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Fuel consumption from light commercial vehicles in India, fiscal years 2019–20 and 2020–21

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Keywords: CO_2 emissions, LCV baseline, LCV fleet average, LCV fuel consumption, mini truck, pickup

Introduction

In April of 2020, responding to severe air quality problems in many Indian cities, the Indian government introduced its Bharat Stage VI (BS VI) emissions standards for all new sales of automobiles, which replaced the Bharat Stage IV (BS IV) norms.[1] While BS VI does not govern carbon dioxide (CO_2) emissions (but instead covers pollutants like carbon monoxide [CO], particulate matter [PM], oxides of nitrogen [NOx] and others), these new emission standards prompted manufacturers to make changes to their light commercial vehicle (LCV) models, or introduce new BS VI LCV models. This paper examines the CO_2 emission implications of vehicle model changes between the last year of BS IV (fiscal year 2019–20) and the first year of BS VI (FY 2020–21). The purpose is to highlight the potential contribution to India's climate stabilization efforts of future standards for CO_2 and fuel consumption in LCVs.

Our analysis is useful in several ways to transportation, fuel (efficiency), and climate policymakers. It establishes a baseline of fleet average fuel consumption (using CO_2 emissions as a proxy) that could be useful for future efforts to develop an effective CO_2 emission standard. It assesses the performance of India's LCV fleet against that of the European Union (considering the differences in curb weight and vehicle size in the two jurisdictions), revealing the potential for emissions improvement in Indian LCVs through such regulations. And it suggests the expected performance of LCV manufacturers if a star-labeling standard or India's existing passenger car fuel consumption standards were to be adapted for LCVs.

1 The urgent need to improve air quality led the Indian government to decide in 2016 to skip BS V standards in favor of BS VI standards, for implementation starting in April 2020, the first instance in the world of such leapfrogging. See *India Bharat Stage VI emission standards*, (ICCT: Washington, DC, 2016) https://theicct.org/sites/default/files/publications/India%20BS%20VI%20Policy%20Update%20vF.pdf.

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The paper focuses on the N1 (load-carrying LCVs) category of vehicles, which consists of mini trucks and pickups. It includes a brief comparison with the performance of the M1 (passenger cars) category of vehicles[2]. This paper is a continuation in the series of working papers on the Indian LCV market, dating back to 2016.[3]

Background

The light-duty vehicle market was approximately 83% passenger cars (PCs) and 17% LCVs in FY 2019–20; this shifted slightly to 85% PCs and 15% LCVs in FY 2020–21.[4] LCVs are used in India as "last-mile" connectivity to move goods to their destination. As shown in Figure 1, sales of Indian goods-carrying LCVs reached a peak of 0.56 million in FY 2018–19. But in FY 2019–20 sales declined by 27% and the downtrend continued further in FY 2020-21, when the Indian automobile market shifted to BS VI standards, and when COVID-19 and subsequent lockdowns impacted the Indian economy.

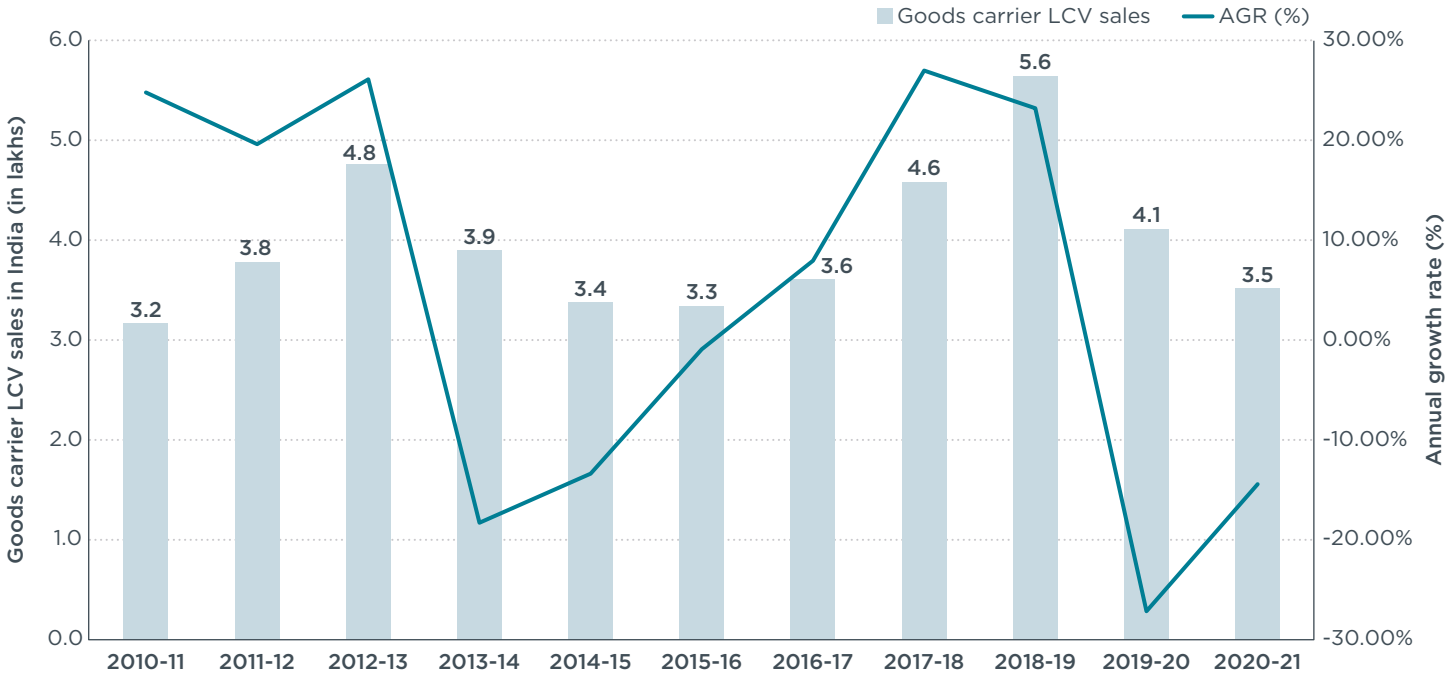

Figure 1. Sales of goods-carrying LCVs in India

[a] Source: ICCT's analysis on SIAM data

The Indian LCV market is dominated by mini trucks, and this was true for both FY 2019–20 and 2020–21, with sales shares of 56.6% and 55.8% in these two years. Pickups made up the remaining 43.4% and 44.2% shares, respectively. Most mini trucks are used as a transport link to interior areas where the roads may not be wide enough to accommodate large commercial vehicles. Such roads require a unique segment of vehicles with a small footprint and sub one-ton payload capacity; these constituted 69% of India's mini trucks in FY 2020–21. The curb weight of these vehicles is lighter, which results in lower CO_2 emissions on test cycles. Pickups, on the other hand, are used

2 N1 vehicles are goods-carrying motor vehicles that have a gross vehicle weight not exceeding 3.5 tons. M1 vehicles are passenger-carrying motor vehicles that have no more than eight seats in addition to the driver's seat, and whose gross vehicle weight does not exceed 3.5 tons.

3 Aparna Menon and Anup Bandivadekar, *Light commercial vehicles in India, 2014–15: Technology assessment and international comparisons* (ICCT: Washington, DC, 2016), https://theicct.org/publications/light-commercial-vehicles-india-2014-15-technology-assessment-and-international, and Ashok Deo and Anup Bandivadekar, *Fuel consumption from light commercial vehicles in India, fiscal year 2018–2019*, (ICCT: Washington, DC, 2021), https://theicct.org/sites/default/files/publications/India-fuel-lcv-jan2021.pdf.

4 The market shares for FY 2019–20 and FY 2020-21 are derived from sales data from Segment Y.

for both commercial and personal purposes. They generally have multi-cylinder diesel engines and higher payload capacities.

Diesel LCVs, which had significant market share earlier, dropped from 97.2% in FY 2019–20 to 69.9% in FY 2020–21. This 27.3 percentage point loss in market share was captured almost entirely by petrol LCVs, which claimed 24.3% of the market in FY 2020–21. The substantial increase in petrol LCV sales might be attributed to the high upfront cost of diesel vehicles, which require expensive after-treatment systems to meet stringent BS VI standards.

There were 7 manufacturers in FY 2019–20: Mahindra & Mahindra, Tata Motors, Ashok Leyland, Maruti Suzuki India, Isuzu Motors India, Piaggio Vehicles, and Force Motors. Piaggio Vehicles and Force Motors fell off the list after the BS VI norms in FY 2020–21.

Data sources and database construction

The vehicle attributes and technical parameters analyzed are curb weight, footprint, CO_2 emissions, fuel consumption, engine displacement, fuel type, and power. The sales data were obtained from Segment Y Automotive Intelligence, an independent international automotive data supplier. This data, however, did not include all the vehicle parameters needed for our analysis. Also, the fuel economy of many variants was not available in Segment Y data. Therefore, in constructing the database, we included information from additional sources. Some of the missing vehicle specifications, such as curb weight and dimensions[5] were obtained from manufacturer and third-party websites. The footprint of the vehicles was calculated from track length (wheelbase) and average track width data.[6] Fuel economy information was obtained either from dealers and their brochures or from the manufacturer and other commercial websites.[7]

Constructing the database primarily involved integrating the Segment Y sales data and fuel economy data based on vehicle make and model. However, there were instances where a single vehicle model had multiple variants; in the absence of additional information, this analysis assumes the specifications will be similar to those of sister variant(s). The effect of this assumption is minimal, as the variation in fuel economy across variants is small relative to the variation across models. Still, it creates some uncertainty. Once the database[8] was assembled, we calculated the sales-weighted averages of all parameters for the N1 segment. All CO_2 values used in our analysis are measured on a standard Modified Indian Drive Cycle (MIDC).[9]

Fleet characteristics of LCVs in India

Table 1 shows the LCV fleet characteristics by fuel type. Post-BS VI, the diesel fleet lost 27.3% of market share, the market share of CNG vehicles nearly doubled, and the market entry of gasoline mini trucks has created a new gasoline LCV fleet that was missing in the pre-BS VI period. Higher capacity and higher power engines were dominated

5 Data collected from manufacturers' websites, droom.in, www.trucks.cardekho.com, indotrux.com.

6 Vehicle footprint is the product of the distance between axles of the vehicle (wheelbase) and the distance between the centerline of the tires (average track width). Where vehicle track dimensions were not readily available from manufacturers' websites, front and rear track widths were calculated from vehicle width using the factors of 0.8594 and 0.8571 and the wheelbase was calculated from vehicle length using the factor 0.6188. These factors were taken from the results of ICCT's "Analysis of passenger car dimensions in the European Union, 2010".

7 Fuel efficiency and other vehicle parameters taken from www.trucks.cardekho.com, www.autos.maxabout.com, www.vicky.in, www.youtube.com, www.autoportal.com, commercialvehicleinfo.com, www.driveinside.com, a2zvehicle.com, tractruck.com, buytruck.in, www.carandbike.com, and www.indiamart.com.

8 EU data for 2019 from Sonsoles Diaz, Peter Mock, Yoann Bernard, Georg Bieker, Izabela Pniewska, Pierre-Louis Ragon, Felipe Rodriguez, Uwe Tietge, and Sandra Wappelhorst, *European vehicle market statistics 2020/21*, (ICCT: Washington, DC, 2021) https://theicct.org/publications/european-vehicle-market-statistics-202021; data for 2020 provided by Dataforce.

9 The MIDC cycle consists of an urban driving cycle and extra urban driving cycle. https://www.araiindia.com/CMVR_TAP_Documents/Part-14/Part-14_Chapter03.pdf.

by diesel. CNG LCV fleet has shifted to smaller capacity engines in FY 2020–21, with engines smaller than 1000 cc having a 50% market share within the CNG segment. The dent in the diesel market share was largely due to the petrol vehicles (24.3% market share), led by the Tata Ace Gold and Maruti Suzuki Super Carry models. Petrol models smaller than 1000 cc had a 71.6% share of petrol LCV sales. This is a new segment which has the potential of capturing further market share in coming years with the infusion of new gasoline technologies.

Table 1. LCV fleet characteristics by fuel type

Fleet characteristics	FY 2019–20			FY 2020–21		
	Diesel	CNG	Petrol	Diesel	CNG	Petrol
CO_2 emissions (g/km)	152.6	149.3	0	153.6	154.9	136.4
Curb weight (kg)	1228	1380	0	1453	1290	864
Footprint (m^2)	3.7	3.7	0	4.1	3.6	2.7
Engine displacement (cc)	1595	1884	0	1912	1448	836
Engine power (kW)	33.5	43.7	0	49.2	34.1	31.1
Market share (%)	97.2	2.8	0	69.9	5.8	24.3

Note: Segment Y data shows no sales of electric LCVs, but the Vahan[10] data listed the sales of light-goods electric vehicles for FY 2019–20 and FY 2020–21 as 42 and 29 units, respectively.

Figures 2 to 5 in this section compare the fleet characteristics of LCVs[11] for different vehicle parameters like curb weight, CO_2 emissions, engine displacement, engine power, and footprint. Some highlights from the analysis are:

CO_2 emissions and curb weight

Average curb weight increased sharply, by 24%, from FY 2011–12 to FY 2014–15. Post-FY 2014–15, the curb weight dropped by 2% to 5% and again reached FY 2014–15 levels in FY 2020–21. There is an increase of 5.5% from 1,232 kg in FY 2019–20 to 1,300 kg in FY 2020–21. (Figure 2.) This is due to the increase in fleet average curb weight of the top 3 manufacturers (Tata, Mahindra, and Ashok Leyland) in the mini trucks' diesel segment as well as to Piaggio's discontinuation of its lighter BS IV mini truck models in the shift to BS VI. The change in the pickups' CNG sales (from Mahindra's Bolero MaxiTruck to Bolero Pik-up), though not very significant, has also contributed to an increase in average curb weight.

10 "Vahan," Ministry of Road Transport and Highways – MoRTH, Government of India, accessed 19th November 2021, https://vahan.nic.in/nrservices/.

11 For FY 2011–12, 2014–15, 2017–18, and 2018–19, data are from Aparna Menon and Anup Bandivadekar, *Light commercial vehicles in India, 2014–15: Technology assessment and international comparisons*, (ICCT: Washington, DC, 2016), https://theicct.org/sites/default/files/publications/India%20LCVs_White-Paper_ICCT_23122016.pdf; and Ashok Deo and Anup Bandivadekar, *Fuel consumption from light commercial vehicles in India*, FY 2018–2019, (ICCT: Washington, DC, 2021), https://theicct.org/publications/fuel-consumption-lcv-india-jan2021.

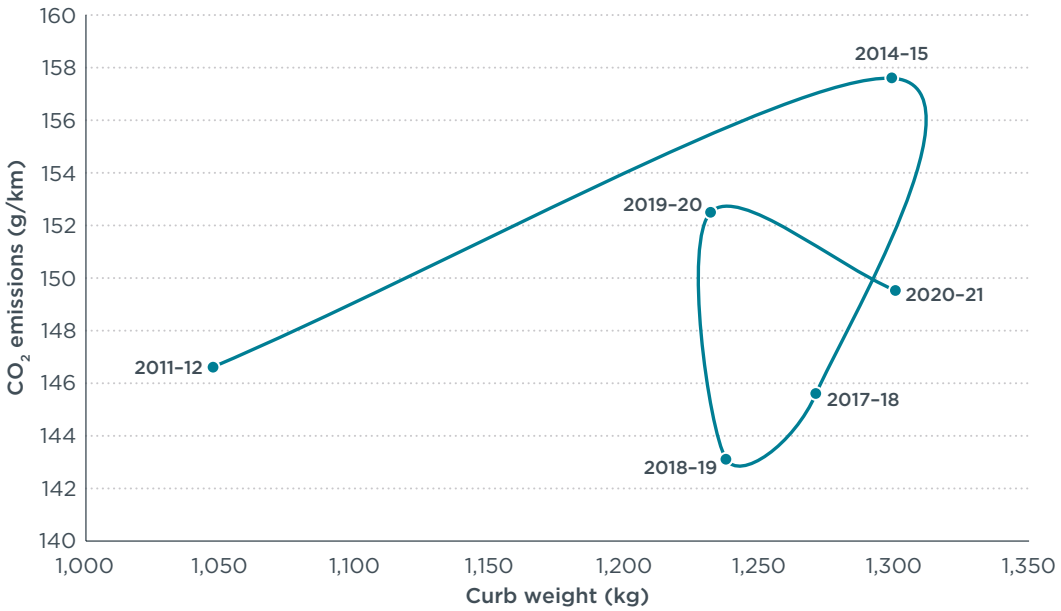

Figure 2. Fleet average CO_2 emissions and curb weight of Indian LCVs, 2011–12 through 2020–21

Average CO_2 emissions decreased from 152.5 g/km in FY 2019–20 to 149.5 g/km in FY 2020–21, almost a 2% reduction. The diesel pickup segment saw reductions in CO_2 among all the manufacturers' fleet average emissions post-BS VI.

Engine displacement

The average engine displacement of LCVs increased slightly from 1,603 cc in FY 2019–20 to 1,624 cc in FY 2020–21. (Figure 3.) This is largely because of an increase in the share of models with higher engine displacement in the mini truck (diesel and petrol) segment. Maruti Suzuki's Super Carry, with an engine capacity of 1196 cc, increased its sales to become the third highest seller in the mini truck segment in FY 2020–21, whereas sales of Mahindra Jeeto, with 625 cc–670 cc engine capacity decreased, and Maruti Suzuki discontinued its lower capacity 793 cc diesel Super Carry in the shift to BS VI.

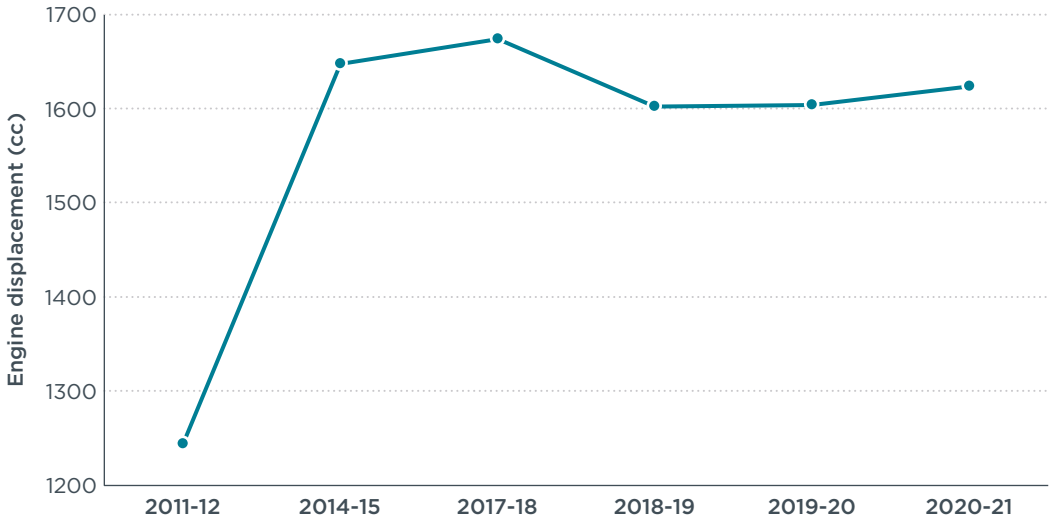

Figure 3. Fleet average engine displacement of Indian LCVs, 2011–12 through 2020–21

Fleet average engine power

Fleet average power increased considerably from 33.7 kW in FY 2019–20 to 43.9 kW in FY 2020–21, and power-to-weight ratio also increased from 0.025 kW/kg in FY 2019–20

to 0.033 kW/kg in FY 2020–21. (Figure 4.) This increase in engine power in FY 2020–21 is primarily due to manufacturers discontinuing their lower engine power models like Tata Ace (the 8 kW and 12 kW models), Mahindra Jeeto (the 8 kW model), Maruti Suzuki Super Carry (the 24 kW model), and Piaggio Porter (the 11 kW and 21 kW models) in the diesel mini trucks segment as compared to FY 2019–20. At the same time, the diesel pickups fleet saw their engine power increase by 10.7% due to Tata Yodha, with an engine power of 74 kW.

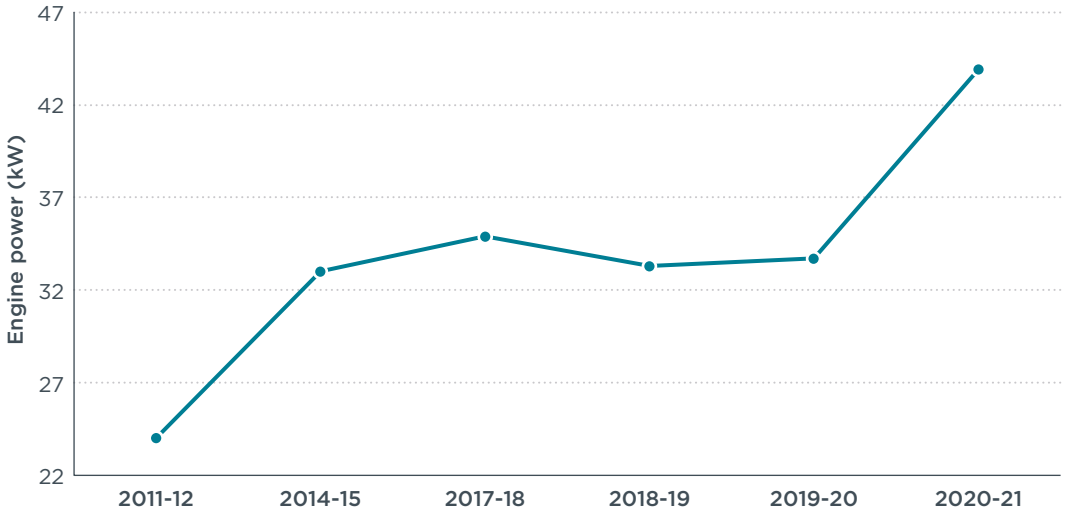

Figure 4. Fleet average engine power of Indian LCVs, 2011–12 through 2020–21

Fleet average footprint

The average footprint remained the same at 3.7 m^2 in both fiscal years. (Figure 5.)

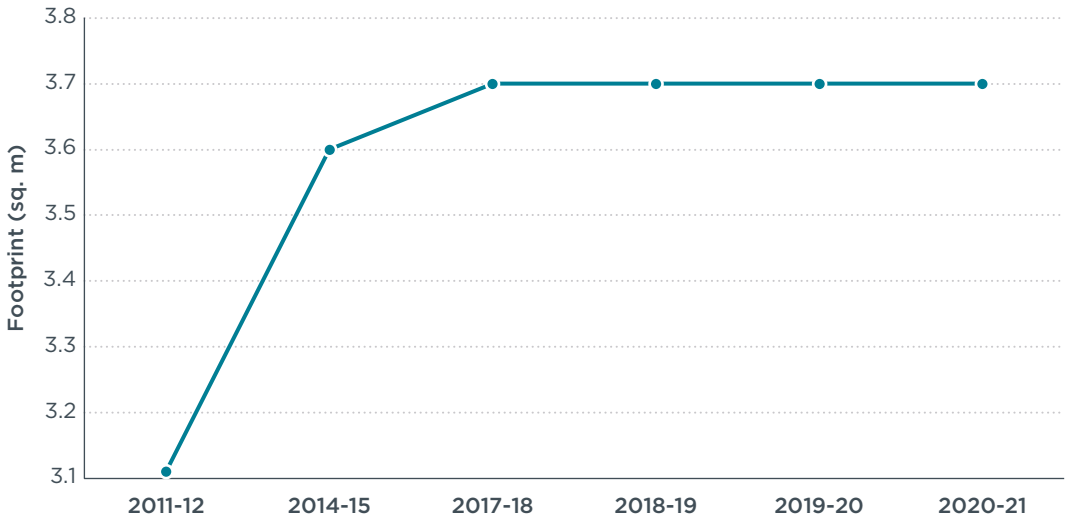

Figure 5. Fleet average footprint of Indian LCVs, 2011–12 through 2020–21

The change in the fleet characteristics of LCVs from FY 2019–20 to FY 2020–21 is primarily due to the shift to the petrol mini trucks with more engine displacement and power. It also reflects the discontinuation of lighter and low-powered diesel mini trucks by multiple manufacturers. The Tata Yodha pickup, which captured significant market share in FY 2020–21, also impacted the overall fleet characteristics trend.

LCV comparison by manufacturer

Table 2 compares the sales-weighted average values of fleet characteristics, along with the market shares, of FY 2019–20 and FY 2020–21 LCVs, by manufacturer. Mahindra and Tata clearly dominate the Indian LCV market with a combined 84% and 79% market share in FY 2019–20 and FY 2020–21, respectively. While Ashok Leyland and Maruti Suzuki increased their LCV market share in the BS VI regime, Mahindra, Tata, and Isuzu saw a dip in their shares. Piaggio and Force Motors did not offer any LCV models for sale in FY 2020–21 after the shift to BS VI. Gasoline mini trucks from Tata and Maruti Suzuki are the new entrants.

Table 2. LCV fleet characteristics by manufacturer, FY 2019–20 and FY 2020–21

	Market share (%)		Diesel (%)		Petrol (%)		CNG (%)		Curb weight (kg)		Engine displacement (cc)		Engine power (kW)		Footprint (m^2)		Power/weight (kW/kg)	
Manufacturer	FY 2019–20	FY 2020–21	FY 2019–20	FY 2020–21	FY 2019–20	FY 2020–21	FY 2019–20	FY 2020–21	FY 2019–20	FY 2020–21	FY 2019–20	FY 2020–21	FY 2019–20	FY 2020–21	FY 2019–20	FY 2020–21	FY 2019–20	FY 2020–21
Mahindra & Mahindra Ltd.	46	40	97	94	-	-	3	6	1450	1487	2146	2229	42	46	4.4	4.3	0.029	0.030
Tata Motors Ltd.	38	39	100	49	-	45	0	7	996	1161	1067	1128	22	36	3.0	3.4	0.022	0.029
Ashok Leyland Ltd.	10	13	90	100	-	-	10	0	1264	1384	1478	1478	42	55	3.3	3.5	0.033	0.040
Maruti Suzuki India Ltd.	5	8	90	-	-	91	10	9	872	871	833	1196	26	53	2.8	2.8	0.030	0.062
Isuzu Motors India Pvt. Ltd.	1	0.4	100	100	-	-	0	0	1754	1758	2487	2483	67	59	4.9	4.8	0.038	0.033
Piaggio Vehicles Pvt. Ltd.	0.1	-	100	-	-	-	0	-	842	-	823	-	15	-	2.4	-	0.018	-
Force Motors Ltd.	0.2	-	90	-	-	-	10	-	1719	-	1947	-	43	-	4.3	-	0.025	-

As the table indicates, both Mahindra and Tata have seen an increase in their CNG models' shares whereas Ashok Leyland's CNG sales dropped to zero in FY 2020–21. But the major share of sales for both Tata (45%) and Maruti (91%) came from their BS VI petrol models.

Figure 6 shows the sales share by manufacturer of the BS IV models in FY 2019–20 and the BS VI variants in FY 2020–21, respectively. Tata clearly dominated mini truck sales with 56.7% and 51.6% share in FY 2019–20 and FY 2020–21, respectively. Mahindra is the market leader in the pickup category with 84.6% and 75.9% share in FY 2019–20 and FY 2020–21, respectively. Isuzu has a market presence only in the pickup category.

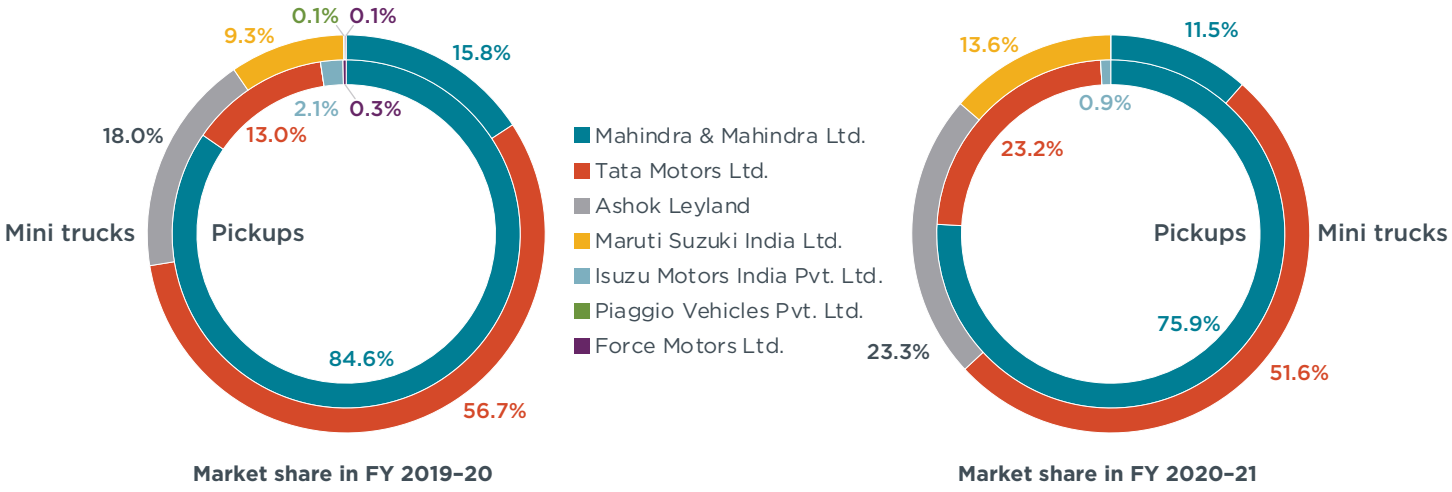

Figure 6. LCV sales breakdown of mini trucks and pickups, by manufacturer

Figure 7 shows the CO_2 emissions and curb weight of the fleet of FY 2019–20 and FY 2020–21 vehicles. The size of the circles corresponds to the size of the market share of the manufacturers. The CO_2 emissions of the Maruti Suzuki and Tata fleets increased after the sales share of their BS VI petrol mini trucks increased significantly compared to the reduced sales of their diesel mini trucks. Despite the higher average fleet curb weight in FY 2020–21 for Ashok Leyland, Mahindra, and Isuzu, the CO_2 emissions declined due to better technologies such as after-treatment systems.

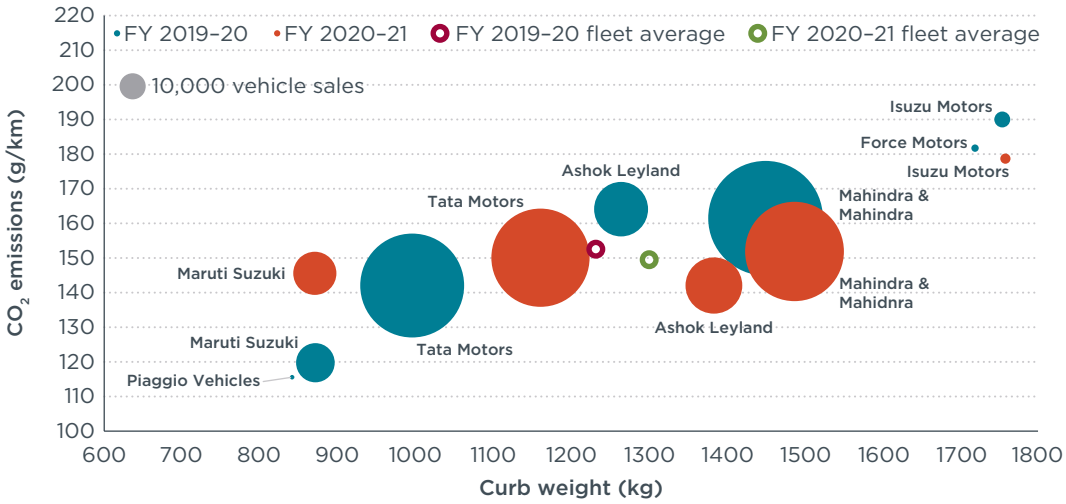

Figure 7. Fleet average CO_2 emissions vs. curb weight, FY 2019–20 and FY 2020–21

Table 3 gives the percentage improvement or decline in each manufacturer's fleet CO_2 emissions. Ashok Leyland shows the greatest improvement, followed by Mahindra and Isuzu. Note that both Maruti and Tata have replaced diesel mini truck variants with gasoline-powered alternatives, which have higher CO_2 emissions.

Table 3. CO_2 emissions comparison, by manufacturer

Manufacturer	CO_2 reduction (%) from FY 2019–20 to FY 2020–21[a]
Mahindra	6.0
Tata	-5.6
Ashok Leyland	13.4
Maruti	-21.5
Isuzu	5.9

[a] negative values indicate an increase in CO_2 emissions

Figure 8 compares the CO_2 and vehicle footprint of FY 2019–20 and FY 2020–21 manufacturer fleets. The size of the circles corresponds to the market share of the manufacturers. As per our analysis, the average fleet footprint does not seem to have any direct effect on CO_2 emissions.

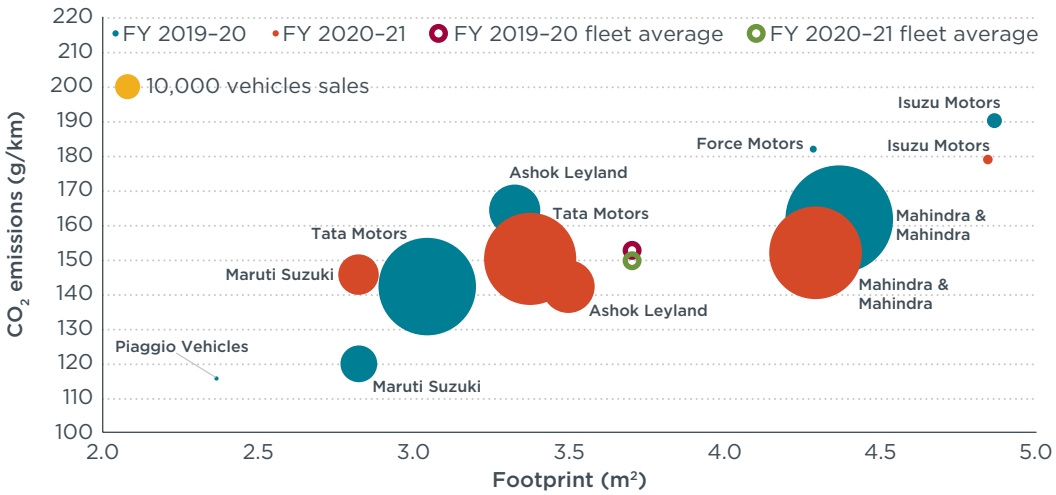

Figure 8. Fleet average CO_2 emissions vs. footprint, FY 2019–20 and FY 2020–21

Comparison of mini trucks and pickups

Mini trucks have long dominated the Indian LCV market and this was no less true for FY 2019–20 and FY 2020–21. Figure 9 shows shares of the LCV market held by manufacturers and body types. Tata Ace was the highest selling LCV in India FY 2019–20, whereas Tata Ace Gold captured the top spot in FY 2020–21. Mahindra Bolero MaxiTruck remained the top pickup model both in FY 2019–20 and FY 2020–21. Maruti Suzuki Super Carry captured a 7.6% market share, becoming the third highest-selling model in the mini truck category in FY 2020–21 and displacing Mahindra Jeeto (sales of which decreased from 8.8% in FY 2019–20 to 5.8% in FY 2020–21). The double cabin Mahindra Bolero Camper replaced Mahindra Imperio with roughly the same market share. The market share of the single cabin Mahindra Bolero MaxiTruck pickup nearly doubled in FY 2020–21, consolidating its top position in the pickup segment. Tata Yodha also gained a sizable 10.2% market share in FY 2020–21, becoming the second-best seller in the pickup segment.

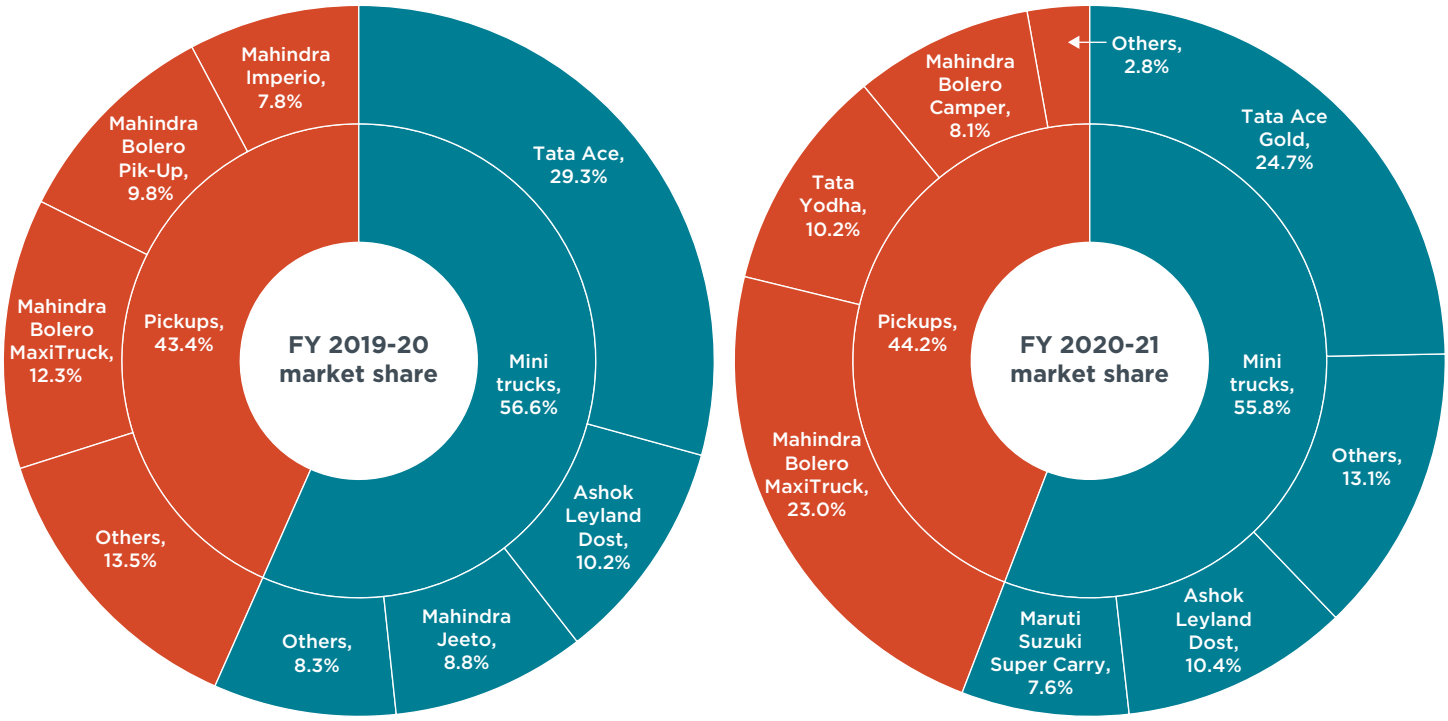

Figure 9. Market share by body type and top sellers

Additionally, our analysis from FY 2019–20 to FY 2020–21 shows that variants that were complying with BS IV standards were entirely phased out or replaced with BS VI models.

Figure 10 gives the CO_2 values of some of the variants that were upgraded from BS IV to BS VI. The Bolero Pik-Up, one of the top-selling products of Mahindra, reduced its CO_2 emissions by 6.5% in the BS VI upgrade and Isuzu's D-Max BS VI variant reduced its CO_2 emissions by 5.9%. Tata's Ace Gold (which replaced the lighter Tata Ace) and Maruti Suzuki's Super Carry are among the top sellers in the mini truck segment, and their CO_2 emissions increased by 9.9% and 12.4% in BS VI models, respectively. This is due to the high sales of petrol versions (introduced in the BS VI regime) over the previously dominating diesel ones for both Super Carry Ace Gold models. Ashok Leyland Dost models showed the highest improvement in the shift to BS VI with an average CO_2 emissions reduction of 12.2%. A couple of manufacturers, Force Motors and Piaggio Vehicles, did not introduce BS VI models during FY 2020–21. The upgrades in pickups reduced the overall CO_2 emissions of manufacturers more than the improvements in mini trucks.

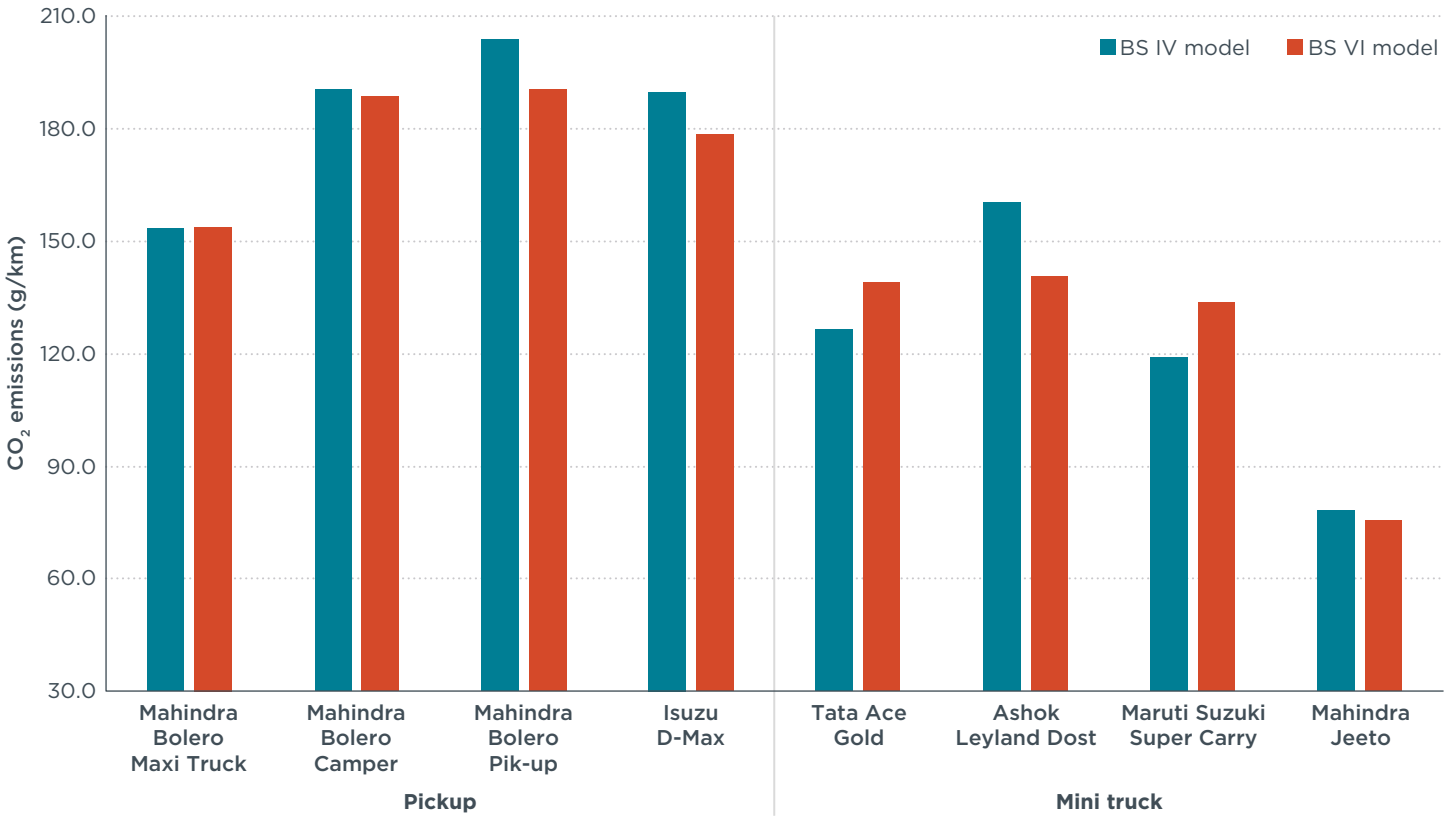

Figure 10. CO_2 emissions (BS IV and BS VI), select models

Table 4 gives the fleet characteristics of mini trucks and pickups for FY 2019–20 and 2020–21. From FY 2019–20 to FY 2020–21, the average CO_2 emissions of mini trucks increased by 6.9% from 125.5 g/km to 134.2 g/km. This increase, despite the shift to BS VI models, is thought to be due to petrol models' capture of a nearly 46% market share in the mini truck segment in FY 2020–21 from 0% in FY 2019–20. The average CO_2 emissions of pickups decreased by 10% from 187.7 g/km to 168.9 g/km. This is due to the significant reduction in fuel consumption of high-selling BS VI models across manufacturers, and to Tata Yodha (10.2% market share and CO_2 emissions of 180.1 g/km) displacing the more emitting (refer Figure 10) Mahindra Bolero Pik-up (CO_2 emissions of 203.7 g/km in FY 2019–20. In addition, the market share of the top 3 sellers in the segment fell from 9.8% in FY 2019–20 to 2.4% in FY 2020–21.

The average curb weight of mini trucks increased from 900 kg in FY 2019–20 to 1011 kg in FY 2020–21. This is due to higher FY 2020–21 sales numbers of heavier models like Tata V10, Tata V30, and Mahindra Supro, as well as to reduced sales of lighter models like Tata Ace (replaced with the heavier Ace Gold) and Mahindra Jeeto as compared to FY 2019–20. The average curb weight of pickups remained the same, at 1666 kg in FY 2019–20 and FY 2020–21.

From FY 2019–20 to FY 2020–21, the average footprint of mini trucks increased slightly from 2.8 m^2 to 3 m^2. The average footprint of pickups also increased from 4.4 m^2 to 4.6 m^2. Some newly added vehicles like the Tata Yodha, which has a wider stance of 5 m^2 and a market share of 10.2%, have contributed to the increase.

The average engine displacement of mini trucks has increased from 862 cc in FY 2019–20 to 976 cc in FY 2020–21. This rise is largely because of the shift to petrol mini trucks and because the Ashok Leyland Dost and Bada Dost diesel models, with a higher engine displacement of 1478 cc, sold more than the lower engine displacement models from other manufacturers in FY 2020–21.

Table 4. Comparison of characteristics between mini trucks and pickups

Fleet characteristics	FY 2019–20		FY 2020–21	
	Mini trucks	Pickups	Mini trucks	Pickups
CO_2 emissions (g/km)	125.5	187.7	134.2	168.9
Curb weight (kg)	900	1666	1011	1666
Footprint (m^2)	2.8	4.4	3.0	4.6
Engine displacement (cc)	862	2571	976	2443
Power (kW)	19.8	51.9	33.5	57.1
Power to weight ratio (kW/kg)	0.020	0.031	0.032	0.034
Market share (%)	56.6	43.4	55.8	44.2

Most mini trucks have a smaller footprint, lower curb weight, and lower CO_2 emissions compared to pickups, which tend to have bigger engines and heavier curb mass, both of which increase their fuel consumption and in turn CO_2 emissions.

Figure 11 illustrates the curb weight and CO_2 emissions of mini trucks and pickups. In FY 2020–21, the emissions of mini trucks (with a fleet average curb weight of 1011 kg) were 39% lower than that of pick-ups (with a fleet average curb weight of 1666 kg). The linear trend lines suggest that both mini trucks and pickups emit significantly more as their curb weight increases.

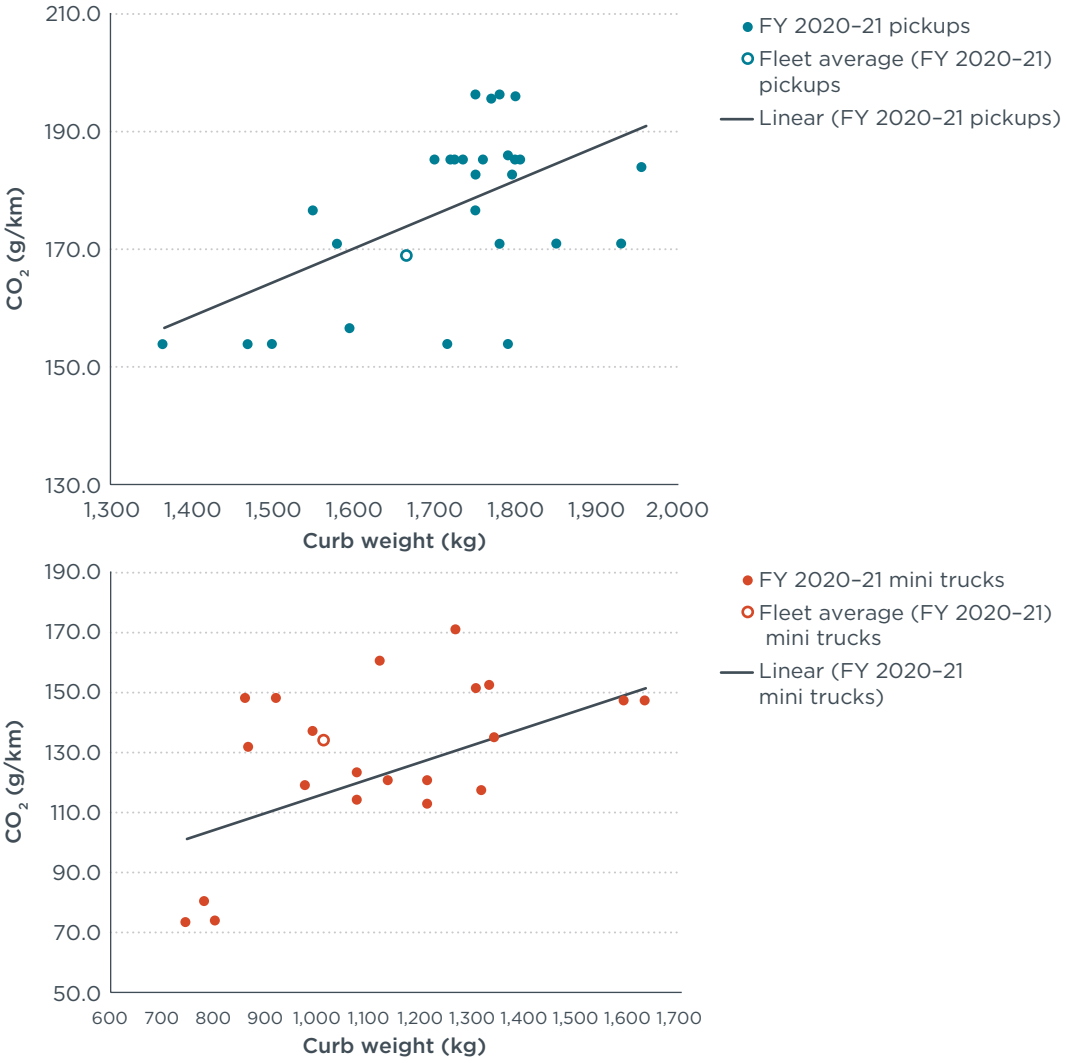

Figure 11. Curb weight versus CO_2 emissions regression for mini trucks and pickups, FY 2020–21

Comparison with the European Union

In 2019, the on-road vehicle market share for passenger cars in the European Union[12] (EU) was 86.4% and the LCV market share was 11.2%.[13] Trucks and buses > 3.5 t made up the remaining 2.4%. LCVs are also categorized as N1 vehicles in the EU, and Table 5 details the fleet characteristics of LCVs in both India and the EU. Our analysis shows that the engines in the LCV fleet in India are generally smaller than in the EU fleet. Fleet average curb weight in India is significantly lower by 595 kg compared to the EU fleet.

Table 5. LCV fleet characteristics in India and the EU

Fleet characteristics	India		EU	
	FY 2019–20	FY 2020–21	2019	2020[a]
Engine displacement (cc)	1603	1624	1927	1903
Curb weight (kg)	1232	1300	1874	1895
CO_2 emissions (g/km)[b]	152.5	149.5	160	155.7
Power (kW)	33.7	43.9	95	95
Power to weight ratio (kW/kg)	0.027	0.033	0.051	0.050
Footprint (m^2)	3.7	3.7	5.4	NA
Automatic transmission (%)	0	0	9	NA
Diesel (%)	97	70	93	94.3
Compressed natural gas (%)	3	6	1.3	0.7

[a] The European Environment Agency (EEA) published preliminary CO2 monitoring data for PCs and LCVs in June 2021. EEA data is for the EU-27, UK, Iceland, and Norway. http://co2vans.apps.eea.europa.eu/ accessed November 22, 2021.

[b] India has adopted the European emission test procedure NEDC, with one difference. The maximum speed of 120 km/h has been lowered to 90 km/h in the extra urban driving part of the cycle (EUDC). The revised cycle is called the modified Indian driving cycle (MIDC). https://www.araiindia.com/CMVR_TAP_Documents/Part-14/Part-14_Chapter03.pdf.

[c] Source: ICCT analysis of Segment-Y data for India; EU data from Sonsoles Diaz, Peter Mock, Yoann Bernard, Georg Bieker, Izabela Pniewska, Pierre-Louis Ragon, Felipe Rodriguez, Uwe Tietge, Sandra Wappelhorst, *European vehicle market statistics 2020/21*.

The average CO_2 emissions from the EU fleet[14] are higher than in India. This is primarily due to LCVs in EU being bigger in terms of engine displacement, curb weight, and footprint. Figure 12 demonstrates the relationship between curb weight and CO_2 emissions for the Indian and EU LCV fleets and shows the relative position of each manufacturer when compared with EU CO_2 emission standards.[15] At similar emissions of CO_2, most of the EU manufacturers produce vehicles with a larger footprint and higher curb weight. This suggests that the EU LCVs are, on average, more fuel efficient than the Indian vehicles. All EU manufacturers are meeting the 2017 target in 2019 and few have fleet average values close to meeting 2020 targets.[16]

12 Data is for the EU-27 + UK (previously EU-28).

13 EU LCV market share and fleet characteristics for 2019 from Diaz, Mock, et al., *European vehicle market statistics 2020/21*, (ICCT: Washington, DC, 2021).

14 CO_2 data for EU is NEDC-based (New European Driving Cycle). The EU is transitioning from the old NEDC test procedure to the WLTP (Worldwide Harmonized Light Vehicle Test Procedure).

15 The European Commission, CO_2 emission performance standards for cars and vans, https://ec.europa.eu/clima/eu-action/transport-emissions/road-transport-reducing-co2-emissions-vehicles/co2-emission-performance-standards-cars-and-vans_en

16 In 2020, a type-approval CO_2 emissions target of 147 g/km (NEDC) came into force for the new European van fleet, replacing the 2017 target of 175 g/km. Sonsoles Díaz, *The often forgotten larger, heavier cousins of passenger cars: Europe's CO_2 regulation for vans*, (ICCT: Washington, DC, 2021) https://theicct.org/blog/staff/europe-co2-regulation-vans-jun2021. There are no annual targets in the EU; instead, a stepwise scheme is used.

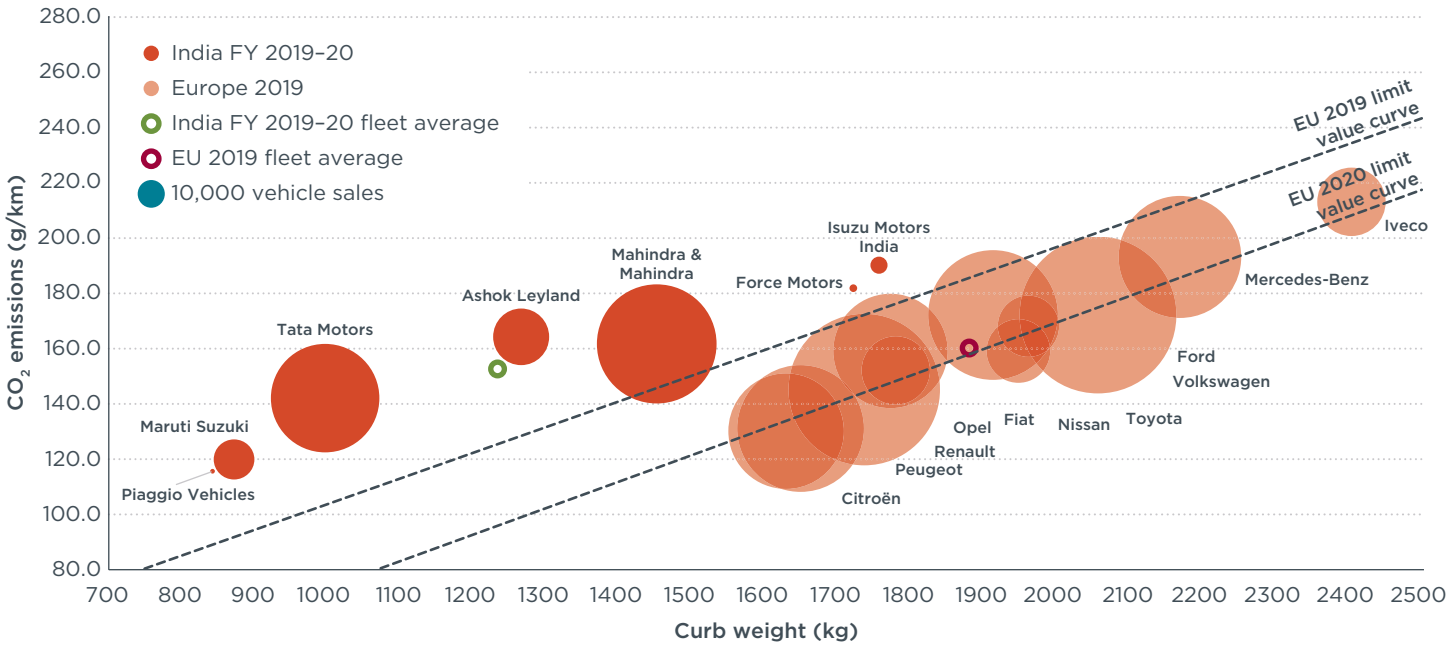

Figure 12. Curb weight versus CO_2 emissions for India and EU.

The size of the circles is reflective of market size.

Source: ICCT's analysis on Segment-Y data for Indian data; EU 2019 data from Diaz, Mock, et al., *European vehicle market statistics 2020/21*.

As Figure 12 also shows, most of the Indian manufacturers have a large gap with the 2020 EU target in FY 2020–21. This is because the slope of European standards is quite high for Indian vehicles, which are lighter than EU LCVs. Additionally, the European Union has set targets for 2025 and 2030 for LCVs; this can be a reference for India to draft its own targets for 2030. As per these targets, new EU LCVs' CO_2 emissions, on average, should decline by 15% from 2025 on and by 31% from 2030 relative to the 2021 baseline.[17] Furthermore, the European Commission has recently proposed a stronger target for vans for 2030 (-50%) and a new 2035 target of -100%, which are pending negotiations with the European Parliament and EU member states.[18] Expressed in NEDC terms, using the current 2020 CO_2 target of 147 g/km as the baseline, these reductions would translate to a target value of 125 g/km (2025) and 101 g/km (2030).

Table 6 considers Indian manufacturers' CO_2 performance if EU LCV fuel consumption standards were adopted in an Indian scenario.

Table 6. Gap between LCV CO_2 emissions (FY 2020–21) in Indian and EU LCV targets

Manufacturer	Market share (%)	Curb weight (kg)	CO_2 emissions (g/km)	EU 2020 equivalent target (g/km)	CO_2 reduction required (%)
Mahindra & Mahindra	39.9	1487	151.9	120.2	26.4
Tata Motors	39.1	1161	150.1	88.9	68.9
Ashok Leyland	13.0	1384	142.1	110.2	28.9
Maruti Suzuki India	7.6	871	145.5	61.0	138.5
Isuzu Motors India	0.4	1758	178.7	146.2	22.2
Total	**100.0**	**1300**	**149.5**	**102.3**	**46.2**

17 The European Commission, CO_2 emission performance standards for cars and vans, https://ec.europa.eu/clima/eu-action/transport-emissions/road-transport-reducing-co2-emissions-vehicles/co2-emission-performance-standards-cars-and-vans_en.

18 Peter Mock, *The European Commission's fitness program for climate protection sluggards*, (ICCT: Washington, DC, 2021), https://theicct.org/blog/staff/european-commission-fitfor55-jul2021.

The table shows that Indian LCVs need to reduce their CO_2 emissions considerably (ranging from 22.2% to 138.5%) to meet the EU targets for LCVs. But this specific emission target would be different if a similar target for LCVs is developed for the Indian fleet as the average mass of the fleet is lower for the Indian fleet compared to the EU fleet.

LCV technology comparison

EU LCVs have energy efficient technology that could also be used in India. Moreover, most of the pickups in India share architecture with SUVs in the M1 category and could readily use some of the same technologies to improve fuel efficiency, including start-stop, low-resistance tires, and electric power steering. Apart from these, the EU LCV market is also adopting alternative powertrain technologies, in addition to the usual internal combustion engine vehicles (ICE), although their sales penetration is still nascent as shown in Table 7.[19]

Table 7. India and EU LCV market shares (%) by powertrain type in 2019 and 2020

	India		Europe	
	2019	**2020**	**2019**	**2020**
FCEV	0.00	0.00	0.00	0.00035
BEV	0.00	0.00	1.35	2.06
HEV	0.00	0.00	0.12	0.11
ICE	100	100	98.23	96.99
MHEV	0.00	0.00	0.11	0.63
PHEV	0.00	0.00	0.13	0.16

[a] *Source:* ICCT analysis of Segment-Y data for India and Dataforce data for the EU

Although ICEs clearly dominate EU sales numbers, with 97-98% market share in 2019 and 2020, battery electric vehicles (BEVs) dominate non-ICE sales and have also increased their market share, from 1.35% in 2019 to 2.06% in 2020. Other non-ICE tech models available in the EU are plug-in hybrid (PHEV), mild-hybrid (MHEV), and hybrid-electric (HEVs) vehicles. Even a fuel-cell electric vehicle (FCEV) model made an entry in 2020, with total sales of 6. The non-ICE models made available in the EU market increased from ~36% in 2019 to ~45% in 2020. With the increase in availability, the sales share of non-ICE models also increased from 1.7% in 2019 to 3% in 2020.

With the shift to BS VI, Indian LCVs shifted to petrol (24.3% market share) and the diesel share declined from 97% in 2019 to 69% in 2020. But in the EU, diesel models remain popular with their sales share increasing slightly by 0.41% while petrol models fell by 1% from 2019 to 2020. During the same period, electric LCV sales in the EU gained slightly, by 0.7%.

Shift from Euro 5 to Euro 6 versus BS IV to BS VI

The fleet sales shift from one emission standard to the next happens gradually in the EU. Euro 5 standards started in 2009 for the N1 fleet in Europe and despite a bit of mix in the interim years, 2012 is assumed to have had the highest share of Euro 5 fleet. Hence 2012 has been chosen as the comparison year for the Euro 5 LCV fleet. Starting in September 2015, the Euro 6 standards kicked in for new light commercial vehicles.[20] By 2018, 98% of LCVs were Euro 6, so 2018 is considered the last year of the Euro 6 phase-in.[21] The shift from BS IV to BS VI happened from FY 2019–20 to FY 2020–21 in India, not gradually

19 European LCV market data for 2019 and 2020 provided by Dataforce.

20 Transportpolicy.net, EU: Light-duty: Emissions, https://www.transportpolicy.net/standard/eu-light-duty-emissions/.

21 Diaz, Mock, et al., *European vehicle market statistics 2020/21*, (ICCT: Washington, DC, 2021).

but with a 100% BS VI sales mandate starting from April 2020. Table 8 compares the fleet parameters during this shift in both EU and India.

Table 8. Indian and EU LCV fleet parameters during emissions regime change

Fleet characteristics	India		EU	
	FY 2019–20 (BS IV)	FY 2020–21 (BS VI)	2012 (Euro 5)	2018 (Euro 6)
Engine displacement (cc)	1603	1624	1935	1909
Curb weight (kg)	1232	1300	1751	1829
CO_2 emissions (g/km)	152.5	149.5	178	158
Engine power (kW)	33.7	43.9	83	93
Footprint (m^2)	3.7	3.7	5.1	5.3
Automatic transmission (%)	0	0	3	7
Diesel (%)	97	70	97	94
Natural gas (%)	3	6	0.7	1
Petrol (%)	0	24	NA	NA

[a] Source: ICCT's analysis on Segment-Y data for Indian data and for EU 2012 and 2018 data from Diaz, Mock, et al., *European vehicle market statistics 2020/21*, (ICCT: Washington, DC, 2021).

During this shift to stricter emissions standards, there was a significant shift to petrol models in India (to avoid the expensive after-treatment solutions for diesel models) but this shift to petrol is not significant in the EU. Although diesel models continue to dominate in the EU, electric LCVs are rising with a market share of 1.4% in 2019 and 2% in 2020. Indian LCVs' CO_2 emissions decreased by 2% with the rise of petrol models while CO_2 emissions from EU LCVs declined by 11.2% from 2012 to 2018. As the European Commission adopts stricter CO_2 targets, the availability and sales share of electric LCVs is bound to increase in the EU.

The EU LCV engines on average are almost 300 cc bigger than engines in Indian LCVs, and EU LCVs are heavier as well, by more than 500 kg. Both Indian and EU LCVs became powerful with the fleet average engine power increasing by ~30% and ~12%, respectively, but EU engines are twice as powerful as Indian ones. The EU LCVs are slightly bigger, in terms of their average footprint, during this emissions regime change, whereas the Indian fleet's average footprint remained unchanged. But the average footprint of Euro 6 EU LCVs is significantly larger—by 43.2%—than the Indian BS VI fleet. The share of automatic transmission in EU LCVs reached an all-time high of 7% (it further increased to 9% in 2019), whereas the Indian market still entirely prefers manual transmissions.

Figure 14 shows the transition in both Europe (Euro 5 LCV sales peaked in 2012 and 98% Euro 6 LCV sales were achieved in 2018) and India (100% BS VI sales from FY 2020–21). As can be seen from the figure, the changes in fleet mix to meet the stricter emission norms (and models being economical upfront cost-wise in India) have resulted in the emissions reductions to some extent.

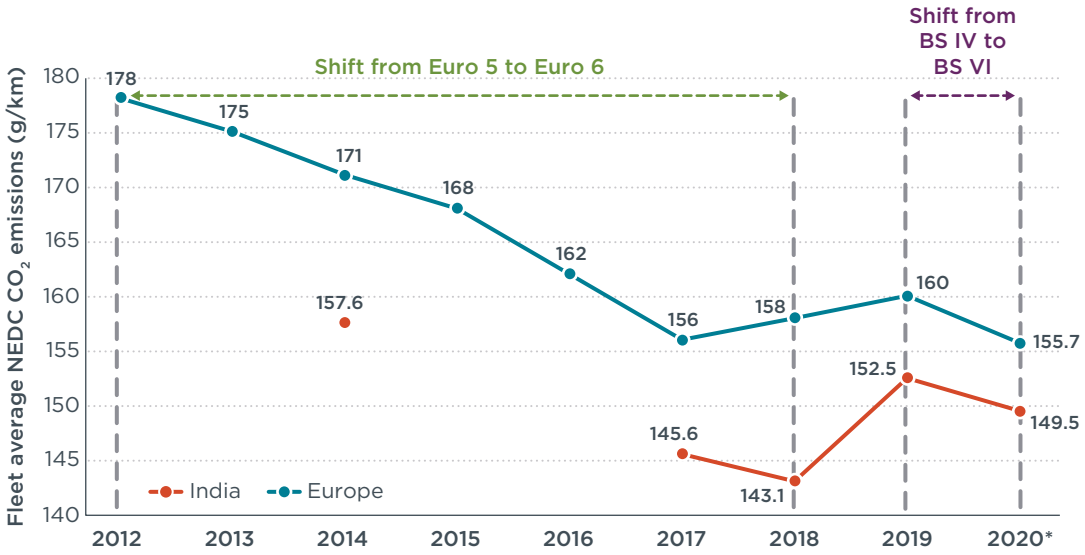

Figure 14. CO_2 emissions during emissions regime change

Source: ICCT analysis on Segment-Y data for Indian data; EU 2012 and 2018 from Diaz, Mock, et al., *European vehicle market statistics 2020/21*, (ICCT: Washington, DC, 2021).

Note: CO_2 emissions for EU 2020 is from the preliminary CO_2 monitoring data for PCs and LCVs published by the European Environment Agency (EEA) in June 2021, http://co2vans.apps.eea.europa.eu/. EEA data is for the EU-27, UK, Iceland, and Norway.

Electric LCVs in India

Electric LCVs (e-LCVs) are emerging in India, with more models being released into the market. Currently, the electric models' sales are almost negligible as shown in Table 1. In India, electric LCVs that meet certain technical criteria are eligible for various national level and state level incentives like purchase incentives, interest cost subvention, and exemption from carriage permits.[22] A few states have adopted targets like model electric mobility cities with 100% commercial and logistics fleets. Currently, two electric N1 models from Mahindra & Mahindra have been listed as eligible for the national level incentives[23] and more models have been announced[24] or are under development.[25] The trend of using electric 3-wheelers as goods-carriers, replacing the mini trucks to some extent, is also picking up fast in India. This is being supported by campaigns like Shoonya[26] from the Indian government.

Most recently, Delhi government's transport minister announced exemption for e-LCVs[27] to ply and idle-park on few identified Delhi roads during no-entry hours (congestion hours). In addition to this, Delhi government is also empaneling pure electric kit manufacturers, to encourage retrofitting ICEs to EVs, benefitting especially the diesel vehicles since their life is limited by law in Delhi to 10 years.

22 Various Indian states have announced multiple incentives for electric vehicles; few of these are directed specifically to electric LCVs. See https://www.niti.gov.in/sites/default/files/2021-04/FullReport_Status_quo_analysis_of_various_segments_of_electric_mobility-compressed.pdf.

23 The FAME-II portal lists electric vehicles in India that are eligible for the Union Government's incentives. http://fame2.heavyindustry.gov.in/ModelUnderFame.aspx.

24 Omega Seiki Mobility unveiled an electric LCV, M1KA, with bookings starting in the fourth quarter of 2021, https://economictimes.indiatimes.com/industry/renewables/omega-seiki-mobility-unveils-electric-small-commercial-vehicle/articleshow/86368179.cms.

25 Tata Motors Ltd. is developing an electric LCV based on its existing product Ace, https://www.livemint.com/auto-news/tata-builds-small-ecv-gears-up-for-year-end-launch-11616609405044.html.

26 Shoonya is a zero-pollution delivery campaign promoted by NITI Aayog and RMI that aims to reduce pollution in India by accelerating deployment of EVs for final-mile deliveries, https://twitter.com/Shoonya_India.

27 In this Delhi government exemption, LCVs include 3-wheeler goods carriers (L5N category) and N1 category vehicles, https://timesofindia.indiatimes.com/city/delhi/e-vehicles-can-ply-in-no-entry-hours/articleshow/87788346.cms.

Fuel-economy labeling for LCVs

India's BEE previously proposed a passenger vehicle fuel efficiency labeling program, though it never got implemented. It is a five-star rating system based on the gasoline equivalent fuel consumption of the vehicle. The BEE formulated rating bands, shown in the Table 9, and pursuant to this, the ranges of fuel consumption for each would be calculated using the curb weight (W) of the vehicle in kilograms.

Table 9. BEE's proposed star rating bands for passenger cars (M1 category)

Manufacturer	Gasoline equivalent fuel consumption levels (l/100km)
1 Star	FC ≥ 0.00330xW+3.0034
2 Star	0.00330xW+3.0034 ≥ FC > 0.00264xW+3.0034
3 Star	0.00264xW+3.0034 ≥ FC > 0.00216xW+3.0034
4 Star	0.00216xW+3.0034 ≥ FC > 0.00168xW+3.0034
5 Star	FC ≤ 0.00168xW+3.0034

While this labeling program was not designed for LCVs, for this analysis, the same star-rating bands were applied to LCVs based on their gasoline equivalent fuel-efficiency values, and then plotted in Figure 15. This was used given that the N1 category and M1 category models in India generally share the same engines and powertrains, especially for manufacturers present in both segments. Doing so for the BS VI vehicles (FY 2020–21) shows that 8% of the vehicles would get a one-star rating, and 10% would be assigned a five-star rating. The percentage of vehicle sales receiving two, three, and four stars would be 38%, 24%, and 20%, respectively. A fuel-economy labeling program can be implemented on LCVs in India.

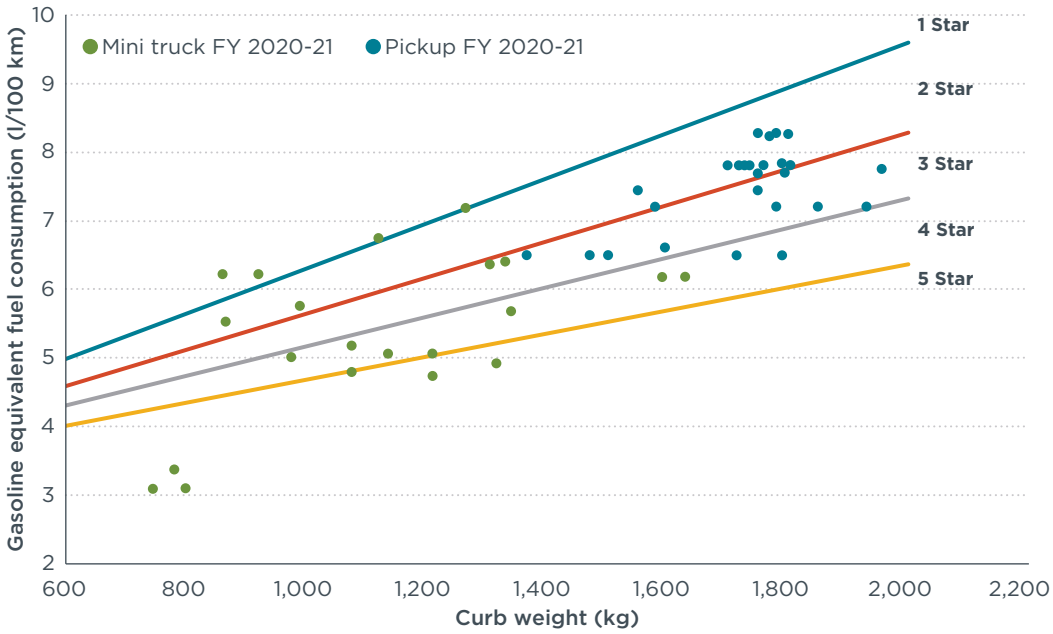

Figure 15. LCV fuel consumption labeling exercise based on proposed star rating bands for passenger cars

Fuel economy comparison with M1

India's fuel consumption standard for M1 category passenger vehicles, the first such standard in the country, was implemented on April 1, 2017, by Ministry of Road Transport and Highways (MoRTH) in collaboration with the Bureau of Energy Efficiency

(BEE).[28] The standard uses the average fuel consumption of all vehicles sold by the manufacturers in the fiscal year. Based on this standard it is expected that the passenger car fleet fuel consumption would decline.[29] The government should prioritize implementing a similar standard for LCVs, which could supplement the expected reduction of fuel.

Figure 16 compares the CO_2 emissions of the M1 and N1 category fleets in India. These segments have the same powertrain and similar engine displacements. Passenger cars have a lighter weight and better efficiency compared to LCVs. The passenger car fleet average CO_2 values are 122.4 g/km[30] and 121.3 g/km,[31] which are ~13% and ~19% better than the fleet average values for LCVs for FY 2019–20 and FY 2020–21. Most of the pickups have similar architecture as SUVs in passenger cars and thus most of the technologies can be easily applied in both segments.

The passenger car segment has a higher share of gasoline vehicles and LCVs are primarily diesel variants. However, during the shift to BS VI emission standards in FY 2020–21, this changed because the aftertreatment systems needed for diesel variants are expensive. Gasoline LCVs occupied almost a quarter of the market share, especially in the mini truck segment as it is dominated by lower power requirements. For example, the Maruti Suzuki Super Carry has been launched with a gasoline variant and the diesel model has been discontinued. Within the sales of Tata Ace Gold, India's highest selling LCV, the petrol version accounted for 70.6% of sales whereas the diesel model's share was only 18.8%.

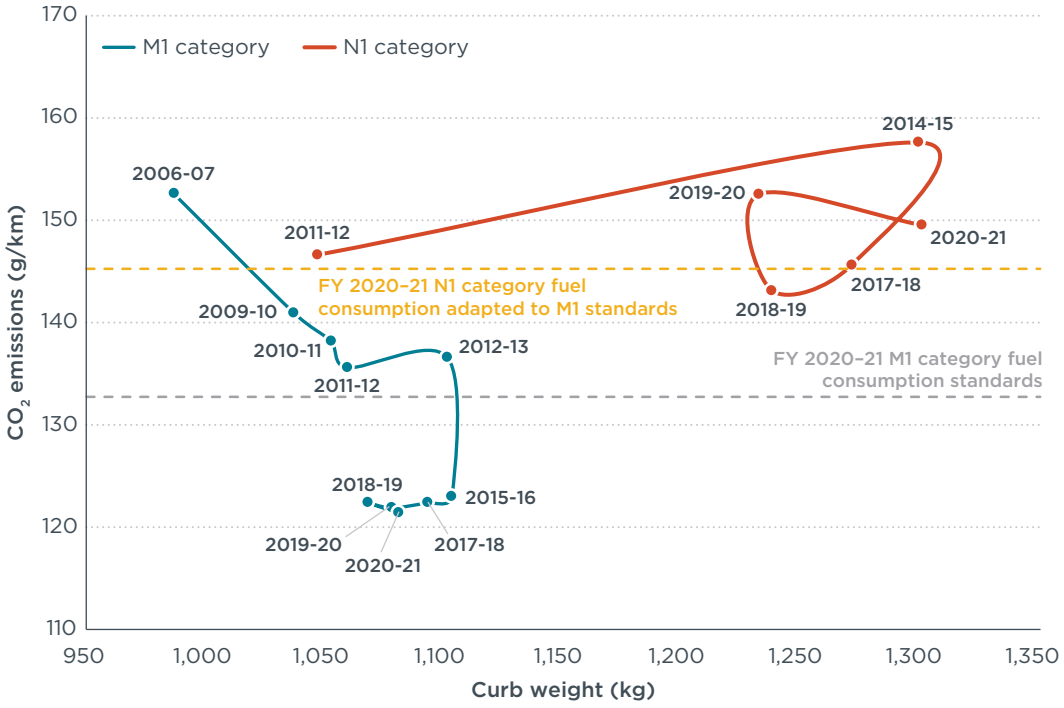

Figure 16. Fuel economy (CO_2 emissions) comparison of M1 and N1 category vehicles

28 Corporate average fuel efficiency standards for passenger cars were published by the Bureau of Energy Efficiency at https://beeindia.gov.in/content/fuel-efficiency.

29 It is expected that these standards for passenger cars would lead to a reduction of 22.97 million tons of fuel consumption by 2025, https://beeindia.gov.in/content/fuel-efficiency.

30 Ashok Deo, *Fuel consumption from new passenger cars in India: Manufacturers' performance in fiscal year 2019-20*, (ICCT: Washington, DC, 2021), https://theicct.org/publications/fuel-consumption-pv-india-apr2021.

31 Ashok Deo, *Fuel consumption from new passenger cars in India: Manufacturers' performance in fiscal year 2020-21*, (ICCT: Washington, DC, forthcoming).

Table 10 gives the CO_2 performance of individual LCV manufacturers against the M1 category fuel consumption standards.[32] For each manufacturer, an individual target is calculated based on the average weight of the manufacturer's vehicle fleet. It is therefore possible for manufacturers to balance higher emissions from some models with emissions from more fuel-efficient vehicles.

Table 10. CO_2 emissions gap compared with FY 2020–21 passenger car fuel consumption standards, by manufacturer

Manufacturer	Curb weight (kg)	CO_2 emissions (g/km)	CO_2 target based on M1 industry average weight (g/km)	Gap (%)
Mahindra & Mahindra	1487	151.9	155.9	2.5
Tata Motors	1161	150.1	137.3	-9.3
Ashok Leyland	1384	142.1	150.0	5.3
Maruti Suzuki	871	145.5	120.8	-20.5
Isuzu Motors	1758	178.7	171.3	-4.3
Overall	**1300**	**149.5**	**145.2**	**-3.0**

Other than Mahindra & Mahindra and Ashok Leyland, most of the manufacturers have a gap with the M1 FY 2020–21 fuel economy standard. The overall performance of 149.5 g/km is 3% higher than a possible fleet average target of 145.2 g/km in FY 2020–21.

Summary and conclusions

LCV sales slumped 14.8% from FY 2019–20 to FY 2020–21. Despite this, the majority of manufacturers introduced modified or new LCV models that adhere to the new BS VI emission norms. The fleet average CO_2 emissions level for LCVs in India was 152.5 g/km and 149.5 g/km in FY 2019–20 and FY 2020–21, respectively. Some highlights from our analysis:

- CO_2 emission standards, if implemented, would stimulate the inclusion of additional fuel efficiency technologies such as idle start-stop, low-resistance tires, and low viscosity engine oils. Also, mandates and incentives for bringing in zero-emission technologies like electric LCVs will increase their availability in the market and their share of sales, as observed in the EU.
- In FY 2019–20, the fleet average CO_2 emissions of Indian LCVs were 3.5% lower than emissions from the EU LCV fleet. However, fuel consumption standards are mass-based, and thus a lighter fleet must meet a stricter CO_2 target. While heavier, the European LCVs have better technology, and this helps them to meet 2019 EU targets. Based on fleet average weight, Indian LCVs would have to further improve by 37% and 32% to meet the EU targets for 2019 and 2020, respectively.
- If India's existing passenger car fuel efficiency standards were adapted for N1 category vehicles, the fleet average CO_2 target for FY 2020–21 would be 145.2 g/km. The performance of LCVs in FY 2020–21 was 149.5 g/km, which falls short by about 3%. Similar but modified standards based on the LCV fleet's fuel consumption and curb weight can be developed for the N1 segment.
- CNG penetration is currently low in both pickups and mini trucks and makes up less than 4% and 7% in these segments, respectively. This share of CNG LCVs might increase as India looks to become less dependent on foreign petrol and diesel in favor of domestically produced CNG, and given that CNG fuel is more economical than petrol and diesel in India.

32 The reference weight and procedure for calculations are as defined by MoRTH/CMVR/ TAP-115/116: Issue No.: 4 for M1 category, https://www.icat.in/pdf/fuel_consumption_standards.pdf.

» No strong hybrids or mild hybrids were offered for sale in India in either FY 2019–20 or FY 2020–21. There were sales of some electric versions of LCVs. Having a CO_2 standard could incentivize the introduction of these new technologies. Also, long-term emissions targets (for 2025 and 2030, as in the EU) will also give manufacturers a clear strategic direction for LCVs in India.

» BEE's star-rating bands for LCVs could provide customers with necessary information on efficient and inefficient models. Star labels can complement other regulatory metrics such as fleet average fuel consumption.