4.3 Consumption of petroleum products

Petroleum use is directly related to the development of any country or region. The same is true for the city of Pune. The heavy use of personalized transport in the form of two and four wheelers has caused a rapid growth in the overall demand for petroleum products within the city. In addition, the demand for domestic and industrial LPG has also grown given the increasing residential and industrial usage of the fuel. There has been increase in the sales[49] for almost all petroleum products.[50]

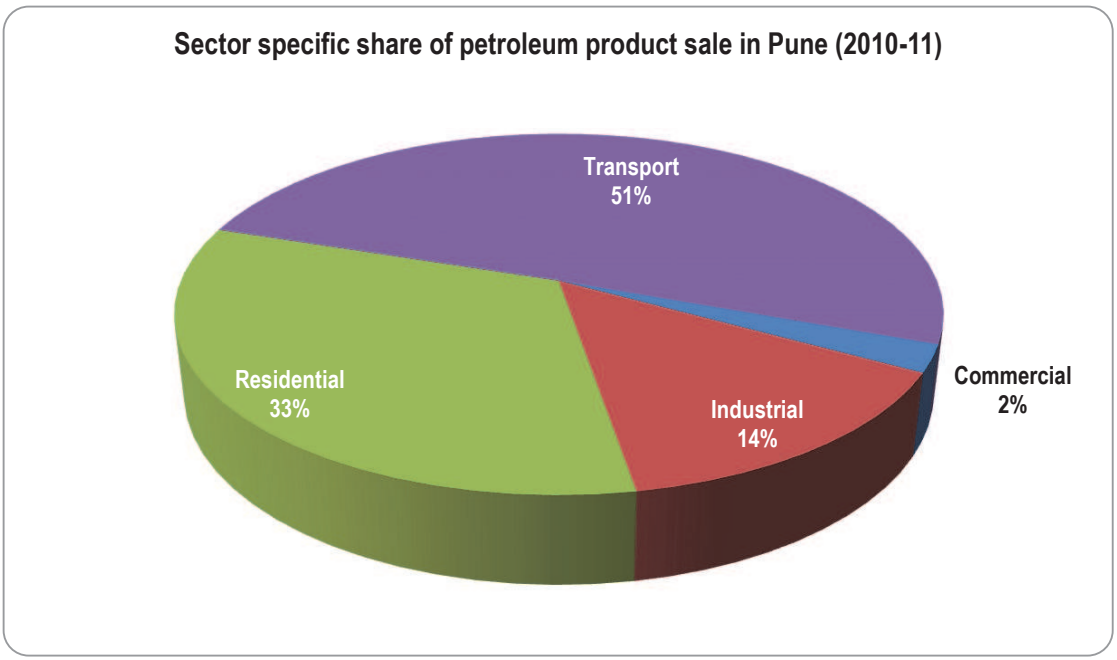

Figure 14: Sector-specific share of petroleum product sale in Pune (2010–11)[51]

The data for the petroleum usage from the city was collated using information provided by the three oil majors in the city, Bharat Petroleum Corporation Limited (BPCL), Hindustan Petroleum Corporation Limited (HPCL), and Indian Oil Corporation Limited (IOCL) for five years between 2006–07 and 2010–11. The fuels that were considered were Compressed Natural Gas (CNG), Furnace Oil (FO), High Speed Diesel (HSD), Kerosene, Light Diesel Oil (LDO), Liquefied Petroleum Gas (LPG), and Motor Spirit or Petrol, all of which are retailed at different end points such as petrol pumps and door to door deliveries. Aviation Turbine Fuel (ATF) consumption numbers were available, but have been reported separately given the Scope 2 methodology adopted for the study.

Barring the sales of kerosene and Auto LPG, which have either stayed the same or dropped in some years, the sales of all kinds of petroleum products have been on the rise in

[49] Information about sales of petroleum products within the city of Pune was collated from information received from three petroleum majors, BPCL, HPCL and IOCL. Consistent petroleum sales data was available only from 2006-07 to 2010-11.

[50] Petroleum products comprise of CNG, Furnace Oil, HSD, Kerosene, LDO, LPG and Motor Spirit. However, ATF consumption and emissions numbers are reported separately.

[51] As per data collected from IOCL, BPCL, HPCL, and MNGL for the study

the last few years. Sales of fuels like ATF and CNG, particularly, have shot up in the last couple of years given the large increase in the number of flights in and out of the Pune Lohgaon Airport and the government directive for switching auto rickshaws to CNG.

As shown in **Figure 14** the transport sector is the highest consumer of petroleum products in the city with 51% share of the total sales [compared in metric tonnes (MT)], followed by domestic or residential consumption of petroleum products at 33%.

4.3.1 Use of petroleum products in the transport sector

The transport sector is the largest consumer of energy in the form of petroleum products. Petrol or Motor Spirit, Diesel, Auto LPG, and CNG are the principle forms for energy used to drive mobility within the city.

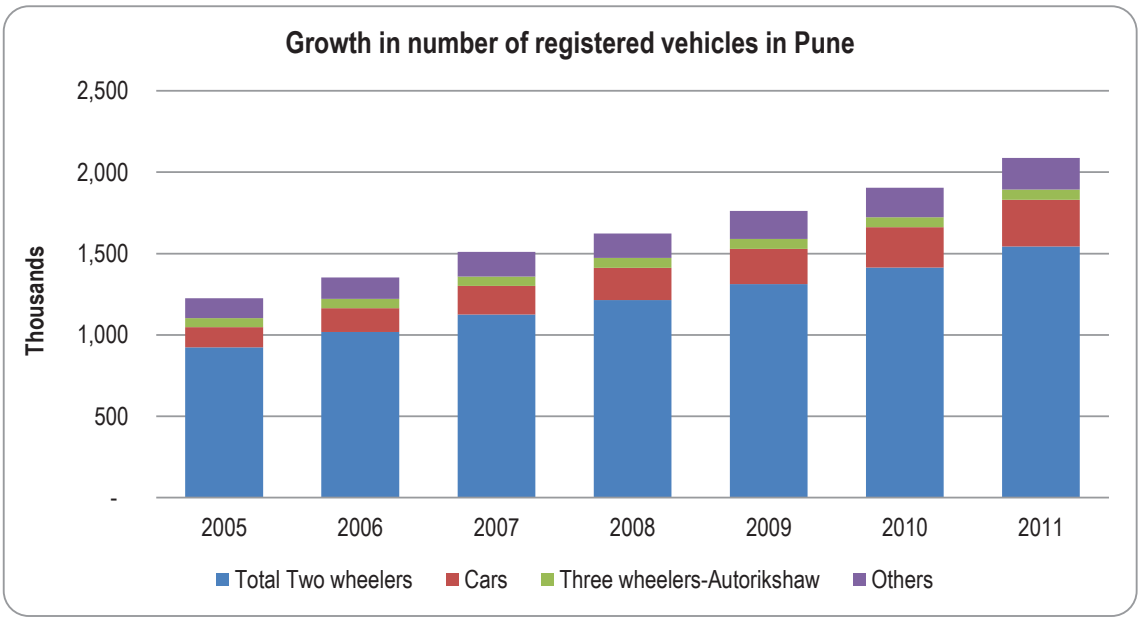

Figure 15: Growth in the number of registered vehicles in Pune[52]

The increasing number of two and four wheelers on the roads, which primarily use petrol, has sparked of a high-growth trajectory for the demand of fuel in Pune. The fuel sales of petrol have been growing in proportion with the total number of registered petrol vehicles in the city. The similar is true for diesel and diesel vehicles such as buses, taxis, heavy, and light commercial vehicles.

Petrol (Motor Spirit) and diesel (HSD) sales figures have gone up by 39% and 73.30%, respectively, between 2006–07 and 2010–11. These two fuels jointly contributed about 96% of the total fuel consumed in MT by the transportation sector in the year 2010–11. There is a steady growth rate of sales of petroleum products used in the transport sector between the years 2007–08 and 2009–10.

[52] As per data procured from RTO Pune in 2011

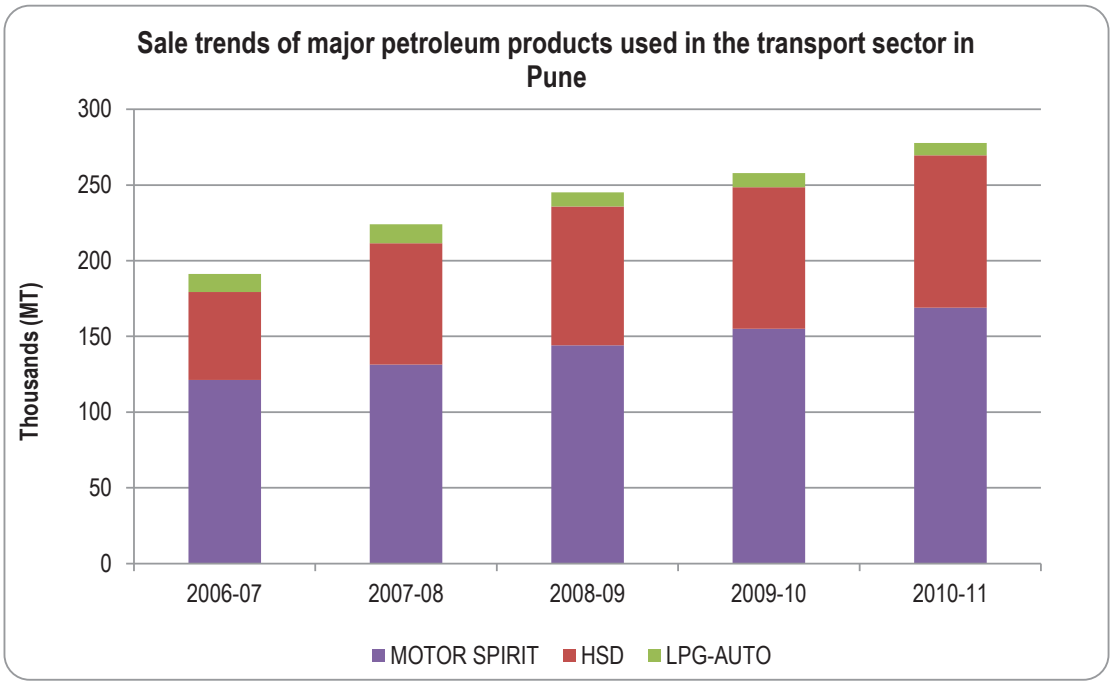

Figure 16: Sale trends of major petroleum products used in transport sector in Pune[53]

Auto LPG has seen some fluctuation in sales volumes with some year sales values going lower than the previous years. The sales volumes of Auto LPG have dropped from 9,503 MT to 8,167 MT between 2009–10 and 2010–11. One possible reason for the same might be the introduction of CNG in Pune since 2009–10. CNG sales volumes have gone up from 660 MT in 2009–10 to 2,166 MT in 2010–11, an increase by 3.28 times.

[53] As per data procured from IOCL, BPCL, and HPCL for the study

4.3.2 Domestic use of petroleum products

Petroleum products for domestic use comprise of LPG (domestic) and kerosene.

In Pune, kerosene is sold through select channels of the Public Distribution System (PDS) whereas LPG (domestic) is retailed directly to homes by the fuel companies. The rising incomes and increasing standards of living have led to a drop in the overall sale of kerosene across the city and more households switching to LPG (domestic). Kerosene's share in domestic consumption of petroleum products has declined; the fuel is primarily used by low-income households.

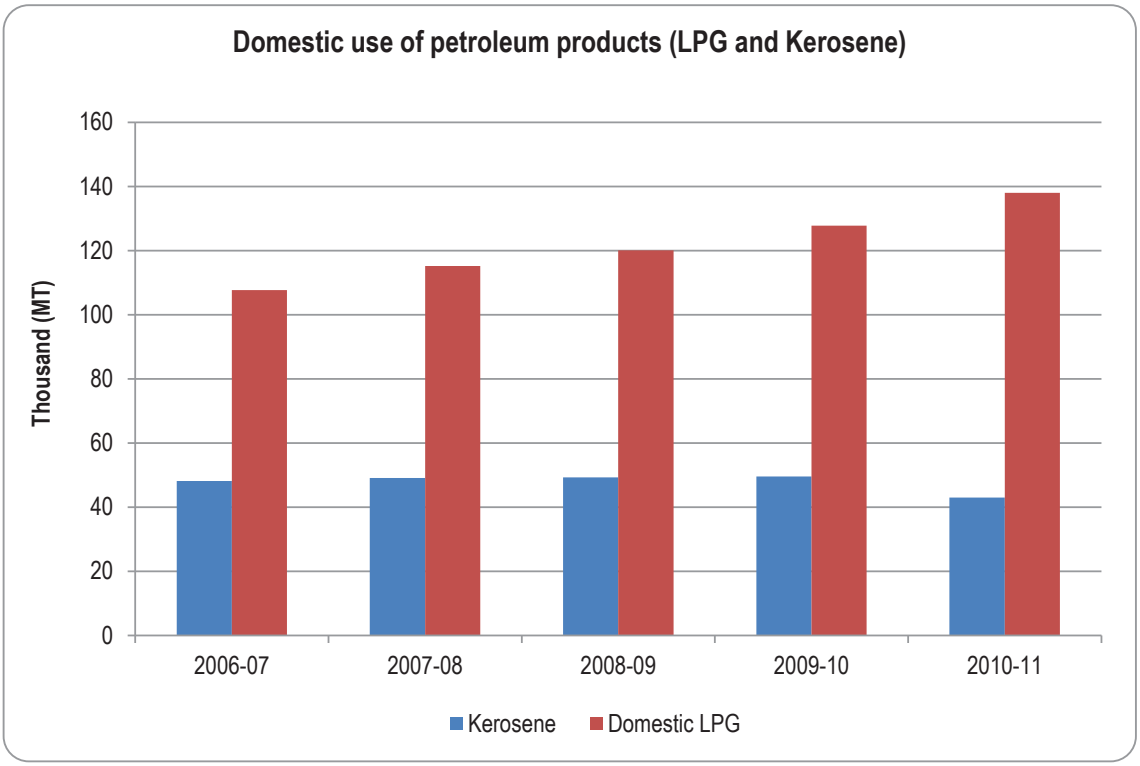

Figure 17: Domestic use of petroleum products (LPG and Kerosene)[54]

On the other hand, LPG is a much better and convenient fuel with lesser negative impacts to human health. Hence, the use of domestic LPG has grown from 107,701.96 MT to 138,004.50 MT between 2006–07 and 2010–11 at a CAGR of 5.08%.

Residential consumption of petroleum products (in the form of domestic LPG and kerosene) formed 33% of the overall consumption of petroleum products (in MT) in the city in 2010–11.

[54] As per data procured from IOCL, BPCL, HPCL & PDS (rationing office) for the study

4.3.3 Consumption of petroleum products in the commercial and industrial setups

Commercial and industrial setups have a demand for petroleum products to run their machinery, boilers, chillers, and so on. Furnace oil, LDO, and LPG for commercial purposes are the primary fuels used in these sectors.

Keeping in line with the industrial growth in Pune, the requirement for furnace oil and commercial LPG has been growing in the last few years. Furnace oil sales have increased from 29,593 MT to 45,558.96 MT between 2006-07 and 2010-11 at a growth rate of 8.99% per annum. Likewise, the sales for commercial LPG have increased from 10,728.14 MT to 13,516.63 MT during the same period at a CAGR of 4.72%.

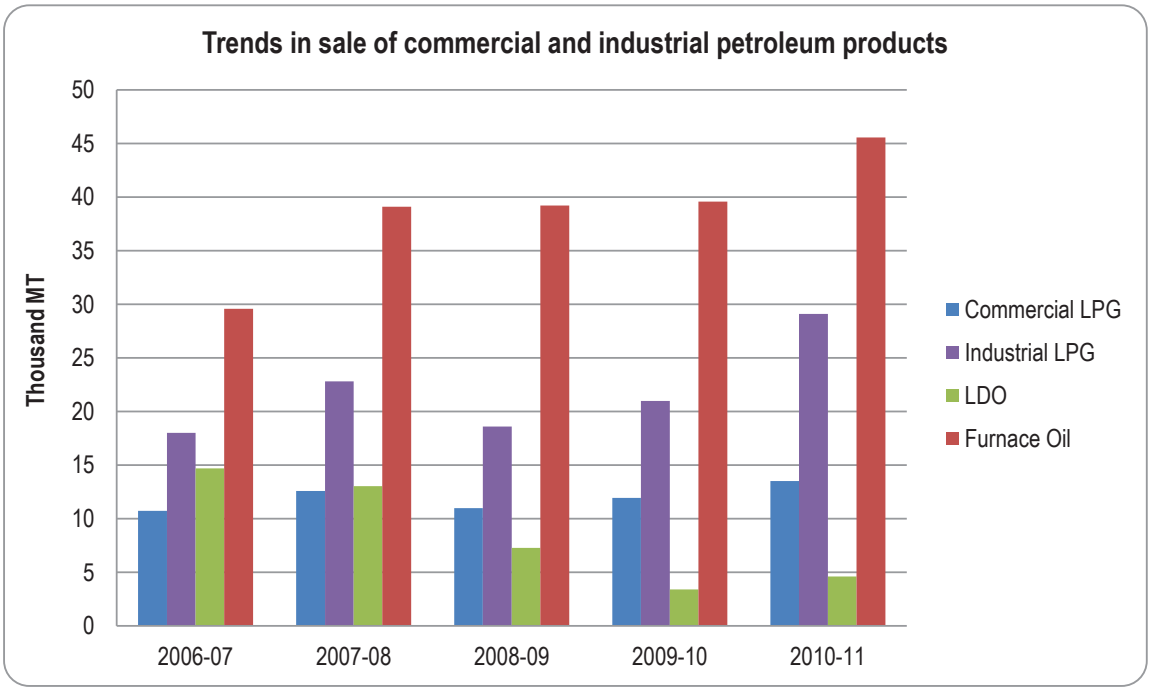

Figure 18: Trends in sale of commercial and industrial petroleum products[55]

[55] As per data procured from IOCL, BPCL, and HPCL for the study

4.4 Emissions from petroleum products

The heavy use of petroleum products in Pune has resulted in increased levels of CO_2 emissions. This section gives the calculations carried out to estimate CO_2 emissions on account of use of petroleum products in the city.

4.4.1 Emissions calculations from petroleum products

Emissions from petroleum are calculated using Indian fuel specific emission factors used in India's National Communication to the UNFCCC Secretariat. The product specific fuel sales information that was provided by different fuel companies in Pune were first converted into a uniform unit of metric tonnes (MT) for ease of calculations as presented in **Table 6**.

Table 6: Conversion factors for KL to MT of particular petroleum products[56]

Conversion Factor	LPG	Petrol	Kerosene	Diesel	Fuel oil	CNG
KL to MT	0.542	0.74	0.806	0.839	0.939	0.185

Once assimilated in the uniform units of mass, the subsequent data is converted into CO_2 equivalent emission values using Indian fuel-specific emission factors as shown in **Table 7**.

Table 7: Derivation of petroleum emission factors from energy content

Petroleum Product	Emissions by energy content (T CO_2/MJ)	Calorific value (MJ/kg)	Emissions by weight (T CO_2/kg)	Emissions per tonne (T CO_2/MT)
Diesel	74.10	43.00	3,186	3.19
Petrol	69.30	44.30	3,070	3.07
Kerosene	71.90	43.80	3,149	3.15
ATF	71.50	44.10	3,153	3.15
Furnace oil	77.40	40.40	3,127	3.13
LPG	63.10	47.30	2,985	2.98
CNG	56.10	48.00	2,693	2.69

The emissions are subsequently calculated by multiplying the amount of fuel sales in units of mass with the CO_2 emission factors per tonne given in **Table 7**. One complete example of the conversion is given in **Equation 2.**

[56] Source: British Petroleum http://www.bp.com/conversionfactors.jsp

Actual Example:

Petrol Sales
168,948.92 MT [A]

Emissions factors using fuel calorific values for Petrol
3.06999 tCO_2 /MT [B]

Emissions from Petrol sales in 2010-11
518,671.49 tCO_2 [A*B]

Equation 2: Calculation of emissions from petroleum products

4.4.2 Emissions generated from the use of petroleum products

The increase in consumption of petroleum products has led to increased CO_2 emissions. In 2010–11, the emissions from the use of petroleum products resulted in a total of 1,967,299 tCO_2 being generated from Pune. Of this, 51% emissions were generated by the transport sector, 32% by the residential sector and about 17% by the industrial and commercial sectors put together.

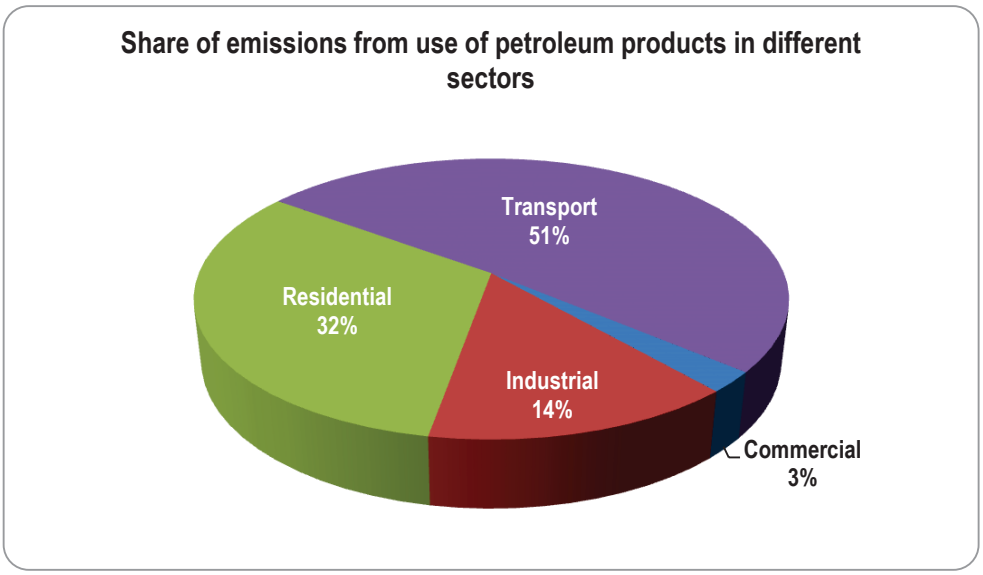

Figure 19: Share of emissions from use of petroleum products in different sectors

Driven by the heavy use of two and four wheelers in the city, petrol has become the largest emitter of CO_2 emissions amongst all fuels occupying a 60% share in the transport CO_2 emissions mix. This amounted to 518,671.49 tCO_2 of emissions from petrol use for transport in 2010–11. Diesel, which is the second-most intensively used petroleum product, occupies a share of about 37% in the CO_2 emissions from the transport sector. The fuel generated about 320,684.37 tCO_2 emissions in the year 2010–11, up from 185,050.00 tCO_2 in 2006–07.The other

two fuels used for road transport — CNG and auto LPG — were responsible for 30,209.38 tCO_2 emissions in the city.

A recent development in Pune has been a high growth in the number of flights to and from the city. This has led to the increase in the overall demand for ATF from the airport bunkers. ATF, which was earlier retailed only by IOCL, is now also sold by the other majors, BPCL and HPCL. This has resulted in substantial growth in the overall emissions resulting from the fuel that is distributed from bunkers at the Pune airport (266,144.51 tCO_2 in Pune in 2010–11). However, these CO_2 emissions are not treated to be part of the city's emissions footprint in the Scope 2 methodology that has been chosen for this study.

Second to transport, the residential or domestic sector is also a large consumer of petroleum fuels sold in Pune, generating about 547,226.96 tCO_2 in 2010–11. The principle fuels, kerosene and LPG share about 25% and 75% of the overall demand of the households and generate emissions in the same proportions. Domestic LPG generated 411,892.38 tCO_2 and kerosene 135,334.58 tCO_2 in 2010–11. The two fuels had a share of 24% of the overall CO_2 emissions from all kinds of petroleum product use in the city.

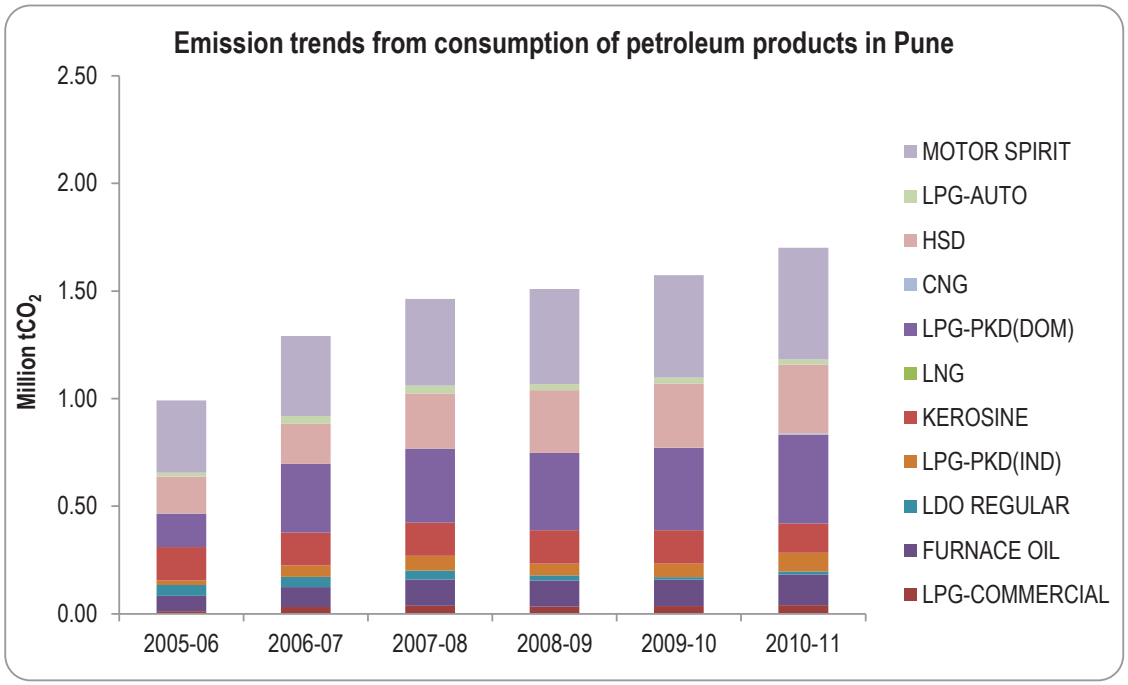

Figure 20: Emission trends from consumption of petroleum products in Pune

Petroleum products used in the industrial and commercial sectors were responsible for 17% of the total CO_2 emissions generated from the use of petroleum products in the city. Of this, LPG used in these sectors is responsible for 45% of the emissions, whereas furnace oil is responsible for 50%. The remaining 5% of the emissions from the sectors are generated from the use of light diesel oil in industry.