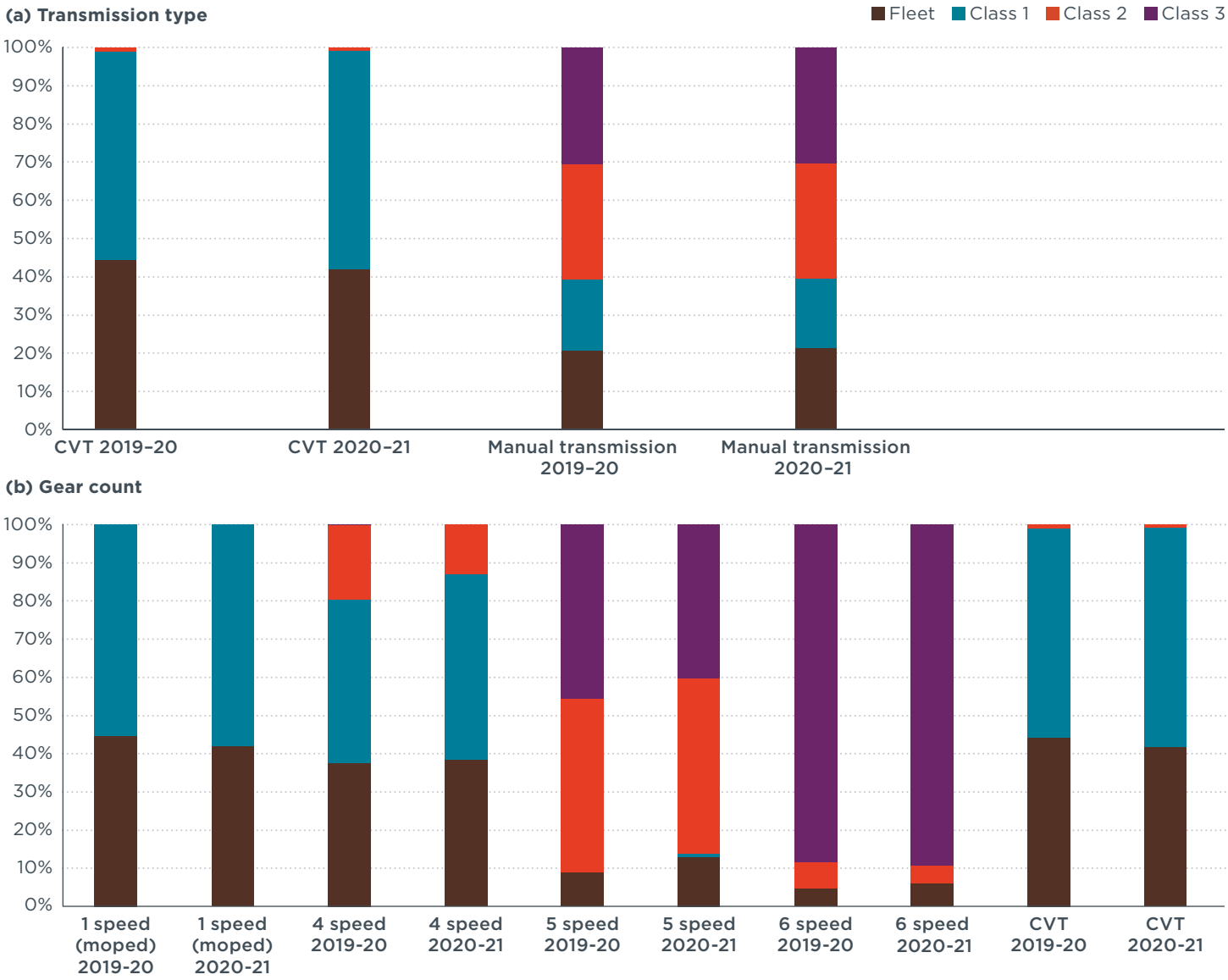

Figure 6. Transmissions of two-wheelers by class

Breakdown by manufacturer

The seven manufacturers in Figure 7 represented 98.8% of new two-wheeler sales in FY 2020–21 and 99.0% of sales in FY 2019–20. The sales-weighted averages of all specifications for these major manufacturers are shown in Table 4. The fuel consumption level of Bajaj is the least.

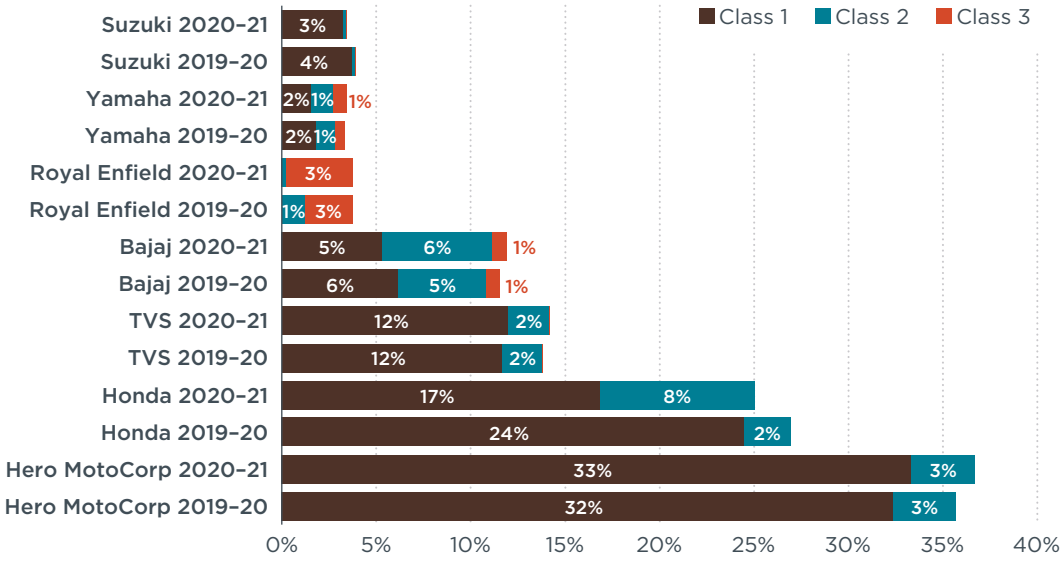

Figure 7. Market share of new two-wheeler sales by manufacturer, FY 2019–20 and FY 2020–21

Table 4. Sales-weighted averages of two-wheeler specifications by manufacturer

Type	Engine size (cc)		Curb weight (kg)		Max engine power (kW)		Fuel consumption (liter /100 km)		CO_2 emissions (g/km)		Top selling model		Market share	
	2019–20	2020–21	2019–20	2020–21	2019–20	2020–21	2019–20	2020–21	2019–20	2020–21	2019–20	2020–21	2019–20	2020–21
Fleet	124.5	125.6	116.6	116.4	7.2	7.3	1.7	1.6	40.5	38.2	Splendor+	Splendor+ (FI)	100%	100%
Hero MotoCorp	103.6	104.9	111.8	108.9	6.3	6.5	1.6	1.5	36.7	34.8	Splendor+	Splendor+ (FI)	35.6%	36.7%
Honda	116.3	120.1	112.5	112.6	6.5	6.9	1.7	1.6	41.3	38.9	Activa 5G 110	Activa 6G 110 (FI)	26.9%	25.3%
TVS	117.5	117.6	105.1	107.9	6.3	6.2	1.8	1.6	42.3	38.9	XL 100	XL 100 (FI)	13.8%	14.2%
Bajaj	130.4	130.4	128.7	133.8	8.8	8.8	1.6	1.5	37.3	34.5	Platina 100 ComforTec	Pulsar 125 Neon (FI)	11.5%	11.9%
Royal Enfield	358.3	352.9	190.8	192.0	15.7	15.2	2.6	2.3	60.4	53.7	Classic 350	Classic 350 (FI)	3.8%	3.8%
Yamaha	133.9	140.2	128.0	119.8	8.1	8.7	1.9	2.0	46.3	47.9	FZ 150 V3.0	FZ 150 V3.0 (FI)	3.3%	3.4%
Suzuki	126.9	126.3	104.6	106.2	7.3	7.2	1.8	1.7	42.7	39.4	Access 125	Access 125 (FI)	3.9%	3.4%
Others	186.2	161.6	121.8	112.4	13.3	11.9	2.3	2.1	54.3	50.2	—	—	1.3%	1.2%

Figure 8 (a) shows the type of two-wheelers offered by manufacturer. The sales volume of electric two-wheelers is too small to be shown in the figure. Among the major manufacturers, Bajaj and TVS are the only ones that have electric two-wheelers in their fleet. In FY 2020–21, the electric two-wheeler models available for sale from these manufacturers were the Bajaj Chetak and TVS iQube; they had market penetration of nearly 0.08% and 0.05%, respectively, in their overall fleets. As of July 2021, these electric models were only available for retail sale in certain cities, including Maharashtra and Karnataka.[7]

7 Prashant Singh, "Bajaj Chetak Electric vs TVS iQube vs Ather 450X: City-wise availability July' 21," *Hindustan AutoDesk*, July 23, 2021, https://auto.hindustantimes.com/auto/two-wheelers/bajaj-chetak-electric-vs-tvs-iqube-vs-ather-450x-city-wise-availability-july21-41627011575507.html

Figure 8. Key parameters, by manufacturer

As also shown in Figure 8, Yamaha increased the market share of its models with engine size more than 150 cc by nearly 6% in FY 2020–21 as compared to FY 2019–20. As compared to that share in FY 2017–18, this increase was nearly 18% for Yamaha.

Regarding transmissions, Suzuki and Honda have the most CVT models, and are followed by Yamaha and TVS. Transmission type in FY 2020–21 was similar to that in FY 2017–18. Nearly 82% of the models of Hero MotoCorp in FY 2020–21 were equipped with 4-speed gears and only 10% of the Hero MotoCorp models used 5-speed gears. However, Hero MotoCorp's 5-speed-equipped gear models increased from 1% in FY 2017–18 to 10% in FY 2020–21. Similarly, the second best-selling manufacturer, Honda, also increased its 5-speed-gear models from 9% in FY 2017–18 to nearly 33% in FY 2020–21. Of the two-wheelers in Bajaj's portfolio, 38% were equipped with 5-speed gears in FY 2020–21. This was a 10% increase from FY 2017–18. Royal Enfield, which had no 6-speed-gear models in FY 2017–18, had 2% of its models equipped with 6 gears in FY 2020–21.

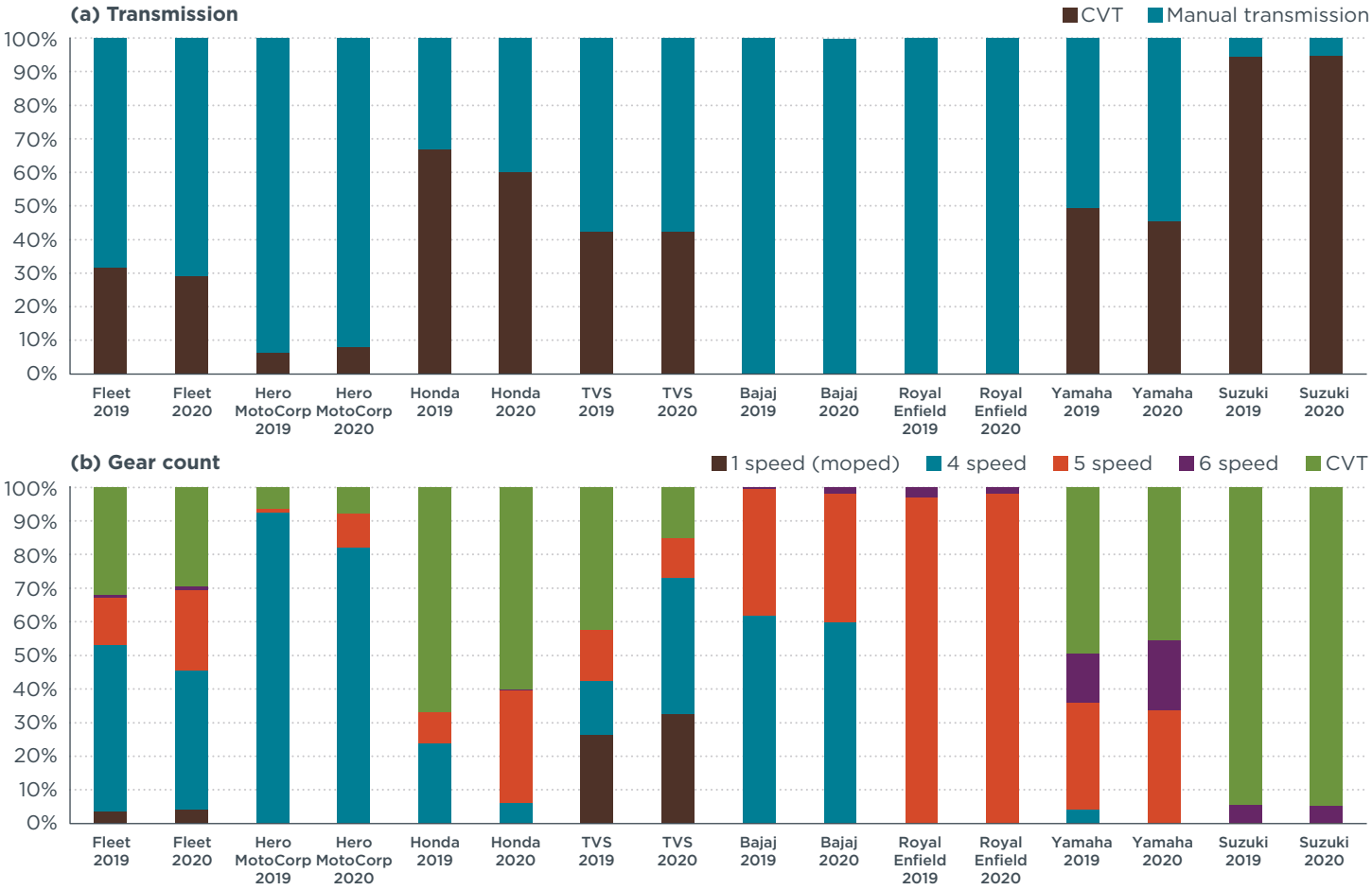

Figure 9. Production of (a) transmissions and (b) gears, by manufacturer

Fuel consumption

This section analyzes the fleet features and fuel consumption of two-wheelers sold in FY 2020–21 by class and by manufacturer. Figure 10 shows the fuel consumption by class and type, plotted as function of curb weight, engine power, and engine size. Class 1 models have the lowest fuel consumption levels in the fleet. The fuel consumption level of scooters continues to be higher than that of class 1 motorcycles, and is similar to the levels in FY 2017–18. Figure 10(b) and 10(c) shows that for scooters with the same curb weight/engine displacement, there are varying fuel consumption levels. We see that heavier models tend to consume more fuel than lighter models.

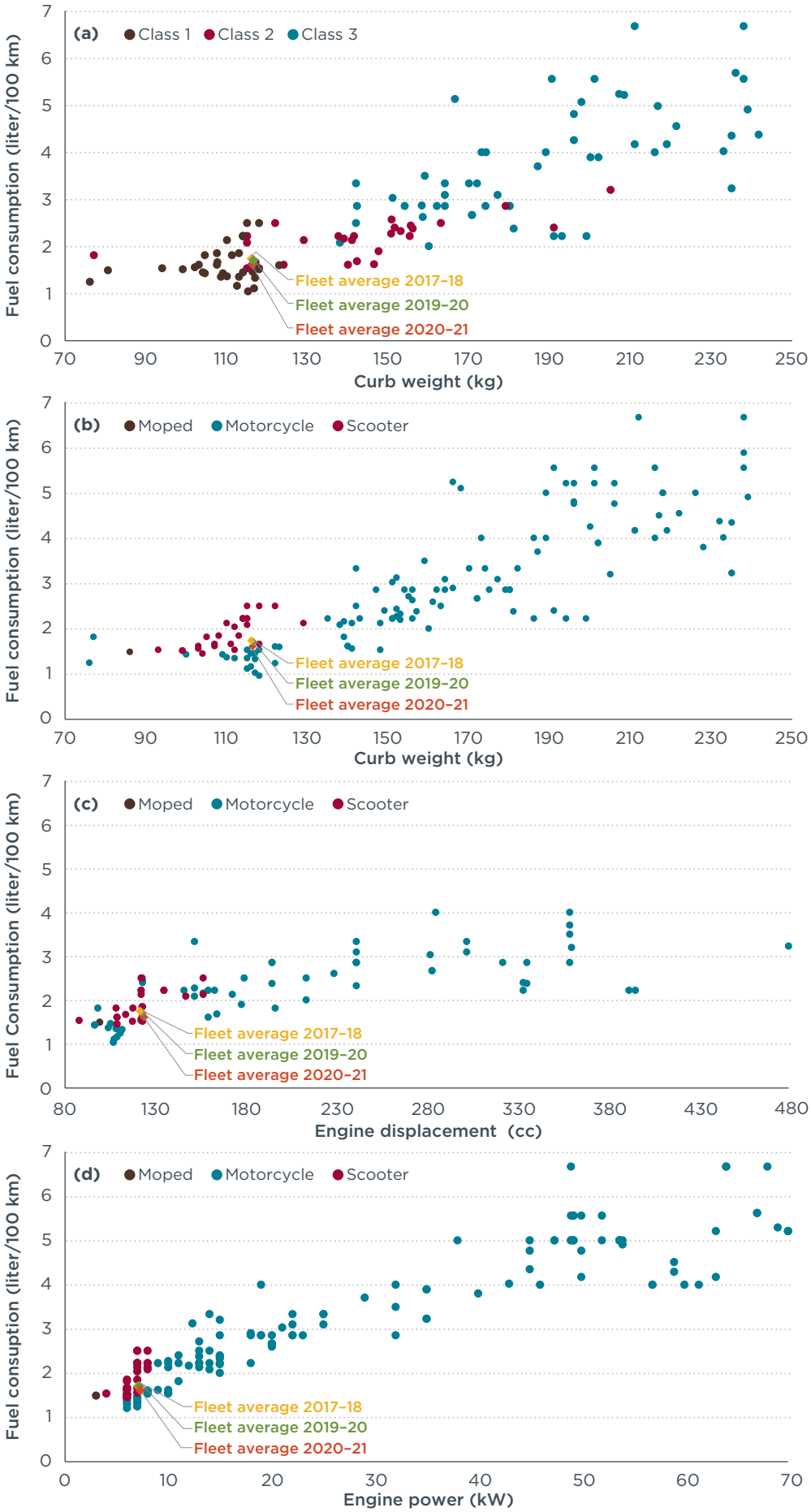

Figure 10. Average fuel consumption of new two-wheelers sold in FY 2020–21 as function of (a) curb weight by three classes, (b) curb weight by type, (c) engine displacement and (d) engine power. Each dot represents a two-wheeler model.

Figure 11 presents the fuel consumption levels of the top manufacturers, and all except Yamaha have reduced fuel consumption in FY 2020–21 as compared to their levels in FY 2017–18. Overall fleet average fuel consumption fell by nearly 7% in FY 2020–21 compared to FY 2017–18. Recent studies showed that fuel economy is one of the most important factors influencing Indian two-wheeler buyers' purchase decisions.[8] The sales-weighted fuel consumption of the top seven manufacturers shows that Hero MotoCorp and Bajaj are the only two manufacturers that have fleet average fuel consumption less than the overall fleet average for FY 2020–21.

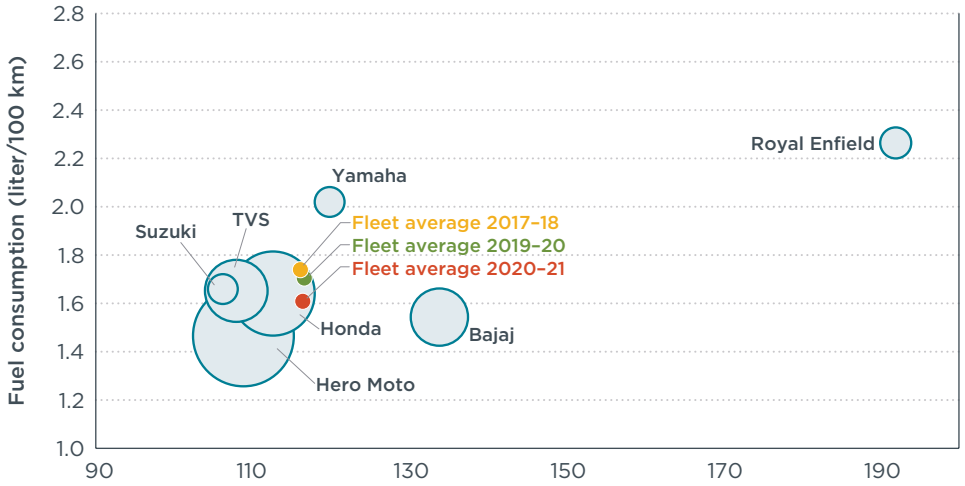

Figure 11. Average fuel consumption as a function of curb weight of major two-wheeler manufacturers for models sold in FY 2020–21

Electric two-wheelers

The market share of electric two-wheelers increased from 0.1% in FY 2017–18 to 0.2% in FY 2019–20 and 0.3% in FY 2020–21. The model with the maximum battery capacity, 3.3 kWh, is the Okinawa iPraise. The Hero Electric Photon was the top-selling model in FY 2017–18 and continued to be the top-selling model in both FY 2019–20 and FY 2020–21. The market share of this model was only 0.02% in the overall two-wheeler market in FY 2020–21. Hero Electric and Okinawa make only electric two-wheelers and they are the top selling manufacturers, with market shares of 49.4% and 40.9%, respectively, in the electric two-wheeler market.

Parameter options for fuel consumption standards

Earlier ICCT analysis showed that setting ambitious but feasible fuel consumption standards paves the way for overall reduction of fuel consumption and accelerated electrification of the fleet.[9] The simplest way to reduce fuel consumption from new vehicles would be to set a uniform target that has to be met by all models of each manufacturer. However, vehicle characteristics vary significantly, and applying a uniform target would lead to changes in the current competitive balance within the two-wheeler market. Instead, indexing fuel consumption standards to a vehicle attribute allows the given fleet to remain diverse in terms of vehicle size and functionality. The different attributes that can be the basis of such standards are engine displacement, curb weight, and engine power. These are easily measured and correlate reasonably well with CO_2 emissions and fuel consumption.

8 Prateek Bansal, Rubal Dua, Rico Krueger, and Daniel J. Graham, "Fuel Economy Valuation and Preferences of Indian Two-Wheeler Buyers," *Journal of Cleaner Production*, 294 (2021): 126328. https://www.sciencedirect.com/science/article/pii/S0959652621005485

9 Sunitha Anup, Ashok Deo, *Fuel consumption standards for the new two-wheeler fleet in India*, (ICCT: Washington, DC, 2021), https://theicct.org/publications/fuel-consumption-2w-india-aug2021

One disadvantage of choosing engine displacement—a measurement of engine size—is that the electric two-wheeler models cannot be included in the regulation on this basis. The curb weight and engine power, meanwhile, can be considered as technical parameters for all two-wheeler models.

Currently, passenger vehicle fuel consumption standards in India are based on a linear target curve based on curb weight.[10] The CO_2 emissions target allows for higher emissions for heavier vehicles, while lighter vehicles are only allowed lower emissions. In this way, the weight-based vehicle emission standard discourages the reduction of vehicle weight. However, this discouraging effect of a curb-weight-based standard can be entirely alleviated by choosing appropriate slope reductions to all points on the sales-weighted trend line of all the vehicles currently on the market. Figure 12 illustrates the two-wheeler market of FY 2020–21 with curb weight as the utility parameter for a fuel consumption standard.

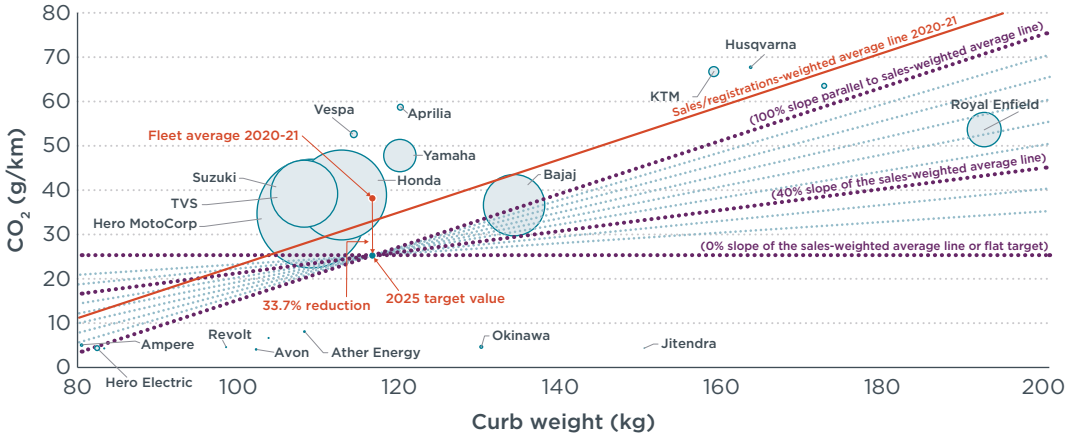

Figure 12. CO_2 emissions of all manufacturers with target for 2025, illustrating varying slopes of target line

Taking the target value for the standard as the pivot point, the sales-weighted trend line can be rotated and a compromise between the advantages and disadvantages of a flat and utility-based emission standard can be reached. The x-coordinate of the pivot point can be maintained at the same fleet average curb weight, 116.4 kg. The y-coordinate of the pivot point has been assumed for the proposed fuel consumption target for 2025, 25.3 gCO_2/km, from previous ICCT analysis. This pivot point corresponds to a CO_2 reduction of 33.7% from the fleet average CO_2 level in FY 2020–21. A flat target (i.e., with a slope of zero) imposes the same target value for each manufacturer; on the other hand, a standard with a 100% slope fully considers the curb weight of a vehicle. The multiple options of slope between 0% and 100% are shown in Figure 12.

To illustrate the distributional impact of a fuel consumption standard on manufacturers, this study chooses a 40% slope for 2025. The equation of the line corresponding to the 40% slope is given by

$$CO_2 \text{ emission in gram per kilometer} = 0.2405 \times W - 2.6977$$

Where W is the weighted average curb weight of all new two-wheelers in kilograms

By assuming this, the dispersion of fuel consumption of the various models would be lesser in 2030 as compared to 2025, and the target line would be flatter. As a result, this study considers a 30% slope line for 2030.

10 Government of India, Ministry of Road Transport and Highways, "Fuel efficiency norms for M1 category of vehicles," (2016), https://morth.gov.in/sites/default/files/notifications_document/Notification_no_G_S_R_954_E_dated_04_10_2016_regarding_Fuel_Efficiency_Norms_for_M_1_Category_of_vehicles_0.pdf

Figure 13 illustrates the two-wheeler market of FY 2020–21 with curb weight as the utility parameter for a fuel consumption standard for 2030. Similar to the pivot point estimation for 2025, the x-coordinate of the pivot point for 2030 is the fleet average curb weight and the y-coordinate of the pivot point is the proposed fuel consumption target for 2030, 20.5 gCO_2/km, from previous ICCT analysis. This pivot point corresponds to a CO_2 reduction of 46.3% from the fleet average CO_2 level in FY 2020–21. The equation of the line corresponding to the 30% slope is given by

$$CO_2 \text{ emission in gram per kilometer} = 0.1804 \times W - 0.4983$$

Where W is the weighted average curb weight of all new two-wheelers in kilograms

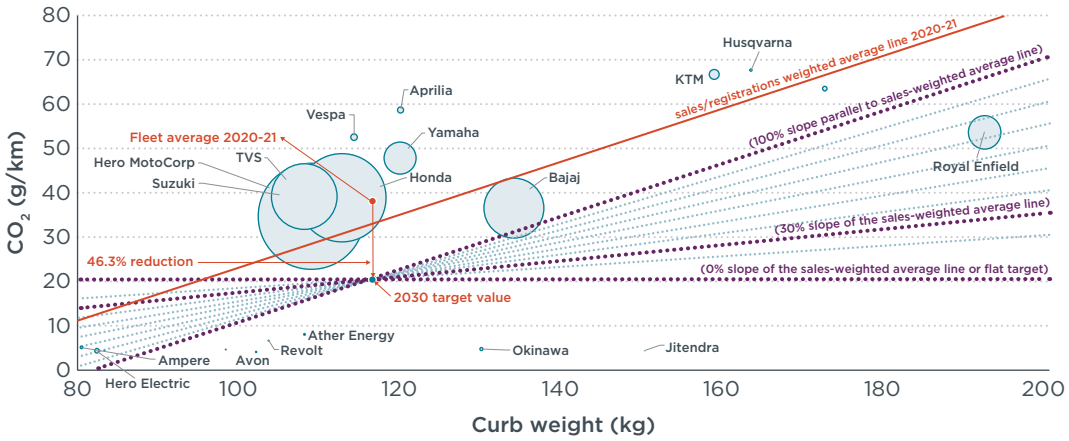

Figure 13. CO_2 emissions of all manufacturers with target for 2030, illustrating varying slopes of the target line

Table 4 shows the absolute CO_2 reduction percentage required for each manufacturer for the proposed targets for 2025 and 2030, using a curb-weight-based fuel consumption standard. Of all the manufacturers, Bajaj would need to reduce CO_2 the least to meet the proposed target for 2025. Additionally, the CO_2 reduction requirement for the top seven manufacturers is mostly achievable with internal combustion engine (ICE) technologies alone, as found by the earlier ICCT analysis.[11]

11 Sunitha Anup, Ashok Deo, and Anup Bandivadekar, *Fuel consumption reduction technologies for the two-wheeler fleet in India*, (ICCT: Washington, DC, 2021), https://theicct.org/publications/2w-fuel-reduction- india-mar2021

Table 4. CO_2 reduction percentage required by each manufacturer to meet the proposed targets based on curb weight

Manufacturer	Market share in 2020–21	Curb weight (kg)	CO_2 reduction required for proposed target for 2025 (40% slope reduction) from 2021 level	CO_2 reduction required for proposed target for 2030 (30% slope reduction) from 2021 level	CO_2 reduction required for proposed target for 2030 (30% slope reduction) from 2025 level
Hero MotoCorp	36.70%	108.9	32.4%	44.9%	14.4%
Honda	25.35%	112.6	37.3%	49.1%	16.7%
TVS	14.2%	108.9	40.6%	51.6%	13.8%
Bajaj	11.9%	133.9	19.4%	35.4%	28.0%
Royal Enfield	3.76%	192.0	19.0%	36.4%	47.3%
Yamaha	3.43%	119.8	45.5%	55.9%	20.9%
Suzuki	3.42%	106.2	42.0%	52.6%	12.6%
KTM	0.37%	158.6	46.9%	57.9%	37.7%
Vespa	0.19%	114.1	53.0%	61.8%	17.6%
Aprilia	0.17%	119.9	55.5%	64.0%	20.9%
Jawa	0.11%	172.2	39.1%	51.9%	42.0%
Hero Electric	0.10%	82.4	0%	0%	0%
Okinawa	0.05%	129.9	0%	0%	0%
Ampere	0.05%	80.5	0%	0%	0%
Husqvarna	0.04%	163.1	46.1%	57.3%	39.2%
Ather Energy	0.02%	108.0	0%	0%	0%
BMW	0.02%	178.6	51.9%	62.1%	43.9%
Benelli	0.02%	206.5	38.1%	51.6%	50.7%
Avon	0.02%	102.0	0%	0%	0%
Revolt	0.01%	103.6	0%	0%	0%
Kawasaki	0.01%	215.1	63.1%	71.2%	52.4%
Benling	0.01%	66.0	0%	0%	0%
Triumph	0.005%	210.4	62.1%	70.4%	51.5%
Jitendra	0.005%	150.0	0%	0%	0%
Harley-Davidson	0.004%	257.2	49.2%	60.6%	59.6%
Mahindra	0.002%	186.0	55.7%	65.2%	45.8%
Ducati	0.001%	203.9	59.2%	68.1%	50.1%
Avan Motors	0.001%	62.0	0%	0%	0%
NDS Eco	0.001%	98.3	0%	0%	0%
Indian	0.001%	324.7	32.7%	48.2%	67.4%
CF Moto	0.0001%	183.1	55.5%	65.0%	45.1%

The previous ICCT analysis showed that there already exist cost-effective ICE technologies that can provide up to a 42% reduction in fuel consumption. Additionally, for motorcycles with engine sizes greater than 150 cc, reductions in fuel consumption of up to 54% can be achieved by including mild hybridization. Recall that Yamaha increased the number of models of more than 150 cc engine size in FY 2020–21. Recently, Yamaha also launched a hybrid model in the two-wheeler market.[12]

The top-selling two-wheeler manufacturer, Hero MotoCorp, would require nearly a 14% reduction in 2030 from its proposed fleet level for 2025. From 2020 to 2030, Hero MotoCorp would require average CO_2 reduction of nearly 3.8% per year in order to attain the proposed 2030 target. At the same time, Hero MotoCorp has already increased its fuel efficiency levels by 2.3% per year from 2017 to 2020. The top-selling model of Hero MotoCorp, the Splendor+, showed improved fuel efficiency of 1.3% per year within the same time period.

12 Lijo Mathai, "Yamaha India Opens up About 150cc Bike Segment Penetration, EVs, FZ25 Price Cut," *Express Drives*, August 5, 2021, https://www.financialexpress.com/auto/bike-news/yamaha-india-opens-up-about-150cc-bike-segment-penetration-evs-fz25-price-cut-fascino-review/2304949

Designing fuel and energy consumption standards suitable for both electric vehicles and combustion engine vehicles is the subject of ongoing study.[13] The energy consumption of an electric vehicle expressed in kWh/100 km can be considered as comparable to tailpipe CO_2 emissions. The variation of energy consumption of two-wheeler models for FY 2020–21 is shown in Figure 12. The diversity of the models is better utilized for the utility parameter of curb weight as compared to engine power. Additionally, the energy consumption of an electric motor is largely dependent on its *instantaneous power* output rather than its *maximum rated power* (which is available in the specifications of a model).[14] Hence, this study takes into account the utility parameter curb weight for the fuel consumption level and labeling of the fleet.

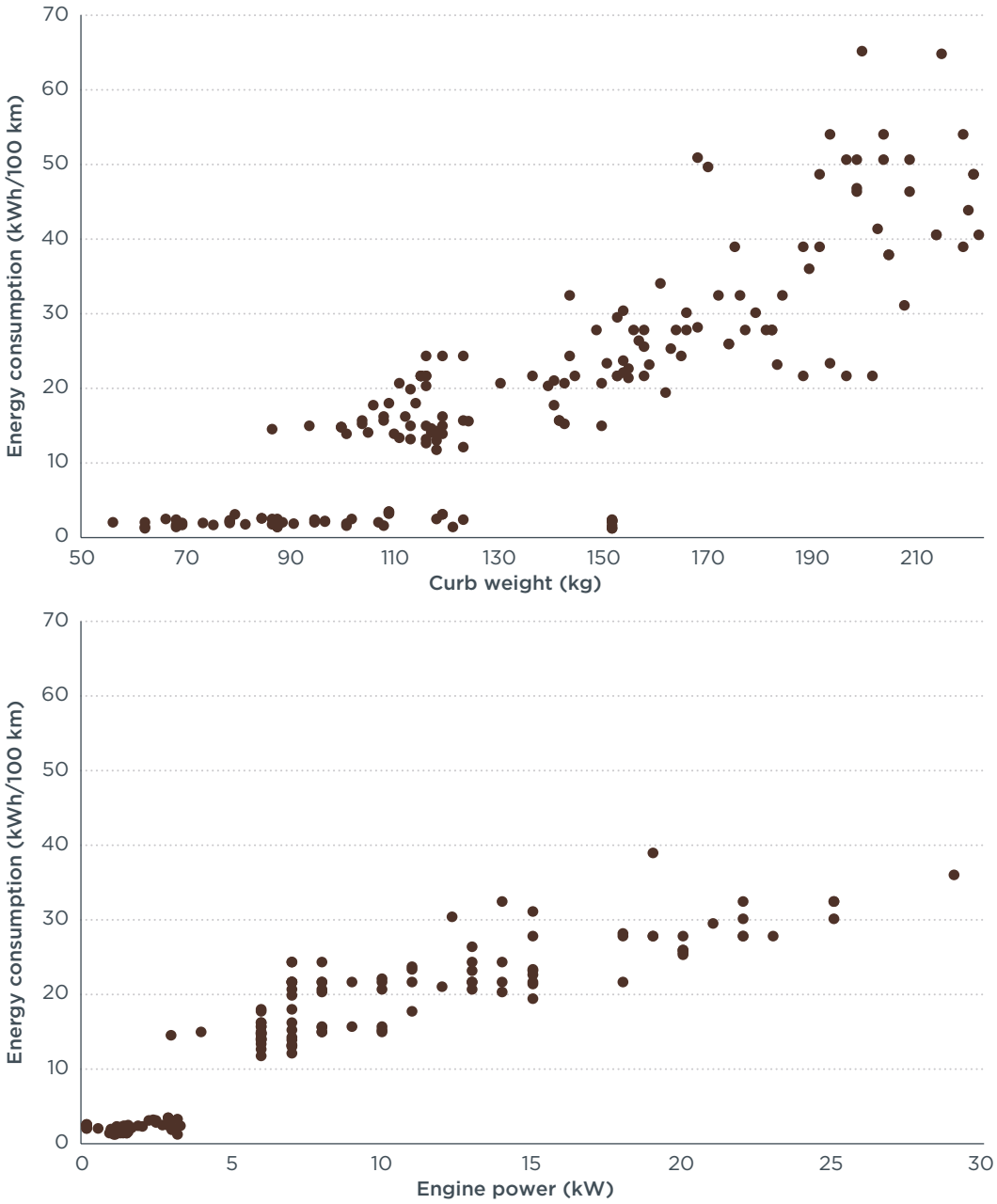

Figure 14. Energy consumption of two-wheeler models versus (a) curb weight and (b) engine power

13 Agora Verkehrswende, *Notes on the revision of the EU CO_2 emission performance standards for cars and light commercial vehicles*, (2021), https://www.agora-verkehrswende.de/fileadmin/Projekte/2021/Flottengrenzwerte/Agora-Verkehrswende_Notes_on_the_revision_of_the_EU_CO2_emission.pdf

14 Martin Weiss, Kira Christina Cloos, and Eckard Helmers, "Energy Efficiency Trade-Offs in Small to Large Electric Vehicles," *Environmental Sciences Europe*, 32, no.1 (2020): 1–17. https://enveurope.springeropen.com/articles/10.1186/s12302-020-00307-8#change-history

Best-in-class models

CO_2 emissions levels can be compared across a range of curb weights. In other words, a comparison of CO_2 emission levels can identify the "best-available" technologies that already exist for two-wheelers. This section attempts to make that comparison, and Figure 15 identifies the best-in-class models based on curb weight. The classes of curb weights considered are less than or equal to 100 kg, between 100 kg and 125 kg, between 125 kg and 150 kg, between 150 kg and 200 kg, and more than 200 kg. The model with the lowest CO_2 emissions in each category is chosen as the best-in-class model.

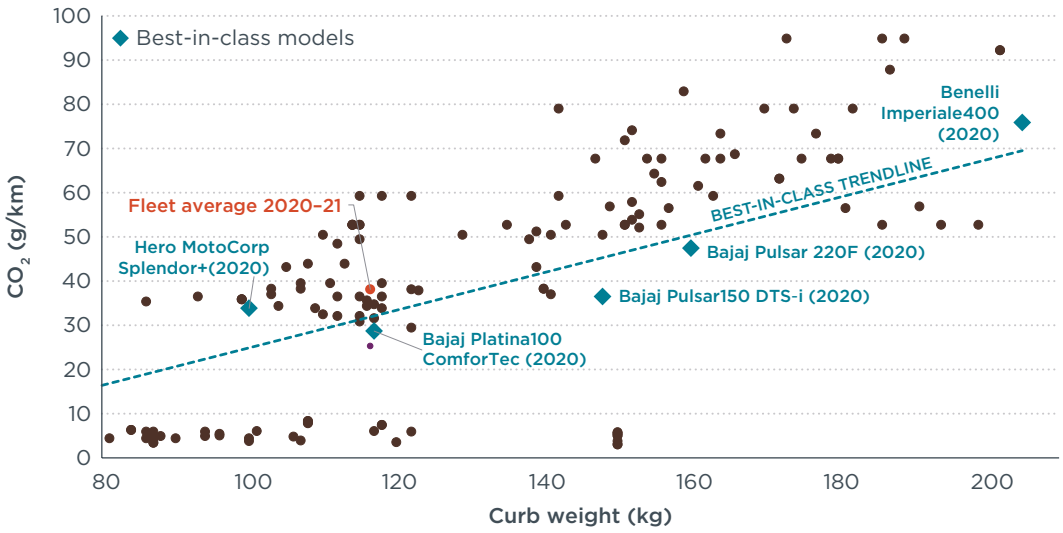

Figure 15. CO_2 emissions versus curb weight with best-in-class vehicles with 40% slope reduction trend line for 2025 target

Table 5 compares the best-in-class models with the worst-in-class models. Recall from Figure 2(b) that the market share of two-wheeler models weighing less than 125 kg is nearly 82%. Even though the number of models in the categories of those weighing more than 150 kg is reasonably high, the market share of those models is just 6.5%. Without considering the electric models in the category of between 100 and 125 kg, the difference in the CO_2 levels of best-in-class and worst-in-class models is nearly 51%. Note that the sales-weighted fleet average for FY 2020–21 is 116.4 kg. The proposed fuel consumption standard corresponding to the 40% slope reduction of the trend line is also represented in Figure 15. Observe that all the electric two-wheeler models lie below the best-in-class trend line and below the 40% slope trend line.

Table 5. Fuel consumption of two-wheeler models in 2020–21 based on curb weight category

Curb weight category	≤100 kg	(100-125 kg]	(125-150 kg]	(150-200 kg]	≥ 200 kg
Number of models	8	39	16	51	60
Best-in-class CO_2(g/km)	33.9	28.7	36.5	47.4	75.8
Worst-in-class CO_2(g/km)	36.5	59.3	79.0	158.9	182.4
Sales-weighted average CO_2(g/km)	34.2	36.5	44.0	55.8	95.5

Star rating labeling for two-wheelers

Based on the gasoline-equivalent fuel consumption of the vehicle, a five-star rating system could be designed for the two-wheeler fleet. A possible formulation of a star-rating band is illustrated in Figure 16 and in Table 6, calculated using the curb weight of the two-wheeler in kilograms. This estimation is based on assigning a 5-star rating to all models that satisfy their target under ICCT's proposed fuel consumption target for 2025.

For assigning star ratings other than 5-star, the slope of the 5-star rating line equation is reduced in regular intervals.

Table 6. Star rating bands for two-wheeler category for regression based on ICCT's proposed 2025 target

Star rating	Gasoline-equivalent fuel consumption levels (liter/100km)
1 star	FC ≥ 0.0342xW+0.117
2 star	0.0342xW+0.117 ≥ FC > 0.02277W+0.117
3 star	0.02277xW+0.117 ≥ FC > 0.0212W+0.117
4 star	0.0212W+0.117 ≥ FC > 0.0147W+0.117
5 star	0.0147W+0.117 ≥ FC > 0.0082W+0.117

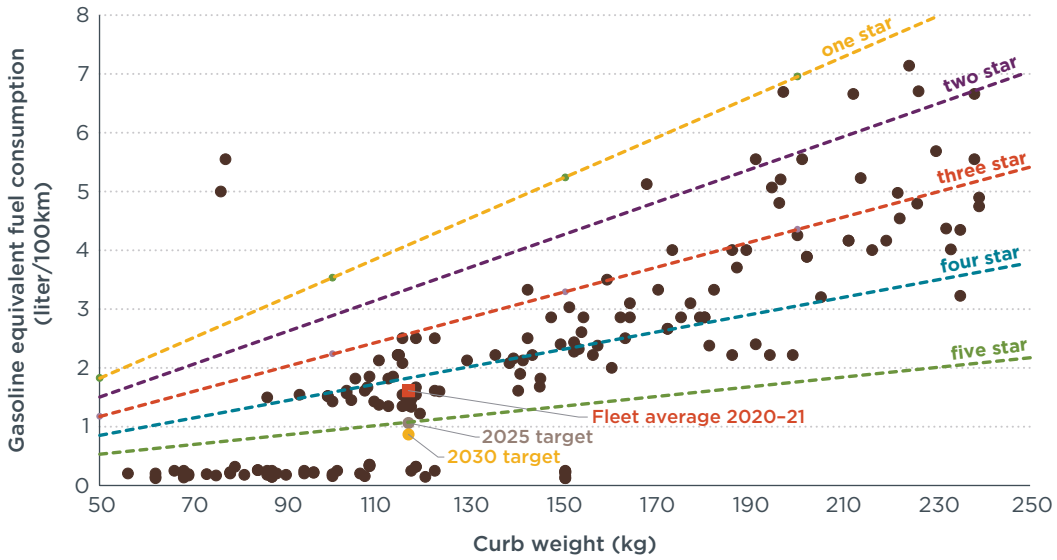

Figure 16. Illustration of a potential star rating for the two-wheeler fleet based on ICCT's proposed fuel consumption target regression for 2025

Among the current two-wheeler models, only electric two-wheelers can be assigned a 5-star rating. The market share of combustion engine two-wheeler models for the other star ratings is shown in Table 7.

Table 7. Market share of star rating based on 2025 target

Star rating	2 star	3 star	4 star	5 star
Sales-weighted market share for labeling design based on 5 stars given to 2025 target	0.4%	12.4%	86.9%	0.3%

Similarly, by assigning 5-star rating to all models that satisfy their fuel consumption levels according to ICCT's proposed 2030 target, Figure 17 is plotted and is based on sales from FY 2020–21. Only electric two-wheeler models are assigned a 5-star rating and other models follow equations of the 5-star rating line equation with reduced slope in regular intervals. Table 8 shows the market share of models based on their rating related to the target for 2030.

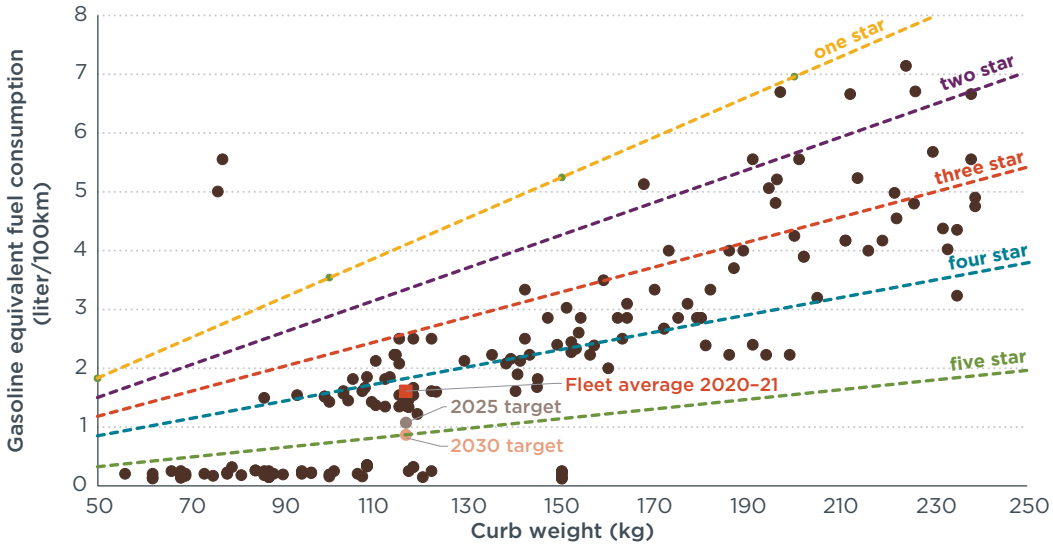

Figure 17. Illustration of star rating for two-wheeler fleet based on the target regression for 2030

Table 8. Market share of star rating based on 2030 target

Star rating	2 star	3 star	4 star	5 star
Sales-weighted market share for labelling design based on 5 stars given to 2030 target	0.5%	35.3%	63.9%	0.3%

Key findings

This study summarizes the characteristics of the two-wheeler market in India using data about models sold in FY 2019–20 and FY 2020–21. This is an update of a prior study of the new two-wheeler fleet in FY 2017–18. The key two-wheeler parameters of engine displacement, engine power, curb weight, transmission, fuel type, fuel consumption under WMTC, and CO_2 emissions were analyzed. There are currently no fuel consumption standards for this vehicle segment. However, based on ICCT's earlier estimation of feasible fuel consumption targets for 2025 and 2030, this study explored how the two-wheeler market would fare in terms of fuel consumption, if such targets are adopted.

The key findings are:

» The fleet average CO_2 emission level of two-wheelers in India was 38.2 g/km in FY 2020–21. Compared to the fleet average in FY 2017–18, this is 7% less.

» The penetration of electric two-wheelers increased marginally from 0.1% in FY 2017–18 to 0.2% in FY 2019–20 and then to 0.3% in FY 2020–21.

» Curb weight can be considered as a utility parameter option for fuel consumption standards for the new two-wheeler fleet. A slope reduction that is 40% of the weighted average trend line can be chosen to give advantage to the models which are light and reasonably fuel efficient.

» Adoption of ICCT's proposed fuel consumption targets for 2025 and 2030, namely 25.3 g CO_2/km and 20.5 gCO_2/km, would result in 33.7% (2025) and 46.3% (2030) fuel consumption reduction from the fleet average fuel consumption level of FY 2020–21.

» The comparison of best-in-class models with the other models in each category shows there a great deal of room for improvement in the fuel consumption level in each of these categories.

» A fuel efficiency labeling program could be designed for the two-wheeler fleet and the star rating bands of the two-wheeler models would allow for comparison of the various models in the market.