REPORT ON ASSESSMENT OF INDUSTRIAL AIR POLLUTION IN DELHI-NCR

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Centre for Science and Environment

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Contents

1. OVERVIEW REPORT ON ASSESSMENT OF INDUSTRIAL AIR POLLUTION IN DELHI-NCR

Contents

1. Introduction

A scoping study on industrial air pollution has been conducted in districts and regions with prominent industrial clusters in Delhi-NCR, covering states of Rajasthan, Haryana, and Uttar Pradesh—Alwar, Bhiwadi, Gurugram, Faridabad, Panipat, Sonipat and Ghaziabad—to identify pollution hotspots and major air polluting sectors. This study will assist relevant stakeholders in preparing and implementing an effective action plan to control air pollution from the concerned industrial areas/sectors.

The Air Quality Index (AQI) data and the Comprehensive Environmental Pollution Index (CEPI) scores for these districts clearly portray the concerning levels of environmental quality in these areas (see *Table 1: Details of area, population, AQI and CEPI score of the study areas*). AQI is an index for reporting the quality of air in an area whereas CEPI is a nationwide score developed by the Central Pollution Control Board (CPCB) which captures the various dimensions (air, water, and land) of environmental quality of a given location.

Table 1: Details of area, population, AQI, and CEPI score of the study areas

All the study areas have a higher population density than the average population density of India

District	Area (in sq.km)	Population (in lakhs)	Population density (persons/ sq.km)	AQI (Feb 2019–Feb 2020)	CEPI score (2018)
Rajasthan					
Alwar (excluding Bhiwadi)	8,336	3.6	438	152	-
Bhiwadi (city)[1]	44.06	1.04	2,381	247	79.63
Haryana					
Gurugram	732	8.76	1,200	162	76
Faridabad	741	18.1	2,442	184	62.17
Panipat	1,268	12.1	950	165	83.54
Sonipat	2,260	14.5	640	108	-
Uttar Pradesh					
Ghaziabad	1,273	46.8[2]	3,700	160	72.30

Source: Census of India, 2011, CPCB, Central Control Room for Air Quality Management—All India

Of the seven regions selected for this study, five are critically polluted under the CEPI index. The AQI in all the chosen areas ranges between 100 and 200 which shows that all these areas are moderately polluted, except Bhiwadi which is severely polluted with an AQI of 247. While high population density is a concern in all these areas, **regions/districts like Ghaziabad, Faridabad, Bhiwadi and Gurugram, which have a population density of more than 1000 persons/sq.km, are even more prone to air pollution related health risks**. Consequently, there have been concerns over air pollution in these areas which have resulted in a number of National Green Tribunal (NGT) cases with respect to industrial air pollution from various sectors.

BOX 1: Prominent NGT cases

The increase in the number of NGT cases in an area are an indicator of the magnitude of the pollution problem. Some of the NGT cases which highlight the polluting sectors and problematic areas have been mentioned below:

1. **Order of the National Green Tribunal regarding stone crushers complying with environmental norms, Haryana, 02/09/2019[3]:** Counsel for the State of Haryana states that a decision has been taken to continue the stone crushers already set up. However, the State Pollution Control Board (SPCB) will verify whether the stone crushers are complying with the pollution norms. Earlier, NGT in an order had directed that no stone crushers be permitted to operate unless they obtain consent from the SPCB, procure no objection certificate from the concerned authorities and have Environmental Clearance (EC) from the competent authority.

2. **Judgement of the National Green Tribunal regarding location of Hanuman Mineral and Grinding Mill, Tehla Road, Rajgarh in the vicinity of a residential area, 24/03/2014[4]:** M/s Hanuman Mineral and Grinding Mill, Tehla Road, Rajgarh. It was submitted that the unit was located in the vicinity of a residential area and the pollution it was causing adversely affected the residents as well as the educational institutions located in the area.

3. **Order of the National Green Tribunal regarding burning of copper wire, Loni, Ghaziabad, 24/10/2019[5]:** Incident regarding copper wire being burnt at Kabul Nagar, Kargil Colony, Behta Hajipur and Dhama Colony in Loni, Ghaziabad. Taking into consideration the remedial action that was taken, the NGT disposed of the case.

4. **Order of the National Green Tribunal regarding industrial pollution by a cement tiles factory, Alwar, Rajasthan, 04/12/2019[6]:** A cement tiles factory was causing air pollution and extracting underground water. Report by the Rajasthan State Pollution Control Board (RSPCB) informed the Tribunal that the unit was operating without obtaining prior Consent to Establish (CTE) and Consent to Operate (CTO) from the SPCB and that the land on which the unit was established has not been converted for industrial purpose. A closure order has been issued and unit has been closed. The NGT directed submission of a compliance report within one month on the aspect of environmental compensation for illegal operation of the unit.

5. **Order of the National Green Tribunal regarding unauthorized polluting factories in residential area of Panipat, Haryana, 29/07/2019[7]:** Application was filed by the Residents Welfare Association of Sector 18, Panipat, Haryana against unauthorized polluting factories without Consent to Establish in residential areas under the provisions of the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974. Industries which are in 'red category' are discharging toxic effluents into the irrigation canal and also polluting the river Yamuna.

6. **The order of the National Green Tribunal regarding industries polluting air and water in Faridabad, Haryana, 20/12/2019[8]:** Regarding illegal industries being run by Rising tech Industries, Flicker India, Metal Life and Metal Care in non-conforming area at Faridabad without consent of the Haryana SPCB under the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974.

7. **Pollution board raids Panipat, Sonipat units, 29/03/2019[9]:** Special teams of the CPCB on Thursday conducted raids in industrial units, especially dyeing units, in Panipat and Sonipat. Earlier, the NGT had expressed dissatisfaction over the report submitted by a committee of representatives of the CPCB and local administration on pollution caused by industries in Panipat and Sonipat districts.

8. **Air pollution: NGT orders inspection around Panipat refinery[10]:** The NGT has taken note of a plea alleging air pollution by the Panipat Refinery in Haryana and formed a committee to look into the issue.

Infrastructure in industrial areas

The basic infrastructure of industrial areas in the study is managed by different government bodies. For example—industrial areas in Alwar (including Bhiwadi) in Rajasthan are managed by Rajasthan State Industrial Development & Investment Corporation Ltd (RIICO). Although SPCBs are responsible for ensuring the overall environmental compliance of industries, including air pollution from industrial areas, the bodies which manage industrial areas are tasked with maintaining basic infrastructure like roads, plantations, waste management, etc. which play a significant role in curbing air pollution (see *Table 2: Organizations that manage industrial areas*).

Table 2: Organizations that manage industrial areas

Infrastructure development agencies are major stakeholders responsible for maintaining industrial areas

Area	Managing organizations of industrial areas
Alwar	Rajasthan State Industrial Development & Investment Corporation (RIICO)
Bhiwadi	Rajasthan State Industrial Development & Investment Corporation (RIICO)
Gurugram	Haryana State Industrial & Infrastructure Development Corporation (HSIIDC)
Faridabad	Haryana State Industrial & Infrastructure Development Corporation (HSIIDC)
Panipat	Haryana State Industrial & Infrastructure Development Corporation (HSIIDC)
Sonipat	Haryana State Industrial & Infrastructure Development Corporation (HSIIDC)
Ghaziabad	Municipal Corporation, Ghaziabad

Source: CSE

2. Industrial profile of study areas

In order to understand the industrial profile of study areas CSE had approached the respective SPCBs for the required data. In most of the study areas, CSE got data directly from SPCBs of particular districts. But, for a few areas, CSE had to extract data from the latest CTO documents of various industries uploaded on the websites of the respective SPCBs. The main data collected was the type of fuel being used, quantity of fuel being consumed, capacities of various combustion equipment being used (e.g. boiler, furnace, thermal fluid heater (TFH) and DG set) sector, type of industry, and the location of the industry.

CSE has assessed and analyzed only the air polluting industries in each region, i.e. the industrial units where fuel is being used (in process, heating or cooling operations, or utilities, etc.). This analysis has been done based on the estimated pollution load in various study areas which has been calculated based on the fuel consumption in combustion equipment being used in the industries. Unorganized sectors like brick kilns have been discussed separately and are not included in the list of air polluting industries mentioned in the table below. On the basis of this categorization Faridabad has the highest number of air polluting units, followed by Sonipat, Bhiwadi, Panipat, Alwar, Ghaziabad, and Gurugram.

All the industrial areas have industries with stack emissions whereas Alwar has a large number of industries with fugitive emissions. About 1000 industries in Alwar are sources of fugitive emissions, in addition to the air polluting units mentioned in the table below. These industries primarily comprise of stone works, mineral based units, chemicals, engineering based units, etc. The district of Alwar has around 302 mineral grinding units which are a matter of concern with respect to fugitive emissions.

Table 3: Air polluting industry profile

Faridabad has highest number of air polluting industries

Sr. no.	Industrial cluster/region	No. of units	Major industrial sectors
1	Alwar	156	Chemicals and food processing
2	Bhiwadi	328	Metal and chemicals/pharmaceuticals
3	Gurugram	125	Textile
4	Faridabad	948	Metal
5	Panipat	231	Textile
6	Sonipat	390	Textile
7	Ghaziabad	146	Textile

Source: CSE 2019–2020 (based on the data provided by respective SPCBs)

3. Combustion equipment range

The estimate of pollution loading done in this study is based on emissions from the stacks of combustion equipment installed in the industries. Process emissions are not considered while estimating the loading. The combustion equipment includes small boilers of capacity ranging from 0.5 tonnes per hour (TPH) to 50 TPH, Thermopacks or thermic fluid heaters, and different types of furnaces (reheating, melting, cupola, etc.).

Based on the data collected from different SPCBs or extracted from CTO documents, the quantity of this equipment installed in industries in different regions is given in the table below.

Table 4: Capacity range and quantity of combustion equipment

Boilers are the most widely used combustion equipment in the industries

Equipment	Alwar	Bhiwadi	Ghaziabad	Faridabad*	Gurugram*	Panipat	Sonipat*	Total
Furnace	54	264	20	36	9	13	95	491
Boiler	63	111	140	132	69	163	212	890
<2 TPH	44	53	102	54		53		306
2–<10 TPH	8	48	24	65		98		243
10–<15 TPH	5	7	4	8		7		31
>15 TPH	6	3	10	5		5		29
TFH	5	89	8	7	1	31	37	178
Up to 10 lakh kcal/hr	3	69	6	5		19		102
11–20 lakh kcal	1	14	2	1		6		24
>20 lakh kcal/hr	1	6	0	1		6		14

*Data partially available/capacity of equipment not available

Source: CSE 2019–2020 (based on the data provided by respective SPCBs)

The equipment details for industries located in Faridabad, Gurugram and Sonipat are partially available, or the capacity of the equipment is not provided. Therefore not much detailing of equipment range could be done for these regions.

Since details about types of furnace are partially available or not available, no categorization is given for furnaces. Overall, there are about 500 furnaces installed in the seven study areas. Bhiwadi has the highest number of furnaces, due to the presence of metal-based industries in the region.

There are total 890 boilers. No categorization of boilers could be done for Gurugram and Sonipat region in the absence of data. But, overall the majority of boilers are <2 TPH in capacity (in some areas termed as baby boilers).

4. Fuel usage

Before analyzing the area and sector-wise fuel consumption pattern of the industries in various study areas, it is essential to understand how the quantity of the fuel consumed by industries in these areas was determined.

4.1 Methodology for determining the quantity of fuel consumption

The most significant data required regarding fuel was the type and quantity of fuel being consumed in industries located in the study areas. For some districts CSE got the date for fuel type and quantity directly from the respective SPCBs or the CTO documents on their website. In the districts where this data was not readily available, the quantity of fuel being consumed was calculated based on the capacity of the combustion equipment being used in the industries along with its number of operational hours. The capacity of the combustion equipment was sourced from the respective SPCBs or extracted from the CTO of individual industries uploaded by PCBs on their website; whereas the operational hours for every industry were assumed based on the sector to which the particular industry belonged.

Fuel usage in industrial areas is mainly in **boilers** for the purpose of steam generation, in **furnaces** for heating and melting purposes, in **thermal fluid heaters** for heating purposes or for process applications, and in **diesel generators** to provide power back up. The major fuels used in the industries are coal, wood, liquid fuel (high speed diesel, furnace oil, and low sulphur diesel), agro waste, and piped natural gas (PNG).

For estimating fuel usage in different equipment, factors have been worked out based on different parameters of installed equipment and the fuel used. The detailed process used to calculate the fuel quantity being consumed by various combustion equipment is mentioned below:

- **Calculation of fuel consumption by boilers**: Fuel to steam generation ratio has been used to estimate the fuel consumption in boilers. Calorific value of the fuel and the efficiency of the boiler are used to calculate the said ratio. The calorific value of fuel and the efficiency of the boiler with respect to different fuels have been sourced from the Energy Efficiency in Thermal Utilities, Bureau of Energy Efficiency (BEE) handbook (2015). The detailed table on boilers using different fuels and their respective factors for the estimation of fuel consumption is given below.

Table 5: Factors for boilers (tonne of fuel/tonne of steam)

Parameter	Remarks	Coal	Fuel oil	Agro	Wood	Gas	Source
Calorific value (kcal/kg)	A	4,000	10,500	3,500	4,800	12,300	BEE handbook
Efficiency	B	70%	75%	70%	70%	75%	
Useful cal value (kcal/kg)	A*B	2,800	7,875	2,450	3,360	9,225	Calculated
Enthalpy of steam (at 10 kg/cm^2 and 180°C)	C	665	665	665	665	665	BEE handbook
Factor	C/A*B	0.24	0.08	0.27	0.20	0.07	

Source: BEE Handbook, 2015

The fuel consumed per hour in the boiler can be calculated by multiplying the given capacity of the boiler (in tonnes per hour) with the factor of

the fuel being used. The fuel consumption per hour shall be multiplied by the no. of operational hours in a day to get the quantity of the fuel consumed per day.

- **Calculation of fuel consumption by furnaces**: Fuel to molten metal generation ratio has been used to estimate the fuel consumption in furnaces. Calorific value of the fuel and efficiency of the equipment is used to calculate the said ratio. The calorific values and the efficiency of the furnace with respect to different fuels have been sourced from the BEE handbook. The detailed table on furnaces using different fuels and their respective factors for the estimation of fuel consumption is given below:

Table 6: Factors for furnace (tonne of fuel/ tonne of metal melt)

Parameter	Coal	Fuel oil	Agro	Wood	Gas	Source
Mass of stock (tonne)	1	1	1	1	1	
Efficiency	25%	25%	25%	25%	25%	Furnace efficiency based on typical efficiency range of furnaces; BEE handbook
Specific heat of MS scrap (Kcal/kg °C)	0.16	0.16	0.16	0.16	0.16	BEE handbook
Latent heat (Kcal/kg)	65.28	65.28	65.28	65.28	65.28	BEE handbook
Initial temp. of stock (°C)	30	30	30	30	30	Assumed ambient temp. in the range of 25–40°C
Final stock temp. (°C)	1,300	1,300	1,300	1,300	1,300	Reheating or melting furnace operating range
GCV of fuel (kcal/kg)	4,000	10,500	3,500	4,800	12,300	BEE handbook
Factor	0.27	0.10	0.31	0.23	0.09	Calculation below

Source: BEE Handbook, 2015

Formula used for the calculation of fuel used per tonne of metal melt (or factor) in a furnace is:

$$M_{fuel} = \frac{M_{stock}\,((Sp\ heat_{stock} * (T_{final} - T_{initial})) + Latent\ heat_{stock})}{Eff_{furn} * Cal.\ Value_{fuel}}$$

Where,

M_{fuel} = Mass of fuel used per tonne of metal melt
M_{stock} = Mass of stock (1 tonne)
Sp heat $_{stock}$= Specific heat of stock (taken for MS scrap)[11]
Latent $heat_{stock}$= Latent heat of stock (taken for MS scrap)
T_{final}= Final temperature of stock
$T_{initial}$= Initial temp of stock
Eff_{furn}= Furnace efficiency[12]
Cal. Value $_{fuel}$ = Calorific value of fuel

The fuel consumed per hour in the furnace can be calculated by multiplying the given capacity of the furnace (in tonnes per hour) with the factor of the respective fuel being used.

The fuel consumption per hour shall be multiplied by the no. of operational hours in a day to get the quantity of the fuel consumed per day. The no. of operational hours of the industry will be assumed depending upon the sector to which the industry belongs.

- **Calculation of fuel consumption by TFH:** The capacity and efficiency of the TFH along with the calorific value of the fuel and the number of operating hours (assumed on the basis of industrial sector) of the industry are used to calculate the per day fuel consumption by the TFH by using the formula given below:

  Fuel consumption in TFH/day = ((Capacity (kcal/hr)/ Cal value) * Eff.)/1000 * Operating hours

  Therefore, for example:
  A coal fired TFH capacity = 1,500,000 kcal/hr (15 lakh kcal/hr)
  Calorific value of fuel used—Coal = 4000 kcal/kg
  Efficiency[1314] = 80%
  No. of operating hours in a day = 12 hours
  Fuel consumption in TFH = (((1500000/4000) * 0.8)/1000) * 12 hrs/day
  = 3.6 tonnes per day

- **Calculation of fuel consumption in diesel generator:** The capacity or rating of the DG set, motor efficiency (Eff_{motor}), power factor, specific fuel consumption, and the no. of operating hours per day (assumed as three hours per day for all DG sets) are required to calculate the quantity of diesel being consumed in a DG set per day by using the formula given below:

  Fuel consumption for DG = (KVA* Eff_{motor} * Power factor) * Sp fuel cons. * Optg. hours)/1000

  Therefore, for example:
  DG capacity = 750 KVA
  No. of operating hours daily = 3 hours
  Fuel consumption = ((750*0.9*0.9)*0.28*3)/1000
  = 0.51 tonnes per day

After the calculation of the daily fuel consumption from various combustion equipment using the formulae and factors mentioned above, it is required to streamline the fuel consumption data and extrapolate the same to an annual consumption figure in tonnes per year assuming the industries are operational 330 days in a year.

4.2 Fuel consumption in study areas

After calculating and compiling the fuel consumption by different air polluting industries in the study areas, the data was analyzed to understand the amount of fuel consumption taking place in different industrial areas of different districts along with the consumption patterns in various industrial sectors.

Total consumption of coal by industries in all seven districts has been estimated to be around 1.41 million tonnes per year. Coal consumption is highest in Sonipat district, where the total estimated coal consumption is about 0.42 million tonnes per year. The lowest coal consumption is in the Gurugram district at about 0.03 million tonnes per year. The highest consumption of wood as a fuel is also in Sonipat. Highest agro waste fuel consumption is in Alwar at around 0.43 million tonnes per year. Based on the available data, piped natural gas consumption is highest in Sonipat while PNG consumption data was not available for the Bhiwadi region.

Table 7: District-wise fuel consumption (in million tonnes per year)

Coal usage in Sonipat is maximum whereas agro-based fuel usage is maximum in Alwar district

Sr. no.	District/ region	Agro	Coal	Gas	Liquid fuel	Wood
1	Alwar	0.43	0.16	0.006	0.02	0.01
2	Bhiwadi	0.08	0.27	NA	0.04	0.04
3	Faridabad	0.03	0.17	0.07	0.19	0.01
4	Ghaziabad	0.09	0.22	0.02	0.01	0.03
5	Gurugram	0.03	0.04	0.01	0.05	0.01
6	Panipat	0.20	0.12	0.004	0.03	0.02
7	Sonipat	0.26	0.42	0.11	0.19	0.30
	Total (million tonnes)	1.14	1.41	0.22	0.53	0.43

Source: CSE 2019–2020 (based on the data provided by respective SPCBs)

It has been observed that even though a PNG line is available in many of the industrial areas, industries are still using other conventional fuels. The probable reason behind these industries not shifting to natural gas is the cost. As per CSE's estimate, if a coal consuming industry switches over to natural gas as its major fuel, its cost towards fuel increases by about 2.5 times.

Use of agro residue as fuel is high in Alwar, Panipat and Sonipat. Exploring the availability of agro residue and formulating a clear policy on the usage of agro residue as a fuel can reduce dependency on coal. During the surveys in different industrial areas, it was observed that a lot of industries are willing to use or keep using agro residue as a fuel.

Table 8 clearly shows that textile, food processing, metal-based, and chemical/ pharma industries are the largest consumers of coal in the seven study areas. Food processing industry is the largest consumer of agro-based fuel followed by sugar industry and distilleries. Metal-based industry is the largest consumer of liquid fuel followed by textile industry. Textile industry is also the largest consumer of wood as a fuel.

Table 8: Sector-wise fuel consumption in all seven districts (tonnes per year)

Textile sector emerges as the largest coal consuming industrial sector

Sector	Wood	Agro	Liquid fuel	Gas	Coal
Automobile	132	0	49,843	12,746	29,510
Ceramics and refractory	0	0	1,224	594	14,828
Chemical/pharma	39,797	75,466	25,057	1,051	119,752
Distillery	0	220,262	0	0	35,574
Electronics & home appliances		29,938	468	277	2,673
Engineering			1,819	2,776	12,870
Food processing	9,086	418,525	23,927	40,346	317,754
Metal based	15,047	297	319,792	92,303	34,168
Miscellaneous	26,080	51,937	24,129	17,518	60,043
Plastic/packaging	12,738	24,693	7,175	410	32,680
Plywood	2,310	0	0		12,870
Pulp and paper	1,568	0	147	0	92,228
Rubber goods	3,498	5,538	8,471	7,454	82,214
Sugar	3,300	231,198	0	3,300	0
Textile	316,225	78,325	71,202	41,396	459,877
Total	429,781	1,136,180	533,252	220,171	1,407,040

Source: CSE 2019–2020 (based on the data provided by respective SPCBs)

5. Assessment of industrial pollution load

The key indicator for assessment of air pollution in any area is the loading of pollutants into the ambient environment from different sources in the area.

Under this study the pollution load is estimated for three main pollutants from industrial sources—particulate matter (PM), sulphur dioxide (SO_2), and nitrogen oxides (NO_X).

5.1 Methodology for determining the pollution load

CSE could not get emission data of the industries from any of the study areas. Therefore, pollution load was determined based on the fuel consumption data of the industries, which was directly shared by the SPCBs or was calculated by using combustion equipment details (as mentioned in section 4.1) provided by SPCBs or extracted from the CTOs of the industries available in public domain. The pollution load has been calculated in two scenarios i.e. controlled and uncontrolled, which have been defined below:

1. *Controlled pollution load:* This load has been calculated considering various industrial sectors existing in the region, equipment installed and types of fuel being used in each industry. It is assumed under this scenario that all the industries operating are in compliance with the norms and have proper air pollution control devices (APCDs) installed.

The CPCB emission standards for various combustion equipment have been taken to estimate the controlled pollution load for PM, SO_2 and NO_X (see *Table 9: Emission standards for combustion equipment*). Along with this the requirement of air for combustion was also taken from the BEE handbook to calculate the controlled pollution load.

Table 9: Emission standards for combustion equipment

There are multiple standards for combustion equipment with different capacities

Sr. no.	Capacity (TPH)	PM emission limit (mg/Nm^3)	SO_2 emission limit (mg/Nm^3)	NO_X emission limit (mg/Nm^3)
Small industrial boilers (coal or liquid fuel)[15, 16]				
1	Less than 2	1,200	400	300
2	2 to less than 10	800	400	300
3	10 to less than 15	600	400	300
4	15 and above	150	400	300
5	Boilers using agriculture waste as fuel[17]	500		
TFH	Varying	150/500/600/800/1,200	400	
Furnace				
1	Cupola furnace			
A	<3 TPH	450	300	400
B	>3 TPH	150		400
2	Arc furnace	150		
3	Induction furnace	150		
4	Reheating furnace	150	300	1000
DG set[18]	>800 KW or 1,000KVA	75/100 (based on fuel used)	<2% sulphur content	710–1100 ppmv (based on date of commissioning)

Source: Environmental standards for ambient air, automobiles, fuels, industries and noise, CPCB, 2000

2. *Uncontrolled pollution load*: This load has been calculated considering that there is minimal air pollution control technology installed in the industries. An emission factor for each fuel is taken from AP-42 (USEPA, 2000)[1920], considering the different types of combustion equipment installed in the industries in all the study areas. The sulphur content is considered as per the fuel properties given in BEE handbook (2015). The uncontrolled pollution load was calculated using the fuel quantity, emission factor for different fuels, and the sulphur content.

5.2 Limitations and assumptions of the assessment

1. Volatile organic compounds (VOC) and fugitive emissions from the industrial sector have not been considered in the pollution loading. The major focus of the study is on PM, SO_2 and NO_X emissions from the industrial stacks.

2. Fuel specifications are taken from the BEE handbook, 2015 to calculate the pollution load since actual fuel analysis reports are not available for the industries.

3. Operating days for the industry have been assumed as 330 days and number of operating hours has been assumed in the range of 8 to 24 hours, depending on the industrial sector. The operating hours of DG sets has been assumed as three hours per day.

4. Controlled pollution load is estimated considering that all the operating industries are in compliance with the applicable emission norms with proper air pollution control devices. The emission standards are consolidated after taking into consideration the different industrial sectors and fuel usage.

5. Uncontrolled pollution load is estimated considering minimal air pollution control technologies are installed. Emission factors used for estimation of load have been considered keeping in view all the different industrial sectors located in the industrial area and the different types of combustion equipment installed there.

6. The data gathered from SPCBs was often incomplete for some industries with respect to the capacities (tonnes per hour) of their pollution sources (boiler, furnace, etc.). In those cases minimum capacity assumption has been taken for them. Also, DG sets data was inadequate in some of the districts.

In our review of the industrial pollution load methodology, we have found that there is great variance in the different studies conducted (see *Box 2: Industrial pollution emission inventory and source apportionment studies: review*).

5.3 Pollution loading in study areas

Based on the calculation methodology explained above, pollution loading has been estimated from various industrial areas as well as industrial sectors in the study areas. This helps in identifying major hotspot areas for industrial air pollution along with the industrial sectors which are largely responsible for this.

Box 2: Industrial pollution emission inventory and source apportionment studies: review

In order to get a better understanding of the magnitude of the estimated pollution load figures in the study conducted by CSE in 2019–20, the pollution load figures of some other cities have been referred to, from emission inventory or source apportionment studies sponsored by CPCB and conducted by reputed environmental or technical institutions in the country.

The cities which have been mentioned for reference are places which have a significant number of industries and a greater share of industrial pollution load. These reference pollution loading figures act as benchmarks that would help in understanding the scale of the industrial pollution load in the various regions of NCR (covered under the CSE study).

As per the table below, pollution load of Delhi, Bangalore, Kanpur and Bhiwadi is sourced from different technical studies conducted in the past. We have referred to the studies done about a decade ago as well as the studies from the recent past, to understand the kind of environmental degradation that has happened in the past years.

Table: Comparison of industrial pollution load from cities in other studies (in tonnes/annum)

City/region	PM	SO_2	NO_x	Remarks
Delhi (without power plants, 2018)[21]	1,300	4,600	1,600	Report on Source Apportionment of $PM_{2.5}$ & PM_{10} of Delhi NCR for Identification of Major Sources, TERI, Aug 2018.
Bangalore (2010)[22]	2,847	2,997	6,274	A study supported by CPCB and conducted by TERI in 2010 was sourced from the CPCB website. The study shows a total 168 air polluting industries in the city.
Kanpur (2010)[23]	1,004*	795	3,177	A study supported by CPCB and conducted by IIT Kanpur in 2010 was sourced from the CPCB website.
Bhiwadi (2020)[24]	1,314	3,665	2,255	A study supported by RSPCB and conducted by IIT Kanpur in 2020.

*The PM value mentioned represents only PM_{10}

Estimates of industry's contribution of PM and other pollutants vary widely across the studies. One of the reasons for variations in the inventory is the difference in what constitutes industrial activity and the method used to calculate emissions.[25]

For example, CPCB (2010) did not include brick kilns for their estimate. Guttikunda (2018) included construction as an industrial activity, including brick and cement industries. TERI (2018) used red and orange category industries only, where it included fuel consumption as well as stack emissions data for the final estimate.

CSE has included industries using any type of fuel, its consumption, details of combustion equipment and emission standards applicable to each, for calculating the controlled emissions. Whereas, uncontrolled emissions are estimated using the AP-42 (USEPA, 2000).

Estimation of the emission load for all the seven regions studied is given in the table below.

Table: Pollution load of district/regions in CSE study (in tonnes/year)

City/region	Controlled			Uncontrolled		
	PM	SO_2	NO_x	PM	SO_2	NO_x
Alwar	1,811	1,390	1,998	4,453	1,807	2,127
Faridabad	1,308	1,775	1,723	3,026	8,252	2,877
Ghaziabad	1,256	860	1,249	2,985	1,791	2,395
Gurugram	379	482	491	845	1,964	705
Sonipat	3,916	3,623	4,522	7,901	9,891	6,854
Bhiwadi	1,542	1,187	1,582	3,675	3,424	3,280
Panipat	1,149	973	1,295	2,705	2,067	1,633

It is to be mentioned that there are no standards as such which signify whether the pollution load is high or low. Moreover, each inventory conducted by some organization has considered different samples for its estimation. However, based on the loading estimates, pollution abatement plan is given in each of the study.

CSE's estimates for Bhiwadi region is compared to the recently conducted IIT-Kanpur study, which reveals that the emission load from both the studies are nearly matching.

Table 11: District-wise pollution load (in tonnes per year)

Sonipat region has the highest PM load

Pollutant	Load	Alwar	Faridabad	Ghaziabad	Gurugram	Sonipat	Bhiwadi	Panipat	IIT-K Bhiwadi report
PM	Controlled	1,811	1,308	1,256	379	3,916	1,542	1,149	1,314
	Uncontrolled	4,453	3,026	2,985	845	7,901	3,675	2,705	
SO_2	Controlled	1,390	1,775	860	482	3,623	1,187	973	3,665
	Uncontrolled	1,807	8,252	1,791	1,964	9,891	3,424	2,067	
NO_X	Controlled	1,998	1,723	1,249	491	4,522	1,582	1,295	2,255
	Uncontrolled	2,127	2,877	2,395	705	6,854	3,280	1,633	

Source: CSE 2019–2020 (based on the data provided by respective SPCBs)

The industrial pollution load from these districts is high. CSE's results for Bhiwadi cluster are compared to another similar research study conducted by IIT-Kanpur for the region. The comparative analysis shows the pollution load estimation done by CSE for Bhiwadi closely matches with the study by IIT-K. The pollution load from these industries is largely due to the use of coal and biomass.

Sonipat region has significant liquid fuel and coal consumption in its respective industrial areas and subsequently has the highest pollution load among all districts. Though Alwar had marginally lesser coal consumption than Bhiwadi, the use of more biomass (four times that of Bhiwadi) has spiked the pollution load.

5.4 Hotspot identification

Based on CSE's analysis, estimation, and observation in the different study areas, major pollution hotspots have been identified in each industrial region/ cluster. The identified hotspots along with their corresponding pollution load have been given in the table below:

Table 12: Pollution load (in tonnes per year) in identified hotspot areas

Hotspots contribute in the range of 30–80 per cent in the total load of respective regions

District/ region	Industrial cluster	Pollutant (tonnes per year)						Avg. % share in loading
		Controlled			Uncontrolled			
		PM	SO_2	NO_X	PM	SO_2	NO_X	
Alwar	Matsya Industrial Area (MIA)	734	512	754	1,797	845	1,221	43%
Faridabad	Ballabhgarh	874	1,246	1,189	2,001	5,808	1,844	68%
Ghaziabad	Sahibabad	442	280	404	1,126	855	1,122	39%
Gurugram	South Gurugram	274	399	376	619	1,881	585	81%
Sonipat	District Industries Centre (DIC)	1,988	1,988	2,334	4,744	6,581	3,477	56%
Panipat	Israna	542	420	627	1,265	542	627	36%
Bhiwadi	Bhiwadi 1 to 4	1,042	747	1,038	2,491	1,984	2,251	65%

Source: CSE 2019–2020 (based on the data provided by respective SPCBs)

The above mentioned areas are the most critical hotspots of industrial air pollution in the study areas. There are more air pollution hotspots which have been mentioned in the individual reports of different districts.

5.5 Sector-wise pollution load

The overall sector-wise pollution load from all the seven districts clearly show that textile, metal, food processing and chemical/pharmaceutical industries are the major contributors to air pollution. These four sectors are responsible for almost 73 per cent of the overall pollution load in these seven districts in Delhi-NCR. The overall sector-wise pollution load has been shown in Table 13.

The analysis of pollution loading from different sectors in different regions is also very significant to highlight so that area or district specific action plans can be prepared. Metal industry is the major polluter in Faridabad whereas textile sector is the major polluter in the districts of Ghaziabad, Sonipat and Panipat. In Bhiwadi the maximum loading is from chemical and pharmaceutical processing industries whereas in Alwar district, distillery sector is the major polluter. Gurugram has the automobile industry as the highest contributor to the region's pollution load. Mineral grinding units in Alwar and industrial waste burning in Panipat, Alwar, and Bhiwadi were also major sources of fugitive emissions. The district/area wise pollution loading from their major industrial sectors has been shown in Table 14.

Table 13: Sector-wise overall pollution load (in tonnes per year)

Textile and metal-based industry are the major overall polluting sectors

Sector	Avg. % share in total loading	Pollutant (tonnes per year)					
		Controlled			Uncontrolled		
		PM	SO_2	NO_x	PM	SO_2	NO_x
Automobile	4%	242	392	588	553	2,003	560
Ceramics/refractory	1%	64	44	66	163	149	162
Chemicals/pharmaceutical	7%	878	713	1,069	1,963	1,758	1,599
Distillery	5%	683	517	775	1,699	517	775
Engineering	1%	57	43	64	145	157	145
Metal-based	21%	1,375	2,424	3,636	3,010	12,465	3,075
Miscellaneous	5%	524	477	715	1,143	1,299	1,299
Food processing	18%	2,415	1,769	2,654	6,022	3,111	3,754
Electronics	1%	85	68	102	210	68	102
Plastics/packaging	2%	257	210	315	568	492	449
Pulp and paper	3%	146	230	344	983	658	978
Rubber goods	3%	384	275	413	956	887	926
Sugar	4%	181	461	691	1,397	461	691
Textile	27%	3,377	2,631	3,946	6,643	5,885	6,581

Source: CSE 2019–2020 (based on the data provided by respective SPCBs)

Table 14: Pollution load from major polluting industrial sectors (in tonnes per year)

Textile emerged to be the major polluting sector

Region/ district	Sector	Major fuel	Avg. % share in total loading	Pollutant (tonnes per year)					
				Controlled			Uncontrolled		
				PM	SO_2	NO_x	PM	SO_2	NO_x
Alwar	Distillery	Agro	28%	630	484	725	1,561	484	725
Faridabad	Metal	Liquid fuel	39%	373	891	691	772	4,907	794
Ghaziabad	Textile	Coal	28%	357	239	356	775	423	423
Gurugram	Automobile	Liquid fuel	33%	86	195	153	180	1,067	185
Sonipat	Textile	Wood	37%	1,659	1,378	1,882	2,530	2,447	2,854
Panipat	Textile	Coal	51%	536	385	529	1,298	1,111	1,217
Bhiwadi	Chemical/ pharmaceutical	Coal	34%	553	418	572	1,267	1,038	1,102

Source: CSE 2019–2020 (based on the data provided by respective SPCBs)

The major fuels mentioned in the above table are those with highest consumption in the major polluting sectors. Coal has emerged to be the fuel used in most of the polluting sectors. Proper pollution abatement plans are required for each of these sectors to reduce the overall loading of the respective regions.

6. Overall observations and recommendations

- **Poor quality of inventory data**—Although most of the PCBs in the study areas had made an inventory of industries, it was often incomplete and at times inaccurate. Many of the study areas either did not have data on fuel consumption or a very accurate inventory of the pollution sources and their capacities in every industry of their area, thus making the evaluation of pollution load a bit challenging. It is recommended for all the regulators to prepare a complete, updated and accurate inventory of the industries which will further assist them in identifying the areas or sectors of concern from the perspective of environmental pollution.

- **Inadequate data on brick kilns and other small scale sectors**—There is little to no data on small scale industries or other unorganized sectors like brick kilns, etc. in most of the areas. According to the CSE assessment these sectors are significant contributors to the overall pollution loading in industrial areas. Most of the regional offices did not have a detailed inventory of brick kilns (mostly just the numbers) and there was no database on illegal small scale units operating in their areas.

- **Requirement of strategy for baby boilers**—CSE noticed that there are a number of baby boilers (with capacity < 2 TPH) installed in the industries. A large number of baby boilers were found being used in small scale textile industries in Panipat and Ghaziabad. The emission norms for such boilers (1200 mg/Nm^3) are quite relaxed as compared to the norms for big boilers installed in the organized sector thereby providing huge margin for such industries to pollute the environment. Moreover, installing a continuous emissions monitoring system (CEMS) on such small boilers is not economical for the industries and therefore it is necessary to explore other monitoring options which are economically feasible to the medium and small-scale industries where these boilers are installed. Proper guidelines should be available to monitor the emissions from these boilers.

- **Lack of clear fuel policy**—A clear fuel policy is required which mentions which fuels are banned and which clean fuels are recommended for industries to use now and in the future. Fuels that can be used in the long run by industries need to be made clear. Especially with the cost dynamics between coal and PNG, a lot of industries are looking at agro waste as a potential fuel which they are willing to use but are unsure if this will be allowed in the future. The regulators should also mention proper timelines for the implementation of such a policy to fast-track the change in fuel use and subsequently reduce the pollution load.

- **Lack of manpower and capacity in PCBs**—During the survey visits the CSE team also visited the State Pollution Control Board's regional offices. It was observed that the SPCBs lack manpower and the available manpower is highly over utilized. The periodic inspection and monitoring of the industries (specifically small scale industries) by the regulatory bodies to check and ensure compliance could not be conducted since the concerned officer is involved in various administrative assignments. There is an urgent requirement for SPCBs to develop the capacity of its existing officials and increase the manpower. It is also important to shift to technologies and

systems which need least monitoring and ensure maximum compliance to reduce the unrealistic work load on board officials. In Panipat there are only three technical staff members for 324 industries. The situation is similar in Alwar.

- **Restructuring of CTOs to include relevant information on fuel, equipment, etc.**—Since the industrial equipment and fuel consumption data was not available in many of the study areas, the required data is extracted from the CTO of industries. The basic requirement to estimate and analyze the pollution load is the detail of combustion equipment/pollution source of the industries and the type of fuel used in the industry. It is observed that there is no standard pro forma for CTO and the information is either not mentioned or partially available in the document. Regulators should standardize the CTO format so as to include all the important information (related to industries' production capacity, fuels consumed, combustion equipment installed and its capacity, and air pollution control devices installed) in a structured manner.

- **Economic costs for switch over to natural gas**—CSE observed that many industrial areas have access to natural gas as proper infrastructure is available, but the cost of shifting from conventional fuel to piped natural gas doesn't go well with the industries resulting in their unwillingness to switch over to PNG. The non-coverage of PNG under Goods and Services Tax (GST) and the application of Value Added Tax (VAT) on it in states like Haryana makes it even more expensive compared to other fuels. The cost dynamics of different fuels with respect to the generation of per kg of steam is shown in the table below (rate of natural gas has been considered as Rs 35 per SCM).

Table 15: Cost of steam generation with various fuels

Fuel	Price of steam—Rs/kg
Coal	1.6–1.7
Furnace oil	1.8–1.9
Natural gas	2.2–2.3
Light Diesel Oil (LDO)/High Speed Diesel (HSD)	3.9–4.1

Source: Nestle Inc., 2019

- **No data on the number of operational hours of industries and their DG sets**—Information related to operating hours of industries and the DG sets installed is not available in the data shared by the various PCBs. DG consumes significant quantity of diesel in the industrial areas and contributes to the loading pattern. Therefore, there is a need to make a complete inventory of DG sets along with the number of operating hours for each of them.

- **Poor road infrastructure, which adds substantially to fugitive dust emissions**—In most of the industrial areas visited, it was observed that the condition of the roads is very poor. The agencies responsible for the development of industrial areas should develop a robust system for the maintenance and development of infrastructure in industrial areas. Almost all districts which were studied had many industrial areas (even the major ones) with poor road conditions with the movement of heavy vehicles on them which led to high amount of

PM_{10} fugitive emissions in the area. This was recorded by the CSE team while measuring the ambient air quality in different areas.

- **Improper industrial waste management and open burning of industrial waste**—One of the most important aspects of industrial area development is the management of industrial waste which is generated in that area. It has been observed in most of the industrial areas that waste is dumped in the open dumping yards where it is burnt leading to hazardous emissions. Only in a few areas in Bhiwadi was there a waste collection system run by the industrial associations but no waste management system or facility was found in any of the other industrial areas visited.

- **More needs to be done for the abetment of fugitive emissions from industries, especially in Alwar district**—Some industrial areas, especially in the Alwar district, have industries where fugitive emissions are a major source of pollution. It was observed during the survey that sectors like mineral grinding, stone works, etc. need to be focused upon to control fugitive dust in the environment. Moreover, not much work has been done on the ground in these sectors to address this problem. Proper handholding and tailor made pollution control mechanisms will surely improve the environmental scenario in these sectors.

- **Issues with land-use planning with regard to communities living in close vicinity of industrial areas**—It was observed in many of the industrial areas visited that residential colonies/areas are in close vicinity of the industries, making people prone to different diseases due to air pollution. There seem to be flaws in urban planning in the area, since the industries came into existence first and people started to settle in these areas slowly and gradually. The labour force of industries is provided by such colonies at the cost of the health of their residents. CSE recommends that all the industrial area development agencies and urban planning departments should properly coordinate to clearly demarcate industrial and residential areas; and come up with remedial measures or buffer zones to prevent the residential population from the effects of air pollution from industries. Proper land use planning should be done for upcoming industrial areas or the expansion of the existing ones. Meteorology of the area should necessarily be considered while planning.

- **Good practices by industrial associations**—CSE observed that in many of the industrial areas, industrial associations are doing a good job in maintaining the infrastructure in the industrial area, following good environment management practices, and also working towards the development of the area in association with the administrative bodies. CSE recommends that industrial associations should be identified and considered as major stakeholders in the air pollution action plans being prepared by the PCBs. They can play a very significant role in improving air quality.

- **Requirement of technology-based standard for small scale industries**—Norms for small scale industries should be technology based rather than concentration based, since existing concentration based norms are impossible to monitor, especially given the current capacity of PCBs.

- **Centralized steam generation units for industrial sectors**—Most of the small scale industries have installed individual low capacity boilers for the purpose of steam generation. The opportunity to install a centralized

steam generation system should be explored. This will help in improving the efficiency of the system and indirectly reduce fuel consumption in the industrial areas. It would also make it much easier to monitor a few centralized steam generation units rather than a large number of baby boilers located in small industries.

- **Inadequate action plans by the PCBs—**There are existing action plans prepared by the PCBs for these study areas. Some of them are covered under the action plans for non-attainable cities, some have CEPI based action plans and some are included in both these categories and hence have two action plans. However, the plans for non-attainable cities seem to be inadequate in terms of industrial pollution because they are neither in detail nor do they even mention the major industrial areas in and around those cities or even the major sectors which are responsible for polluting those areas. For example, the action plan for Alwar city does not mention Matsya Industrial Area nor mineral grinding industries which are in close vicinity of the city and major sources of pollution. The CEPI action plans are more detailed and mention some actions to be taken but ground analysis shows that here implementation is poor. Therefore, regulatory bodies need to come up with time bound, detailed and effective action plans with clear implementation strategies.

2. DISTRICT PROFILES ON INDUSTRIAL AIR POLLUTION

I. Alwar district

Contents

1. Introduction

Five prominent cities of Rajasthan—Alwar, Jaipur, Jodhpur, Kota, and Udaipur—are on the list of 122 cities prepared by the CPCB for not meeting the set standards of air pollution in India between 2011 and 2015.[26] The CPCB report mentioned that the pollution level of these five cities has spiked and failed to meet the National Ambient Air Quality Standards. These cities were declared as non-attainment cities based on the findings of the CPCB report as well as the WHO air quality database.[27] According to medical experts, the air quality condition in these cities has increased the risk of respiratory diseases among their populations. Some major sources of air pollution in these cities are vehicular emissions, industrial pollution, road dust, open waste burning, etc. Each of these sources needs to be examined individually in a comprehensive manner to measure their actual contribution to the air pollution of the specific region.

The enlistment of Alwar city as one of the five non-attainment cities in Rajasthan makes it a significant region to be studied with respect to various sources of air pollution. This report studies and focusses on emissions from industries in the Alwar district to get a better understanding of their contribution to the overall air pollution and to determine the hotspots of industrial pollution in this region. Since industries are usually located in industrial areas which are spread across Alwar district, this study covers the whole district and not just Alwar city. Bhiwadi is the largest industrial cluster in the district and is also considered one of the most crucial areas in terms of industrial pollution, therefore **a separate chapter has been prepared for the Bhiwadi region. The current chapter focuses on the rest of the industrial areas in Alwar district except Bhiwadi.**

In terms of industrial pollution, Alwar district has both stack and fugitive emission sources depending on the kind of industries in different areas. With respect to fugitive emissions, mineral and stone based industries have a significant role to play. The Aravali hills are a good source of both. As per the Department of Mines and Geology, the total production of minerals in Alwar during 2014–15 was about 3.77 million tonnes.[28] Various mineral and stone based industries such as mineral grinding and stone crushers operate in the district and are responsible for a major amount of fugitive emissions. The major pollutant through fugitive emissions is particulate matter, especially PM_{10}. In regions of Alwar which have more stack-based industries, industrial types like chemical, food processing, metal etc. make a significant contribution to stack-based emissions. The major pollutants through stack emissions other than PM are CO, SO_2, and NO_X coming out from stacks of the various industries due to combustion of various fuels.

To get a better understanding of industrial pollution in Alwar district, it is essential to know about the various industrial areas and the various types of industries in the district. The report covers the sources of air pollution in industrial areas, the pollution load calculation for each area and the whole district, along with a detailed explanation of the pollution scenario of the major industrial areas in the district based on the calculated load as well as the field surveys conducted by the CSE team. Towards the end, the report mentions the role of RIICO and the inadequacy of the air pollution action plan for Alwar city before concluding by highlighting the industrial pollution hotspots in the district as well as the major industrial sectors responsible for air pollution in these areas and in the district as a whole.

2. Industrial areas in Alwar district

There are a large number of industrial units in Alwar district, spread over 24 designated industrial areas having large, medium and small-scale units.[29] Of these industrial clusters, the major industrial areas of Alwar are located in and around Bhiwadi, Alwar city, Rajgarh, Behror, Shahjahanpur, Neemrana I and II, etc. All these industrial areas are established and managed by RIICO, which is a government enterprise incorporated under Companies Act, 1956 on 28 March 1969.

RIICO has 28 regional offices all over Rajasthan and five regional offices in the district of Alwar, out of which two offices are in Bhiwadi region and the other three are in Alwar city, Ghilot and Neemrana. RIICO's major role is to administer the development and management of the industrial areas; from the allotment of industrial plots to providing infrastructure facilities like roads, street lights, drains, energy, water, and waste management. **The role of RIICO in maintaining the condition of roads, housekeeping of industrial areas, ensuring plantation, and managing industrial waste makes it a significant stakeholder in the air pollution scenario of the respective industrial areas.** All major industrial areas in Alwar district are listed below. All of these areas are managed by RIICO.

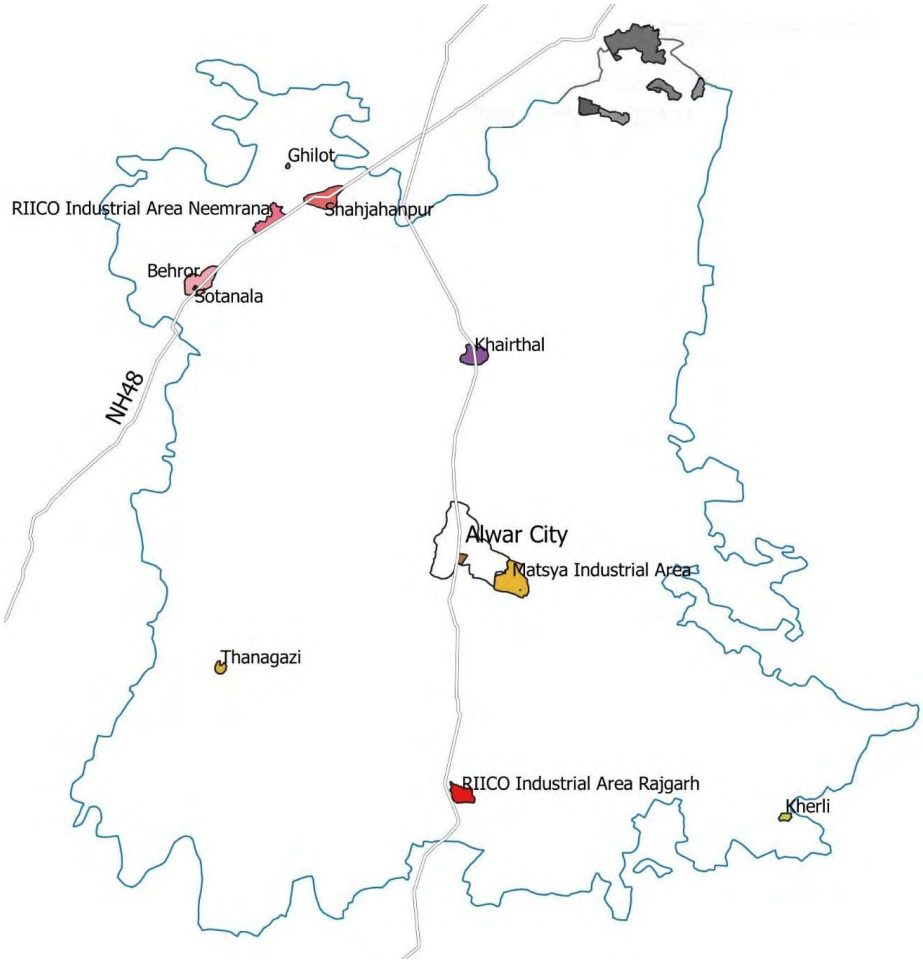
Table 16: Industrial areas in Alwar district

Sr. no.	Industrial area	Sub-district	Area in acre	Number of plots
1	MIA	Alwar	1,804	701
2	MIA Ext.	Alwar	201	204
3	MIA (south & east)	Alwar	186	203
4	Old Industrial Area	Alwar	179.96	59
5	Kherli	Alwar	180	59
6	Ghiloth	Alwar	1,929.7	306
7	Khairthal	Alwar	69.93	134
8	Behror	Behror	281	263
9	Shahjahanpur	Behror	203	190
10	Sotanala	Behror	152	80
11	Neemrana (Phase I to II)	Behror	960	110
12	EPIP Neemrana	Behror	211	220
13	Neemrana (Japanese Zone)	Behror	1,166	132
14	Thanagazi	Thanagazi	33.12	56
15	Rajgarh	Rajgarh	40.59	112
Bhiwadi Industrial Area				
1	Sare Khurd	Bhiwadi	94.59	63
2	Salarpur	Bhiwadi	1,056.18	293
3	Karoli	Bhiwadi	971.32	322
4	Keharani	Bhiwadi	1,216.88	355
5	Rampur Mundana	Bhiwadi	63.28	273
6	Khushkhera	Tijara	826	1,017

Sr. no.	Industrial area	Sub-district	Area in acre	Number of plots
7	IID, Centre Khuskhera	Tijara	152	479
8	Chopanki	Tijara	802	1,107
9	Tapukara	Tijara	781	22
10	Pathredi	Tijara	538	115

Source: MSME, Govt. of India, 2011

Map 1: Industrial areas in Alwar district, Rajasthan (excluding Bhiwadi)



Source: CSE, 2019

Alwar district (excluding Bhiwadi) has a total of 17 categories of industries that have been declared highly polluting by the CPCB. The major manufacturing sectors located in Alwar are mineral grinding, engineering, food processing, chemicals, plastics, etc. The industrial clusters in the northern part of the district are mostly dominated by large and medium scale stack-based industries whereas the southern part, which is close to the mineral mining regions of the Aravali hills, is dominated by medium and small scale industrial units with fugitive emissions which are basically mineral and stone based industries. MIA, which is the biggest industrial area in the district (apart from Bhiwadi) has a

mix of all scales of industries with stack as well as fugitive emissions. Some major small-scale industries in Alwar district include mineral grinding units, brick kilns, a few units of Calcium Chloride ($CaCl_2$) manufacturing, and stone crushers. The most number of industrial units in the district are from sectors like mineral grinding, food processing, engineering, chemical, and stone works (see *Table 17: Number of industrial types in Alwar district by category*).

Table 17: Number of industrial types in Alwar district by category

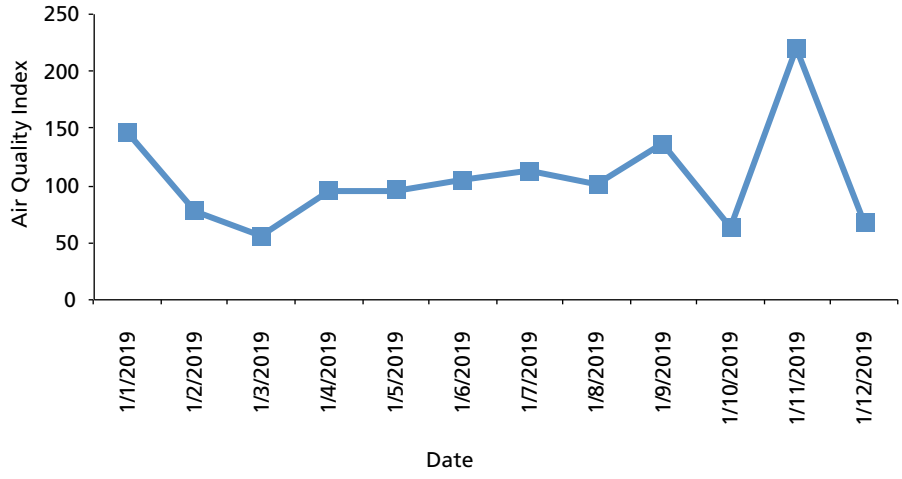
Category	Type Of industry	No. of units	Total no. of units
Red	Adhesive	1	253
	Bottling	11	
	Cement	29	
	Chemicals	97	
	Common incinerator	2	
	Fuel & lubricants	7	
	Paint	9	
	Paper-based	22	
	Pharmaceuticals	17	
	Textiles	35	
	Waste management	23	
Orange	Automobile and auto parts	7	1,004
	Building and construction	21	
	Ceramics and refractory	5	
	Cosmetics and hygiene	8	
	Distilleries and breweries	10	
	Engineering	183	
	Food processing	208	
	Plywood and laminates	7	
	Glass	3	
	Group housing	15	
	Hotels	101	
	Metal-based (ferrous & non-ferrous)	44	
	Mineral-based	302	
	Rubber products	10	
	Stoneworks	77	
	Synthetic resin and foam	3	
Green	Educational institutes	5	110
	Electronics and home appliances	13	
	Footwear	5	
	Furniture	2	
	Plastics	85	
White	Agricultural equipment	2	5
	Water	3	
	Total	1,372	

Source: CSE 2019–2020 (based on the data provided by RSPCB)

3. Air pollution in industrial areas of Alwar district

Alwar city, being declared as a non-attainment city, is monitored for air pollution on a continuous basis. There are two continuous monitoring stations for ambient air quality monitoring within Alwar District—one in Alwar city and another in Bhiwadi. The rest are all manual monitoring stations. There are no grossly polluting industries (GPI) in Alwar district. The AQI for Alwar city ranged between 63 and 220 in the year 2019. The AQI of Alwar peaked in the month of November in 2019 when the air quality of the entire Delhi-NCR area was reported to be significantly poor under the 'hazardous' category (see *Figure 1: Air Quality Index of Alwar city in the year 2019*).

Figure 1: Air Quality Index of Alwar city in the year 2019



Source: CPCB, 2019

The industrial profile of each industrial area determines its contribution to the overall emissions load of the region and Alwar city. The sources or type of emissions from industrial areas have been classified under three broad categories:

1. Stack emissions from industrial operations
2. Fugitive emissions from industrial operations
3. Fugitive emissions from industrial waste burning

Other categories include fugitive dust emissions caused due to poor infrastructure such as unpaved/damaged or poorly maintained roads and vehicular emissions.

3.1 Stack emissions from industrial operations

- There are a total of 156 industries with stack emissions in Alwar district (excluding Bhiwadi) which are distributed across various industrial areas.

- These are basically controlled emissions of SO_X, NO_X, CO, CO_2, $PM_{2.5}$, PM_{10}, etc. from boiler operations in large and medium scale industries.

- Some small scale industries such as brick kilns, engineering works, plastics

(plastic grain production for recycling), and cattle feed units may also have stack emissions.

- The most number of stack-based industries are in Matsya Industrial Area (45 per cent) and Neemrana (26 per cent) (see *Figure 2: Distribution of industries with stack emissions in industrial areas of Alwar district*).

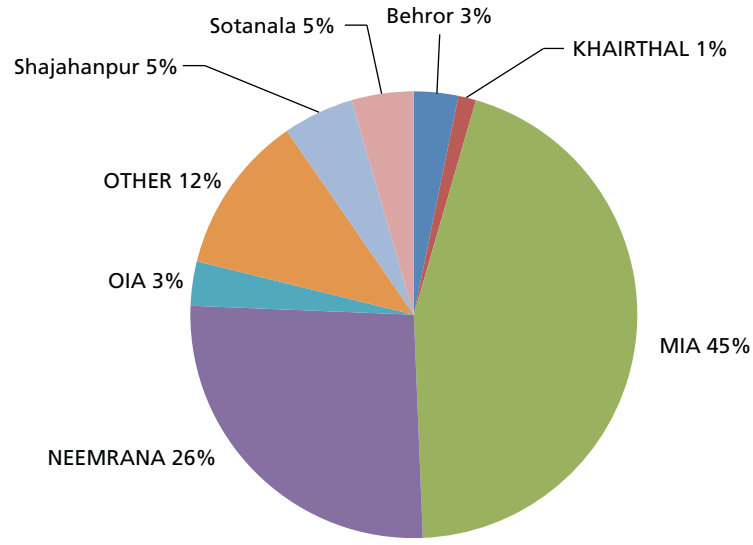
- The number and type of industrial units with stack emissions in Alwar district are given in the table below.

Table 18: Type and number of industrial units with stack emissions in Alwar district (excluding Bhiwadi region)

Type of industry	Total no. of units
Ceramics and refractory	4
Chemical	33
Distillery	8
Electronics and home appliances	5
Engineering	19
Food processing	29
Metal-based	24
Miscellaneous	17
Pharmaceuticals	5
Rubber products	4
Textile	7
Waste management	1
Total	156

Source: CSE 2019–2020 (based on the data provided by RSPCB)

Figure 2: Distribution of industries with stack emissions in industrial areas of Alwar district



Source: CSE 2019–2020 (based on the data provided by RSPCB)

3.2 Fugitive emissions from industrial operations

- There are a total of 1039 industries with probable fugitive emissions of some kind in Alwar district (excluding Bhiwadi) which are distributed across various industrial areas.

- These are basically emissions of dust, $PM_{2.5}$, PM_{10}, etc. especially from medium and small scale industries such as mineral grinding.

- Mineral grinding is the major industry responsible for fugitive dust emissions in Alwar district.

- The most number of industries with fugitive emissions are in MIA (46 per cent), Neemrana (10 per cent) and Rajgarh (six per cent) (see *Figure 3: Distribution of industries with fugitive emissions in industrial areas of Alwar district).*

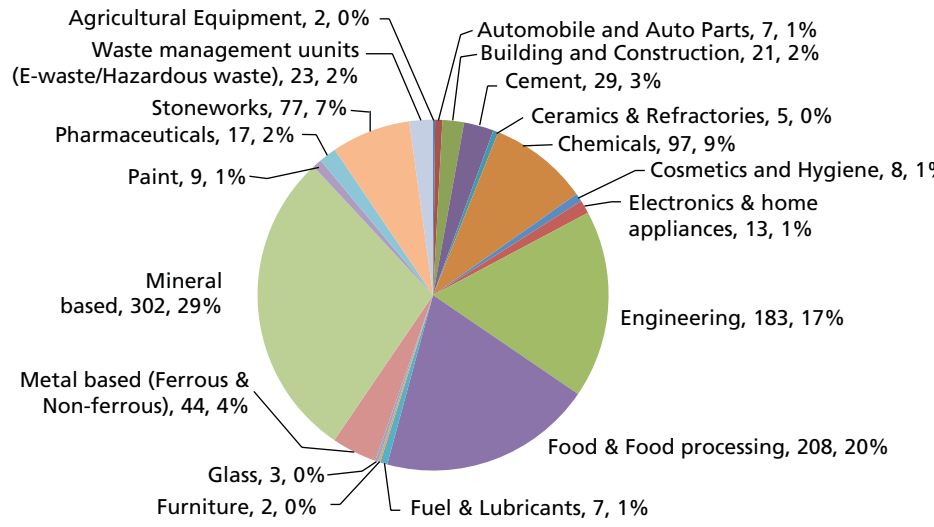
- Number and types of industrial units with fugitive emissions in Alwar district are given in the table below.

Table 19: Number and type of industrial units with probable fugitive emissions in Alwar district (excluding Bhiwadi region)

Type of industry	Total no. of units
Cement	29
Fuel & lubricants	7
Pharmaceuticals	17
Chemicals	97
Waste management (e-waste and hazardous waste)	23
Paint	9
Automobile and auto parts	7
Building and construction	21
Metal based	24
Engineering	183
Plywood & laminates	10
Cosmetics and hygiene	8
Mineral based	302
Stone works	77
Glass	3
Ceramics & refractory	5
Food processing	88
Refined edible oil	50
Furniture	2
Electronics & home appliances	13
Flour mills	62
Agricultural equipment	2
Total:	1,039

Source: CSE 2019–2020 (based on the data provided by RSPCB)

Figure 3: Distribution of industries with fugitive emissions in industrial areas of Alwar district



Source: CSE 2019–2020 (based on the data provided by RSPCB)

3.3 Fugitive emissions from industrial waste burning

- Emissions due to negligence and poor management of solid waste from industries which are dumped in open areas/landfills and then burnt.

- Industrial waste management has been observed to be significantly poor in Bhiwadi and other industrial areas, where industrial waste is dumped and burnt not just in the landfills but also at random places along the roads.

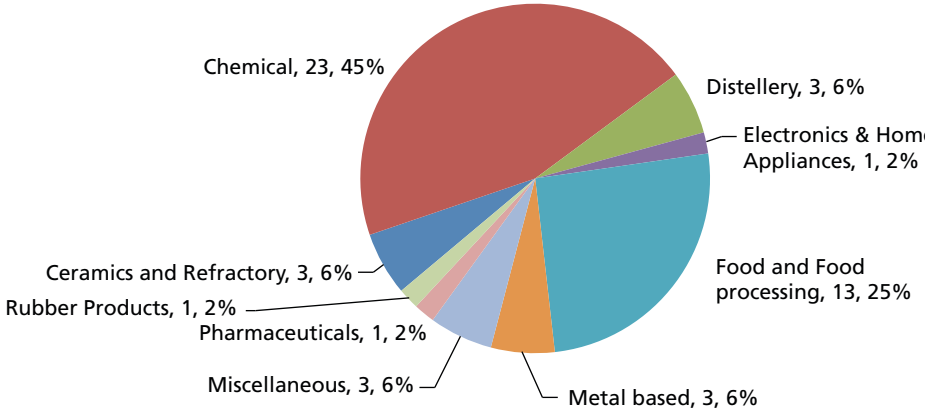
- Industrial waste mismanagement and burning was observed even in well managed areas with sound infrastructure such as EPIP Neemrana and MIA.

4. Major industrial areas in Alwar district (excluding Bhiwadi)

4.1 Matsya Industrial Area (MIA) and MIA Extention, Alwar

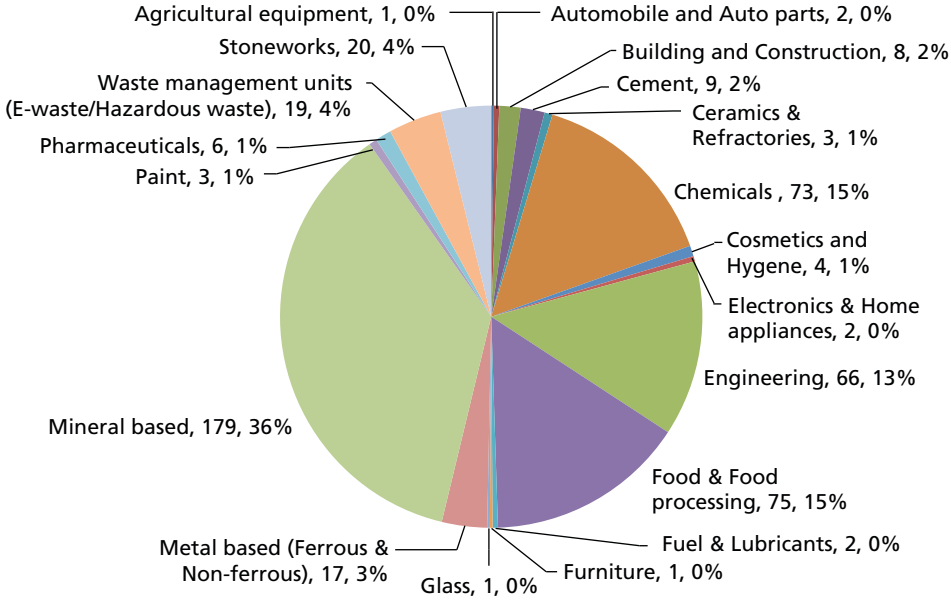
MIA is spread over 2,148 acres (8.7 km^2) 4–5 km to the southeast of Alwar city. It is the largest industrial area in Alwar district (apart from Bhiwadi). There are a total of around 545 industries in MIA with around 491 industries with probable fugitive emissions and 70 industries with stack based emissions. Predominant stack based industries in MIA are **chemical and food processing industries** (see *Figure 4: Share of industrial sectors with stack emissions in MIA*). Predominant industry with significant **fugitive emissions (smoke, VOCs and dust)** are **mineral based industries** such as mineral grinding, etc., and **chemical based industries** (see *Figure 5: Share of industrial sectors with fugitive emissions in MIA*).

Figure 4: Share of industrial sectors with stack emissions in MIA



Source: CSE 2019–2020 (based on the data provided by RSPCB)

Figure 5: Share of industrial sectors with fugitive emissions in MIA

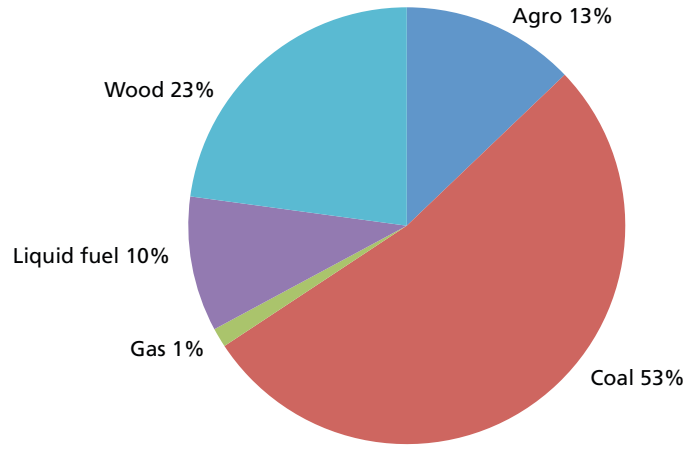


Source: CSE 2019–2020 (based on the data provided by RSPCB)

4.1.1 Fuel usage in MIA

More than half (53 per cent) of the industries in MIA are using coal, followed by 23 per cent of industries using wood, around 13 per cent of industries using agro waste, and 10 per cent using liquid fuel. There is a clear dominance of coal usage in MIA (see *Figure 6: Share of fuel usage in Matsya Industrial Area in Alwar district*).

Figure 6: Share of fuel usage in Matsya Industrial Area in Alwar district



Source: CSE 2019–2020 (based on the data provided by RSPCB)

4.1.2 Information gathered from field surveys

While surveying the Matsya Industrial Area the CSE team came across a mix of industries but primarily they were chemical industries in the chemical zone of MIA and mineral grinding units. Although there were a number of food processing and engineering based industries as well, the most visible ones in terms of emissions were mineral grinding and chemical factories. The mineral grinding industries were most abundant in the area and were the major source of visible fugitive emissions in the whole area. The observations made and the information gathered by the CSE team about mineral grinding industries and chemical industries have been discussed below:

Mineral grinding industries

MIA and surrounding areas near Alwar city have 179 odd units producing stone powder (largely calcium carbonate) with their production capacity ranging between 300 to 1,500 metric tonnes (MT) per month. There are also a few large scale grounded calcium carbonate (GCC) production units in MIA with production capacity ranging from 1,000 MT to 1,500 MT.

The waste powder generated in these units is about 10 per cent of the total production of GCC depending on the capacity of the unit. The total generation of powdered waste from GCC production in 179 units could range between 5,000–30,000 MT per month; a large part of which escapes any control system (if any) in the units and becomes fugitive emissions, staying in the air or accumulating on the roads, vegetation, buildings, etc. Majority of the mineral grinding units are not even fully covered and the grinding and crushing of stones is happening in semi-open facilities.

The stone dust generated from marble/dolomite grinding is a health hazard which could lead to respiratory disorders and diseases among the people working in these industries and also those living nearby. CSE's team observed in MIA that white coloured dust was visible all over the area—suspended in the air as fugitive emission, accumulated on the roads and vegetation and marble slurry spread over empty plots. Even the roofs and walls of the industry itself are covered with white dust.

Image 1: Mineral grinding operations being carried out in semi-open area in MIA

Image 2: Mineral grinding operations being carried out in open area in MIA

Image 3: Stack emissions from a packaging factory in MIA

Image 4: Marble slurry dump on a vacant plot in MIA

Source: CSE, 2019

Chemical industries

There are two large chemical zones in the MIA where all the chemical factories are located. Out of the total 97 chemical factories in Alwar district, 73 are in MIA. Some of them are stack-based while others have the risk of fugitive emissions from VOCs, etc. There are a lot of old chemical plants too, some of which are non-operational or running on age old technologies. In terms of small scale industries, about 13 industries which produce $CaCl_2$ are also within MIA. Most of them have production capacities ranging from three to four MT per day, barring two units that have production capacities of six and 10.5 MT per day. These small scale industrial units use wood as fuel and have furnaces as air pollution source.

Ambient air quality monitoring in MIA

The PM_{10} standard for industries being followed by the mineral grinding units in Alwar is 600 mg/Nm^3 from a distance of three to ten meters from the operational process (as told by RSPCB) and the general ambient air quality standards for PM_{10} and $PM_{2.5}$ as per the National Ambient Air Quality Standards is 100 for PM_{10} (24 hours) and 60 for $PM_{2.5}$. The ambient air quality measured using Aerocet™ in four out of five places within MIA show PM_{10} levels significantly exceeding the national standards; they were even above the PM_{10} standard of 600 mg/Nm^3, which is a standard for fugitive emissions near operational processes (see *Table 20: Average values of PM of different micron sizes as recorded in MIA and MIA extension*). However, industrial operations at mineral grinding units alone weren't the only culprits. Poor road conditions with frequent movement of vehicles on the road further increase dust emissions within MIA.

Table 20: Average values of PM of different micron sizes as recorded in MIA and MIA extension

Place	GPS location (lat/long)	Date of monitoring	Average values of PM emissions		
			$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)	TSP (µg/m^3)
Near 20 Microns Ltd, MIA road, MIA	27.515857, 76.679667	21 November 2019	131	417	417
Near Kalpataru Estate, MIA	27.509702, 76.705825	21 November 2019	188	5,221	5,221
Near Varun Beverages, MIA road	27.525833, 76.692070	21 November 2019	107	916	1,119
Near Ajanta Polyemers Pvt. Ltd, MIA	27.516616, 76.692217	21 November 2019	135	1,515	1,961
Behind Mahesh Edible Oil Mill, MIA	27.508642, 76.674349	21 November 2019	152	1,343	1,689

Source: Aerocet™ air monitoring data, CSE, 2019.

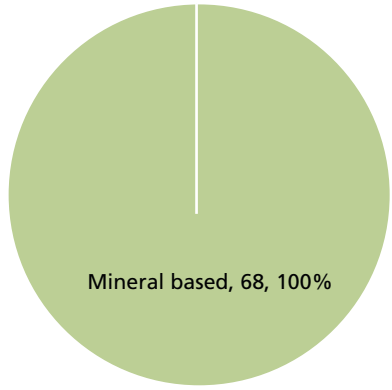
General infrastructure

An area as large as MIA and its extension, which has a well-planned layout, is expected to have well-managed infrastructure too. On the contrary, several shortfalls were observed during the visit to the area in terms of infrastructural provisions. The roads in MIA were found to be in remarkably poor condition. They were crumbling and damaged at several locations, they were full of dust and garbage, and sidewalks were observed to be full of stocks of stones lying in the open. Barring few large-scale industries such as Havells, Varun Beverages, Roca, etc. which have well maintained plantations along their boundaries, the industries of the entire area have poorly managed their surroundings. Vegetation is sparse and mostly covered in dust from industries and roads. There is an **urgent need for intervention from RIICO** for better management of the infrastructure to control dust emissions in MIA.

4.2 RIICO Industrial Area, Rajgarh

Rajgarh's RIICO Industrial Area is spread over 40.59 acres. There are a total of 69 industries in the area out of which 68 are operational units of mineral grinding industries of various capacities. **Only one stack-based plywood industry** is present in this area. Therefore there **is no issue of stack emissions in this area as hardly any fuel is being used**. No chart for stack emissions in the area has been shown as there is only one stack-based industry in the area.

Figure 7: Share of industrial sectors with fugitive emissions in Rajgarh



Source: CSE 2019–2020 (based on the data provided by RSPCB)

4.2.1 Information gathered from field surveys

The entire industrial area is in close proximity to the hills of Aravalli and quite compact compared to other industrial areas. The nearby stone/marble mining area in *Tehla* region is the major supplier of stones and minerals in this area. The production capacities of these units vary between 20 to 60 tonnes of stone powder per day. This way, considering that about 10 per cent of the total powder produced is suspended as dust in the air, the **dust pollution load should vary between 130 to 390 tonnes per day in the area**.

In the majority of mineral grinding units in Rajgarh Industrial Area, the grinding operations are carried out in open or semi-open facilities, releasing a substantial quantity of dust in the air. The density of the industrial units is also high and almost all of the machines that were observed in the area are not fitted with dust suction facility. The poor condition of roads in the area also exacerbates the pollution load. Therefore, the working conditions were found to be poor; labourers are exposed to high level of dust pollution in Rajgarh Industrial Area.

Ambient air quality monitoring in Rajgarh Industrial Area

The dust emissions level are high here and it is evident through the ambient air quality data collected by the CSE team (see *Table 20: Average values of PM of different micron sizes as recorded in RIICO Industrial Area, Rajgarh, Alwar*) and the photographic evidence which depicts roads and vegetation completely covered by stone dust in the region (see *Image 5* and *Image 6*). The condition of housekeeping, roads and fugitive dust in this area was even worse than in MIA.

Table 20: Average values of PM of different micron sizes as recorded in RIICO Industrial Area, Rajgarh, Alwar

Place	GPS location (lat/long)	Date of monitoring	Average values of PM emissions		
			$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)	TSP (µg/m^3)
RIICO Industrial Area, Rajgarh	27.223391, 76.610247	22 November 2019	384	2,852	3,832
RIICO Industrial Area, Rajgarh	27.223313, 76.611089	09 December 2019	288	2,689	2,689

Source: Aerocet™ air monitoring data, CSE, 2019

Image 5: Dust emissions from mineral grinding operation in an open area at RIICO, Rajgarh

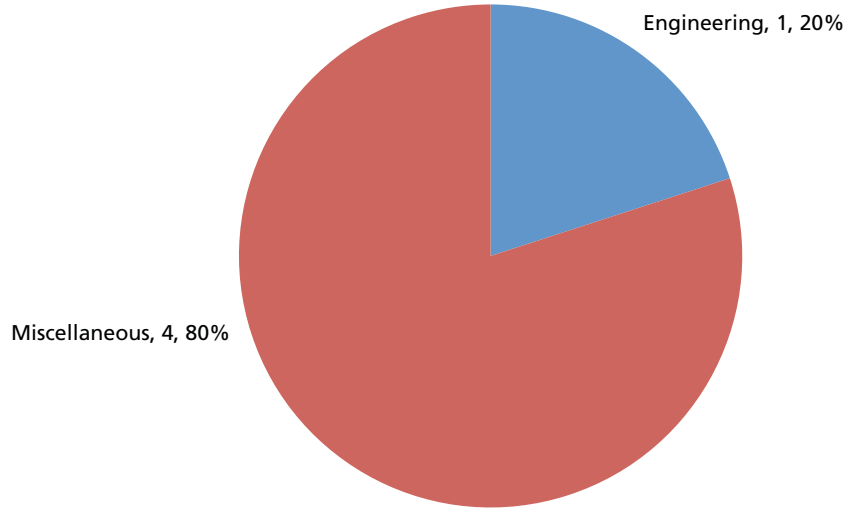
Image 6: Trees and road covered in stone dust generated from mineral grinding in RIICO, Rajgarh

Source: CSE, 2019

4.3 RIICO Industrial Area, Behror

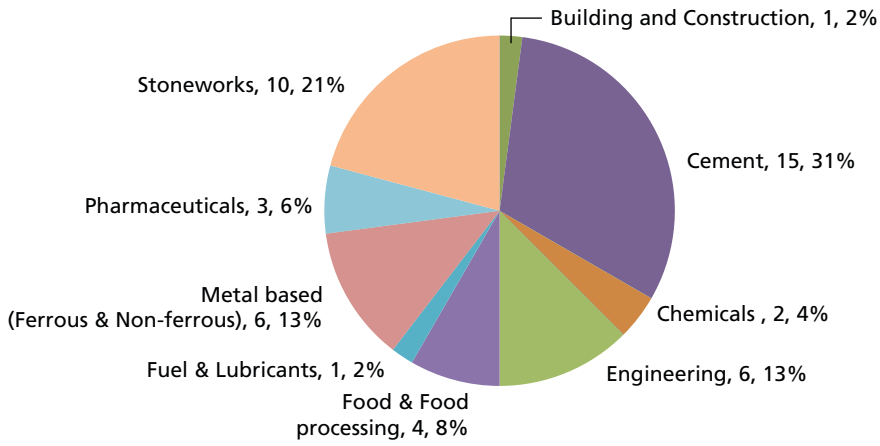
Behror has been industrialized since the early 1990s; the industrial area is known as RIICO Industrial Area. In total there are 70 industries in Behror. Out of 70, only five are stack-based industries and around 45 industries are with fugitive emissions. There are 15 cement units in this area but 14 of them are grinding units (hence a source of fugitive emissions). The share of industrial sectors in Behror with respect to stack and fugitive emissions has been shown in the figures below. The area is still under development.

Figure 8: Share of industrial sectors with stack emissions in Behror Industrial Area



Source: CSE 2019–2020 (based on the data provided by RSPCB)

Figure 9: Share of industrial sectors with fugitive emissions in Behror Industrial Area

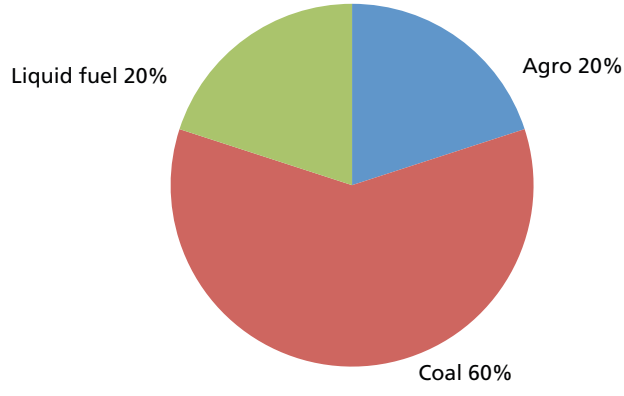


Source: CSE 2019–2020 (based on the data provided by RSPCB)

4.3.1 Fuel usage

There are only five stack-based industries in Behror. The predominant fuel used in these industries is coal. Three out of five industries are using coal and the other two are using liquid fuel and agro waste (see *Figure 10: Share of fuel usage in Behror Industrial Area in Alwar district*)

Figure 10: Share of fuel usage in Behror Industrial Area in Alwar district



Source: CSE 2019–2020 (based on the data provided by RSPCB)

4.3.2 Information from field surveys

In terms of pollution, Phase-I of the RIICO Industrial Area in Behror was observed to be insignificant as no stack emissions or dust emissions were observed there. In Phase-II stack emission is being generated from boiler operations from a metal-based manufacturing unit. Industries with significant fugitive emissions are cement and stone works.

Ambient air quality monitoring in Behror Industrial Area

With respect to ambient air quality monitoring, the RIICO Industrial Area in Behror was found to be in poorer condition compared to Neemrana Industrial Area (discussed later). Although the average value of $PM_{2.5}$ is under the AQI

category of 'moderately polluted', the average value of PM_{10} is under 'poor' AQI category. Stack emissions were observed from one metal-based industry and no significant dust emissions were observed. The general condition of roads and other infrastructure in the industrial area appeared to be satisfactory and no waste burning sites were found.

Table 21: Average values of PM of different micron sizes as recorded in RIICO Industrial Area, Behror, Alwar

Place	GPS location (lat/long)	Date of monitoring	Average values of PM emissions		
			$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)
Near Rajasthan Polymers, Phase 1, RIA Behror	27.900277, 76.307174	22 November 2019	84	294	362
Near Greenlam Veneers, RIA Behror	27.904435, 76.302695	22 November 2019	69	391	514

Source: Aerocet™ air monitoring data, CSE, 2019.

Image 7: Stack emissions from a manufacturing unit in RIICO Industrial Area, Behror

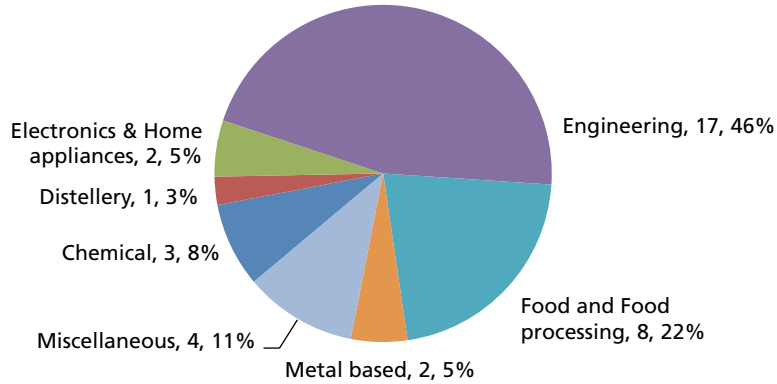
Source: CSE, 2019

RIICO Industrial Area in Behror has a well-planned layout and management of infrastructure appeared to be satisfactory. Plantations in the outer limits of the industries were observed to be well managed and condition of roads is also good.

4.4 RIICO Industrial Area, NIC (M), EPIP Neemrana and Old Industrial Area (Neemrana-II)

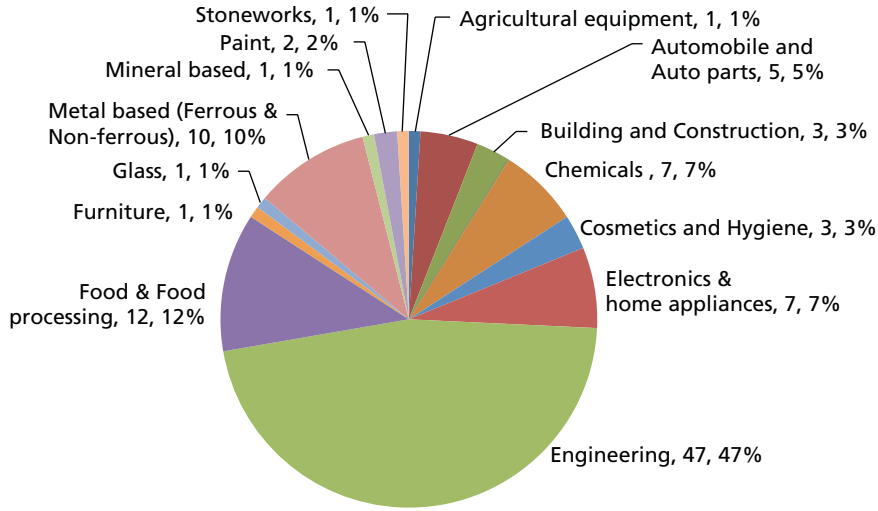
Neemrana is the second largest industrial area in Alwar district after MIA (excluding Bhiwadi region). Neemrana is divided into four sub industrial areas which are RIA Neemrana, NIC (M) RIA Neemrana, EPIP RIA Neemrana and the Old Industrial Area. There are a total of 159 industries in Neemrana area altogether. Out of these around 100 have probable fugitive emissions and 41 industries have stack-based emissions.

Figure 11: Share of industrial sectors with stack emissions in Neemrana Industrial Area



Source: CSE 2019–2020 (based on the data provided by RSPCB)

Figure 12: Share of industrial sectors with fugitive emissions in Neemrana Industrial Area

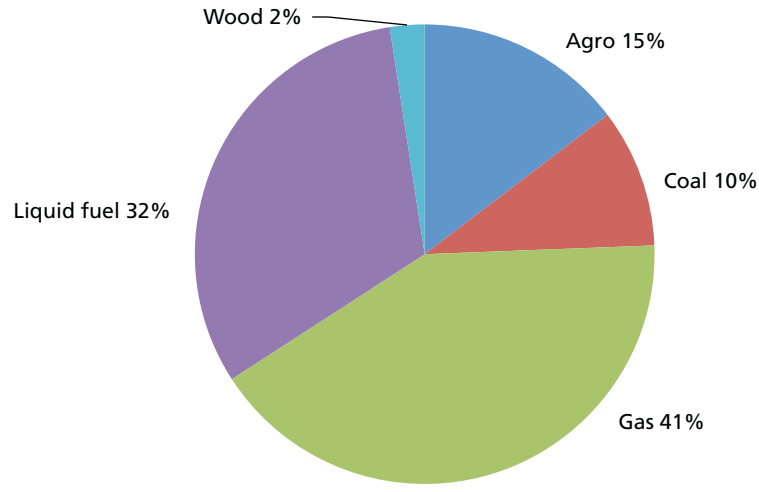


Source: CSE 2019–2020 (based on the data provided by RSPCB)

4.4.1 Fuel usage

The predominant fuel used in 41 per cent of the industries of Neemrana is gas. Around 32 per cent of the industries are using liquid fuel, followed by 15 per cent using agricultural residue and 10 per cent using coal. The fuel usage in Neemrana is much less coal dependent compared to Matsya Industrial Area (see *Figure 13: Share of fuel usage in Neemrana Industrial Area in Alwar district*)

Figure 13: Share of fuel usage in Neemrana Industrial Area in Alwar district



Source: CSE 2019–2020 (based on the data provided by RSPCB)

4.4.2 Information from field surveys

EPIP Neemrana Industrial Area was set up as a Japanese zone. The area is very well maintained with clean roads and well-manicured plantations along the roadside. This sub division of RIA Neemrana basically has engineering, plastic, textile, metal-based and textile industries. The division of NIC(M) has predominantly engineering based industries.

In the far end of the industrial area in EPIP Neemrana, evidence of industrial waste dumping and burning was found (see *Images 8–11*). While general observation did not suggest very high level of emissions from industries, mismanagement of industrial waste was clearly evident from a couple of sites within the industrial area.

Image 8: Industrial waste burning in a dump yard in EPIP Neemrana

Image 9: Burnt industrial waste dumping in EPIP Neemrana

Image 10: Waste dump right in front of a bio-degradable tableware factory in EPIP Neemrana

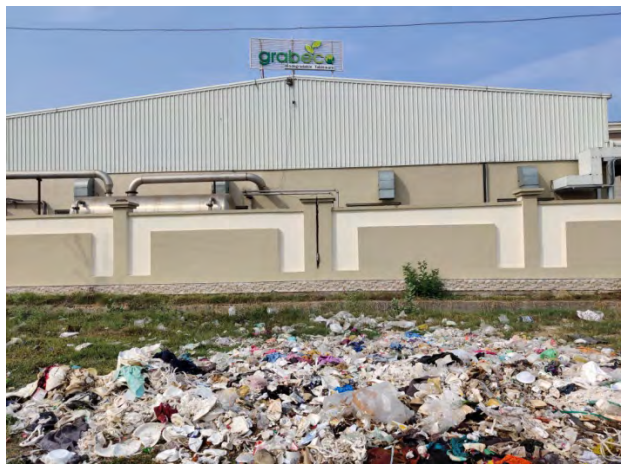


Image 11: Industrial waste dumped and burned near biodegradable tableware factory in EPIP Neemrana

Source: CSE, 2019

The Old Industrial Area of Neemrana was also observed to be very well maintained with clean roads and good vegetation. However, some stack emissions and burning of general waste were found at a couple of industries (see *Image 12* and *Image 13)*.

Image 12: Waste burning in Old Industrial Area, Neemrana

Image 13: Stack emissions in Old Industrial Area, Neemrana

Source: CSE, 2019

Ambient air quality monitoring in Neemrana Industrial Area

Barring few sites of waste dumping and burning, the industrial areas in Neemrana appeared to be well planned and managed. Plantations are present in the entire industrial area surrounding the industrial units as well as along the roads and on dividers. Condition of roads is very good—no road in the area was found to be in poor condition. Dust is at a minimum level therefore PM_{10} emissions were recorded to be not very high compared to other industrial areas (see *Table 22: Average values of PM of different micron sizes as recorded in RIICO, EPIP Neemrana and Old Industrial Area of Neemrana*).

Table 22: Average values of PM of different micron sizes as recorded in RIICO, EPIP Neemrana and Old Industrial Area of Neemrana

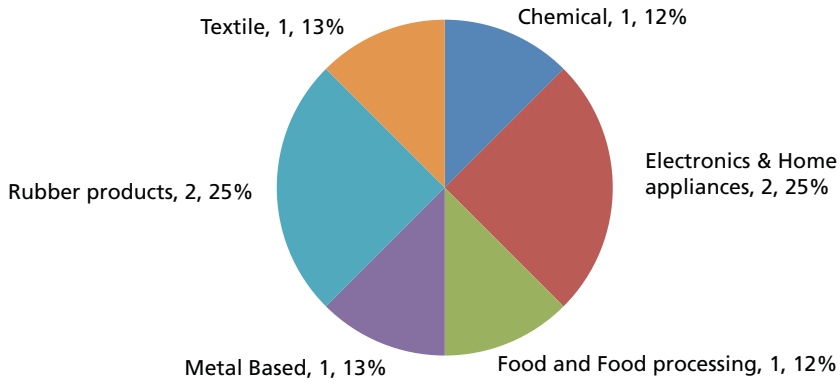
Place	GPS location (lat/long)	Date of monitoring	Average values of PM emissions		
			$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)	TSP (µg/m^3)
Near Schon Ultrawares Pvt. Ltd, EPIP Neemrana	27.963874, 76.362434	22 November 2019	60	141	161
Near RIICO Park, OIA, Neemrana	27.980535, 76.389762	22 November 2019	64	180	206

Source: Aerocet™ air monitoring data, CSE, 2019.

4.5 RIICO Industrial Area, Shahjahanpur

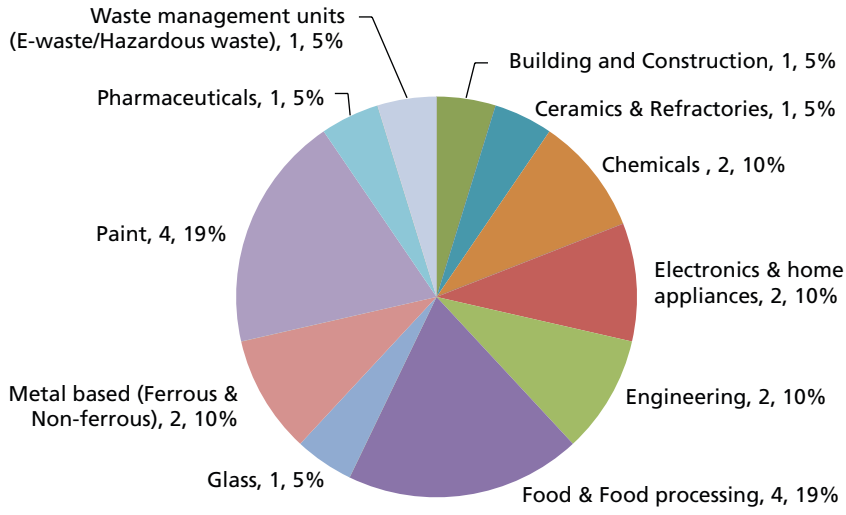
This industrial area is spread across 230 acres. There are around 200 plots but currently there are a total of only 35 industries in this area out of which 21 industries have probable fugitive emissions and eight industries are stack-based having stack emissions.

Figure 14: Share of industrial sectors with stack emissions in Shahjahanpur Industrial Area



Source: CSE 2019–2020 (based on the data provided by RSPCB)

Figure 15: Share of industrial sectors with fugitive emissions in Shahjahanpur Industrial Area

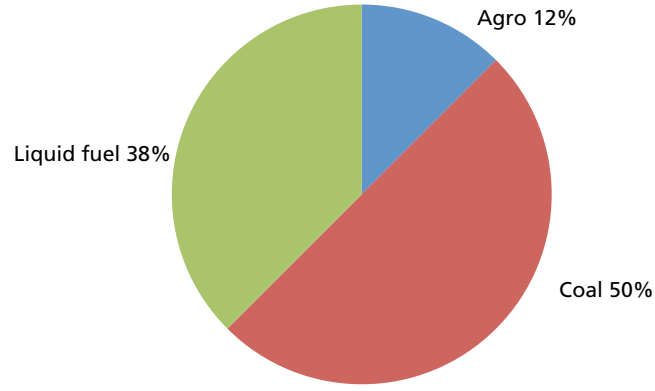


Source: CSE 2019–2020 (based on the data provided by RSPCB)

4.5.1 Fuel usage

There are only eight stack-based industrial units in Shahjahanpur Industrial Area. Half of them are using coal as a fuel, three of them use liquid fuel and only one industry uses agricultural residue (see *Figure 16: Share of fuel usage in Shahjahanpur Industrial Area in Alwar district*).

Figure 16: Share of fuel usage in Shahjahanpur Industrial Area in Alwar district



Source: CSE 2019–2020 (based on the data provided by RSPCB)

4.5.2 Information gathered from field surveys

The area has a mix of industries, prominent among which are rubber, plastic, and food processing industries. There were also a few metal-based, paint and two chemical industries in the area. Stack emissions from a few industries were observed during the visit.

Ambient air quality monitoring in Shahjahanpur Industrial Area

Industrial area of Shahjahanpur appears to be under-developed and poorly managed. Dust emissions were observed to be high along with industrial waste burning. Poor condition of roads and burning of waste were the probable reasons behind spiked PM_{10} readings (see *Table 23: Average values of PM of different micron sizes as recorded in RIICO Industrial Area, Shahjahanpur*).

Table 23: Average values of PM of different micron sizes as recorded in RIICO Industrial Area, Shahjahanpur

Place	GPS location (lat/long)	Date of monitoring	Average values of PM emissions		
			$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)	TSP (µg/m^3)
Near Vanasthali Textiles, RIICO, Shahjahanpur	28.008018, 76.456182	22 November 2019	94	1,584	2127

Source: Aerocet™ air monitoring data, CSE, 2019

Image 14: Stack emissions and poor road condition in RIICO Industrial Area, Shahjahanpur

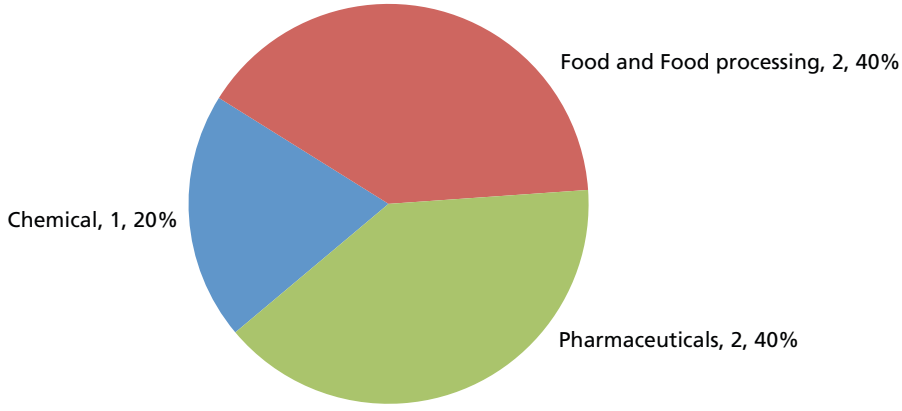
Image 15: Waste burning outside a paint manufacturing factory in RIICO, Shahjahanpur

Source: CSE, 2019

4.6 Old Industrial Area, Alwar

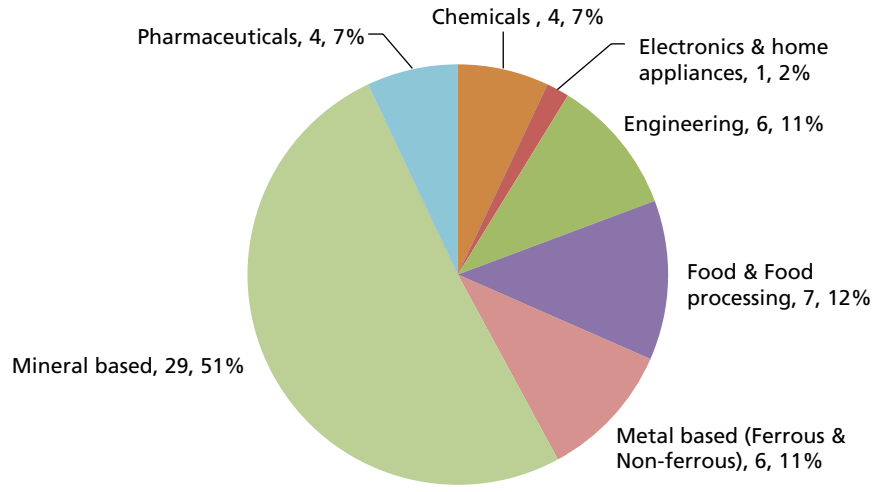
The Old Industrial Area lies in the Alwar city. It has a total of 62 industries out of which only five are stack-based industries and 57 are with fugitive emissions. Mineral based industries are the most in number (29).

Figure 17: Share of industrial sectors with stack emissions in Old Industrial Area



Source: CSE 2019–2020 (based on the data provided by RSPCB)

Figure 18: Share of industrial sectors with fugitive emissions in Old Industrial Area

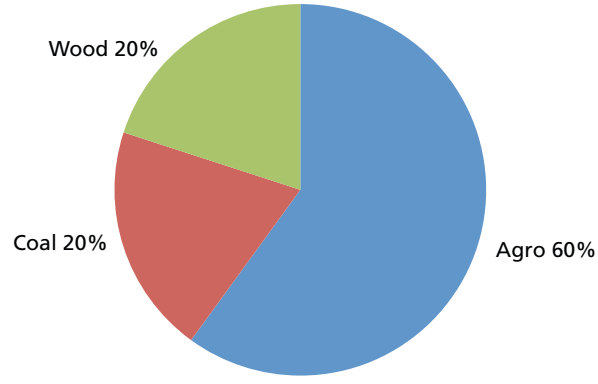


Source: CSE 2019–2020 (based on the data provided by RSPCB)

4.6.1 Fuel usage

There are **only five stack-based industrial units** in Old Industrial Area, out of which three industries are using agricultural waste and one industry each is using coal and wood (see *Figure 19: Share of industrial fuel usage in Old Industrial Area*).

Figure 19: Share of industrial fuel usage in Old Industrial Area



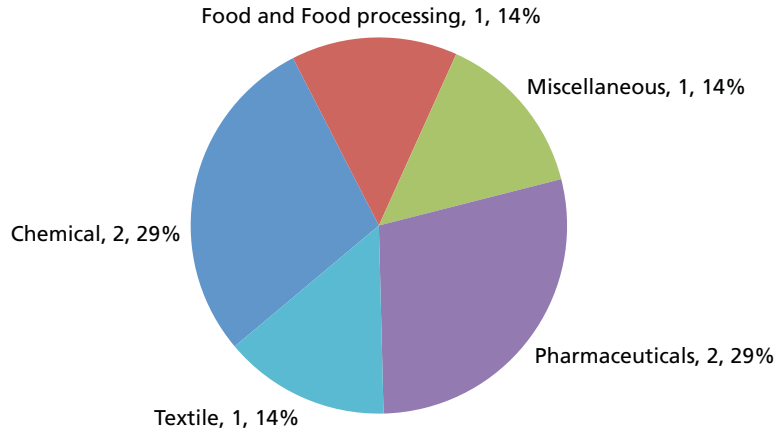
Source: CSE 2019–2020 (based on the data provided by RSPCB)

The area is **significant as it is inside the Alwar city** and has a substantial number of mineral based and other fugitive emission industries which affect the air quality of the city. The issue of fugitive emissions from mineral based industries in the area is **not even addressed in the action plan** prepared by the government to curb the air pollution in the city.

4.7 RIICO Industrial Area, Sotanala

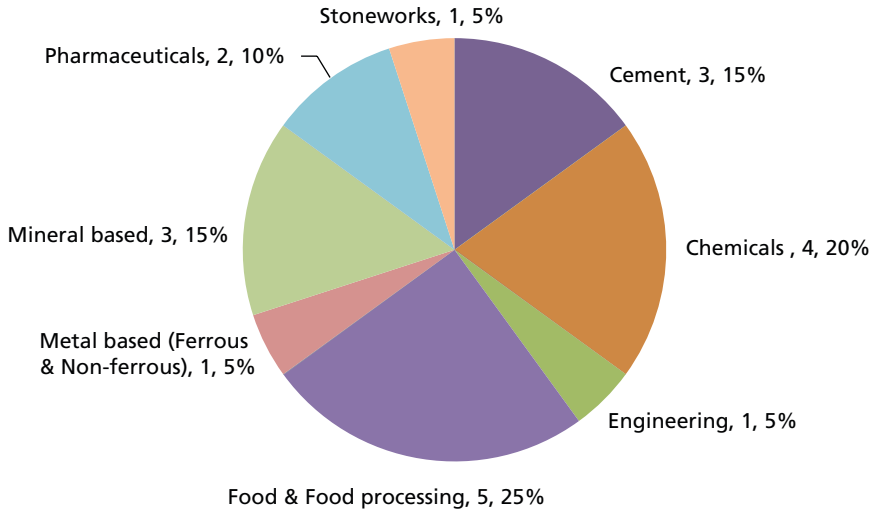
There are a total of 24 industries in this industrial area. Out of these 20 industries have probable fugitive emissions and seven industries have stack-based emissions.

Figure 20: Share of industrial sectors with stack emissions in Sotanala Industrial Area



Source: CSE 2019–2020 (based on the data provided by RSPCB)

Figure 21: Share of industrial sectors with fugitive emissions in Sotanala Industrial Area

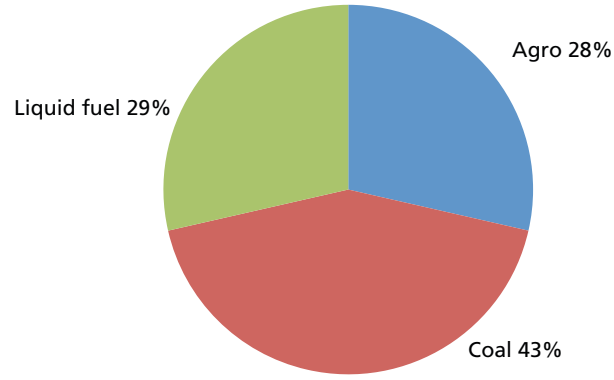


Source: CSE 2019–2020 (based on the data provided by RSPCB)

4.7.1 Fuel usage

There are only seven stack-based industrial units in Sotanala Industrial Area, three of which use coal as fuel while two industries each use liquid fuel and agricultural residue as fuel.

Figure 22: Share of industrial fuel usage in Sotanala Industrial Area



Source: CSE 2019–2020 (based on the data provided by RSPCB)

4.8 Ghiloth Industrial Area

Ghiloth Industrial Area is situated in Alwar district on NH-8 at the Rajasthan–Haryana border. It is part of Ghiloth–Neemrana–Shahjahanpur industrial belt. RIICO and South Korean Trade Promotion Agency (KOTRA) signed a MoU in March 2013 to set up a country specific zone in Ghiloth on the line of the Japanese zone in Neemrana. **It does not have more than 10 industries**. Plastic (three), chemical (one), pharmaceutical (one), and engineering based industries are the industrial types present in the area. The area is relatively new and is under development, therefore it is not significant in terms of pollution load.

4.9 Khairthal Industrial Area

The area has **altogether 39 industries** out of which **25 are food processing units which are mainly oil expeller units and non-air polluting** in nature sine they do not use any fuel. As per the RSPCB data there are **only two operational units** located in the area **which are stack-based**.

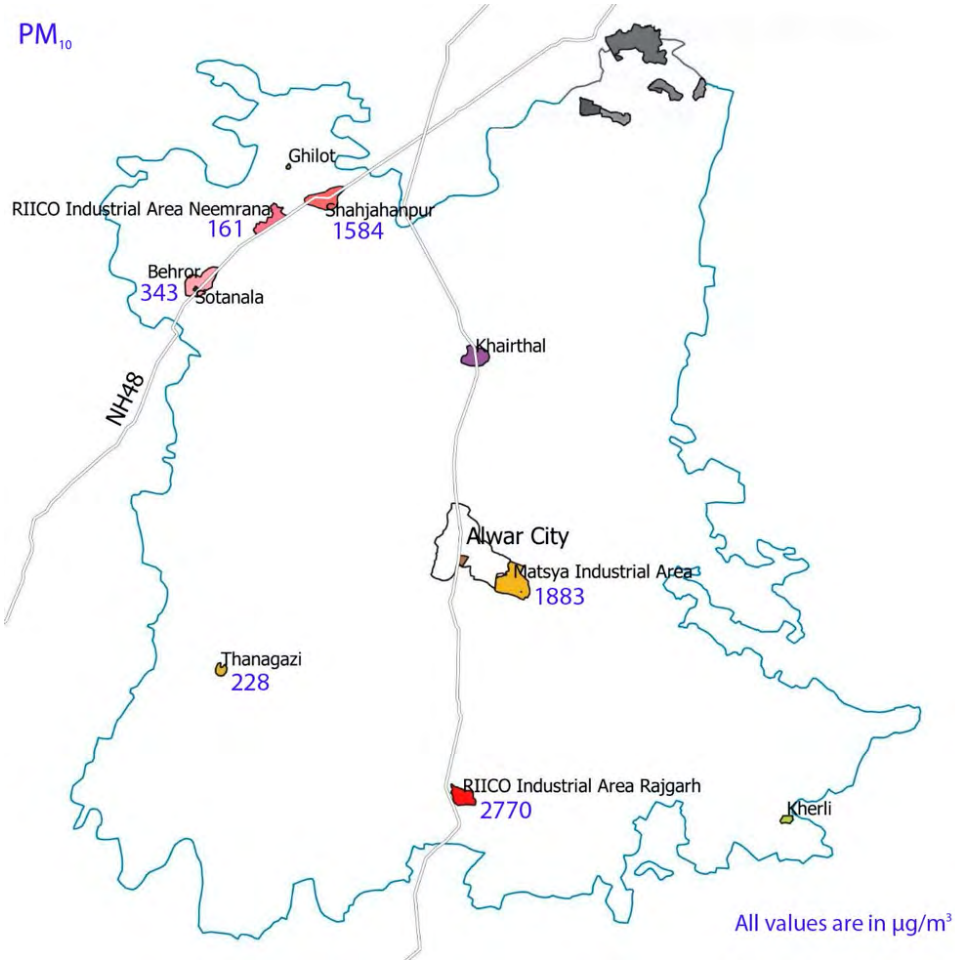
4.10 RIICO Industrial Area, Thanagazi

RIA Thanagazi is a relatively new industrial area established in 2015 and **has a total of seven industries** currently. It has four mineral based industries, one biscuit and bakery unit, one mustard oil mill, one steel box manufacturing unit and a few other units under construction. Most of the land in the industrial area is currently vacant.

5. Estimation of pollution load from industrial areas in Alwar district

As discussed previously, there are four main sources of air pollution in industrial areas, which are stack emissions from industries, fugitive emissions from industries, fugitive emissions from industrial waste burning, and dust emissions due to poor and ill-maintained road infrastructure. In this chapter the air pollution load from 156 stack-based air polluting industries in the Alwar district has been calculated and presented. The estimation of air pollution load through fugitive emissions from industries, industrial waste burning, and poor road conditions was not possible due to the absence of any concrete data for quantification of the fugitive emissions. Therefore, monitoring of ambient air quality in major industrial areas was conducted by the CSE team along with field surveys to understand the situation on the ground. The results of ambient air quality monitoring of industrial areas is shown in Map 2 as well as presented individually under the area wise section of the report.

Map 2: PM_{10} values in major industrial areas of Alwar district, Rajasthan (excluding Bhiwadi region)



Source: Aerocet™ air monitoring data, Centre for Science and Environment, 2019

The key indicator for assessment of air pollution in any area is the loading of pollutants into the ambient environment from different sources in the area. Under this study the pollution load is estimated for three main pollutants—PM, SO_2 and NO_X from industrial sources.

The methodology followed for estimation of the pollution load has been discussed in the first chapter of this report.

The data shared by the RSPCB did not have the quantity of fuel being used by each industry. Therefore, fuel usage has been estimated from the capacities of different combustion equipment being used in the industries.

The data shared by RSPCB was not complete. For example, the capacity of the combustion equipment used in a number of industries in the list was not mentioned. In such cases of missing information a minimum capacity for such equipment has been assumed.

5.1 Fuel usage in industrial areas of Alwar

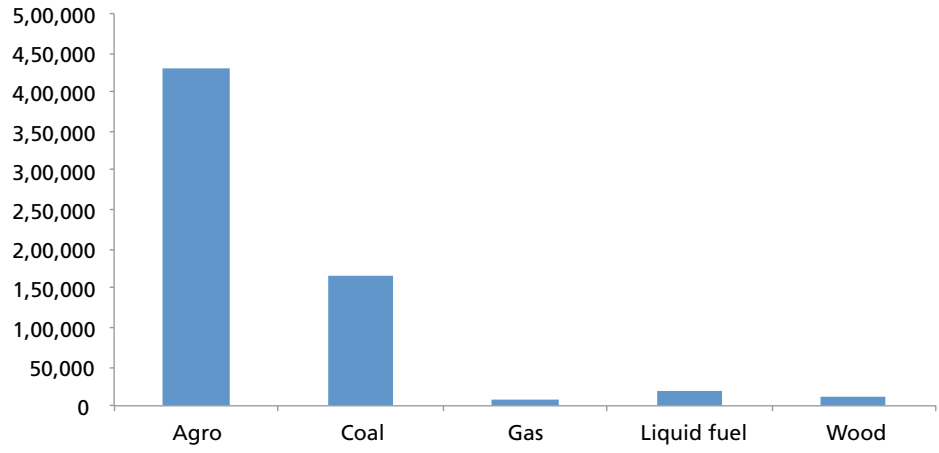
The MIA is the largest consumer of coal followed by Sotanala Industrial Area. The most amount of agro-based fuel is being consumed in Neemrana Industrial Area followed by MIA. Wood as a fuel is also being used in a good quantity in MIA.

Table 24: Quantity of fuel usage in different industrial areas of Alwar district (in tonnes per year)

Industrial area	Fuel (in tonnes per year)				
	Agro	Coal	Gas	Liquid fuel	Wood
Behror	23,522	14,190	-	317	
Khaithal	-	1,485	-	-	-
MIA	107,668	104,366	238	2,915	10,204
Neemrana	149,688	12,870	5,802	3,150	352
Old Industrial Area	24,592	990	-	-	910
Other	94,090	2,396	356	10,488	-
Shahjahanpur	29,938	13,068	-	468	-
Sotanala	2,138	14,989	-	507	-
Total	431,636	164,354	6,396	17,845	11,466

Source: CSE 2019–2020 (based on the data provided by RSPCB)

Figure 23: Total fuel usage in Alwar district (by type, in tonnes per year)



Source: CSE 2019–2020 (based on the data provided by RSPCB)

5.2 Pollution loading from industrial areas of Alwar

In terms of pollution loading from stack-based industries, MIA is the source of around 43 per cent of the overall pollution load of the whole of Alwar district, therefore making **MIA the biggest industrial pollution hotspot in Alwar district**. The second biggest hotspot are the industrial areas of Neemrana which are the source of around 20 per cent of the total pollution load. Therefore **MIA and Neemrana become responsible for almost 60 per cent of the pollution load in Alwar district** thus making these two areas the industrial hotspots of Alwar district in terms of stack emissions. Rest of the areas have a share of less than seven per cent or below individually. The category of 'others' holds a share of around 15 per cent of the overall load but since the industries under this category are dispersed all around the district, it cannot be considered as an air pollution hotspot.

Table 25: Pollution load in different industrial areas of Alwar district

Industrial cluster	Pollutant (tonnes per year)						Avg. % share in total loading
	Controlled			Uncontrolled			
	PM	SO_2	NO_x	PM	SO_2	NO_x	
Behror	116	82	122	293	112	165	6.5%
Khairthal	6	4	5	16	11	16	0.4%
MIA	734	512	754	1797	845	1,221	43.3%
Neemrana	427	345	502	1,051	204	243	20.0%
Old Industrial Area	67	53	80	161	7	29	2.8%
Others	265	257	335	640	395	134	15.4%
Shahjahanpur	128	93	138	320	109	158	6.9%
Sotanala	68	44	63	174	124	162	4.7%
Total	1,811	1,390	1,998	4,453	1,807	2,127	

Source: CSE 2019–2020 (based on the data provided by RSPCB)

5.3 Fuel usage by industrial sectors of Alwar

To get an idea of the pollution load from each industrial sector it is important to have a background idea about the quantity and the kind of fuel being used by the various sectors. The maximum quantity of coal is being consumed by metal-based and food processing industries followed by distilleries and textile units. In the case agro-based fuels, distilleries have taken the lead followed by food processing units.

Table 26: Quantity of fuel used in different industrial sectors of Alwar district (in tonnes per year)

Industrial sector	Agro	Coal	Gas	Liquid fuel	Wood
Ceramics and refractory		713	594	845	
Chemical	32,076	8,395	356	2,513	11,114
Distillery	218,117	23,760			
Electronics & home appliances	29,938	2,673	277	468	
Engineering		12,870	2,776	1,818	
Food and food Processing	87,353	44,392	1,970	9,260	
Metal-based		19,741	238	1,056	
Miscellaneous	32,076	20,348	185	1,425	352
Pharmaceuticals	3,208	990		459	
Rubber products		6,633			
Textile	28,868	22,770			
Waste management		1,069			
Total	431,636	164,354	6,396	17,844	11,466

Source: CSE 2019–2020 (based on the data provided by RSPCB)

5.4 Sector-wise pollution load estimation

The three major sectors with the biggest share of overall pollution load are distilleries, food processing, and metal based industries. In terms of SO_2 load, distilleries, food processing, and chemical industries are the major sectors. All in all in terms of **pollution load from stack based industries, distilleries (28 per cent), food processing (26 per cent), textile (9.3 per cent) and chemical (8.5 per cent) industries are the top four contributors. Altogether these four sectors contribute about 72 per cent of the stack emissions in Alwar district**.

Table 27: Pollution load in different industrial sectors of Alwar district (in tonnes per year)

Sector	Avg. % share in total loading	Pollutant (tonnes/year)					
		Controlled			Uncontrolled		
		PM	SO_2	NO_x	PM	SO_2	NO_x
Ceramics and refractory	0.6%	5	7	7	12	35	12
Chemical	8.5%	158	131	184	327	152	167
Distillery	28.0%	630	484	725	1,561	168	381
Electronics and home appliances	3.9%	85	68	100	210	36	48
Engineering	4.6%	57	43	56	145	156	145
Food processing	26.0%	418	338	462	1,039	647	566
Metal-based	6.2%	84	55	77	214	178	178
Miscellaneous	9.7%	166	122	176	416	195	242
Pharmaceuticals	0.8%	13	11.6	15.2	32	23.5	14.6
Rubber products	1.9%	27.2	16.1	24.2	70.3	46.9	69.8
Textile	9.3%	163.8	111.7	167.6	414.6	161	257
Waste management	0.5%	4.4	2.6	3.9	11.3	7.6	11.3

Source: CSE 2019–2020 (based on the data provided by RSPCB)

6. Major large and medium-scale polluting industries in Alwar district

6.1 Breweries and distilleries

There are a total of **eight breweries and distilleries** in the whole of Alwar district which are air polluting. Three of them are in MIA, one in Neemrana and the rest in other areas. These are industries with stack based emissions. Although a small number compared to other industries, the scale of these industries is huge and they are operational 24 hours thus having a high amount of fuel consumption. The pollution load from this sector is the highest among all other sectors, contributing 28 per cent of the overall pollution load of the whole Alwar district.

6.2 Food processing

There are a total of **88 food processing industries** in Alwar district. The most number of food processing industries are in MIA (48). There are a few in the Neemrana Industrial Area as well. Others are spread across various industrial areas. Food processing units are a probable source of fugitive emissions. Out of 88, around 29 food processing units have stack emissions. In terms of pollution load, this sector holds the second highest share which is around 26 per cent of the whole stack-based pollution load of Alwar district.

6.3 Textile

Altogether there are **35 textile industries** in Alwar district out of which only seven have stack-based emissions. Four of these seven industries are located in Neemrana and the rest in Shahjahanpur, Khairtal and Sotanala Industrial Area. The pollution load from this sector is third highest amongst all sectors, contributing around 9.3 per cent of the overall pollution load of the whole Alwar district.

6.4 Chemical

There are a total of **97 chemical industries** in the Alwar district. The biggest cluster of chemical industries of 73 units is in the MIA. MIA has two chemical zones where all the chemical industries are located. These industries are critical for stack as well as fugitive emissions. Out of 97 units, around 33 units have stack emissions. The principal air pollutants in the chemical industry are VOCs, nitrogen oxides, hydrogen chloride, and sulphur oxides. Steam generation plants are responsible for other emissions from these industries. The chemical sector is responsible for 8.5 per cent of the overall pollution load of the Alwar district.

6.5 Casting & metal-based

Altogether there are **44 casting and metal-based industries,** mostly in MIA and Neemrana. Some casting industries are also in the Old Industrial Area of Alwar city as well. This sector is responsible for stack as well as fugitive emissions. Out of 44, around 24 casting and metal-based units have stack emissions. The pollution load from this sector contributes around 6.2 per cent of the pollution load of the whole Alwar district.

6.6 Cement

Rajasthan has the largest number of cement plants in the country. There are a total of **29 cement plants** in the district of Alwar alone. Out of 29 units, 15 units are located in the Behror Industrial Area, nine in MIA and three in Sotanala. Cement plants have both stack and fugitive emissions but majority of the cement units in Alwar district are grinding units which are responsible for fugitive emissions.

7. Major small and medium-scale polluting industries in Alwar district

7.1 Brick kilns

There are approximately 130 brick kilns operating in the district of Alwar that have the CTO from the State Pollution Control Board. The brick kilns in Alwar are usually not in clusters and are spread in various areas across the districts. Out of 130, around 80 have converted to zigzag technology. This conversion has been an effect of the strong conversion drive in the Delhi-NCR as Alwar comes under the NCR region. The CSE team found quite a number of brick kilns on the Alwar Road while going to Alwar city from New Delhi, although no specific clusters of brick kilns were spotted in Alwar district.

7.2 Mineral grinding industries

These industries carry out the grinding of marble, dolomite, feldspar, quartz and many other variety of stones of varied quality for the production of grounded mineral powder which is used for various purposes depending upon the variety of stone being ground; for example powdered dolomite is grounded calcium carbonate which is used in products like toothpaste, talcum powder etc.; whereas grounded quartz is used for glass related products like bangles, etc. The grounded powder from different stones is also used in various industries such as recycled plastic materials, wall putty, PVC, tar, colour/paints, switches, fibre, etc.

There are around 302 mineral based industries all around Alwar and these are the highest number of industries in Alwar district. The clusters of mineral grinding units in Alwar district are primarily in MIA and RIICO Industrial Area of Rajgarh. They are usually small and medium-scale industries.

The biggest issue with mineral based industries is the non-containment of fugitive emissions during the grinding of minerals; these emissions engulf streets, neighbouring buildings, surrounding vegetation, and even the unit structure and premises. Most of the units run under semi-covered structures which creates an environment of white dust all around the area. The workers who are working in these industries are at a great risk of getting respiratory diseases. Especially in mineral grinding units which grind quartz, it has been noticed that the risk of deadly diseases is even higher (see *Box 3*).

Good practices are rare in this industry and the pollution concern from this industry has not been addressed even in the action plan of Alwar city. For the health and well-being of the people working in these industries and the ones living around these areas, a cleaner way of producing grounded minerals needs to be explored.

7.3 Stone crushers

There are not as many stone crusher units in Alwar district as compared to the surrounding districts. A total of around 22 to 23 stone crusher units are there in the district. These units are spread across various areas of the district and cannot be found in clusters. Only Ramgarh has four to five units in a cluster. The fugitive emissions through stone crushers add immensely to the pollution load of that specific area. Just like the mineral grinding industries, this industry has also been held responsible for the rise in respiratory diseases in the district and the state (see *Box 3*).

Box 3:

Rising cases of silicosis and other respiratory diseases have been largely linked to mineral and stone based mining and industrial activities in Rajasthan. The news reports below clearly show this growing concern in the state.

CAG report slams Rajasthan pollution board for rise in silicosis cases

Press Trust of India | Jaipur
Last Updated at February 28, 2018 20:55 IST

ALSO READ

Raj pollution board failed to initiate effective programme: CAG report

Delhi deploys marshals to check pollution offences

After EPCA, NGT introduces action plan to fight air pollution

Jojari: NGT slaps Rs 10L over "casual attitude" of Rajasthan

NGT orders closure of 19

The number of people dying slow deaths due to silcosis is continuously on the rise from 2013 to 2017 in Rajasthan but the state pollution control board did not take any proactive steps to prevent the disease, a CAG report has revealed.

According to the report, in five districts, the number of silicosis patients detected was 304 in 2013-14 and one death was reported. This number increased to 905 detections and 60 deaths in 2014-15 and 2,186 detections and 153 deaths in 2015-16 and 1536 detections and 235 deaths in 2016-17.

Workers of stone quarries and crushers, sand

Source: Business Standard. https://www.business-standard.com/article/pti-stories/cag-report-slams-rajasthan-pollution-board-for-rise-in-silicosis-cases-118022801157_1.html

Home Politics Elections on the go

POLLUTION

Silicosis plagues stone workers of Rajasthan, but slow, complicated process to disburse aid has left thousands gasping

As many as 7,959 silicosis cases were detected in Rajasthan between January 2015 and February 2017, and in the same period, 449 people died of the disease in five districts.

By Suresh Alakhpura
Apr 03, 2019 16:17:39

Source: Firstpost. https://www.firstpost.com/india/silicosis-plagues-stone-workers-of-rajasthan-but-slow-complicated-process-to-disburse-aid-has-left-thousands-gasping-6363791.html

7.4 Calcium chloride producing units

There are around 16 such units located in MIA. These units basically combine hydrochloric acid with limestone ($CaCo_3$) to produce $CaCl_2$ in liquid form which is further solidified through heat. A furnace is used in the manufacturing process therefore stack emissions through such units are a matter of concern with respect to stack emissions in small scale industries.

8. Role of RIICO on the ground

RIICO has a significant role to play in the development and everyday operations of industrial areas in Rajasthan. Their role in housekeeping, plantations, maintenance of roads, and waste management is critical in terms of air pollution (especially fugitive emissions) in an industrial area.

The RIICO officials said that the repair and maintenance of roads usually takes place at an interval of three to five years whereas the industrial owners differed on this. The RIICO officials agreed that there is no proper system of industrial waste management in place and usually RIICO provides the industries with a land to dump their waste, which unfortunately is burned. RIICO should provide at least two plots of 1000 sq.mts along with waste management facilities in every industrial area, but only plots are provided and no management facilities or systems are in place.

In Bhiwadi, a good initiative called 'Special Purpose Vehicles' (SPV) is being used for proper collection of waste. This vehicle collects waste from different industries but, unfortunately, they are currently dumping it on a dumping site far away; they are planning to collect and send the waste to management facilities. At least the SPV service prevents littering of industrial waste all around the industrial area. This SPV service is being managed by the Industrial Association in Bhiwadi and RIICO plays no role in this.

Such practices need to be brought to other industrial areas like MIA, Neemrana, etc. where industrial waste burning is rampant. The RIICO official also stated that they have the power to send notices to industries in case their raw materials or waste is lying outside their premises, but during the visits, CSE team observed large amounts of waste and raw materials dumped in front of the industries, especially large stones in front of stone cutting units and mineral grinding units. The plantations, except in Neemrana Industrial Area, were not well maintained and not in adequate quantity.

This improper management of services by RIICO makes industrial areas much more prone to air pollution. A lot of industrial areas showed high PM_{10} readings because of poor housekeeping and poor condition of roads which result in a high amount of road dust. Therefore, it becomes very important to consider RIICO as a significant stakeholder in the air pollution scenario of industrial areas. Their role and responsibilities should be clearly defined and there should be a mechanism to ensure that RIICO fulfils its tasks on the ground.

9. Inadequate existing action plan by RSPCB for reducing industrial pollution in Alwar city

The current action plan for the abetment of air pollution (especially $PM_{2.5}$ and PM_{10}) in Alwar city (a non-attainment city) was prepared by the government of Rajasthan. The action plan has prescribed action points under different source groups like vehicle emission control, re-suspension of road dust, emissions from waste burning, emissions from construction and demolition activities, and emissions from industries.

Under the section for control of industrial emissions, the first two points are focused on brick kilns. It includes identification, regular monitoring, use of designated fuel, closure of illegal units and conversion of natural draft to induced draft brick kilns. The other two points mention taking action against non-complying industries and bringing in regulation for setting up new air polluting industries in the urban limits of Alwar city.

The current action plan for industrial pollution does not even discuss the issue of emissions from the largest industrial area in close proximity to Alwar city i.e. MIA. Fugitive emissions from mineral grinding industries, stack and VOC emissions from chemical industries, and stack emissions from food processing should be addressed separately in the action plan for Alwar city. The emissions from the Old Industrial Area should also be looked at and the action plan for Alwar city should be reframed accordingly.

10. Conclusion

The aim of this study has been to understand the sources of industrial air pollution in the district of Alwar to be able chalk out a clear way ahead. Two major outcomes of this study which would be helpful in deciding a future strategy are prominent industrial pollution hotspots in the district and the major air polluting industrial sectors in the large, medium and small scale categories.

10.1 Hotspot industrial areas of Alwar district

The criteria for designating these industrial areas as hotspots is not only based on the stack-based pollution load of that area but also on the ambient air quality measured on site along with the on field information collected while surveying these areas physically.

The biggest hotspot industrial area in terms of **stack-based as well as fugitive emissions** is the **Matsya Industrial Area**. It is the largest industrial area including 491 industries with fugitive emissions (including 179 mineral grinding units) and 70 industries with stack-based emissions which are responsible for almost **43 per cent of the stack-based pollution load** of the whole of Alwar district. The ambient air quality is 'hazardous' due to the amount of fugitive dust in the air. Observations made during the field survey clearly showed the poor air quality of the area. Therefore MIA becomes the top priority hotspot area to be focused upon with respect to industrial air pollution.

The next area which is another hotspot of stack-based industrial pollution is **Neemrana**. It is the second largest industrial area after MIA in Alwar district. Out of a total 159 industries, almost 100 industries are the source of fugitive emissions and around 41 industries have stack emissions. With respect to fugitive emissions, the ambient air monitoring done by CSE shows that PM_{10} is in the 'moderately polluted' category and not in the poor or very poor category. The industrial area in general is well maintained and there aren't too many grinding industries, which are the probable reasons behind low dust emissions in the area. In terms of stack emissions, Neemrana is responsible for 20 per cent of the pollution load in the whole of Alwar district. This clearly shows that **Neemrana is a hotspot industrial area with respect to stack emissions**.

Another area which can be declared as a hotspot industrial area in terms of fugitive emissions is the Rajgarh Industrial Area. It is a comparatively smaller area but with many mineral grinding industries. The ambient air monitoring showed the air quality as 'hazardous' and the observations made during the field survey also showed air quality to be very poor. Therefore, **Rajgarh Industrial Area** has been designated as a **hotspot for fugitive emissions** from industries.

Last but not the least, **Behror Industrial Area**. Although this area may not be termed as a hotspot when compared to other industrial areas named above, the area needs to be taken note of in terms of fugitive emissions due to the presence of 15 cement plants which are basically grinding units. Along with cement plants, it also has 10 units of stonework industries which also cause fugitive emissions in the area. Even the ambient air quality measured in the industrial area was in the 'poor' category, therefore this area **should be prioritized in terms of industrial air pollution (especially fugitive emissions)**.

10.2 Critical industrial sectors in Alwar district

In terms of **fugitive emissions**, **mineral grinding industries** top the list of priority. Along with those work needs to be done with **cement grinding units** and **stone crushers** for abetment of fugitive emissions. These were the industries with the most visible fugitive emissions but all the other industrial types which are in the category of fugitive emissions in this report also contribute through fugitive emissions occurring during various steps of their manufacturing processes.

In terms of **stack emissions**, as an outcome of the pollution load calculation, it is very clear that four sectors are responsible for 72 per cent of the pollution load in the district and these are **breweries**, **food processing, textile, and chemical industries.** Any future action plan for this region or district should come up with pollution abetment steps for these four sectors. Not to forget that focus also has to be kept on small scale stack-based industries such as **small scale chemical units** (ex. $CaCl_2$ manufacturing units in MIA) and also **non-converted and illegal brick kilns (which are often undocumented).**

10.3 The need for well maintained infrastructure

Along with finding critical industries and hotspot industrial areas, it is very important to mention the importance of **RIICO**. To bring down fugitive dust emissions in industrial areas, it is essential to have a **well maintained road network, plantations, proper housekeeping, and a well organized waste management system** (so that burning of industrial waste stops). All this comes under the responsibility of RIICO and is very necessary to improve the air quality of these areas. RIICO had done a fairly good job in Neemrana in terms of maintaining infrastructure (except waste management), a similar track needs to be followed in other industrial areas of the district which suffer from fugitive dust emissions due to the neglected infrastructure they have.

11. Industrial air pollution action plan for Alwar district

Sr. no.	Action points	Responsible agencies	Timeline	Existing scenario
SECTORAL ACTIONS				
1	Implementation of fuel change to natural gas for the major industries of MIA and all industries of Neemrana. Following activities should be pursued to accomplish implementation: • Prepare a report on current status of gas pipeline network and connections, prepare a plan of action to complete the pipeline network in MIA and Neemrana. • Prepare a plan of action on how the stack-based industries in MIA and Neemrana will be convinced to switch to natural gas. • Conduct a meeting with the Petroleum and Natural Gas Regulatory Body (PNGRB) for the inclusion of natural gas under GST, control of price fluctuations, and to ensure provision of natural gas supply through pipelines in these two industrial areas.	Rajasthan State Pollution Control Board, Rajasthan State Industrial Development and Investment Corporation, and local industrial associations	-Three months for current status report on gas pipeline network and the plan of action for the completion of network. -Two months for meeting with PNGRB. -Three months for preparing an advocacy action plan for bringing natural gas under GST and to contain price fluctuations and present the plan to all stakeholders.	-MIA and Neemrana together contribute around 63 per cent of the total overall pollution load of Alwar district (excluding Bhiwadi). Very few industries in both areas have switched to natural gas. -Non-inclusion of natural gas under GST and regular price fluctuations make it a less preferred fuel compared to others.
Mineral grinding industry				
2	Prepare a plan for strict implementation of Mineral Grinding Guidelines by RSPCB for all mineral grinding units in Alwar district (especially in MIA and Rajgarh). The plan should include a minimum of five prominent key steps that all mineral grinding industries would have to implement in their units to prevent closure. The provision of personal protective gear to all workers in these industries should compulsorily be included in the plan and strictly implemented.	RSPCB and Association of Mineral Grinding Industries	Three months	Around 302 mineral grinding units in the district responsible for high amounts of fugitive emissions.
3	Conduct a stakeholder meeting for immediate roll out of the implementation plan.	RSPCB	Immediately after preparation of implementation plan	
Food processing industry				
4	Prepare a stage wise implementation plan and guidelines to switch to natural gas (in MIA and Neemrana) and to agriculture based fuel in other areas.	RSPCB and local industrial associations	Three months for action plan and guidelines	Currently out of 29 air polluting food processing industries in the district, 21 are in MIA and Neemrana.

Sr. no.	Action points	Responsible agencies	Timeline	Existing scenario
5	Conduct a stakeholder meeting for immediate roll out of the implementation plan.	RSPCB	Immediately after preparation of implementation plan	
Distilleries				
6	Distillery and brewery units in MIA and Neemrana should be made to switch to natural gas. Shifting to agriculture based fuel can be an intermediary step until natural gas is made available in the area.	RSPCB and local industrial associations	Three months for preparation of fuel switch plan	Distilleries and breweries in the district are responsible for 28 per cent of the overall pollution load.
7	Until the industries have shifted to natural gas, they should be monitored monthly (as they are few in number and can be easily monitored).	RSPCB	Ongoing until fuel switch. Start monthly monitoring immediately.	Usually such large scale industries have pollution control measures in place, therefore regular monitoring of their emissions would keep their emissions well under check.
Textile industry				
8	All air polluting textile industries in Neemrana shall be made to shift their fuel to natural gas. Shifting to agro-based fuel can be an intermediary step until natural gas is made available in the area.	RSPCB and local industry associations	Two months	Textile industry is responsible for 9.3 per cent of the overall pollution load.
9	Submit a monthly monitoring plan for the seven air polluting textile units.	RSPCB	One month for submission of monitoring plan	Only seven out of 35 textile units have stack-based emissions. The seven units can be monitored on a regular basis.
Chemical industry				
10	Preparation of an implementation plan for all fuel based chemical industries in MIA and Neemrana area to shift to natural gas. Shifting to agro-based fuel can be an intermediary step until natural gas is made available in the area.	RSPCB and local industry associations		Out of total 33 fuel based chemical industries, 23 are in MIA and three in Neemrana. A fuel change policy in these regions can bring a large impact.
11	Conduct a stakeholder meeting for immediate roll out of the implementation plan.	RSPCB	Immediately after preparation of implementation plan	
Brick kilns				
12	Conversion of all non-converted brick kilns in the district to zigzag technology and closure of all illegal brick kilns. Inventorize all non-converted and illegal brick kilns.	RSPCB	Inventory in one month and conversions to be made immediately	

Sr. no.	Action points	Responsible agencies	Timeline	Existing scenario
OTHER ACTIONS				
13	Formation of a committee for the management of industrial areas which would prepare area-wise management plans for • Industrial waste management • Road quality and maintenance • Housekeeping • Plantation The committee shall also fix the responsible entities for each management plan and their schedule of implementation.	The committee shall include representatives from RSPCB, RIICO, local industrial associations, and other experts.	Formation of a committee in two months and preparation of area-wise management plan for all four topics within three months post the formation of the committee.	The condition of the roads, waste management, housekeeping and plantations is poor in a majority of the industrial areas and needs to be improved to control fugitive emissions
14	Setting up a waste management facility in every industrial area for non-hazardous waste on a land allotted by RIICO.	Committee under point no. 13 of the action plan	As a part of the area-wise management plan suggested in point no. 13	Rampant waste dumping and burning was observed in all the industrial areas of the district.
15	Introduction of a chargeable toll system for heavy diesel vehicles for entering different industrial areas. This would control unnecessary movement of heavy vehicles in the area thus bringing down fugitive emissions. CNG vehicles shall be exempted from the charge.	Committee under point no. 13 of the action plan	Within six months	Along with vehicular emissions, the continuous movement of heavy diesel vehicles on roads with poor conditions increases PM_{10} levels in the area.
16	Increasing the capacity of the regional offices of pollution control board by: • Hiring more technical personnel • Strengthening the capacity of their labs and equipment • Training their employees	RSPCB	Hiring of more technical personnel and strengthening of labs in six months and conducting at least five training programmes annually.	The technical staff is far too less to be able to regularly monitor such a large number of large, medium and small scale industries.

II. Bhiwadi region

Contents

1. Environmental profile of Bhiwadi

Bhiwadi industrial cluster spread across 3,800 acres includes Bhiwadi (Phase 1 to 4), Chopanki, Kahrani, Khushkhera, Pathredi, Sarekhurd and Tapukara industrial areas.

RIICO is responsible for the development and management of these industrial areas. Development of physical infrastructure includes roads, power, street light, water supply, drainage, etc. along with provisions of basic social infrastructure. As per the study carried out by Greenpeace and IQAirVisual in 2018, Bhiwadi was among the top five most polluted cities in terms of air pollution. The report is based on $PM_{2.5}$ data from public monitoring sources, with a focus on data which has been published in real-time or near real-time.[30]

Table 28: Ranking of most polluted cities in the world (PM conc. in µg/m³)

Sr. no.	City	2018
CPCB Standard		60 µg/m³ annually
1	Gurugram, India	135.8
2	Ghaziabad, India	135.2
3	Faisalabad, Pakistan	130.4
4	Faridabad, India	129.1
5	Bhiwadi, India	125.4

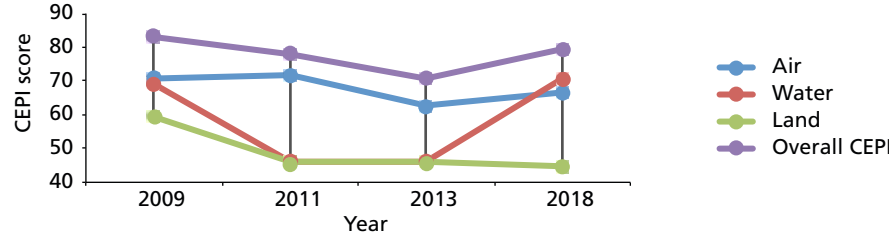
Source: World Air Quality Report $PM_{2.5}$ Ranking

Since 60 per cent of the area in Bhiwadi is being used for industrial activity, its share to the overall pollution load of Bhiwadi is also significant. There is a range of large, medium, and small scale industries from various industrial sectors including metal, chemicals, food processing, rubber, plywood, etc.

In CPCB's nationwide environmental assessment of Industrial Clusters in 2009, Bhiwadi had a CEPI score of 82.91 and was identified as critically polluted (>70) . Further CEPI assessment was done in the years 2011, 2013 and 2018. As per the assessments, both the overall CEPI score and air-CEPI score of Bhiwadi remains above the threshold limit, signifying that Bhiwadi has continued to be under the critically polluted category (see *Figure 24: Trend—Bhiwadi CEPI score*).

In 2013, RSPCB submitted an ambitious action plan for Bhiwadi to CPCB; however, the increased CEPI score in the 2018 assessment clearly highlights lack of appropriate measures being taken and non-adherence to action plans.

Figure 24: Trend—Bhiwadi CEPI score



Source: CSE 2019–2020

2. Profile of Bhiwadi industrial cluster

The Bhiwadi industrial cluster consists of three major industrial areas: Bhiwadi, Chopanki and Khushkhera. Bhiwadi Industrial Area includes Bhiwadi (Phase I to IV), Kahrani, Khijuriwas and Jhiwana. Chopanki includes Pathredi and Sarekhurd. Khushkhera includes Tapukara and Gailpur (see *Map 3: Location of Bhiwadi industrial cluster*). There are 1077 industries in Bhiwadi industrial cluster, out of which approximately 328 industries are air polluting in nature.

Metal fabrication/forging industry is the most prevailing sector in the cluster with about 37 per cent share. Other prominent sectors are chemicals/ pharmaceuticals (21 per cent), synthetic resin/plastic/packaging (eight per cent), food processing (six per cent), and rubber goods (four per cent).

The miscellaneous sector is 13 per cent and is inclusive of units manufacturing auto parts, cables/wire, glass and bathroom fittings, engineering industries laboratory, etc. (see *Figure 25: Industrial sectors in Bhiwadi cluster*).

Map 3: Location of Bhiwadi industrial cluster

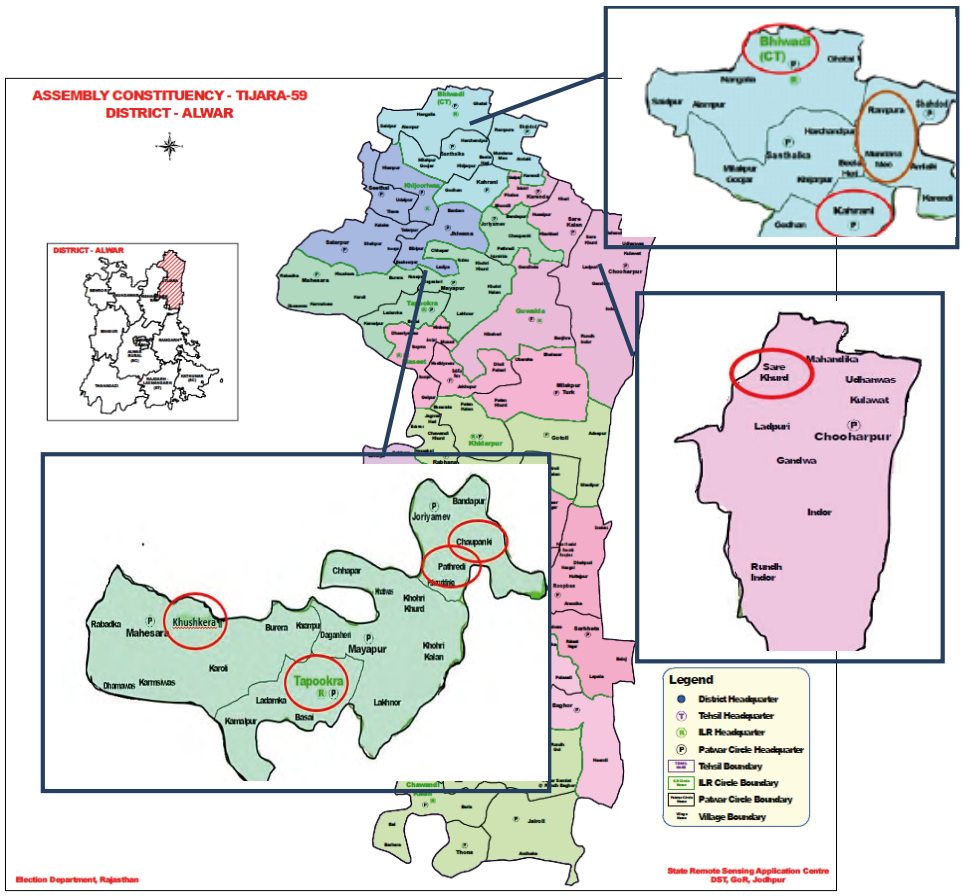
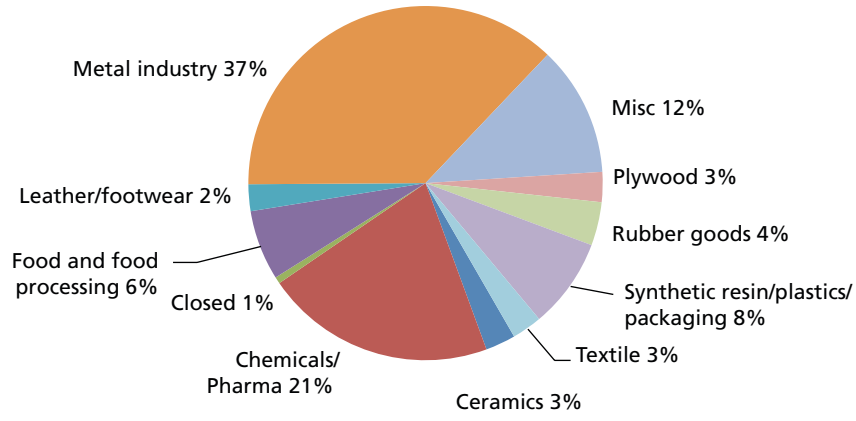


Table 29: Industrial sectors in Bhiwadi cluster

Industrial sector	Bhiwadi	Chopanki	Khushkhera	Total
Ceramics	8	-	1	9
Chemicals/ pharmaceuticals	48	13	8	69
Food processing	9	8	4	21
Leather/footwear	8	-	-	8
Metal industry	88	19	15	122
Misc.	27	7	5	39
Plywood	6	3	-	9
Rubber goods	10	2	1	13
Synthetic resin/plastics/ packaging	14	7	6	27
Textile	6	3	-	9
Closed	-	-	2	2
Total	224	62	42	328

Source: CSE 2019–2020 (based on the data provided by RSPCB)

Figure 25: Industrial sectors in Bhiwadi cluster



Source: CSE 2019–2020 (based on the data provided by RSPCB)

Fuel usage in the cluster

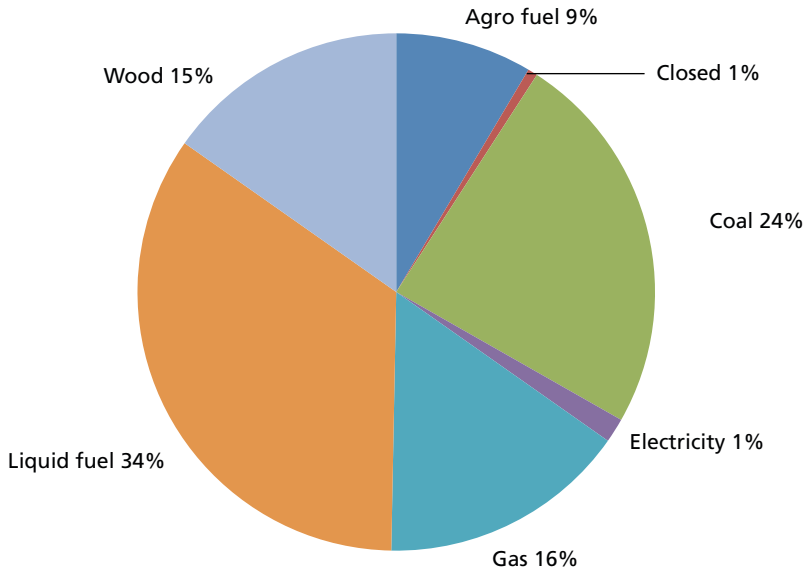
Fuel usage in the cluster is in boilers for generation of steam, furnaces for heating and melting, and in thermic fluid heaters.

Table 30: Number and range of capacity of combustion equipment installed in the industries

Capacity range	No.
Boiler	
<1	34
1 to 3	46
4 to 6	16
7 to 15	13
>15	2
Thermopack	
Up to 10 lakh kcal/hr	69
11–20 lakh kcal	14
>20 lakh kcal/hr	6
Furnace (melting furnace, reheating furnace, etc.)	264

Source: CSE 2019–2020 (based on the data provided by RSPCB)

Figure 26: Fuel usage in Bhiwadi industrial cluster



Source: CSE 2019–2020 (based on the data provided by RSPCB)

CSE estimated total fuel usage in the Bhiwadi industrial cluster to be about 430,000 tonnes per year. Coal is used in about 24 per cent of the industries and its annual consumption is about 273,000 tonnes per year. Approximately nine per cent of the units are using agro waste residue as fuel and its consumption is around 79,000 tonnes per year. Liquid fuel is being used by 34 per cent of the industries, however, its annual consumption is only 41,293 tonnes per year. Wood is used by 15 per cent of the industries and its annual consumption is

36,000 tonnes per year. Sixteen per cent of the industries are using PNG but the fuel use data is not available. Only one per cent of the industries are operating on electricity (see *Figure 26: Fuel usage in Bhiwadi industrial cluster*).

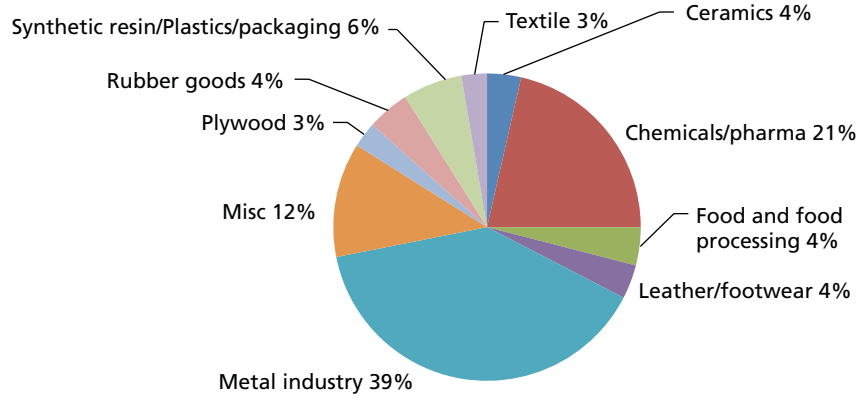
From a total of 328 air polluting industries, approximately 84 per cent (277 industries) are operating on fuel other than PNG with majority of industries (64 per cent) located in Bhiwadi. However, 66 per cent of industries out of these 277 are in process to convert to PNG and have submitted their expression of interest to Haryana City Gas Ltd

Bhiwadi, Khushkhera and Chopanki are the major industrial areas of Bhiwadi cluster. In terms of prominent industrial sectors, Bhiwadi is a mixed cluster. The details of the type of industry in respective industrial area are discussed in next section.

2.1 Bhiwadi Industrial Area

Bhiwadi Industrial Area is divided into four regions namely Bhiwadi (Phase I to IV), Kahrani, Khijuriwas and Jhiwana with 800 industrial units operating in the area. The area has the highest number of red, orange and highly polluting category units in comparison to other industrial areas of Bhiwadi cluster. As per Rajasthan State Pollution Control Board (RSPCB), there are about 224 air polluting industries in Bhiwadi Industrial Area with a majority in Phase I to IV. The major industrial sectors include metal fabrication, chemical, pharmaceutical, synthetic resins, plastics, etc. Total production from the metal industry in Bhiwadi (Phase I to IV) Industrial Area is about 7,500 tonnes per day with 39 per cent of the industries working in metal fabrication, casting, and galvanizing. The chemical/pharmaceutical sector constitutes 21 per cent of the industries with a daily production of around 500 tonnes. About 12 per cent are industries from miscellaneous sectors (see *Figure 27: Industrial sectors in Bhiwadi*).

Figure 27: Industrial sectors in Bhiwadi

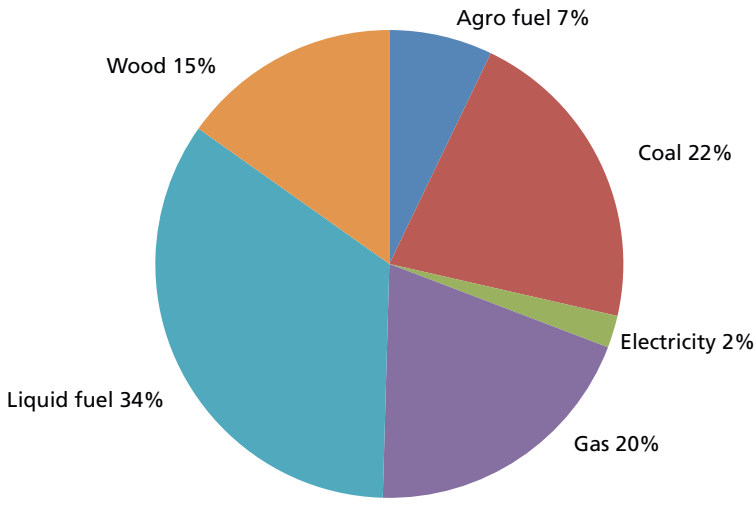


Source: CSE 2019–2020 (based on the data provided by RSPCB)

Fuel usage in Bhiwadi Industrial Area

Out of the total 224 air polluting industries, a majority of industries (34 per cent) are using liquid fuel followed by coal (22 per cent). Only 20 per cent of the industries are operating on PNG while seven per cent of the industries rely on agro waste for process heating and other combustion requirements (see *Figure 28: Fuel usage in Bhiwadi industrial area*).

Figure 28: Fuel usage in Bhiwadi industrial area

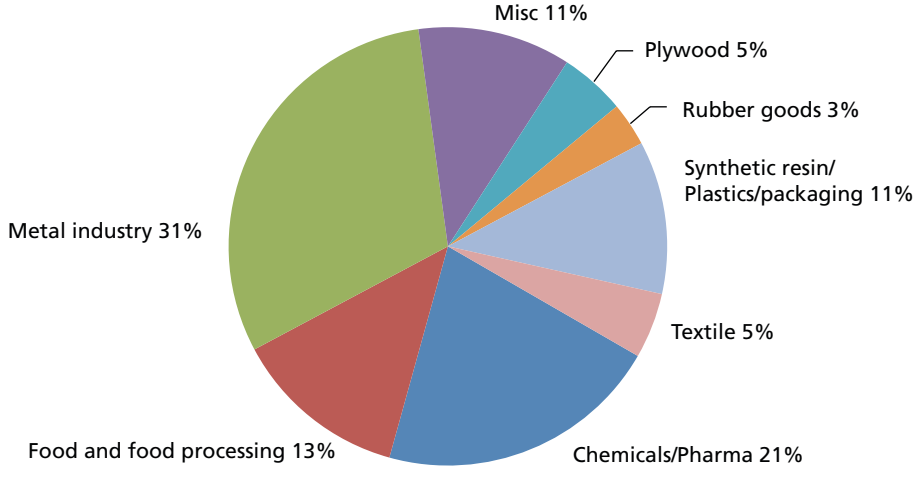


Source: CSE 2019–2020 (based on the data provided by RSPCB)

2.2 Chopanki Industrial Area

Chopanki Industrial Area comprises of Chopanki, Sarekhurd and Pathredi regions. There are 146 industrial units in the area from sectors including metal fabrication, galvanizing, food processing, plastic and polymers, etc. About 62 industries are air polluting with 90 per cent located in the Chopanki region. The major industrial sector is metal industry which has a share of 31 per cent of the total industries and has an average daily production of about 1,100 tonnes. About 21 per cent of the industries with production of 34 tonnes per day belong to the chemical/pharmaceutical sector. Share of food processing sector is about 13 per cent (1,500 tonnes per day).

Figure 29: Industrial sectors in Chopanki Industrial Area

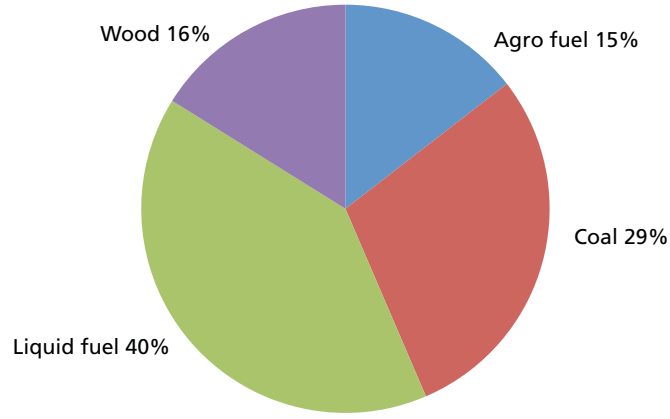


Source: CSE 2019–2020 (based on the data provided by RSPCB)

Fuel usage in Chopanki industrial area

There is no PNG supply available in Chopanki. About 40 per cent of the industries use liquid fuel and 29 per cent use coal (see *Figure 30: Fuel usage in Chopanki*).

Figure 30: Fuel usage in Chopanki

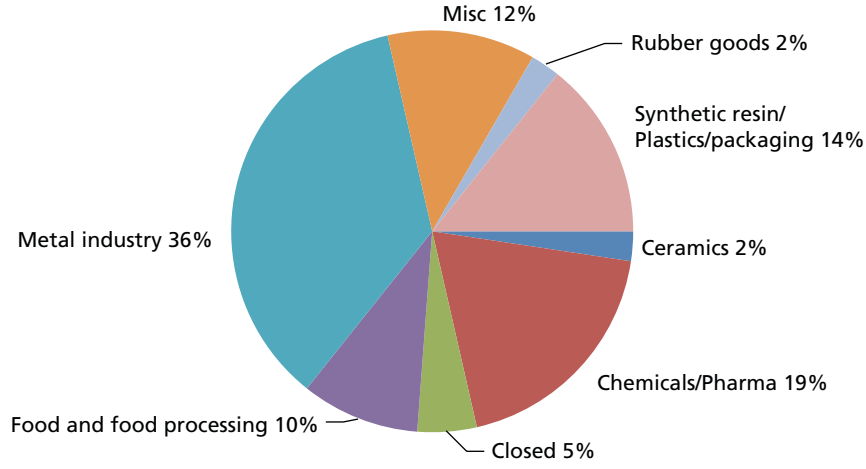


Source: CSE 2019–2020 (based on the data provided by RSPCB)

2.3 Khushkhera Industrial Area

The area comprises of Khushkhera, Tapukara and Gailpur regions. There are about 103 industries in this area. Majority of the industries in the area are under orange category, with no highly polluting industry in the region. About 41 industries are air polluting in nature and major industrial sectors in the area are metal fabrication (36 per cent) with production of about 1,700 tonnes per day, chemical/pharmaceutical sector (19 per cent) with an average daily production of about 160 tonnes, synthetic resin/plastics/packaging (14 per cent) with an average production of about 70 tonnes per day. The other sectors include food processing, rubber, and cement (see *Figure 31: Industrial sectors in Khushkhera Industrial Area*).

Figure 31: Industrial sectors in Khushkhera Industrial Area

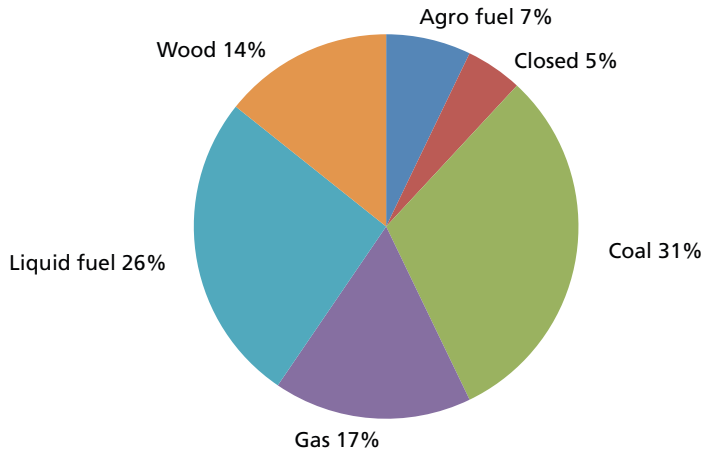


Source: CSE 2019–2020 (based on the data provided by RSPCB)

Fuel usage in Khushkhera Industrial Area

The most common fuels used in the area are coal (31 per cent) and liquid fuel (26 per cent). PNG is used by 17 per cent of the industries while agro waste residue has a small share of seven per cent (see *Figure 32: Fuel usage in Khushkhera*).

Figure 32: Fuel usage in Khushkhera



Source: CSE 2019–2020 (based on the data provided by RSPCB)

Observations from site visit

- Major contributors to air pollution in the region are industries which include metal fabrication, forging, galvanizing, and chemical and pharmaceutical units.
- Industries in this region mainly use agro residue, coal, LDO, HSD, Low Sulphur Heavy Stock (LSHS), wood, etc. as fuel. Only a small fraction of industries have switched to natural gas as per the regulatory requirements.
- Air pollution is evident in the area as black (dust) emissions from stack are clearly observed (see *Image 16 and Image 17*). People living nearby also complained about health issues they are facing due to air pollution.
- In addition, unauthorized waste material used as fuel by many small scale units is adversely affecting the air quality in this region.[32]
- Non-hazardous industrial waste is dumped and burnt in the open, leading to emissions into the environment. The hazardous industrial waste is sent to TSDF facility, Udaipur.
- There is no solid waste management plan for the industrial area.

Image 16: Plastic and industrial waste burning in the open

Image 17: Smoke from stack

3. Estimation of pollution load

The key indicator for assessment of air pollution in any area is the loading of pollutants into the ambient environment from different sources in the area. Under this study the pollution load is estimated for three main pollutants—PM, SO_2 and NO_X from industrial sources. The methodology followed for estimation of the pollution load has been discussed in the first chapter of this report.

3.1 Baseline data for estimating pollution load for Bhiwadi

There are 328 air polluting units in Bhiwadi region as per the data provided by RSPCB. Based on the analysis, total fuel consumption of different types of fuel in the industrial areas is given in the table below.

Table 31: Quantity of fuel used in Bhiwadi industrial cluster (in tonnes/year)

Industrial area	Agro fuel	Coal	Wood	Liquid fuel
Bhiwadi	48,098	192,436	26,344	17,156
Chopanki	25,684	44,303	5,656	19,254
Khushkhera	5,181	36,092	4,594	4,883
Total	78,962	272,831	36,594	41,293

Source: CSE 2019–2020 (based on the data provided by RSPCB)

3.2 Pollution loading from industrial areas of Bhiwadi cluster

Bhiwadi Industrial Area contributes maximum to the overall load of the cluster (65 per cent), followed by Chopanki Industrial Area (23 per cent) and Khushkhera (12 per cent).

Table 32: Pollution load estimation for Bhiwadi industrial cluster

Industrial cluster	Pollutant (tonnes per year)						Avg. % share in total loading
	Controlled			Uncontrolled			
	PM	SO_2	NO_X	PM	SO_2	NO_X	
Bhiwadi 1 to 4	1,042	747	1,038	2,491	1,984	2,251	65%
Chopanki	311	298	354	734	1,008	602	23%
Khushkhera	189	142	190	451	432	427	12%
Total	1,542	1,187	1,582	3,675	3,424	3,280	

Source: CSE 2019–2020

Total uncontrolled pollution load for Bhiwadi cluster is about 3,675 tonnes per year for PM and 3,424 tonnes per year for SO_2. The controlled PM load is about 42 per cent of the uncontrolled. For SO_2, controlled load is about 33 per cent of the uncontrolled. Whereas for NO_X, controlled load is about 45 per cent of the uncontrolled load.

3.3 Sector-wise pollution load estimation

The annual consumption of fuel for each industrial sector is calculated from the data available and accordingly the pollution load is estimated for the sectors which are consuming significant quantity of fuel.

Table 33: Annual fuel consumption in industrial sectors of Bhiwadi cluster (tonnes/year)

Industrial sector	Agro fuel	Coal	Wood	Liquid fuel	Total
Ceramics	-	13,200	-	337	13,537
Chemicals/ pharmaceuticals	34,683	88,589	21,763	11,299	156,334
Food processing	17,005	8,366	1,089	3,829	30,289
Leather/footwear	-	512	-	471	983
Metal industry	-	85,912	2,970	20,796	109,678
Miscellaneous	2,079	13,365	1,551	2,191	19,186
Plywood	-	12,870	2,310	-	15,180
Rubber goods	1,155	30,690	660	239	32,744
Synthetic resin/ plastics/packaging	21,400	18,437	4,983	2,132	46,952
Textile	2,640	891	1,267	-	4,798
Total	78,962	272,832	36,593	41,294	429,680

Source: CSE 2019–2020 (based on the data provided by RSPCB)

Metal industry, chemicals/pharmaceuticals, rubber goods, synthetic resin/ plastics/packaging, and food processing industries are the major polluters in Bhiwadi cluster. The contribution from these sectors together constitutes about 88 per cent of the total pollution load.

Metal industry is the most prevalent sector in Bhiwadi. PM, SO_2 and NO_X pollution load from this sector is 27 per cent, 35 per cent and 30 per cent respectively of the total loading from the cluster.

Chemicals/pharmaceuticals sector is the second largest sector of Bhiwadi. As per the estimates done by CSE, based on the data provided by the RSPCB, the chemical/pharmaceutical sector has emerged as the major contributor to the pollution load, with about 34 per cent share in the estimated total load of PM, SO_2 and NO_X.

Table 34: Pollution load for different industrial sectors

Sector	Avg. % share in total loading	Pollutant (tonnes per year)					
		Controlled			Uncontrolled		
		PM	SO_2	NO_X	PM	SO_2	NO_X
Metal industry	30%	413	351	426	1,020	1,357	1,021
Rubber goods	8%	132	80	119	335	226	328
Chemicals/pharmaceuticals	34%	553	418	572	1,267	1,038	1,102
Synthetic resin/plastics/packaging	9%	151	115	162	349	208	239
Food processing	6%	89	81	103	212	197	122
Ceramics	3%	55	34	50	142	105	141
Miscellaneous	5%	71	55	72	169	174	174
Plywood	4%	61	38	57	143	92	145
Textile	1%	15	11	16	29		16
Leather	0.3%	3	4	4	8	21	8

Source: CSE 2019–2020

Pollution load from the rubber industry is on the lower side as compared to the metal or chemical/pharmaceutical industries. PM and NO_X loading from the sector is nine per cent of the total, whereas SO_2 contributes seven per cent to the total pollution load. Synthetic resin, plastics and packaging sectors contribute nine per cent to the overall load.

Food processing, ceramics, plywood and miscellaneous sectors have very low pollution load in the range of four to six per cent of the cluster load. Contribution from textile, leather and footwear sectors is not very significant.

4. Observations and recommendations

1. The **metal industry, chemical/pharmaceutical sector, synthetic resin/ plastics/packaging, and rubber goods industries are found to be contributing about 82 per cent of the overall pollution load** for PM and SO_2 in the cluster. Of these, **metal and chemical/pharmaceutical together account for 65 per cent of the loading**. It is recommended that these sectors should be focused on and surveyed for updating and improving the technology involved, fuel usage, efficiency of air pollution control technology, and overall resource management.

2. **Bhiwadi Phase I to IV contributes about 65 per cent in the overall pollution load**, since it has the highest number of industries and subsequently more fuel consumption. Only **20 per cent of the industries in Bhiwadi Industrial Area have switched to PNG** till now. It should be mandated by regulatory bodies that industries switch to cleaner fuels within prescribed timelines.

3. More than 70 per cent of the industries in the cluster are using coal, liquid fuel (HSD, LDO and LSHS), wood, or agro-based fuel. **Overall in Bhiwadi cluster only 16 per cent of the total industries have switched to PNG**. As per the analysis of the data provided by RSPCB, about 66 per cent of the industries have plans to switch over to PNG. However, there is no PNG supply in Chopanki.

4. Many of the industries in the cluster are using fuel for steam generation purposes. It is recommended that the concerned industries and stakeholders should hold a **feasibility study for a centralized steam generation facility**, which can fulfil the requirement of steam for all the industries.

5. **Coal consumption in the cluster is about 273,000 tonnes per year;** which subsequently contributes to the loading pattern of the area. However, about **nine per cent of the industries are using about 80,000 tonnes per year agro residue as fuel**. It is recommended for the industries to switch their fuel partially from coal to agro residue waste. That will be beneficial for the environment resulting in reduced emissions into the ambient air to an extent.

6. During the survey, instances of **waste burning in open dumping grounds were observed**. The regulatory bodies need to conduct inspection visits to ensure no industrial or plastic waste is burned and proper disposal is done.

7. Road infrastructure in the industrial area is in very bad shape and requires to be maintained well by the responsible agencies.

5. Action plan for industrial air pollution in Bhiwadi region

Sr. no.	Action points	Agency responsible	Current status
Industry			
1.1	Sector level pollution abatement study to be conducted for metal industry and chemical/pharmaceutical sector, as these are the dominant sectors in the region. A detailed study will help in identifying the potential areas to improve the environmental profile of the sector and reduce the overall load of the area.	RSPCB, third party agencies (identified by the SPCB)	Metal and chemical/pharmaceutical are the major sectors not only in terms of numbers but also with respect to their contribution to the overall pollution load. Focus on these sectors will result in overall reduction and improvement in pollution levels in the area.
1.2	Expedite the shift in industries from conventional polluting fuels (coal, furnace oil, etc.) to cleaner PNG wherever infrastructure is available and push the stakeholders to develop the PNG infrastructure where not available.	Haryana Gas Company Limited, local industrial associations with support from RSPCB if required	PNG infrastructure is not available in most of the area. Where PNG is available, only 15–20 per cent of the industries have switched till now.
1.3	In areas where PNG is not possible due to its non-availability or cost, it is recommended that industries should at least refrain from using fuel oil (FO) as it causes excessive sulphur loading.	Industries, local industrial associations	A significant number of industries are using fuel oil, which has very high sulphur content of about three per cent, which is adding to the existing sulphur loading.
1.4	Use of agriculture based biomass should be promoted in industries. However, the availability of biomass is to be ensured throughout the year.	RSPCB	At present only nine per cent of the industries are using agro residue as fuel.
1.5	Feasibility study for central steam generation unit to be conducted and cost to be estimated.	Local industrial associations with support from industries	There are more than 100 small boilers with a capacity of up to 15 TPH. Small boilers are inefficient and result in more fuel consumption which results in more pollution loading. Moreover, the emission norms are relaxed which gives them margin to pollute.
Regulatory aspect			
1.6	More technical personnel to be hired for RSPCB regional office.	RSPCB	At present, manpower at regional office in Bhiwadi is over-utilized. This is the case with almost all SPCBs.
1.7	RSPCB should conduct surprise inspection of the industries and take stringent actions against the industries found non-complying.	RSPCB	

Sr. no.	Action points	Agency responsible	Current status
Infrastructure and waste management			
1.8	Maintaining road infrastructure in industrial areas. A survey of the area should be conducted to assess the requirement of construction of roads and their maintenance wherever required.	RIICO	Condition of roads in the industrial area is not satisfactory. The roads are in bad shape and at some places absent.
1.9	Provide proper waste management plan for non-hazardous industrial waste and the 42 tonnes of municipal solid waste generated every day. Explore opportunity of establishing a proper waste disposal facility for the waste (like waste to energy plant), depending upon the quantum of waste generated.	RSPCB, technical agencies/ stakeholders	Waste burning in open dumping areas was observed by the CSE team during the survey visits. There is no waste management plan. RIICO has provided the land for open dumping, but even the land is not managed properly and the situation on the ground is very grim.
1.10	Individual industries should take the onus of maintaining the area and roads just outside the boundary of their premises by maintaining a green belt and keeping roads clean.	Industries and local industrial associations	At present, a few industries are doing it, but all others should also try and replicate the same.
1.11	Centralized solar power plant should be installed in Bhiwadi to reduce the running hours of diesel generators.	Local industrial association	A significant number of DG sets are installed in the industrial area which adds to the pollution load.
Commercial sector			
1.12	Commercial sector including hotels and restaurants are using coal for different activities. There is a need to inspect each facility for the presence of proper functional air pollution control devices and push the owners to comply with the regulatory requirements.	RSPCB	Most of the hotels and restaurants are using coal for different applications like tandoor or barbeque without air pollution control systems.
Transportation			
1.13	The regulators and stakeholders should explore the possibility of introducing compressed natural gas (CNG) for vehicles in the region.	RSPCB, Haryana Gas Company Limited	Vehicles are using diesel fuel at present.

III. Ghaziabad district

Contents

1. Environmental profile of Ghaziabad

Ghaziabad city in the state of Uttar Pradesh is part of the National Capital Region. A large and planned city in western Uttar Pradesh, with a population of 2,358,525, it is the administrative headquarters of Ghaziabad district.

As per the study carried out by Greenpeace and IQAir Visual in 2018, Ghaziabad was among the top five most polluted cities in terms of air pollution. The report is based on $PM_{2.5}$ data from public monitoring sources, with a focus on data which has been published in real-time or near real-time.[33]

Table 35: Ranking of most polluted cities in the world (PM conc. in µg/m³)

Sr. no.	City name	2018
CPCB Standard		**60 µg/m³ annually**
1	Gurugram, India	135.8
2	Ghaziabad, India	135.2
3	Faisalabad, Pakistan	130.4
4	Faridabad, India	129.1
5	Bhiwadi, India	125.4

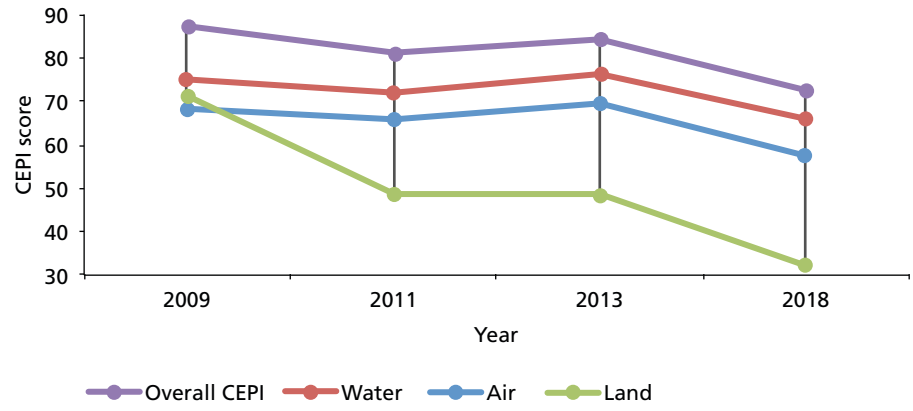
Source: World Air Quality Report PM2.5 Ranking.[34]

Source apportionment study of NCR conducted by Ministry of Heavy Industries and Public Enterprises in August 2018 revealed that industries contribute a significant share of particulate loading into the environment (about 20–30 per cent). Ghaziabad has a range of large, medium and small-scale industries from various industrial sectors including textile, metal, chemicals, pharmaceuticals, food processing, etc.

In CPCB's nationwide environmental assessment of industrial clusters in 2009, Ghaziabad had a CEPI score of 87.37 and was identified as critically polluted (>70).[35] Further CEPI assessment was done in 2011, 2013 and 2018. As per the assessments, the overall CEPI score has come down from 87 in 2009 to 72 in 2018, but it has remained above the threshold limit, signifying that Ghaziabad has continued to be under the critically polluted category (see *Figure 33: Trend—Ghaziabad CEPI score*). However, the CEPI score for air has shown significant improvement during 2009–2018 as it has come down from 68.5 (critically polluted) in 2009 to 57.5 (severely polluted).

The CEPI score in the 2018 assessment clearly underlines that there is still a lot of scope for improvement and a proper action plan needs to be prepared and implemented.

Figure 33: Trend—Ghaziabad CEPI score



Source: CSE 2019–2020

Highlights of comprehensive action plan for Ghaziabad industrial cluster given by UPPCB (dated 31.12.2014)

- Pollution control systems in industries should be regularly monitored in order to ensure compliance.
- Air pollution control systems in major industrial sectors should be upgraded and boilers should be used for steam generation.
- Illegal set up of industries in residential areas should be checked.
- Uttar Pradesh Pollution Control Board (UPPCB) to make an inventory of DG sets in industrial areas and monitor their use.
- Implementation of cleaner technology in order to reduce quantity of process and fugitive emissions. Effective operation and maintenance of installed air pollution control devices to be done by individual industries.
- Switching over to cleaner fuels like PNG.
- Baby boilers in dyeing units use coal and generate uncontrolled stack emissions. Such units need to install air pollution control devices till the time PNG is not available.
- Installation of two continuous ambient air quality monitoring stations.
- Uttar Pradesh State Industrial Development Corporation (UPSIDC) and industries should develop green belt in 20–33 per cent of total area.

2. Profile of Ghaziabad industrial cluster

Ghaziabad industrial cluster consists of industrial areas scattered in nearby regions. There are three major industrial areas namely: Loni, Sahibabad and Bulandshahr Road. Apart from these, Ghaziabad cluster includes Meerut Road Industrial Area, Loha Mandi, Mussorie Gulawati Road, Rajender Nagar IA and Udyog Kunj.

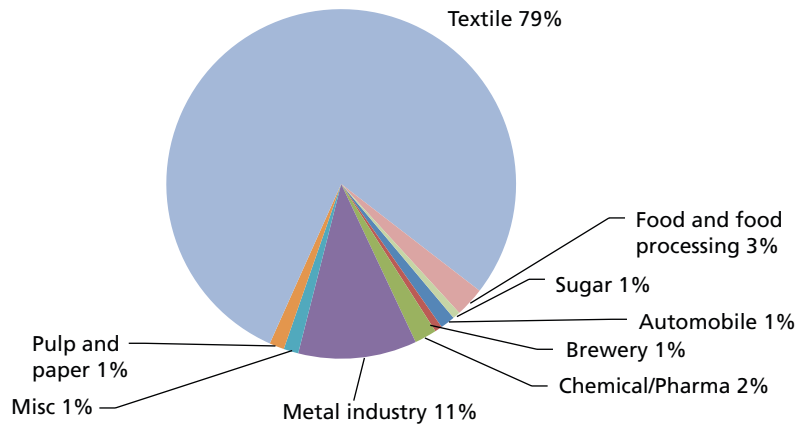
Loni includes Roop Nagar Industrial Area, Tronica City, Arya Nagar Industrial Area, Loni Industrial Estate and Site II Loni Road. Hapur, Dasna, Pilakhua and Modinagar industrial areas are few areas in Hapur and Modinagar region (see *Map 4: Location of industrial areas in Ghaziabad cluster*).

Based on the data provided by UPPCB, there are around 146 air polluting industries in Ghaziabad industrial cluster. About 79 per cent of the total air polluting units are from the textile sector. Metal industry is the other prevailing sector in the cluster with about 11 per cent of the total share. Other prominent sectors are food processing (three per cent), chemicals/pharmaceuticals (two per cent), automobile, brewery, pulp and paper, sugar, and a few miscellaneous industries (one per cent each).

Map 3: Location of industrial areas in Ghaziabad cluster

Source: UPSIDC

Figure 34: Industrial sectors in Ghaziabad cluster



Source: CSE 2019–2020 (based on data provided by UPPCB)

Fuel usage in the cluster

Fuel usage in the cluster is in boilers for steam generation, in Thermopacks for heating, and in furnaces for heating or melting (see *Table 36: Number and range of capacity of combustion equipment installed in the industries*).

Table 36: Number and range of capacity of combustion equipment installed in the industries

Capacity range	No.
Boiler	
<1	84
1 to 3	30
4 to 6	12
7 to 15	6
>15	6
Thermopack	
Up to 10 lakh kcal/hr	6
11–20 lakh kcal	2
>20 lakh kcal/hr	0
Furnace (melting furnace, reheating furnace, etc.)	20

Source: CSE 2019–2020 (based on data provided by UPPCB)

Table 37: Fuel usage in Ghaziabad cluster

Many of the industries in the cluster two fuels (blended or separately)

Industrial area	Agro	Coal	PNG	Wood	Liquid fuel
BS road	1	7		8	8
Dasna		1			1
Loni		86		78	
Meerut Road		1			1
Modinagar	3	3		3	1
Rajender Nagar IA	1	4		3	1
Sahibabad		24	2	4	20
Udyog Kunj				3	2
Total	5	126	2	99	34

Source: CSE 2019–2020 (based on data provided by UPPCB)

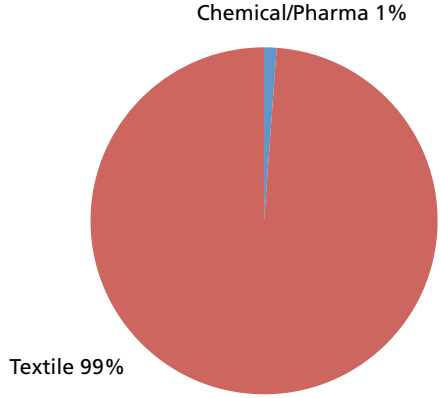
Many industries in the Ghaziabad cluster use more than one fuel. Coal is used in 126 industries and the estimated annual consumption of coal is about 215,000 tonnes per year. About 34,000 tonnes per year of wood and 94,000 tonnes per year agro fuel is consumed in the industries. Few industries in the Sahibabad industrial area use natural gas while liquid fuel is used by 34 industries.

Loni, Sahibabad and Bulandshahr Road are the major industrial areas of Ghaziabad cluster. The details of the types of industries in respective industrial areas are discussed in the next section.

2.1 Loni Industrial Area

Loni Industrial Area comprises of Roop Nagar Industrial Area, Site-2 Loni Road, Rural Industrial Area, Arya Nagar Industrial Area, Shyam Industrial Area and Tronica City. There are about 86 air polluting industries in these areas. The area has the highest number of units in comparison to other industrial area of Ghaziabad cluster. The major industrial sector is textile.

Figure 35: Industrial sectors in Loni Industrial Area

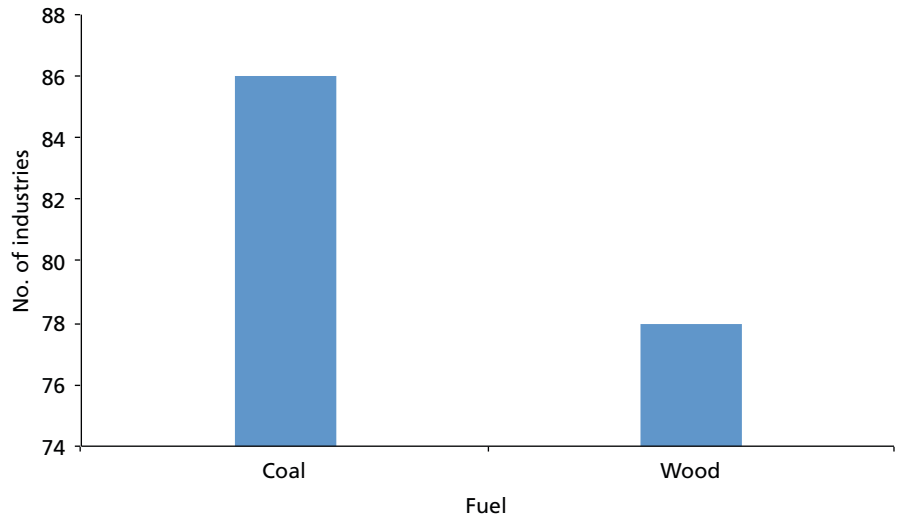


Source: CSE 2019–2020

Fuel usage in Loni Industrial Area

The main fuel used is blend of wood and coal (used by 91 per cent of the units). The remaining nine per cent of the units are using only coal as fuel.

Figure 36: Fuel used in Loni Industrial Area

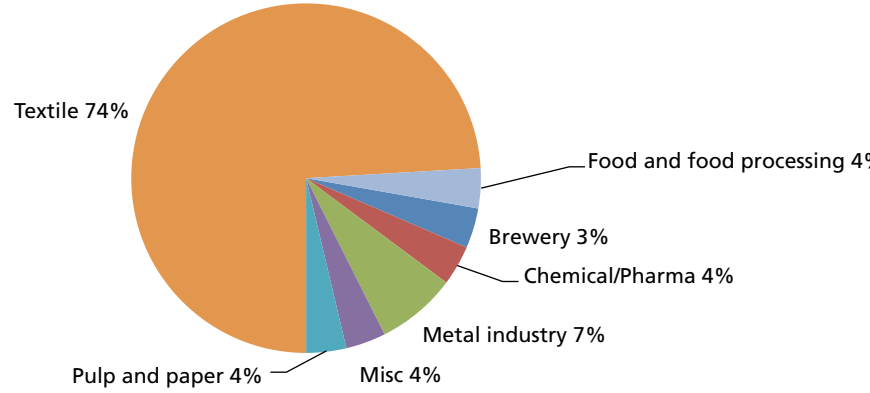


Source: CSE 2019–2020 (based on data provided by UPPCB)

2.2 Sahibabad Industrial Area

Sahibabad Industrial Area has about 27 industries. Industries from Site 4 Industrial Area and Mohan Nagar are included in Sahibabad Industrial Area. Textile is the major sector, with a share of 74 per cent of the total industries. Other sectors in the area include metal, pulp and paper, chemical/pharmaceuticals, food processing, and brewery.

Figure 37: Industrial sectors in Sahibabad Industrial Area

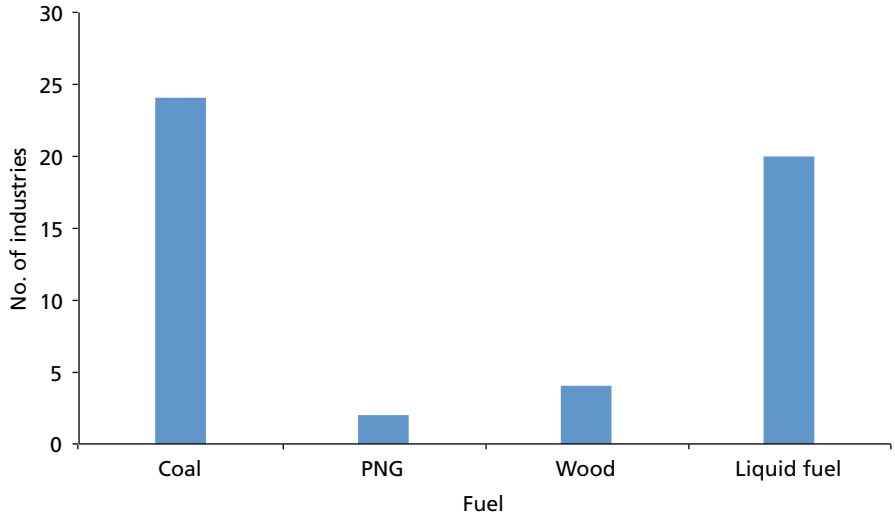


Source: CSE 2019–2020 (based on data provided by UPPCB)

Fuel usage in Sahibabad industrial area

Most of the industries are using coal (24) and liquid fuel (20). Few industries are operating with wood (4) and natural gas (2).

Figure 38: Fuel used in Sahibabad Industrial Area

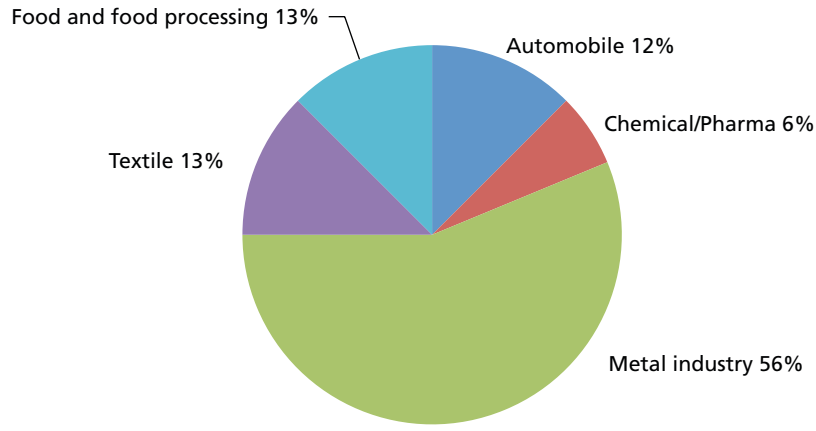


Source: CSE 2019–2020 (based on data provided by UPPCB)

2.3 Bulandshahr Road Industrial Area

About 16 industries in this area are air polluting. About 56 per cent of the industries in the area are metal-based (galvanizing/electrolysis/lead). Food processing (13 per cent), textile (13 per cent) and automobile (12 per cent) are equally distributed in the area. Chemical/pharmaceutical sector has a six per cent share.

Figure 39: Industrial sectors in Bulandshahr Road Industrial Area

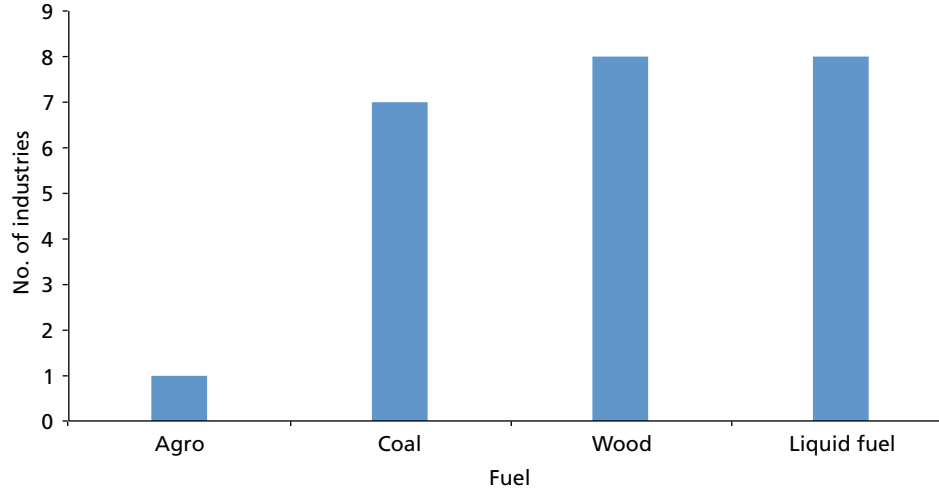


Source: CSE 2019–2020 (based on data provided by UPPCB)

Fuel usage in Bulandshahr Road Industrial Area

Wood, liquid fuel and coal are all almost equally used in the area. Agro waste residue is used by only one industry.

Figure 40: Fuel usage in Bulandshahr Road Industrial Area



Source: CSE 2019–2020 (Based on data provided by UPPCB)

Observations from site visit

- **Loni Industrial Area**

✓ Infrastructure including roads and drainage system was poor in Roop Nagar and Arya Nagar. Waste management is very poor. Local people informed that waste collection vehicles do come but don't collect the waste.
✓ Many industrial welfare associations are working for benefit of the industries and are maintaining the infrastructure within the area. For ex. Ajanta Industry Welfare Association has a membership of about 80 industries. The roads are well maintained and waste is also getting collected at designated locations within the area within its boundary.
✓ PNG is available in Loni Industrial Area but due to the cost industries are not willing to switch to PNG.

- **Sahibabad Industrial Area and Bulandshahr Industrial Area**

✓ Stack emissions were visible in a few industries.
✓ Roads were well maintained.
✓ Local people informed that visible emissions from industrial stacks have significantly reduced in the last five to six months.
✓ The municipal corporation dumps waste in an open ground and no proper disposal facilities are provided. This leads to the local community burning the waste to avoid bad odour and other problems.

- **Dasna Industrial Area**

✓ It is a small industrial area. Earlier, the meat industry was operating here but in the recent past all such industries have been shut down.
✓ Only two medium scale industries—one pulp and paper industry and one agro food manufacturer—are operating in the region. The pulp and paper industry is using coal as fuel. However, the boiler was not under operation during the survey visit.
✓ The road was under construction.

Modinagar Industrial Area

✓ The major industry located in this area is Modi Sugar Mills, which is one of the largest industries in the Ghazaibad industrial cluster.
✓ Metal works, plastics, and textile and dyeing units are located in Sikheda Road Industrial Area in Modinagar.
✓ No continuous visible stack emissions were observed in the area.
✓ Condition of roads in the industrial area is satisfactory. However, fugitive dust was still observed during vehicle movement on the road.

Meeting with Regional Manager, UPSIDC

✓ UPSIDC Regional Manager stated that industries in the Ghaziabad cluster came up in the 1970s; however, there has been encroachment of residential areas into the industrial areas.
✓ Many waste recyclers have been sealed for burning waste like plastic and rubber.
✓ Many environment management related initiatives have been taken up, like rainwater harvesting, solid waste management, etc.

Image 18: Bad condition of the roads in industrial areas

Image 19: Smoke from stack

Image 20: Well maintained roads in Sahibabad Industrial Area

Ghaziabad industries in news

The first is a media report from 06 March 2019 depicting air pollution issues in Ghaziabad. Even though it has shown continuous improvement from 2013 to 2018, the actual situation on the ground depicts otherwise.

Printed from
THE TIMES OF INDIA

Ghaziabad's bane: Pollution from factories, construction sites

TNN | Mar 6, 2019, 08.37 AM IST

GHAZIABAD: Long before the IQAir AirVisual-Greenpeace study came up with its report ranking Ghaziabad as the second-most polluted city in the world, the NCR's industrial hub hogged media headlines for having the worst air quality in the country on at least two occasions - in November 2017 and October 2018.

Experts say industries, vehicles and construction sites are the biggest contributors of coarse pollutants in Ghaziabad - which is otherwise doing reasonably well on other civic parameters - and enforcement mechanism needs to be overhauled to achieve desired results. "Ghaziabad being traditionally an industrial district has close to two dozen industrial belts which emit harmful pollutants, including PM2.5 in the air," said Sushil Raghav, a city-based environmentalist. "While the district administration and the pollution control department claim that effective steps like closing down of polluting industries and imposition of fines are being taken on a regular basis, there are hundreds of illegal polluting industries operating out of the district. And something has to be done to shut them down," he added.

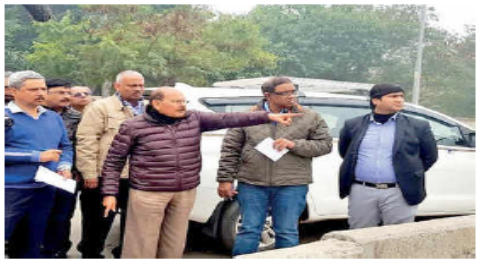
According to experts, the increasing number of vehicles in the past three decades has further aggravated the problem. In 1991, the number of cars and other light motor vehicles in Ghaziabad was just 276. By 2001, the figure increased to 15,070 and by June 2018, the number rose to over 2 lakh. "Mind you this figure is only cars, and buses, three-wheelers and two-wheelers are not accounted into," said Raghav.

The second is a media report from 19 January 2020 regarding the Environment Pollution (Prevention and Control) Authority's (EPCA) visit to Ghaziabad. Industries in the Ghaziabad industrial cluster are still using fuels like coal, charcoal, hard coke, HSD, etc. About 150 industries have still not switched over to cleaner fuels like PNG as per the action plan submitted in 2014. EPCA asked such units to switch to cleaner fuels or close down.

Printed from
THE TIMES OF INDIA

Switch to cleaner fuel or face closure, EPCA chief warns Ghaziabad factories

TNN | Jan 19, 2020, 07.01 AM IST



GHAZIABAD: Environment Pollution Control Authority (EPCA) chairman Bhure Lal visited Kaushambi on Saturday and took stock of measures taken to contain pollution in the township.

In a strict warning to factory owners, Bhure Lal said that all industrial units in the township should shift to cleaner fuel like PNG within a stipulated time, failing which those would be closed. As per Industries Federation of UP, about 50 industries there are still using conventional sources of fuel such as coal and rice husk. And according to the pollution control board officials, there are about 150 units in entire Ghaziabad, which are operating on conventional fuel.

Federation chairman Ashok Choudhary said, "We told Bhure Lal that the production cost increases to about 25% if we use PNG, which would ultimately reflect in the overall pricing of a product and the same manufactured in areas away from NCR, using traditional sources of energy, will obviously be priced less.

So if we do not get any incentive from the government, we will be out of the competition. But we did not get any solution. Moreover, IGL, the company, is not very forthwith in giving us PNG connection."

3. Estimation of pollution load

The key indicator for assessment of air pollution in any area is the loading of pollutants into the ambient environment from different sources in the area.

Under this study the pollution load is estimated for three main pollutants—PM, SO_2, and NO_X from industrial sources. The methodology followed for estimation of the pollution load has been discussed in the first chapter in this report.

3.1 Baseline data for estimating pollution load for Ghaziabad

Total consumption of different kinds of fuel in the industrial areas of Ghaziabad industrial cluster is given below (see *Table 38: Quantity of fuel used in Ghaziabad industrial cluster*).

Table 38: Quantity of fuel used in Ghaziabad industrial cluster (in tonnes per year)

Industrial area	Agro	Coal	PNG	Wood	Liquid fuel
Bulandshahr Road	5,799	52,034		7,286	515
Dasna		25,661			33
Loni		25,566		18,850	
Meerut Road		2,138			4,412
Modinagar	88,478	4,673		2,732	50
Rajender Nagar IA	396	950		713	7
Sahibabad		104,235	24,948	1,940	3,249
Udyog Kunj				2,732	132
Total	94,672	215,258	24,948	34,254	8,397

Source: CSE 2019–2020 (based on CSE's estimation)

Coal is the most consumed fuel in the cluster, followed by agro waste and wood. Very few industries are using PNG in their operations. Liquid fuel is also used in very less quantity.

3.2 Pollution loading from industrial areas of Ghaziabad cluster

Sahibabad, being the largest industrial area of the cluster, contributes the maximum amount to the overall PM load of the cluster (39 per cent), followed by Bulandshahr Road Industrial Area (21 per cent). Loni and Modinagar industrial areas contribute about 13 and 15 per cent respectively to the overall pollution load.

About 60 per cent of the total air polluting industries are located in the Loni Industrial Area; however, the industries are mainly textile/dyeing industry with baby boilers.

Total uncontrolled pollution load for Ghaziabad cluster is about 2985 tonnes per year for PM, 1791 tonnes per year for SO_2 and 2395 onnes per year for NO_X.

Pollution load from Rajendra Nagar IA and Udyog Kunj is insignificant (less than one per cent for each), since these areas are very small.

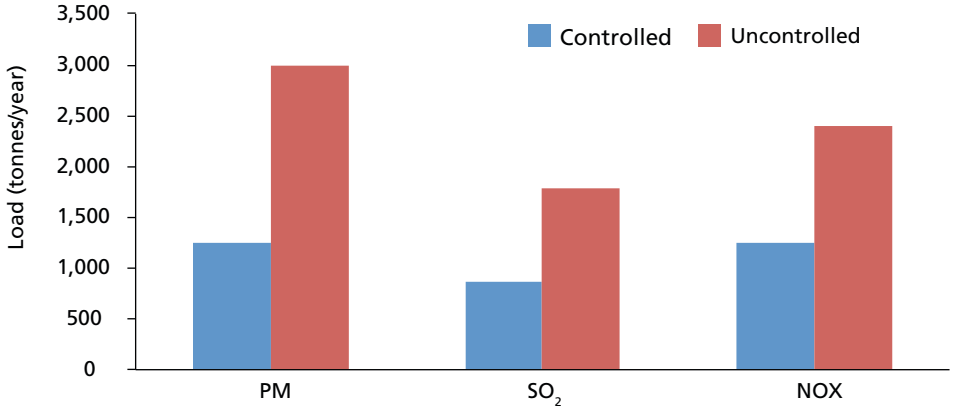
Table 39: Pollution load estimation for Ghaziabad industrial cluster

Industrial cluster	Pollutant (tonnes per year)						Avg. % share in total loading
	Controlled			Uncontrolled			
	PM	SO_2	NO_X	PM	SO_2	NO_X	
Bulandshahr Road	255	162	240	611	388	585	20.5%
Dasna	105	63	94	272	183	270	8.5%
Loni	172	116	174	328	185	349	13.0%
Meerut Road	19	34	29	44	174	45	3.0%
Modinagar	245	192	288	589			15.0%
Rajendra Nagar	7	5	8	15	7	13	0.5%
Sahibabad	442	280	404	1,126	855	1,122	39.0%
Udyog Kunj	10	9	12			12	0.6%
Total	1,256	860	1,249	2,985	1,791	2,395	

Source: CSE 2019–2020

Controlled PM, SO_2, and NO_X load is approximately 58 per cent, 54 per cent, and 60 per cent less than their uncontrolled load (see *Figure 41: Controlled vs uncontrolled emissions*).

Figure 41: Controlled vs uncontrolled emissions



Source: CSE 2019–2020

3.3 Sector-wise pollution load estimation

The annual consumption of fuel for each industrial sector is estimated from the data available for boiler, TFH, and other combustion equipment installed in the industries. Accordingly, the pollution load is estimated for the sectors which are consuming significant quantity of fuel.

Table 40: Annual fuel consumption in industrial sectors of Ghaziabad cluster (tonnes per year)

Industrial sector	Agro	Coal	PNG	Wood	Liquid fuel
Automobile		23,760			
Brewery		9,504			
Chemical/pharmaceutical		15,800		475	66

Industrial sector	Agro	Coal	PNG	Wood	Liquid fuel
Metal industry		7,484	8,316	10,930	762
Miscellaneous			16,632		5,759
Pulp and paper		91,238			33
Textile	16,525	57,016		22,849	416
Food processing	8,650	10,454			1,361
Sugar	69,498				
Total	94,672	215,258	24,948	34,254	8,397

Source: CSE 2019–2020

Table 41: Pollution load estimated for different Industrial sectors

Industrial sector	Avg. % share in total load	Pollutant (tonnes per year)					
		Controlled			Uncontrolled		
		PM	SO_2	NO_x	PM	SO_2	NO_x
Automobile	8%	97	58	87	252	168	250
Brewery	3%	39	23	35	101	67	100
Chemicals/pharmaceuticals	6%	67	40	60	169	114	169
Metal	5%	72	54	78	116	83	129
Miscellaneous	4%	14	37	28	28	207	29
Pulp and paper	24%	139	167	222	639	646	960
Textile	28%	357	239	356	775	423	423
Food processing	6%	67	51	70	169	123	122
Sugar	8%	51	102	204	417	0	0

Source: CSE 2019–2020

Textile industry is the most prevalent sector in Ghaziabad. Subsequently, PM and SO_2 pollution load from this sector is 27 per cent and 25 per cent of the total loading from the cluster. The overall load from the sector is highest in the cluster (28 per cent).

Due to its scale of operation and quantum of fuel consumption, pulp and paper sector has become a significant contributor to the total load from the cluster. However, the controlled PM load from the sector is about 11 per cent of the total controlled PM load.

All other sectors (automobile, brewery, chemical/pharmaceutical, food processing, metal, and sugar) contribute between two to eight per cent of the total load.

Pulp and paper industry: There are two pulp and paper units in Ghaziabad cluster. One is located in Dasna and the other in Sahibabad Industrial Area. Both units consume coal to fulfil their heating and process steam requirement. Forty per cent of the total coal consumed in Ghaziabad cluster is burnt in these units.

Since the pulp and paper sector is an organized sector with proper air pollution control systems and stringent norms (as compared to other small or medium scale sectors), the controlled load from the sector is 11 per cent for PM, 19 per cent for SO_2 and 20 per cent for NO_x. The uncontrolled load from the sector is about 32 per cent of the total load of the cluster, which is highest among all sectors due to the sector's huge coal consumption.

If these units are not operating in compliance with the applicable emission standards, then the contribution of the sector to the pollution load will be significant. However, under normal operation, when these units are meeting the emission norms, there will not be much pollution load from the sector.

4. Observations and recommendations

1. **Coal** is the most used fuel in the cluster and is **consumed by 126 industries out of a total of 146**. **Wood is also used by about 100 industries**. **Agro waste is used by only five industries**. Since these are large scale industries consuming large quantity of fuel, agro-based fuel is the third most consumed fuel in Ghaziabad cluster.

2. About **80 per cent of the units in the cluster belong to the textile sector**, followed by **11 per cent in metal industry**. The loading percentage from textile **is highest (28 per cent).**

3. **CSE recommends that a feasibility study for the textile industries** should be done to explore **opportunities to switch over to PNG** (already available in the Sahibabad area). Looking into the quantum of coal consumption of the textile sector, the pollution loading of the cluster will reduce significantly if these units start using PNG.

4. As per CSE's analysis **textile, and pulp and paper together contribute more than 50 per cent of the pollution loading in the area**. Textile, being a small scale sector, does not have proper pollution control systems. The sector needs upgrades and improvements in technology used, more efficient fuel usage, higher efficiency of air pollution control devices, and better overall resource management. Pulp and paper, being an organized sector, should be surveyed periodically by the regulatory bodies for checking compliance with emission standards.

5. **Sahibabad Industrial Area contributes about 40 per cent to the overall pollution load**. Therefore, CSE recommends that the regulatory bodies should **focus on all the industries in the area** to evolve good environmental management practices for abatement of air pollution.

6. **Coal consumption in the Ghaziabad cluster is about 215,000 tonnes per year,** which contributes to the loading pattern of the area. However, **about 34,000 tonnes of wood is also consumed in the industries per year**. Industries should switch over to cleaner fuels which will result in reduced emissions into the ambient air. If that happens, industries will not be required to shut down during the period when air quality becomes acute.

7. Many of the industries in the cluster are using fuel for steam generation; the concerned industries and stakeholders should hold a **feasibility study for setting up a centralized steam generation facility** which can fulfil the requirement of steam for all the industries.

8. The **municipal corporation should look after infrastructure in the industrial areas**. The councils should concentrate on the construction of roads and providing well planned drainage system in the industrial areas. Proper waste management is also required in these areas to curb the incidents of waste burning near the dumping ground.

5. Action plan for industrial air pollution in Ghaziabad

Sr. no.	Action points	Agency responsible	Current status
Industry			
1.1	Sector level pollution abatement study to be conducted for textile industry, as it is one of the dominant sectors in the region. Detailed study will help in identifying the potential areas to improve the environmental profile of the sector and reduce the overall load of the area. The findings of the study should be shared in stakeholder meetings and specific roles and responsibilities for each stakeholder should be assigned for implementation.	UPPCB, third party agencies (identified by the SPCB), other stakeholders	Textile is the major sector not only in terms of its numbers but also with respect to its contribution to the overall pollution load. Focus on the sector will result in overall reduction and improvement in pollution levels in the area.
1.2	Feasibility study for central steam generation unit to be conducted and cost to be estimated.	Local industrial associations with support from industries	There are more than 100 small boilers with a capacity of up to 15 TPH. Small boilers are inefficient and result in more fuel consumption which results in more pollution loading into the environment. Moreover, the emission norms are relaxed which gives them a higher margin to pollute.
1.3	All the large scale industries including pulp and paper, and sugar units should be surveyed monthly to check the compliance of the units with the applicable emission standards	UPPCB	Pulp and paper, and sugar are large scale sectors which consume significant quantity of fuel, but since these are organized sectors and usually have the required air pollution control systems installed, the emissions are highly controlled. It is only in the case of non-compliance that these sectors may pollute the environment. To keep a check on such instances, monthly survey of the industries is must.
1.4	Expedite the shift in industries from conventional polluting fuel (coal, furnace oil, etc.) to cleaner PNG, wherever infrastructure is available, and push the stakeholders to develop PNG infrastructure wherever it is not available. In areas where a switch to PNG is not possible due to its non-availability or cost, industries should at least refrain from using fuel oil, to reduce sulphur loading.	Industries and local industrial associations, with support from UPPCB if required	PNG infrastructure is not available in some of the areas. A significant number of industries are using fuel oil, which has very high sulphur content of about three per cent, which adds to the existing sulphur loading.
1.5	Use of agro-based biomass should be promoted in industries. Industries should be directed to replace at least five to ten per cent of conventional fuel with biomass.	UPPCB	At present only three per cent of the industries are using agro residue as fuel.

Sr. no.	Action points	Agency responsible	Current status
1.6	Industry associations can play a major role in environmental management of industrial areas. Capacity building of industry associations can help in improving resource efficiency and environmental performance of industries. Initially, UPPCB should prepare an inventory of industry associations and in consultation with the associations should distribute the responsibilities of managing the environment.	UPPCB, local industrial associations	Some industrial associations are maintaining the infrastructure, practicing good housekeeping and managing waste properly. Capacity of these industry associations can be used in a much better way to achieve pollution abatement.
Regulatory aspect			
1.7	Increase UPPCB regional office capacity by hiring more technical personnel. There should be at least one technical staff to manage one to two industrial areas.	UPPCB	
Infrastructure and waste management			
1.8	A survey of the area should be conducted to assess the requirement for construction of roads and maintenance, whichever is required.	Municipal corporation with support of UPSIDC	Condition of the roads in the industrial area is poor.
1.9	Provide proper waste management plan for non-hazardous industrial waste. Explore opportunities for establishing a proper waste disposal facility depending upon the quantum of waste generated.	UPPCB, technical agencies/ stakeholders	Waste burning in open dumping areas was observed by the CSE team. There is currently no waste management plan.
1.10	Individual industries should take the onus of maintaining areas and cleaning roads just outside their premises by maintaining green belts.	Industries and local industrial associations	At present, a few industries are doing it, but all others should also try and replicate the same.

IV. Faridabad district

Contents

1. Environmental profile of Faridabad

Faridabad has 15 industrial clusters spread across 3,100 acres. This area is largely developed by government bodies in HSIIDC, Haryana Urban Development Authority (HUDA), and the Directorate of Industries and Commerce. A number of private developers like DLF have also developed industrial plots with suitable infrastructural facilities in the Faridabad area. The Faridabad district is divided into two sub divisions—Faridabad and Ballabhgarh.

As per the study carried out by Greenpeace and IQAir Visual in 2018, Faridabad was among the top five most polluted cities in terms of air pollution. The report is based on $PM_{2.5}$ data from public monitoring sources, with a focus on data which has been published in real-time or near real-time.

Table 42: Most polluted cities in the world in 2018
Faridabad is amongst the top five most polluted cities

Sr. no.	City name	2018
CPCB Standard		60 µg/m³ annually
1	Gurugram, India	135.8
2	Ghaziabad, India	135.2
3	Faisalabad, Pakistan	130.4
4	Faridabad, India	129.1
5	Bhiwadi, India	125.4

Source: World Air Quality Report $PM_{2.5}$ Ranking[36]

In 2018, Faridabad was considered world's second most polluted city, as per the air quality data presented by WHO. They calculated the annual mean concentration of particulate matter (PM_{10} and $PM_{2.5}$).

Table 43: Most polluted cities in the world in 2018
Faridabad was identified by WHO in 2018 as the second most polluted city in the world

Ranking	City/country	$PM_{2.5}$	PM_{10}
2	Faridabad, India	172	316

Source: WHO Report[37]

CPCB did a nationwide environmental assessment of industrial clusters in 2009 during which Faridabad's CEPI score was estimated to be 77.07, which is critically polluted (>70). Based on the study, 43 industrial clusters were declared as critically polluted with a CEPI score of more than 70. Faridabad was listed in the eighteenth place.

After 2009, the CEPI score was reassessed in 2011, 2013, and 2018 by CPCB. The CEPI score for air decreased during 2009–2013 (from 63.5 to 46), but increased in 2018 to 55.25. Currently, the district is rated as a severely polluted district based on CEPI assessments.

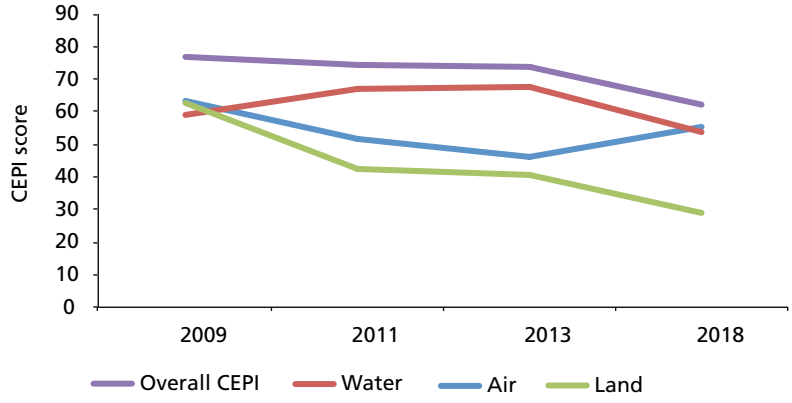
Table 44: Parameter-wise CEPI score for Faridabad industrial cluster

Sr. no.	Parameters	Scores			
Year		2009	2011	2013	2018
1	Air	63.5	51.50	46	55.25
2	Water	59	67.25	67.5	53.75
3	Land	62.7	42.50	40.5	28.75
Overall CEPI		77.07	74.42	73.55	62.17

Source: Comprehensive Environmental Assessment of Industrial Clusters, 2009

Figure 42: Trend of CEPI score in Faridabad

CEPI score for air in Faridabad has increased from 2013 to 2018



Source: CSE, 2019–20

Haryana State Pollution Control Board (HSPCB) submitted its action plan to combat pollution to CPCB in 2014–15. However, the increase in CEPI air score in 2018 suggests that the HSPCB action plan for abatement of pollution in Faridabad needs to be critically analyzed for its effectiveness. The action plan for the industrial sector did not highlight key issues and measures to reduce air pollution. This report aims to fulfil that gap. It aims to analyze industry type, air polluting units, and their fuel type and consumption. Further, it estimates pollution load of Faridabad cluster and provides a broader action plan for the industrial sector.

BOX 4: Deteriorating infrastructure a hurdle in growth

Faridabad has the worst public infrastructure—road, power, water, waste disposal—amongst all the NCR districts. The infrastructure issue has been pulling down industrial growth. The overall growth in export merchandise has gone down by five to ten per cent this year. Big industrial units including Maruti Suzuki, Eicher, and Hero Honda have moved out of Faridabad. Companies that have foreign joint ventures have bought lands for new units outside Faridabad.

The automobile sector accounts for 55 per cent of total business in Faridabad. The auto industry brings an annual turnover of Rs 15,000 crore. The engineering and leather goods industries are the second and third largest and generate a turnover of Rs 6,000 crore and Rs 2,000 crore respectively. However, with the current state of infrastructure, these turnover numbers would be difficult to maintain. Poor infrastructure in the area is also adding to the pollution menace.

Power supply

The city receives no power for nearly three and a half months in a year. The industries in the area manage power cuts by power back-ups like diesel generator sets. Foreign investors prefer not to start industries due to erratic power supply.

Roads

The Delhi-Agra highway is filled with potholes, which have caused several accidents and deaths. Potholes on roads block movement of people, machines, raw materials, and finished goods. According to industrialists, goods going for export from Faridabad which reach Loni and Tughlakabad are prone to frequent damage due to road conditions.

It takes an hour to reach industrial sectors 58, 59, 25, and Ballabhgarh from the Badarpur flyover due to traffic congestion. Delegates of OHM Electric Inc. refrained from investing in Faridabad after being stuck in a massive traffic jam during a site visit.

Though the government is aware of the poor infrastructure and related difficulties—it is not putting enough effort into reform. More funds are diverted to developing industrial model towns in the area with little success.

2. Profile of Faridabad Industrial Area

Faridabad has two industrial clusters—Faridabad and Ballabhgarh. As per the data received from HSPCB, there are around 300 air polluting industries in Faridabad cluster (including hospital, hotels, and construction projects). However, since the focus of the study is mainly the manufacturing sector, the commercial units are not taken into account and the overall assessment is done for about 214 industries. Metals and textile are the two major sectors in Faridabad cluster and constitutes about 70 per cent of the total industries.

There are about 906 units in Ballabhgarh as per the data shared by HSPCB. However, the fuel consuming units are around 734. The prominent industrial sectors in Ballabhgarh are metal, automobile, and textile. Metal industry alone constitutes about 60 per cent of the 734 units.

Map 5: Industrial sectors in Faridabad

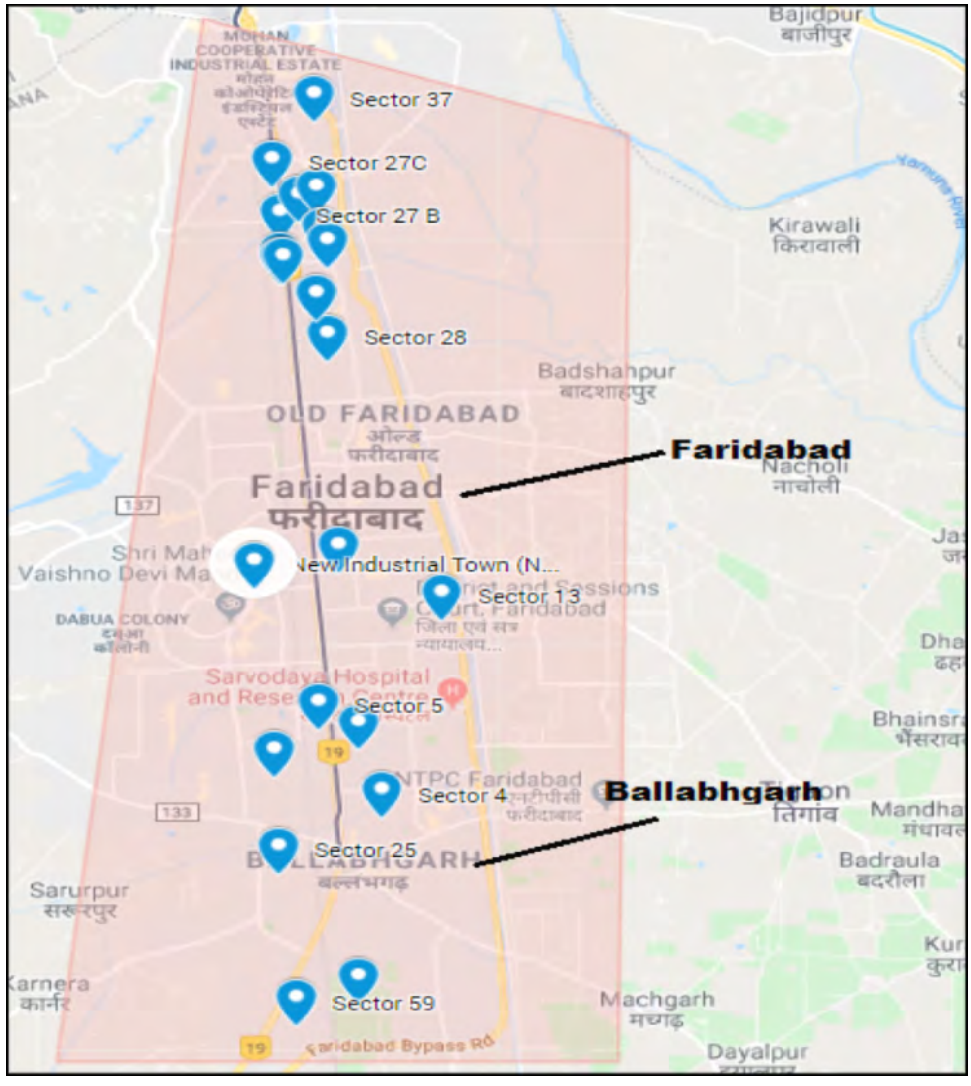


Table 45: Industrial sectors in Faridabad region

Industrial sector	Ballabhgarh	Faridabad	Total	Overall % share
Automobile	84	12	96	10%
Chemical/pharmaceutical	16	10	26	3%
Food	19	2	21	2%
Leather	2	5	7	0.7%
Metal	448	64	512	54%
Miscellaneous	21	19	40	4%
Paper	1		1	0.1%
Petro-products	3	2	5	0.5%
Plastic/packaging	57	5	62	7%
Printing	9		9	0.9%
Refractory	6		6	0.6%
Rubber	19	5	24	3%
Tanneries		1	1	0.1%
Textile	49	89	138	15%
Total	734	214	948	

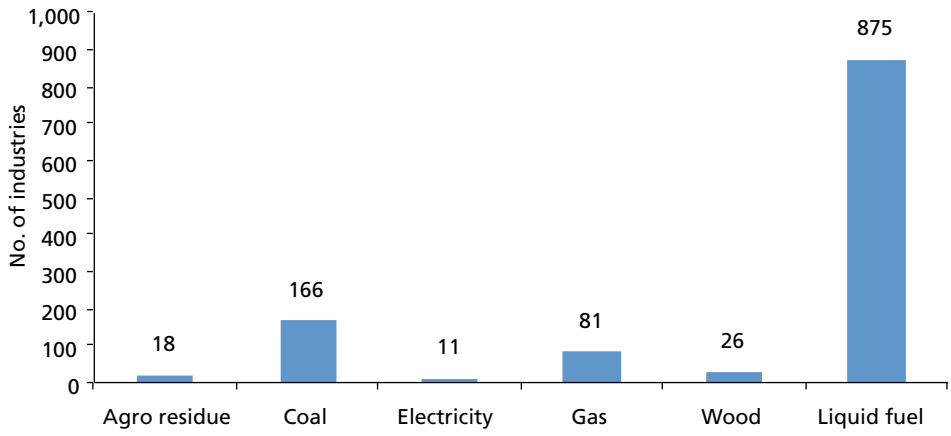
Source: CSE 2019–2020 (based on the data provided by HSPCB)

Fuel usage

Fuel usage in industries is mainly in boilers for steam generation or in Thermopacks for heating. Some of the industries also have furnaces for heating and melting. However, the exact number of these combustion equipments installed in the industries is not available.

Liquid fuel (HSD, LDO, FO, and LSHS) is used in about 90 per cent of the industries. Apart from the process, it is used mainly in DG sets, which are installed in about 780 industries as per the data provided by HSPCB. Coal is used by about 166 industries (18 per cent). Agro residue and wood (one to two per cent each) are not used widely. Currently, only nine per cent of the industries are using cleaner fuel.

Figure 43: Fuel usage in Faridabad region



Source: CSE 2019–2020 (based on the data provided by HSPCB)

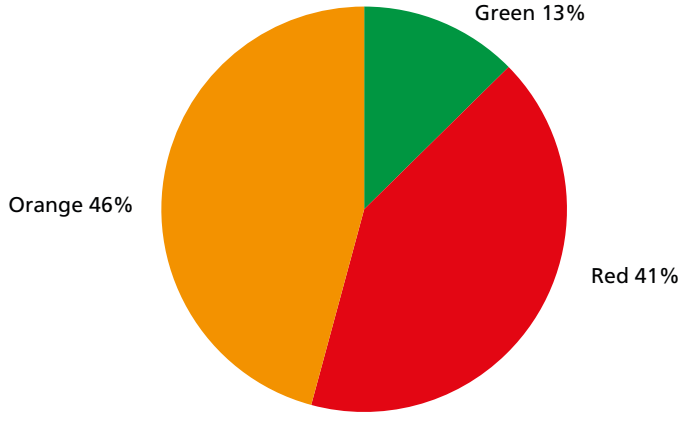
Industries in Faridabad are located either in Faridabad industrial cluster or Ballabhgarh industrial cluster. Each cluster has a number of industrial areas under it.

2.1 Faridabad industrial cluster

Faridabad cluster has 10 industrial areas. Faridabad is famous for manufacturing of tractors, switchgears, refrigerators, shoes, tyres, readymade garments, construction machinery, automobile parts, and light engineering products. These industries are spread across the cluster.

As per the data received from HSPCB by CSE, there are 214 air polluting industries in this cluster. Out of these, 41 per cent (89) are red category industries; 46 per cent (98) are orange category industries; and the rest (27) are green category industries.

Figure 44: Category of industry in Faridabad industrial cluster

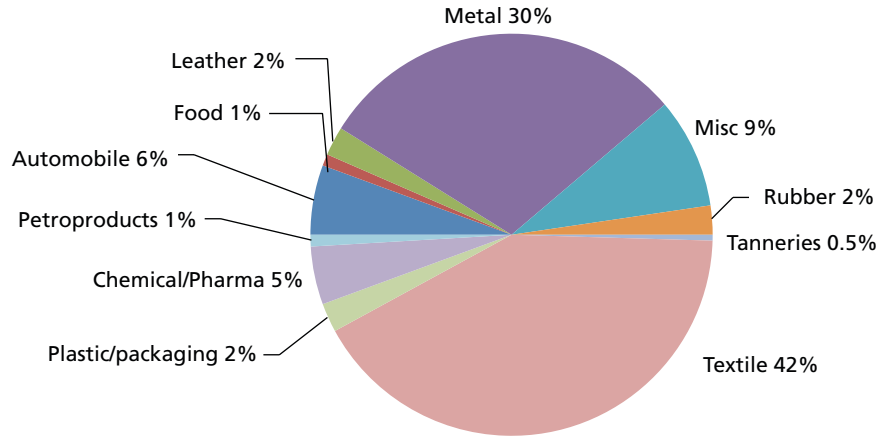


Source: CSE 2019–2020 (based on the data provided by HSPCB)

Faridabad cluster has different industrial areas spread across the region—DLF Phase-I & II; Sector 31 and Sector 32 industrial area; Sector 27A, B, C, and D; and New Industrial Township (NIT). Most of the industries are located in these areas. Additionally, some of the industries are randomly spread across the district.

There are 89 textile units which constitute about 42 per cent of the total industries in the cluster, followed by metal industries (30 per cent). The automobile sector has a six per cent share in the total number of industries, while five per cent of the industries belong to chemicals/pharmaceutical sector. The miscellaneous nine per cent mainly includes hazardous waste management facilities, e-waste recyclers, and electrical and electronics assemblers (see *Figure 45: Industry type in Faridabad industrial cluster*).

Figure 45: Industry type in Faridabad industrial cluster

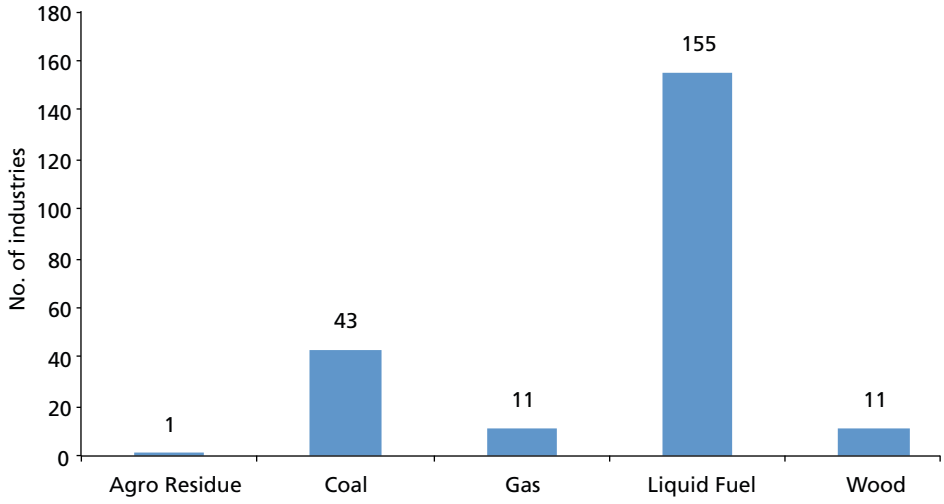


Source: CSE 2019–2020 (based on the data provided by HSPCB)

Fuel usage in Faridabad cluster

Out of a total 214 air polluting industries, liquid fuel is used in about 72 per cent either in the process or for the DG set. There are also industries which are using more than one type of fuel. Coal is used in 20 per cent of the industries; gas and wood is used by a total 10 per cent of the industries; whereas, agro residue is not used extensively in the cluster (0.5 per cent).

Figure 46: Fuel used in Faridabad cluster



Source: CSE 2019–2020 (based on data provided by HSPCB)

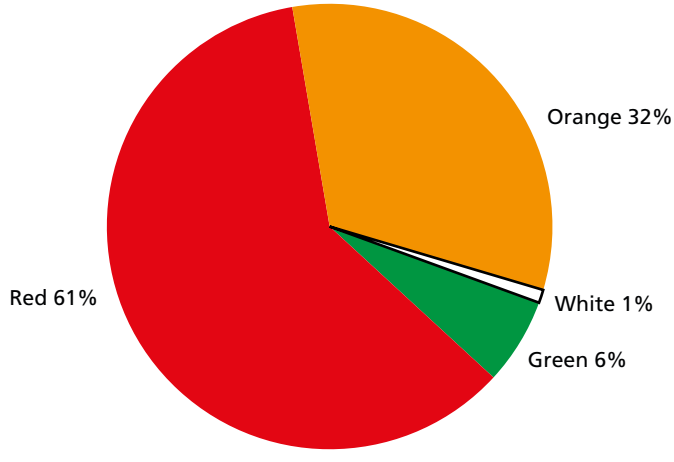
2.2 Ballabhgarh industrial cluster

Out of 734 units, 60 per cent are in the red category, including metal, textile, and automobile industries; 32 per cent are in the orange category, including metal, automobiles, and plastics/packaging units; six per cent are in the green category while only one per cent are in the white category.

Major industrial areas in Ballabhgarh include sector 24, sector 23, sector 25, sector 58 (electroplating zone), sector 59, and sector 6. Industrial areas in Palwal are Baghola, Dhatir, Prithla, Hathin, Dudhola, Tatarpur, and Hodal.

Figure 47: Industry category in Ballabhgarh

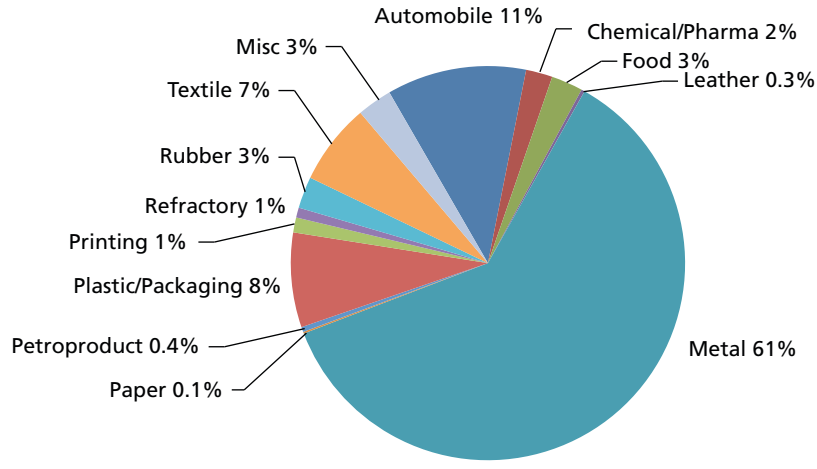
More than 90 per cent of the units belong to the red or orange category



Source: CSE 2019–2020 (based on data provided by HSPCB)

Ballabhgarh cluster has a large number of metal units. Out of a total of 734 units, 61 per cent are metal, 11 per cent are automobile, about eight per cent are plastics/packaging, and seven per cent are textile.

Figure 48: Type of industries in Ballabhgarh industrial cluster

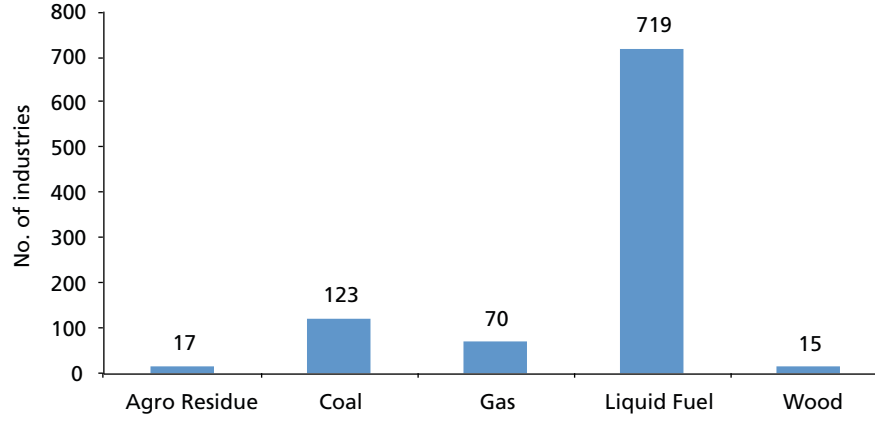


Source: CSE 2019–2020 (Based on data provided by HSPCB)

Fuel usage in Ballabhgarh cluster

Out of the total 734 air polluting industries, liquid fuel is used in about 92 per cent either as process fuel or for DG set. There are industries which are using more than one type of fuel. Coal is used in 17 per cent of the industries; gas is used by 10 per cent of industries, whereas agro residue and wood is used by only four per cent of the industries.

Figure 49: Fuel used in Ballabhgarh cluster



Source: CSE 2019–2020 (based on data provided by HSPCB)

3. Estimation of pollution load

The key indicator for assessment of air pollution in any area is the loading of pollutants into the ambient environment from different sources in the area. Under this study, the pollution load is estimated for three main pollutants—PM, SO_2, and NO_x from industrial sources. The methodology followed for estimation of the pollution load has been discussed in the first chapter in this report.

3.1 Baseline data for estimating pollution load for Faridabad region

There are 948 air polluting units in Faridabad region as per the data provided by HSPCB. Total consumption of different types of fuel is iven in the table below.

Table 46: Quantity of fuel used in Faridabad region (in tonnes per year)

Industrial cluster	Agro residue	Coal	Gas	Liquid fuel	Wood
Ballabhgarh	34,150	103,090	65,394	141,035	7,851
Faridabad	165	71,155	2,034	53,894	3,475
Total	34,315	174,245	67,428	194,929	11,326

Source: CSE 2019–2020 (based on the data provided by HSPCB)

3.2 Pollution loading from industrial areas of Faridabad region

The total pollution load of Faridabad region is divided into Ballabhgarh cluster and Faridabad cluster (see *Table 47: Pollution load estimation for Faridabad region*).

Table 47: Pollution load estimation for Faridabad region

Industrial Cluster	Pollutant (tonnes per year)						Avg. % share in total loading
	Controlled			Uncontrolled			
	PM	SO_2	NO_x	PM	SO_2	NO_x	
Ballabhgarh	874	1,246	1,189	2,001	5,808	1,844	68%
Faridabad	434	529	534	1,025	2,444	1,033	32%
Total	1,308	1,775	1,723	3,026	8,252	2,877	

Source: CSE 2019–2020

Total uncontrolled SO_2 pollution load (8,252 tonnes per year) is high as compared to PM (3,026 tonnes per year) and NO_X (2,877 tonnes per year). This is because of extensive use of liquid fuels which sometimes have sulphur content as high as three per cent. The controlled PM load is about 43 per cent of the uncontrolled load. For SO_2, controlled load is about 22 per cent of the uncontrolled load. Whereas for NO_X, controlled load is about 60 per cent of the uncontrolled load.

3.3 Sector-wise pollution load estimation

The annual consumption of fuel for each industrial sector is calculated from the data available. Accordingly, the pollution load is estimated for sectors which are consuming a significant quantity of fuel.

Table 48: Annual fuel consumption in Faridabad region (tonnes per year)

Industrial sector	Agro residue	Coal	Gas	Liquid fuel	Wood
Automobile	-	1,850	4,506	20,984	132
Chemical/ pharmaceuticals	40	2,228	561	6,960	2,036
Food	12,540	17,292	376	2,860	330
Leather	-	-	-	603	-
Metal	297	11,578	53,501	134,020	495
Paper	-	660	-	70	-
Petro-products	-	-	66	686	-
Plastic/packaging	3,128	12,263	50	4,517	4,125
Printing	-	2,640	-	555	-
Refractory	-	915	-	42	-
Rubber	33	5,696	7,107	3,620	-
Tanneries	-	-	-	42	-
Textile	5,610	113,514	1,261	16,781	3,845
Miscellaneous	12,667	5,610	-	3,190	363
Total	34,315	174,245	67,428	194,929	11,326

Source: CSE 2019–2020 (based on the data provided by HSPCB)

Metal and textile industries are the major polluters in Faridabad region. The total contribution from these sectors together constitutes about 72 per cent of the total pollution load.

Metal industry is the most prevalent sector in Faridabad. Subsequently, PM, SO_2 and NO_X pollution load from this sector is 27 per cent, 55 per cent and 34 per cent respectively of the total loading from the cluster.

Automobile (six per cent), food industry (six per cent), and plastic/packaging (five per cent) are the other sectors with significant pollution load in Faridabad region.

Miscellaneous sector includes hazardous waste management facilities, e-waste recyclers, and electrical and electronics assemblers. It contributes about four per cent to the total load of the region.

Table 49: Pollution load estimated for different industrial sectors

Sector	Avg. % share in total loading	Pollutant (tonnes/year)					
		Controlled			Uncontrolled		
		PM	SO_2	NO_X	PM	SO_2	NO_X
Automobile industry	6%	59	140	108	121	769	125
Chemicals/pharmaceuticals	3%	33	56	50	64	267	67
Food	6%	110	86	115	273	225	205
Metal	39%	373	891	691	772	4,907	794
Miscellaneous	4%	63	60	74	152	155	84
Plastics/packaging	5%	84	77	93	183	250	171
Rubber	2%	32	37	38	78	171	171
Textile	33%	533	406	528	1,329	1,408	1,298
Printing	0.8%	12	10	12	31	39	31
Leather	0.2%	1	4	3	3	22	3

Source: CSE 2019–2020

4. Observations and recommendations

1. **Use of clean fuel should be increased:** Clean fuel is used in about nine per cent of the industries, as per the data provided by the HSPCB. According to the action plan submitted by HSPCB, pipe lines to supply natural gas have been laid in nine industrial sectors. Still, coal and diesel are the prominent fuel choice.

   Only two per cent of the industries are using agro residues as fuel. Nine per cent are using natural gas. Textile sector is the major consumer of coal, followed by food, plastics/packaging, and metal industries.

2. **Shift to clean fuel a priority for textile sector:** Both in Faridabad and Ballabhgarh industrial areas, the textile sector is consuming significant amounts of coal. Clean fuel technologies exist and must be adopted by this sector.

3. **Shift to low sulphur content liquid fuel:** Significant quantity of liquid fuel is used by the industries in the region. Currently, sulphur dioxide emissions by these industries are more or less equivalent to emissions due to coal burning. Therefore liquid fuel with much lower sulphur content is recommended to be used.

4. **APCD installation to curb NO_X from metal industries:** Ensure installation of sufficient air pollution control devices to control NO_X from metal industries.

5. **Action plan reports sufficient pollution control equipment in industries**: CEPI action plan report submitted by HSPCB in 2012 mentions that units in Faridabad region which have the potential to pollute air have adequate devices to control air pollution.

6. **Overall CEPI score is increasing:** The CEPI score for air decreased during 2009–2013 (from 63.5 to 46); however, it further increased in 2018 to 55.25. While CEPI score for water and land has shown a decreasing trend.

7. **Installation of new continuous air pollution monitoring system:** Earlier, only one continuous air pollution monitoring system was available. Experts opine that at least three more such monitoring systems are necessary. However, as per the media report dated 17 March 2020, Faridabad has three new air quality monitors installed in Sector 11, Sector 30 and at VK Chowk in the New Industrial Township area by HSPCB.

8. **Waste burning:** Waste handling in industries must be improved. Burning of waste has been identified as a significant issue in industrial areas. Ensure third-party collection and accounting of waste from industries.

5. Action plan for industrial air pollution in Faridabad

Sr. no.	Action points	Agency responsible	Current status
Industry			
1.1	Sector level pollution abatement study to be conducted for metal and textile industries. Detailed study will help in identifying potential areas to improve the environmental profile of the sector and reduce the overall load of the area. Share the findings of the study and focus areas identified through stakeholder meetings. Share the plan for implementation and assign specific roles and responsibilities for each stakeholder.	HSPCB, third party agencies (identified by the SPCB), other stakeholders	Metal and textile are the major sectors with respect to their contribution to the overall pollution load. Focus on these sectors will result in overall reduction and improvement in pollution levels in the area.
1.2	Expedite shift in industries from conventional polluting fuel (coal, furnace oil) to cleaner PNG. Since a number of industries in Faridabad region use liquid fuel, cost should not be a problem as both the price and calorific value of liquid fuels is comparable to PNG. Awareness should be created among the industries regarding this. In areas where PNG switch is not possible due to its non-availability or cost, and industries are using liquid fuels, industries should at least refrain from using fuel oil in order to reduce sulphur loading.	Local industrial associations and industries	PNG infrastructure is available in about nine industrial areas in the Faridabad region. However, only nine per cent of the industries are using PNG for process or utility. A significant number of industries are using fuel oil, which has very high sulphur content of about three per cent. This adds to the existing sulphur loading.
1.3	Use of agro-based biomass should be promoted in industries. However, the availability of biomass is to be ensured throughout the year. Even the industries using coal should be encouraged to use at least five to ten per cent agro fuel.	HSPCB	At present only two per cent of the industries are using agro residue as fuel.
1.4	Industry associations can play a major role in overall environment management in the industrial areas. Capacity building of industry associations can help in improving resource efficiency and environmental performance of the industries. Initially, HSPCB should prepare an inventory of the industry associations. And then, in consultation with the associations, HSPCB should distribute the responsibilities of managing the environment.	HSPCB, local industrial associations	Some industrial associations are maintaining the infrastructure, practicing good housekeeping and managing waste properly. Capacity of these industry associations can be used in a much better way to achieve pollution abatement.

Sr. no.	Action points	Agency responsible	Current status
Regulatory aspect			
1.5	Increase HSPCB regional office capacity by hiring more technical personnel.	HSPCB	
1.6	HSPCB should conduct surprise inspections of industries and take stringent actions against those found non-complying.	HSPCB	
Infrastructure and waste management			
1.7	A survey of the area should be conducted periodically to assess the requirement for construction or maintenance of road.	HSIIDC	
1.8	Provide proper waste management plan for non-hazardous industrial waste. Explore opportunity for establishing a proper waste disposal facility (like waste to energy plant), depending upon the quantum of waste generated	HSPCB, technical agencies/ stakeholders	
1.9	Centralized solar power plant should be installed in Faridabad to reduce the running hours of DG sets.	Local industrial association	A significant number of DG sets are installed in the industrial area.

V. Gurugram district

Contents

1. Environmental profile of Gurugram

Gurugram Industrial Area is divided into two industrial regions, South and North Gurugram. HSIIDC is responsible for the development and management of the industrial areas; i.e. development of physical infrastructure including roads, power, street light, water supply, drainage, etc. along with provisions of basic social infrastructure.

As per the study carried out by IQAir AirVisual and Greenpeace, Gurugram was the most polluted city in the world in 2018, in terms of air pollution ($PM_{2.5}$). The report is based on 2018 air quality $PM_{2.5}$ data from public monitoring sources, with a focus on data which has been published in real-time or near real-time.[38]

Table 50: Ranking of most polluted cities in the world (PM conc. in µg/m³)

Sr. no.	City name	2018
CPCB Standard		60 µg/m³ annually
1	Gurugram, India	135.8
2	Ghaziabad, India	135.2
3	Faisalabad, Pakistan	130.4
4	Faridabad, India	129.1
5	Bhiwadi, India	125.4

Source: World Air Quality Report $PM_{2.5}$ Ranking.[39]

Gurugram has a range of large, medium and small-scale industries from various industrial sectors including textile, food processing, automobile, metal, etc.

2. Profile of Gurugram industrial cluster

Gurugram Industrial Area is divided into two regions—South and North Gurugram. In South Gurugram, industries are mostly located in IMT Manesar, Udyog Vihar, and Sector-37. In North Gurugram, industries are majorly located in the Nuh and Mewat areas.

Based on the data provided by HSPCB, there are 125 air polluting industries in the Gurugram industrial cluster. Out of these, 38 per cent are textiles (largely dyeing and printing units), 15 per cent are food processing (largely fruits and vegetables processing units), 13 per cent are metal units like metal surface treatment and metal extraction units, 13 per cent are automobile units, five per cent are pharmaceutical units, and two per cent are chemical units (see *Figure 50: Industrial sectors in Gurugram*).

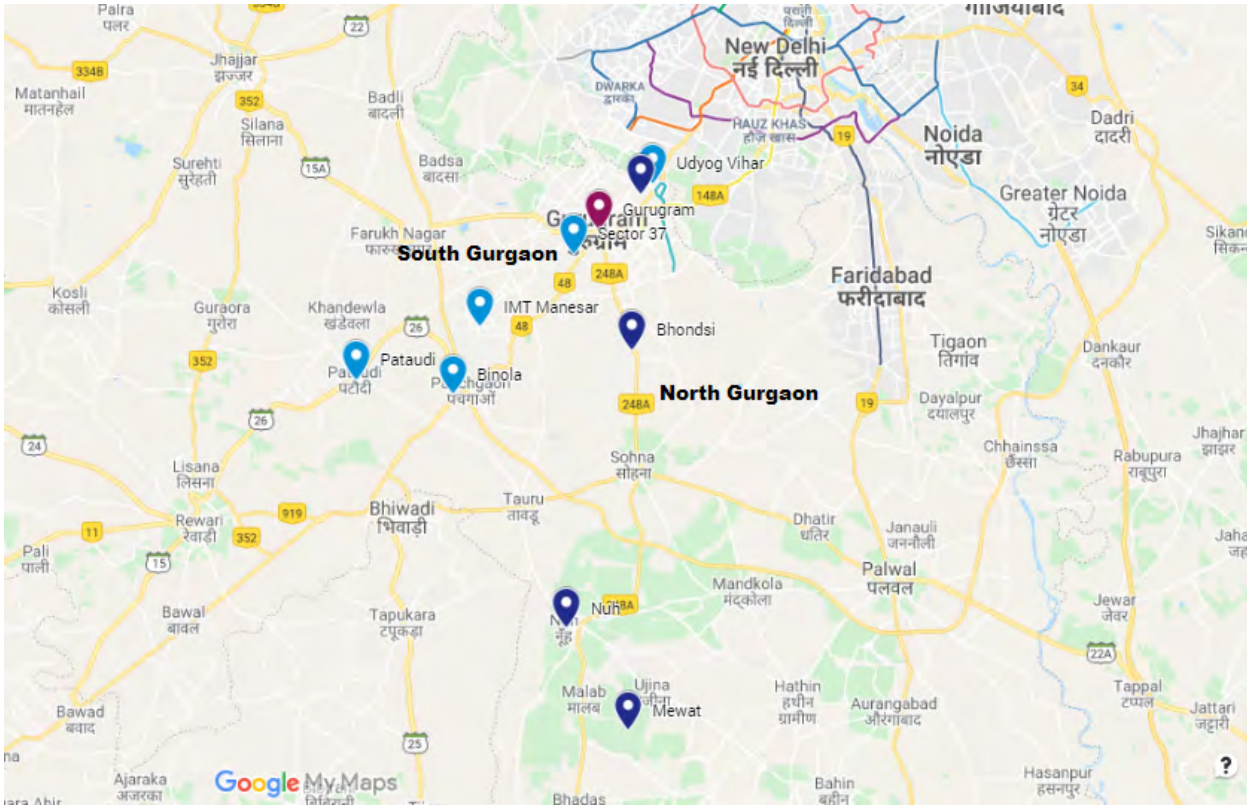
A total of 85 air polluting industries are located in South Gurugram. Industries located in South Gurugram are a mix of textile, metal, automobile, food processing, and chemical units. North Gurugram has 40 air polluting industries. North Gurugram industrial cluster has food processing, textile, automobile and metal units.

Table 51: Sector-wise details of the industries in Gurugram cluster

Industry	South Gurugram	North Gurugram	Total
Textile	40	7	47
Metal	12	4	16
Automobile	10	6	16
Food	9	10	19
Others	8	7	15
Chemical	3		3
Pharmaceutical	3	3	6
Rubber		2	2
Printing		1	1
Total	85	40	125

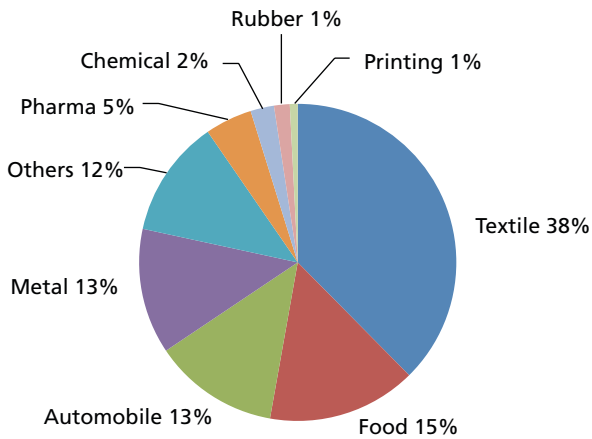
Source: CSE 2019–2020 (based on the data provided by HSPCB)

Map 6: Location of Gurugram industrial cluster



Source: CSE, 2020

Figure 50: Industrial sectors in Gurugram



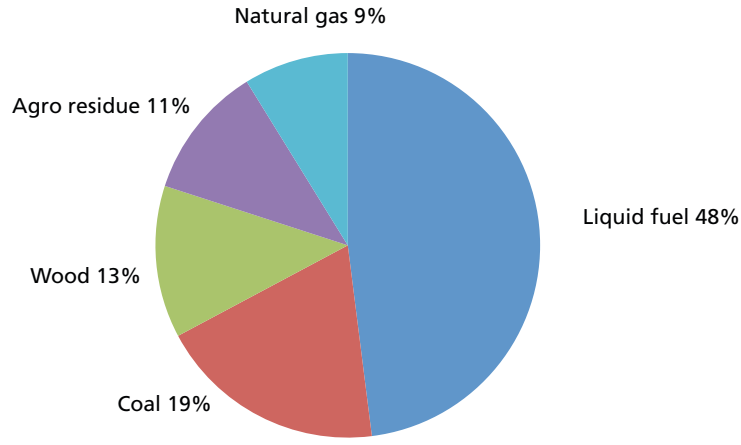
Source: CSE 2019–2020 (based on the data provided by HSPCB)

Fuel usage in the cluster

Fuel is mainly used in boilers for steam generation or in Thermopacks for heating. Some of the industries also have furnaces for heating and melting. As per the data provided by HSPCB, there are about 70 boilers, 10 furnaces and

two Thermopacks installed in the industries. No information is available for about 50 industries.

Figure 51: Fuel usage in Gurugram industrial cluster



Source: CSE 2019–2020 (based on the data provided by HSPCB)

Liquid fuel is used by 48 per cent of the industries in the cluster and its annual consumption is about 47,417 tonnes per year. Approximately 19 per cent of the units are using coal as fuel and its consumption is about 38,151 tonnes per year. Wood is being used as a fuel by 13 per cent of the industries and its annual consumption is about 9,300 tonnes per year. Eleven per cent of the units are using agro waste residue as fuel with an annual consumption of about 31,038 tonnes per year. Nine per cent of the units are using natural gas as fuel and its consumption is about 10,775 tonnes per year.

Table 52: Fuel usage in industries in Gurugram industrial cluster

Type of fuel	South Gurugram	North Gurugram	Total
Agro residue	**1**	**10**	**11**
Agro residue/coal	**1**		**1**
Agro residue/diesel	**1**		**1**
Agro residue/liquid fuel	**1**		**1**
Coal	**17**	**6**	**23**
Coal/HSD	**1**		**1**
Gas/HSD		**1**	**1**
Natural gas/liquid fuel	**3**		**3**
PNG/HSD	**1**		**1**
Natural gas/liquid fuel	**3**	**3**	**6**
Liquid fuel	**50**	**10**	**60**
Wood	**5**	**10**	**15**
Wood/liquid fuel	**1**		**1**

Source: CSE 2019–2020 (based on the data provided by HSPCB)

2.1 South Gurugram Industrial Area

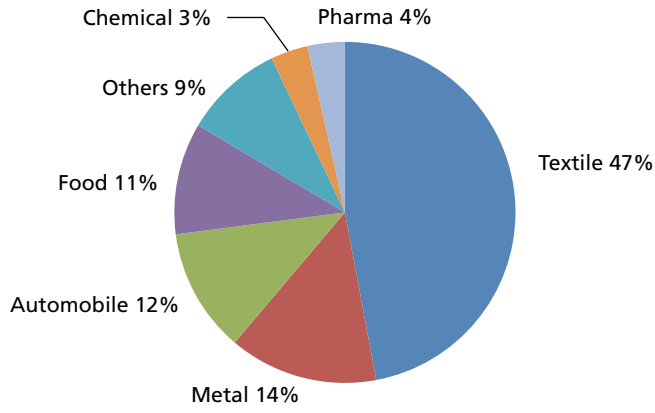
In South Gurugram, industries are located in IMT Manesar, Pataudi, Sector -37, Udyog Vihar and Binola. As per HSPCB, there are about 85 air polluting industries in South Gurugram. The major industrial sectors include textile (47 per cent), metal (14 per cent), automobile (12 per cent), and food processing (11 per cent).

Table 53: Sector-wise details of the industries in South Gurugram

Type of Industry	Sector-37	IMT Manesar	Binola	Pataudi	Udyog Vihar	Total
Textile	23	14	2	-	1	40
Food processing	1	4	-	4	-	6
Metal	4	4	4	-	-	12
Automobile	-	5	5	-	-	10
Others	4	3	1	-	-	8
Pharmaceutical	-	1	2	-	-	3
Chemical	1	-	1	1	-	3
Total	33	31	15	5	1	85

Source: CSE 2019–2020 (based on the data provided by HSPCB)

Figure 52: Industrial sectors in South Gurugram



Source: CSE 2019–2020 (based on the data provided by HSPCB)

Fuel usage in South Gurugram Industrial Area

Out of the total 85 air polluting industries, majority of the industries are using liquid fuel (59 per cent) and coal (21 per cent).

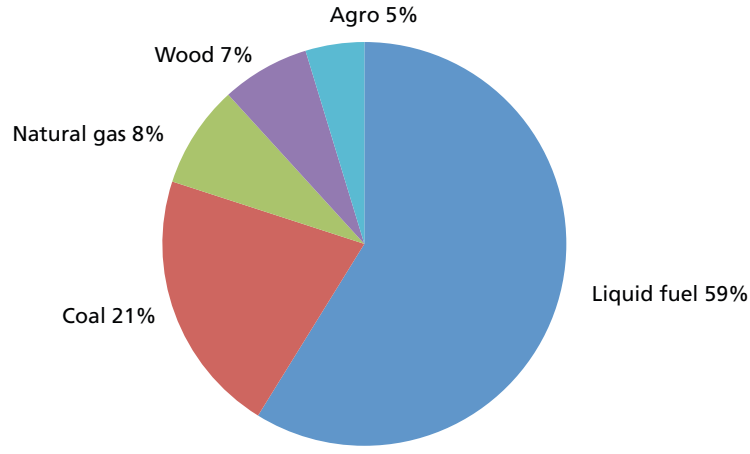
- **Liquid fuel:** Liquid fuel is used by fifty industries. On an average 45,952 tonnes of liquid fuel is consumed per year. Maximum amount of liquid fuel is consumed by the automobiles sector (9,055 tonnes per year), followed by textile sector (5,467 tonnes per year), and metal industry (3,060 tonnes per year).

- **Coal:** Coal is used by 18 industries. Cumulatively, they use about 29,526 tonnes of coal per year. Maximum coal consumption is by textile industries (17,550 tonnes per year), followed by food processing (4,800 tonnes per year), and automobiles (3,900 tonnes per year).

- **Wood:** Wood is used as fuel by six units. Total wood consumption in the area is around 3,480 tonnes per year.

- **Agro residue:** Agro residue is used as fuel by four units and these units consume around 8,100 tonnes of agro residue per year. Out of these four, three are textile units (5,100 tonnes per year) and one is a food processing unit (3,000 tonnes per year).

Figure 53: Fuel usage in South Gurugram



Source: CSE 2019–2020 (based on the data provided by HSPCB)

2.2 North Gurugram Industrial Area

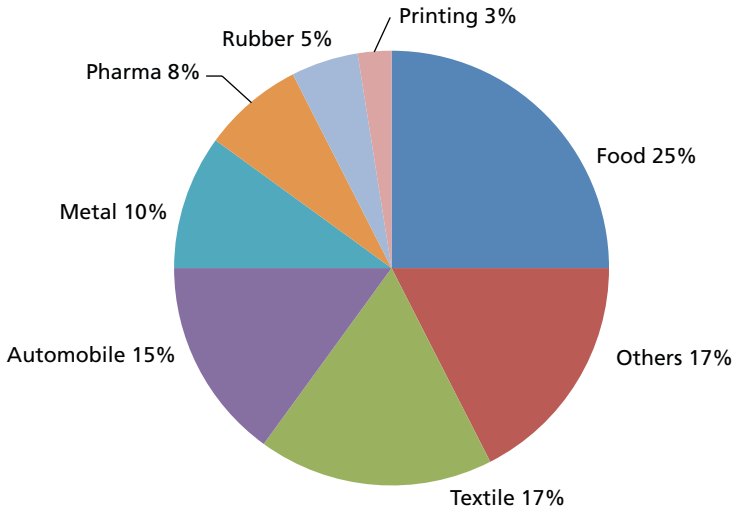
In North Gurugram, industries are located in Nuh, Mewat, Bhondsi, and Sector-18. As per HSPCB, there are about 40 air polluting industries in North Gurugram. The major industrial sectors include food processing (25 per cent), textile (17 per cent), automobiles (15 per cent), and metal (10 per cent).

Table 54: Sector-wise details of the industries in North Gurugram

Type of industry	Nuh	Bhondsi	Mewat	Sector-18	Total
Textile	2	1	3	1	7
Food processing	1	2	5	2	10
Metal	4				4
Automobile	1			5	6
Others	5		1	4	10
Pharmaceutical	2	1			3
Total	15	4	9	12	40

Source: CSE 2019–2020 (based on the data provided by HSPCB)

Figure 54: Industrial sectors in North Gurugram



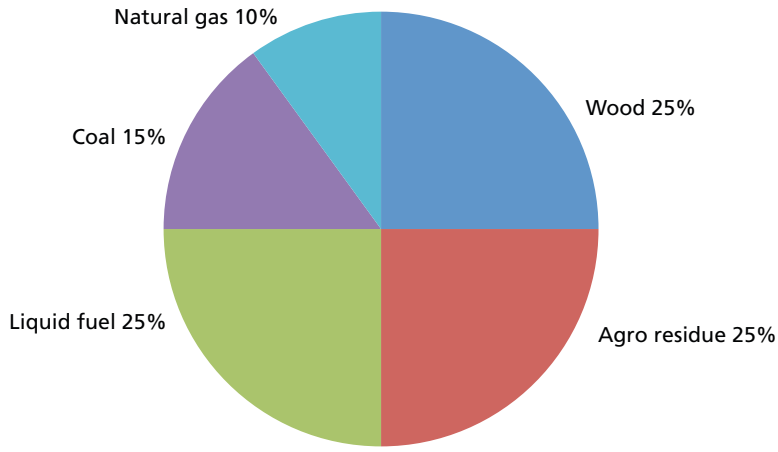
Source: CSE 2019–2020 (based on the data provided by HSPCB)

Fuel usage in North Gurugram Industrial Area

Majority of industries in this area are using wood (25 per cent), liquid fuel (25 per cent) and agro residue (25 per cent) as fuel. Fifteen per cent of the industries are using coal and 10 per cent are using natural gas as a fuel.

- **Wood:** Ten units are using wood as a fuel; 5,820 tonnes of wood is consumed per year in this area.
- **Agro residue:** Ten units are using agro residue as a fuel; three textile units, four food units, two pharmaceutical units, and one rubber unit. About 22,938 tonness of agro residue is consumed per year.
- **Coal:** Six units are using coal as a fuel. About 6,225 tonnes of coal is consumed per year.
- **Liquid fuel**: Ten units are using 1,464 tonnes of liquid fuel per year.
- **Natural gas:** Only three units use 8,616 tonnes of natural gas per year.

Figure 55: Fuel usage in North Gurugram



Source: CSE 2019–2020 (based on the data provided by HSPCB)

3. Estimation of pollution load

The key indicator for assessment of air pollution in any area is the loading of pollutants into the ambient environment from different sources in the area. Under this study the pollution load is estimated for three main pollutants—PM, SO_2, and NO_X from industrial sources.

The methodology followed for estimation of the pollution load has been discussed in the first chapter of this report.

3.1 Baseline data for estimating pollution load for Gurugram

There are 125 air polluting industries in Gurugram. Total fuel consumption in the industrial areas of Gurugram is given in the table below.

Table 55: Quantity of fuel used in Gurugram industrial cluster (in tonnes per year)

Industrial area	Fuel (in tonnes per year)				
	Coal	Wood	Agro-based	Liquid fuel	Natural gas
South Gurugram	31,926	3,480	8,100	45,953	2,158
North Gurugram	6,225	5,820	22,938	1,059	8,617
Total	38,151	9,300	31,038	47,012	10,775

Source: CSE 2019–2020

3.2 Pollution loading from industrial areas of Gurugram

South Gurugram Industrial Area contributes 73 per cent to the overall PM load of the cluster while North Gurugram Industrial Area has 23 per cent share in the total PM load.

Table 56: Pollution load estimation for Gurugram industrial cluster

Industrial area	Pollutant (tonnes per year)						Avg. % share in total loading
	Controlled			Uncontrolled			
	PM	SO_2	NO_X	PM	SO_2	NO_X	
South Gurugram	274	399	376	619	1,881	585	81%
North Gurugram	105	83	115	226	83	120	19%
Total	379	482	491	845	1,964	705	

Source: CSE 2019–2020

Overall controlled PM load is approximately 45 per cent of the uncontrolled PM load, whereas controlled SO_2 is 25 per cent of the uncontrolled SO_2.

3.3 Sector-wise pollution load estimation

The annual consumption of fuel for each industrial sector is calculated from the data available. Accordingly, the pollution load is estimated for sectors consuming significant quantity of fuel. Automobiles, chemicals, food processing, metals, pharmaceuticals, rubber goods, and textile processing industries are the major polluters in Gurugram.

Table 57: Annual fuel consumption in industrial sectors in Gurugram (tonnes per year)

Sector	Liquid fuel	Coal	Natural gas	Agro	Wood
Automobile	28,859	3,900	8,240		
Chemical	2,721		134		
Food processing	1,510	10,845		21,033	1,470
Metal	3,212	120	1,364		600
Others	4,283		504		4,440
Pharmaceutical	779	3,156		1,500	240
Rubber		2,400		1,050	
Textile	5,648	17,700	534	7,455	2,550
Printing		30			
Total	47,012	38,151	10,774	31,038	9,300

Source: CSE 2019–2020

Automobile, textile, and food processing industries are the major sectors contributing about 80 per cent to the total pollution load in Gurugram. However, textile industry has emerged as the main contributor to PM load with about 31 per cent share in the total load estimated.

Table 58: Pollution load—sector-wise

Sector	Avg. % share in total loading	Pollutant (tonnes per year)					
		Controlled			Uncontrolled		
		PM	SO_2	NO_x	PM	SO_2	NO_x
Automobile	33%	86	195	153	180	1,067	185
Chemicals	3%	7	17	13	13	98	14
Food processing	21%	105	81	115	253	131	141
Metal	4%	10	23	18	19	117	20
Miscellaneous	7%	26	40	40	34	155	40
Pharmaceutical	4%	19	16	21	47	50	39
Rubber	3%	12	8	12	32	17	17
Textile	26%	113	101	124	267	329	230

Source: CSE 2019–2020

4. Findings and recommendations

- **Textile, food processing, and automobile industries contribute about 80 per cent to the overall pollution load in the cluster**. These sectors need upgrades and improvements of technology used, more efficient fuel usage, higher efficiency of air pollution control technology, and better overall resource management.

- **South Gurugram Industrial Area contributes about 81 per cent to the overall pollution load**.

- **More than 70 per cent of the industries in the cluster are using liquid fuel (HSD and diesel), coal, and wood**. Only **nine per cent of the total industries have switched to PNG**.

- At present, only about **11 per cent of the industries are using agro residue as fuel**. More agro residue waste should be used in industries. Since it will result in reduced emissions into the ambient air, industries will not be required to shut down during the period when air quality becomes acute. The foremost advantage is that this may avoid uncontrolled stubble burning.

5. Action plan for industrial air pollution in Gurugram

Sr. no.	Action points	Agency responsible	Current status
Industry			
1.1	Pollution abatement study to be conducted for South Gurugram and specifically for textile and printing units. Detailed study will help in identifying the potential areas to improve the environmental profile of the sector and reduce the overall load of the area.	HSPCB	South Gurugram contributes about 81 per cent of the total pollution loading. The textile sector contributes about 26 per cent of the total load.
1.2	Industries should refrain from using fuel oil in order to reduce sulphur loading.	Industries, local industrial associations	A significant number of industries are using fuel oil, which has a very high sulphur content of about three per cent.
Regulatory aspect			
1.3	HSPCB should conduct surprise inspections of the industries and take stringent actions against the industries found non-complying.	HSPCB	
Infrastructure and waste management			
1.4	A survey of the area should be conducted to assess the requirement for construction of roads and maintenance.	HSIIDC	
1.5	Provide proper waste management plan for non-hazardous industrial waste. Explore opportunities for establishing a proper waste disposal facility depending upon the quantum of waste generated.	HSPCB, technical agencies/ stakeholders	
1.6	Individual industries should take the onus of maintaining areas and cleaning roads just outside their premises by maintaining green belts.	Industries and local industrial associations	

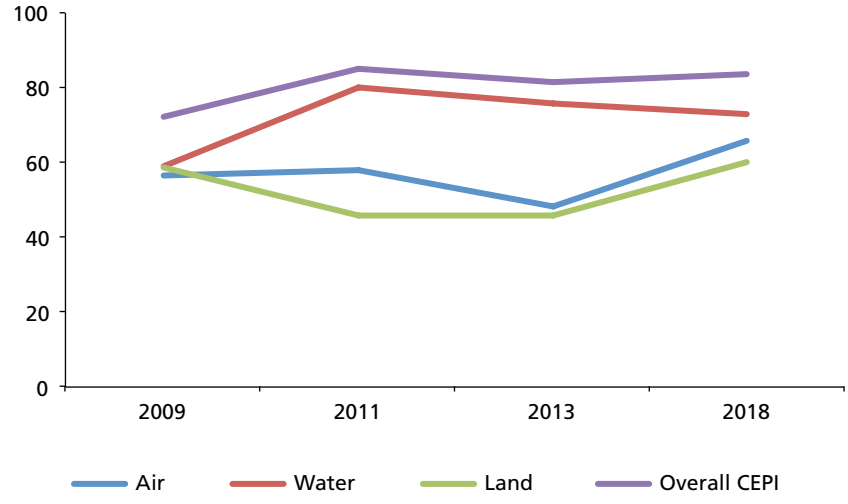
VI. Panipat district

Contents

1. Environmental profile of Panipat

The Panipat district was identified as a critically polluted area in 2009 by CPCB. In 2010, the Ministry of Environment, Forest and Climate Change (MoEF&CC) imposed a moratorium on any new project development in Panipat. At that time, the overall CEPI score of the area was 71.91. This ban was lifted in 2011 after HSPCB gave assurance that they are assessing measures to control pollution and have initiated a pollution monitoring exercise. Subsequently in September 2013, MoEF&CC re-imposed the moratorium on Panipat as the action plans/measures executed between 2010 and 2013 were insufficient. The overall CEPI score of Panipat had risen from a little over 70 in 2009 to 81.27 in 2013 (see *Figure 56: Trend—CEPI score*). The overall CEPI score has further risen to 83.54 in 2018. The CEPI air score has also risen sharply from 48.25 in 2013 to 66 in 2018, raising concerns about the increasing air pollution. Panipat stood in the eleventh spot among the top 100 polluted industrial clusters across the country.

Figure 56: Trend—CEPI score



Source: CSE 2019–2020 (based on data from CPCB)

2. Profile of Panipat industrial cluster

Panipat district has a total of 850 industries, out of which 231 are air polluting industries, according to the data from HSPCB. The data also revealed that there are around 112 brick kilns in the district and around 29 commercial units which basically consist of hotels, hospitals, etc. Textile/fabric units constitute 75 per cent of the total air polluting units. Woollen material, carpets, and other garments are processed in these units.

According to the Ministry of Micro, Small and Medium Enterprises (MSME), there are six main industrial areas in Panipat—1. Industrial Area, Panipat; 2. Sector-25 Phase-I & II, Haryana Urban Development Authority (HUDA); 3. Sector-29 Phase-I, HUDA; 4. Sector-29 Phase-II, HUDA; 5. HSIIDC Samalkha; 6. Israna (see *Map 7: Industrial areas—Panipat*). Some other smaller industrial areas are Bapoli, Madlauda and Sanoli Road. Industrial areas in Panipat are located in close proximity. Large industries are very few in number. The most number of air polluting industries are in Sector-29 Phase-II, HUDA.

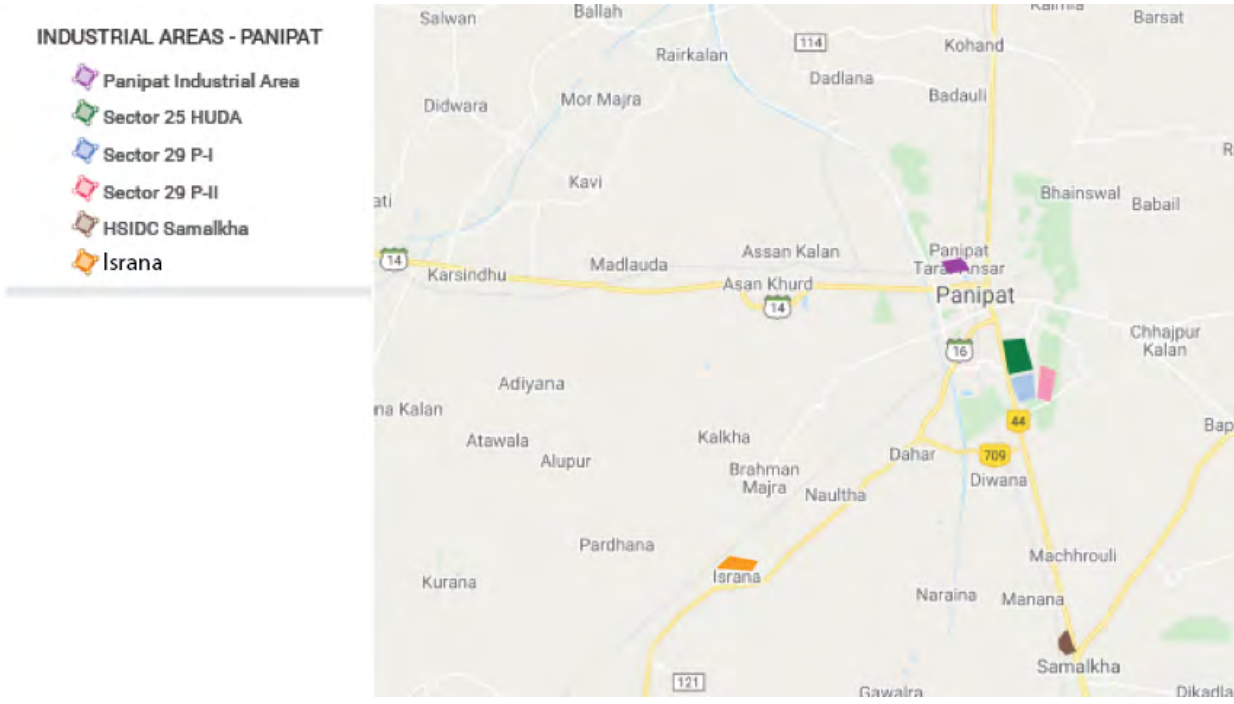
Table 59: Area-wise industrial data of Panipat

Industrial area	Total no. of industries
Bapoli	14
HSIIDC, Samalkha	18
Industrial Area Panipat	56
Israna	27
Madlauda	10
Sanoli Road	11
Sector-25 Phase-I & Phase-II, HUDA	6
Sector-29 Phase-I, HUDA	14
Other	1
Sector-29 Phase-II, HUDA	74
Total	231

Source: HSPCB, analyzed by CSE, 2020

Map 7: Industrial areas—Panipat

Industrial areas are more closely placed



Source: MSME, prepared by CSE, 2020

The textile sector is the most dominant sector in the district followed by metal and food processing industries (see *Table 60: Sector-wise industrial data of Panipat district*).

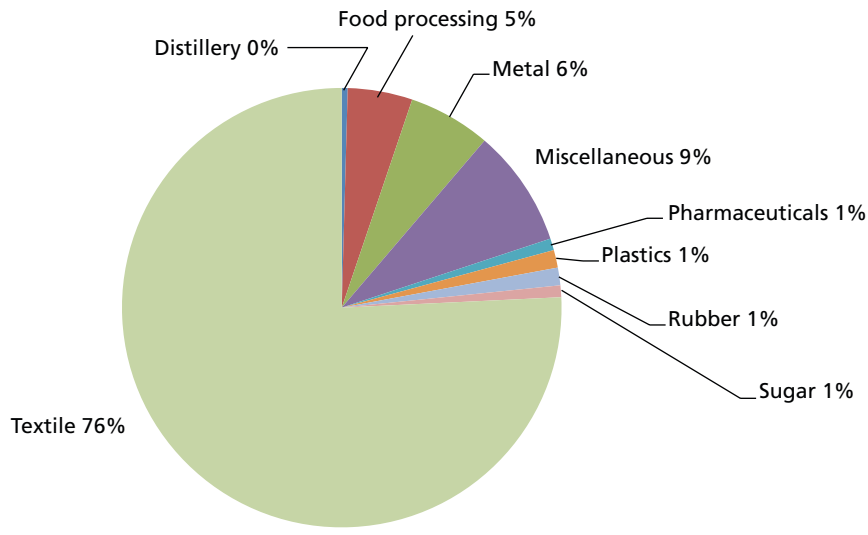
Table 60: Sector-wise industrial data of Panipat district

Sector	Total no. of industries
Distillery	1
Food processing	11
Metal	14
Miscellaneous	20
Pharmaceuticals	2
Plastics	3
Rubber	3
Sugar	2
Textile	175
Total	231

Source: HSPCB, analyzed by CSE, 2020

The miscellaneous category comprises of oil refinery, packaging, paint, fertilizer, cement products, etc. These are very few in number and scattered in different industrial areas of the district.

Figure 57: Share of industrial sectors in Panipat district



Source: HSPCB, analyzed by CSE, 2020

Combustion equipment capacity in Panipat cluster

The major combustion equipments being used in the district are furnaces, boilers and TFHs (see *Table 61: Number and capacity ranges of industrial combustion equipment*).

Table 61: Number and capacity ranges of industrial combustion equipment

Industrial combustion equipment in Panipat					
Boiler		**Furnace**		**TFH**	
Capacity range (in tonnes per hour)	**Number**	**Capacity Range (in tonnes per hour)**	**Number**	**Capacity Range (in lakhs Kcal/ hr)**	**Number**
Up to 3	118	Below 3	9	Below 5	9
3 to 10	33	3 to 10	1	5 to 10	10
Above 10	4	Above 10	3	Above 10	12
Total	156	Total	13	Total	31

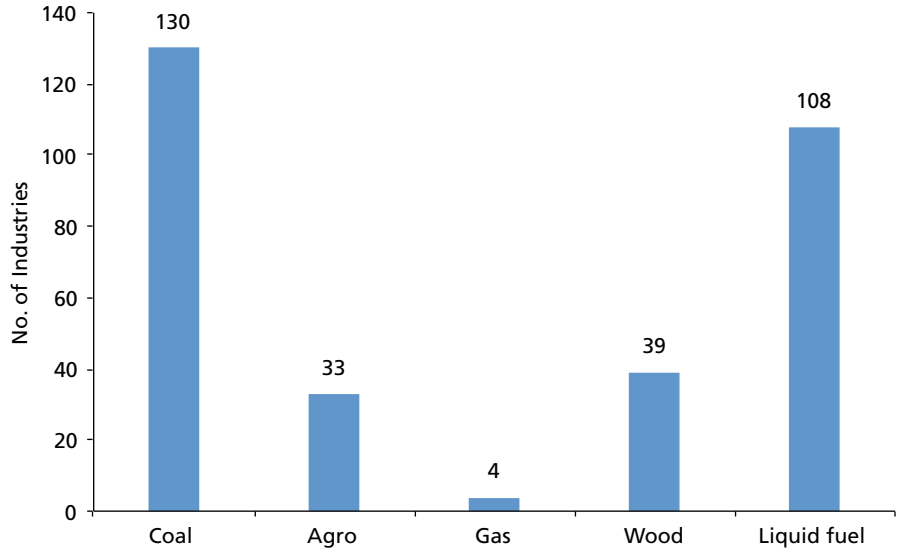
Source: HSPCB, analyzed by CSE, 2020

Boilers are the most used combustion equipment in the whole district and the majority of the boilers being used have a capacity of less than 3 TPH (small and baby boilers).

Fuel usage in the Panipat cluster

Out of 231 air polluting industries, 130 industries used coal as a fuel, 33 industries used agro-based fuel, 39 industries used wood as a fuel, four industries used gas as a fuel (two in Bapoli and one each in Israna and Madlauda). Liquid fuel is being used by 108 industries in the district but mostly to operate DG sets.

Figure 58: Fuel usage by industries in Panipat



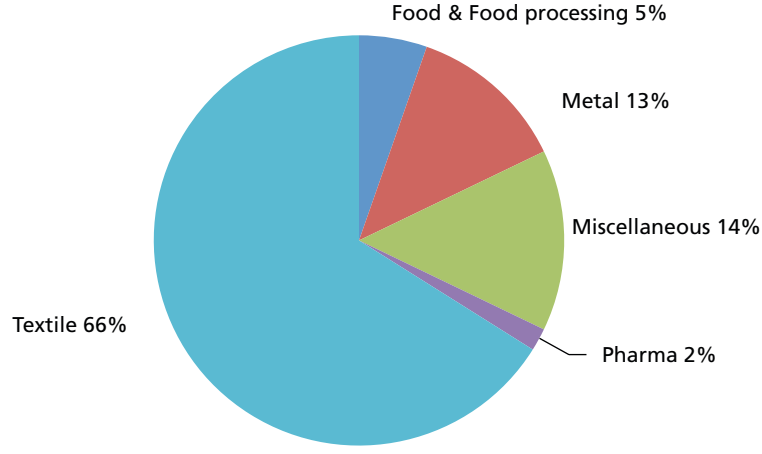
Source: HSPCB, analyzed by CSE, 2020

The largest coal user in Panipat is the Panipat thermal power station. It maintains a coal reserve of 0.287 million tonnes at its premises and uses around 8,000 tonnes per day (2,920 kilo tonnes per annum) according to the Central Electricity Authority. However, in this study, the Panipat thermal power station has been left out of the pollution load calculation to focus on other major industries which need to be worked upon for air pollution abetment.

2.1 Industrial Area Panipat

There are 56 air polluting industries in this area. Textile is the major industry in this area with 37 units. Metal, food processing, and some miscellaneous industries are also present in the area (see *Figure 59: Share of Industrial sectors in Industrial Area Panipat*).

Figure 59: Share of Industrial sectors in Industrial Area Panipat

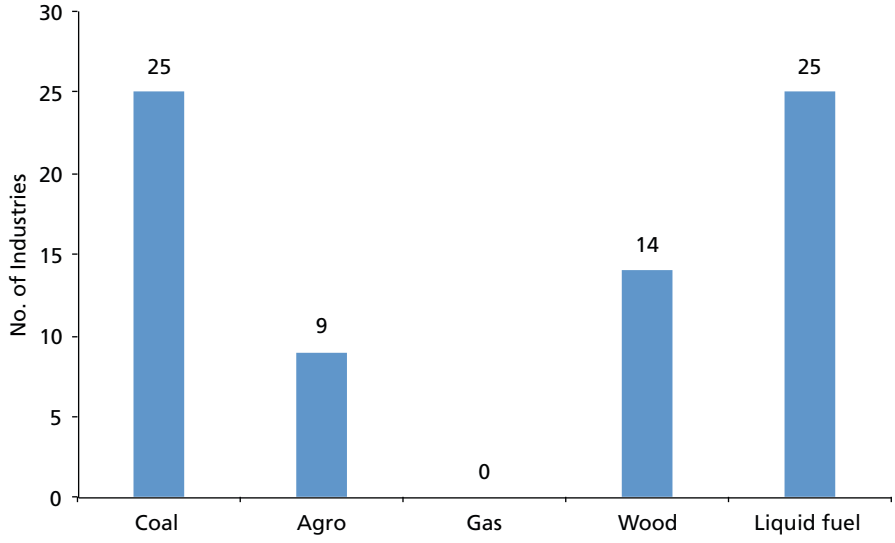


Source: HSPCB, analyzed by CSE, 2020

Fuel Usage in Industrial Area Panipat

Coal is used by 25 industries in the area. The 25 industries which are using liquid fuel are using it to operate DG sets. Apart from that, 14 industries are using wood as a fuel and nine industries are using agro-based fuel (see *Figure 60: Fuel usage by industry in Industrial Area Panipat*). There are cases of multiple fuel usage in a single industry as well.

Figure 60: Fuel usage by industry in Industrial Area Panipat

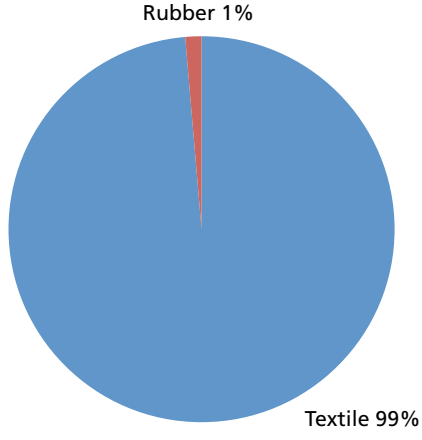


Source: HSPCB, analyzed by CSE, 2020

2.2 Sector 29 Phase-II, HUDA Industrial Area

This is the largest industrial area of Panipat district with most number of air polluting industries. There are a total of 74 air polluting industries in this area. Out of these 74 units, 73 are textile-based units and just one is a rubber-based unit (see *Figure 61: Share of industrial sectors in Sector 29 Phase-II, HUDA Industrial Area*).

Figure 61: Share of industrial sectors in Sector 29 Phase-II, HUDA Industrial Area

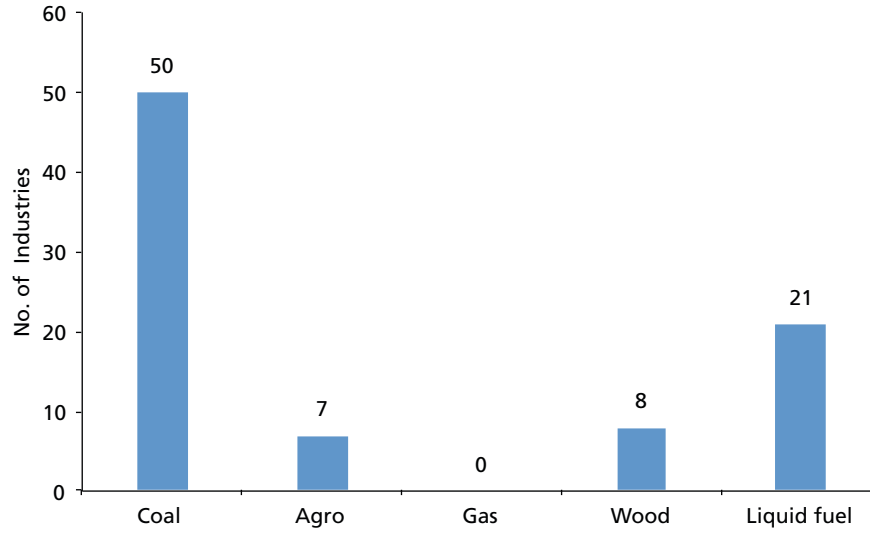


Source: HSPCB, analyzed by CSE, 2020

Fuel Usage in Sector 29 Phase-II, HUDA Industrial Area

Coal is used by 50 industries in the area. The 21 industries which are using liquid fuel are using it to operate DG sets. Apart from that, eight industries are using wood as a fuel and seven industries are using agro-based fuel (see *Figure 62: Fuel usage by industry in Sector 29 Phase-II, HUDA Industrial Area*). There are cases of multiple fuel usage in a single industry as well.

Figure 62: Fuel usage by industry in Sector 29 Phase-II, HUDA Industrial Area

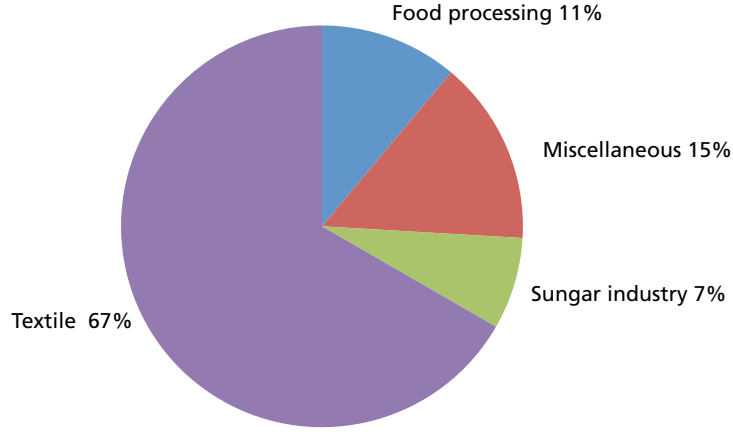


Source: HSPCB, analyzed by CSE, 2020

2.3 Israna Industrial Area

There are a total of 27 air polluting industries in this area. Out of these 27 units, 18 are textile-based units, along with two sugar factories, three food processing units, and four other miscellaneous industries (see *Figure 63: Share of industrial sectors in Israna Industrial Area*).

Figure 63: Share of industrial sectors in Israna Industrial Area



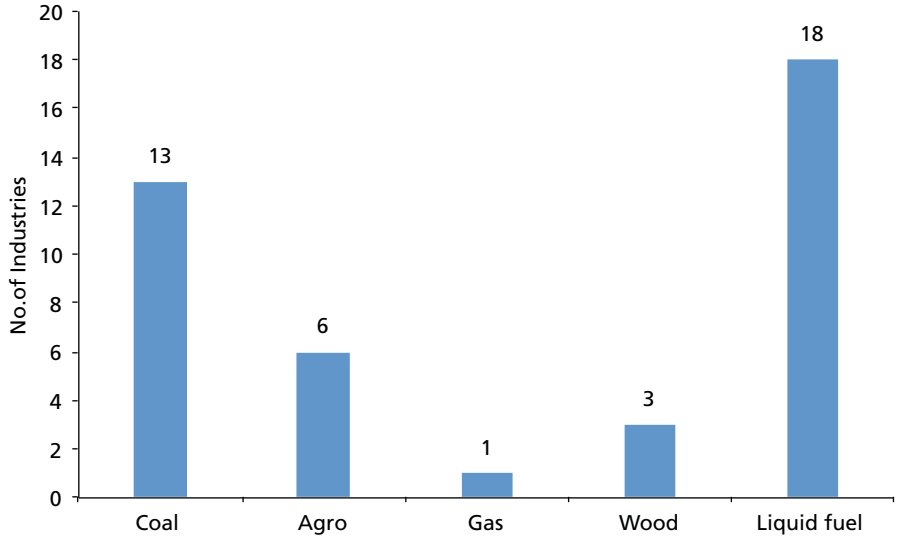
Source: HSPCB, analyzed by CSE, 2020

Fuel Usage in Israna Industrial Area

Around 13 out of 27 industries use coal in the area. The 18 industries which are using liquid fuel are using it to operate DG sets. Apart from that, three industries are using wood as a fuel and six industries are using agro-based fuel (see *Figure 64: Fuel usage by industries in Israna Industrial Area*). The sugar factories in the area are major fuel consumers (agro, wood, and gas) of the whole district. There are cases of multiple fuel usage in a single industry as well.

Figure 64: Fuel usage by industries in Israna Industrial Area

Coal is a major fuel in the area, liquid fuel is being used for DG sets

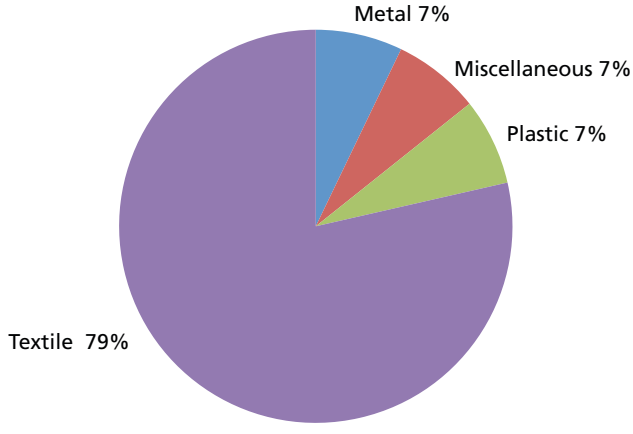


Source: HSPCB, analyzed by CSE, 2020

2.4 Bapoli Industrial Area

There are a total of 14 air polluting industries in this area. Out of these 14 units, 11 are textile-based units, along with one unit each of chemical, metal, and plastics (see *Figure 65: Share of industrial sectors in Bapoli Industrial Area*).

Figure 65: Share of industrial sectors in Bapoli Industrial Area

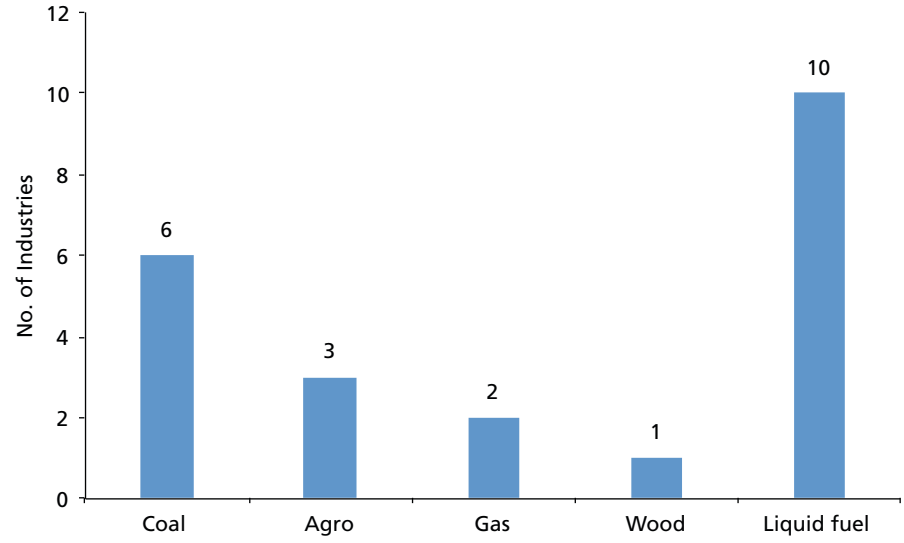


Source: HSPCB, analyzed by CSE, 2020

Fuel Usage in Bapoli Industrial Area

Out of 14, six industries are using coal, three are using agro-based fuel, two are using gas and one is using wood as a fuel. The 10 industries which are using liquid fuel are using it to operate DG sets. There are cases of multiple fuel usage in a single industry as well.

Figure 66: Fuel usage by industries in Bapoli Industrial Area



Source: HSPCB, analyzed by CSE, 2020

3. Estimation of pollution load

The key indicator for assessment of air pollution in any area is the loading of pollutants into the ambient environment from different sources in the area. Under this study the pollution load is estimated for three main pollutants—PM, SO_2, and NO_X from industrial sources. The methodology followed for estimation of the pollution load has been discussed in the first chapter of this report.

3.1 Baseline data for estimating pollution load for Panipat District

Sector 29 Phase-II, HUDA Industrial Area consumes the most amount of coal in the whole district, followed by the industries in Israna and Sanoli Road industrial areas. Israna Industrial Area is also the largest consumer of agro-based fuel, wood, and gas whereas Bapoli Industrial Area is the largest consumer of liquid fuel.

Table 62: Quantity of fuel used in Panipat industrial cluster (in tonnes per year)

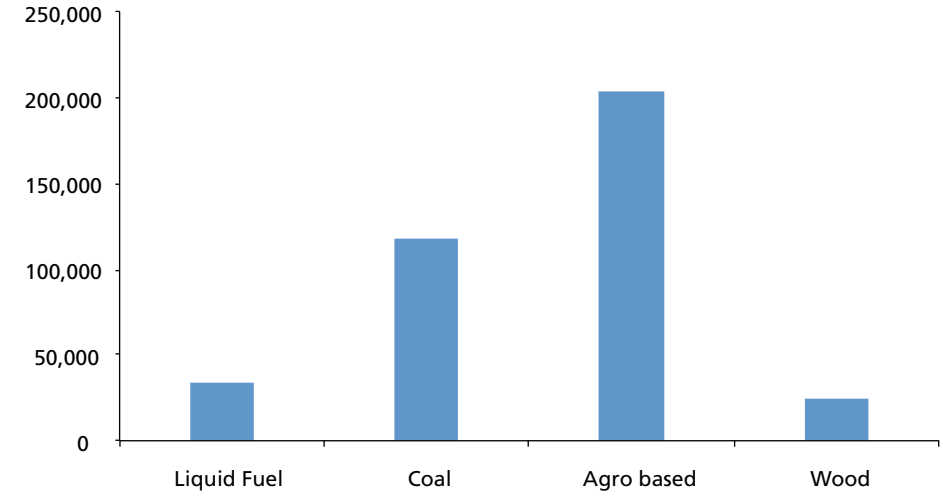
The maximum amount of coal is being consumed in Sector-29 Phase-II. HUDA Industrial Area

Industrial area	Fuel (in tonnes per year)				
	Liquid fuel	Coal	Agro-based	Wood	Gas
Bapoli	17,122	10,065	2,475	1,320	2
HSIIDC, Samalkha	574	2,533	2,170	759	-
Industrial Area Panipat	6,062	11,692	13,447	3,092	-
Israna	474	19,173	169,785	13,464	3,300
Madlauda	1,734	3,729	5,280	231	346
Other	140	990	0	-	-
Sanoli Road	339	15,371	165	-	-
Sector-25 Phase-I & II, HUDA	38	4,462	-	2,310	-
Sector-29 Phase-I, HUDA	36	5,313	2,145	330	-
Sector-29 Phase-II, HUDA	7,704	43,946	8,202	3,343	-
Total	34,223	117,274	203,669	24,849	3,648

Source: HSPCB, analyzed by CSE, 2020

Figure 67: Total fuel usage in Panipat district (by type, in tonnes per year)

More than two lakh tonnes of agro-based fuel is consumed annually



Source: HSPCB, analyzed by CSE, 2020

3.2 Pollution loading from industrial areas of Panipat district

Israna Industrial Area contributes the maximum (36 per cent) to the overall pollution load (including PM, SO_2, and NO_X) of the cluster, followed by Sector-29 Phase-II, HUDA Industrial Area (23 per cent), Bapoli Industrial Area (14 per cent) and Industrial Area Panipat (11 per cent). The reason behind the large share of Israna Industrial Area is the two sugar factories in the area.

Table 63: Pollution load estimation for Panipat industrial cluster

Industrial cluster	Pollutant (tonnes per year)						Avg. % share in total loading
	Controlled			Uncontrolled			
	PM	SO_2	NO_X	PM	SO_2	NO_X	
Bapoli	93	143	132	208	688	199	14%
HSIIDC, Samalkha	20	16	22	45	39	34	2%
Industrial Area, Panipat	106	102	124	243	302	175	11%
Israna	542	420	627	1,265	156	363	36%
Madlauda	33	31	38	80	89	52	3%
Other	4	3	4	11	12	11	1%
Sanoli Road	64	40	58	166	121	164	6%
Sector-25 Phase-I & II, HUDA	27	18	26	54	33	57	2%
Sector-29 Phase-I, HUDA	28	18	27	70	39	59	2%
Sector-29 Phase-II, HUDA	231	182	236	562	589	520	23%
Total	1,148	973	1,294	2,704	2,068	1,634	

Source: HSPCB, analyzed by CSE, 2020

Total uncontrolled PM load for Panipat cluster is 2,704 tonnes per year; SO_2 load is 2,068 tonnes per year and NO_X load is 1,634 tonnes per year. Controlled PM and SO_2 load is less than half of the uncontrolled PM and SO_2 load, whereas there is not as much difference between the controlled and uncontrolled loading of NO_X.

3.3 Fuel consumption in industrial sectors of Panipat district

The annual consumption of fuel for each industrial sector is calculated from the data available, considering 330 days of operation annually. The maximum amount and the majority of coal is consumed by the textile sector, more than one lakh tonnes per year. The sugar and food processing sectors are the largest consumer of agro-based fuel (1.6 lakh tonnes per year) whereas the textile sector is the largest consumer of wood as a fuel (almost 11 thousand tonnes per year).

Table 64: Annual fuel consumption in industrial sectors in Panipat cluster (tonnes per year)

Sector	Fuel (in tonnes per year)				
	Liquid fuel	Coal	Agro-based	Wood	Gas
Distillery	-	2,310	2,145	-	-
Food processing	4,623	25	14,215	429	-
Metal	17,108	5,735	-	-	-
Miscellaneous	975	3,779	5,115	9,900	-
Pharmaceutical	56	-	3,960	-	-
Plastics	31	-	165	-	-
Rubber	1,352	-	-	66	347
Sugar	-	-	16,1700	3,300	3,300
Textile	10,078	10,5425	16,369	11,154	1
Total	34,223	117,274	203,669	24,849	3,648

Source: HSPCB, analysed by CSE, 2020

3.4 Pollution loading from industrial sectors of Panipat district

Pollution loading has been calculated based on the annual fuel consumption by various sectors. The textile and sugar industries are jointly responsible for around 76 per cent of the pollution load in the district. Textile industry holds the biggest share (51 per cent) of the overall pollution load, followed by the sugar industry (25 per cent). The metal industry stands at the third place in terms of pollution load with a share of 12 per cent, followed by the food processing industry with a share of five per cent.

Table 65: Quantity of fuel used in different industrial sectors of Sonipat district (in tonnes per year)

Sector	Coal	Wood	Agro-based	Liquid fuel	Natural gas
Food	226,380	5,773	257,730	485	38,000
Textile	142,560	274,630	858	38,280	39,600
Rubber	36,796	2,772	3,300	3,260	
Others	9,980	3,960		546	
Metal	3,595	53		142,704	28,920
Plastic	1,980	3,630		495	360
Printing	1,749	462		665	131
Energy	957	5,052		2,739	
Chemical	594	4,168		202	
Paper	330	1,568		44	
Total	424,921	302,068	261,888	189,420	107,011

Source: CSE 2019–2020 (based on the data provided by HSPCB)

4. Observations and recommendations

1. **Textile and sugar industries** are the highest contributors to the pollution load. While it can be assumed that the sugar industry (which are just two units) would have air pollution control measures in place (being a large scale industry) which can be monitored from time to time, the 50 per cent contribution from textile units is from 175 industries using mostly small scale boilers which are challenging to monitor regularly.

2. **Sector 29 Phase-II HUDA, Israna, and Bapoli industrial areas** are together responsible for almost 73 per cent of the overall pollution load in the district. Therefore, these areas should specifically be focussed on to bring down the pollution load of the entire district.

3. **Action plan reports sufficient pollution control equipment in industries**: CEPI action plan report submitted by HSPCB in 2015 mentions that most factory units (373 units) have adequate devices to control air pollution. Despite which the pollution levels in the city and pollution load from the factory units are high.

4. **Inadequate capacity of regulatory bodies and infrastructure:** Only three technical staff are available in the department according to the HSPCB action plan (one scientist, one assistant environmental engineer, and one junior environmental engineer). Considering the number of polluting industries in the district, not enough time is available to inspect each industry. The Panipat office sends the samples for testing to HSPCB laboratory in Panchkula (157 km away from Panipat district). HSPCB has four laboratories to test samples—one each in Gurugram, Faridabad, Hisar, and Panchkula.

5. **Overall CEPI score is increasing:** The overall CEPI score is increasing. Particularly, the score reflecting air quality has steeply increased between 2013 and 2018. From 48.25 in 2013, the CEPI score for air has spiked to 66. This score is even higher than the score recorded in the 2009 assessment. In 2009, the CEPI score for air was 56.5 and it increased to 57.75 in 2011.

6. **Inadequate number of continuous air pollution monitoring systems:** Only one continuous air pollution monitoring system is available. Experts opine that at least three more such monitoring systems are necessary (see *Annexure 1: Continuous air pollution monitoring data of Panipat*).

Based on the observations, the following recommendations may be considered:

1. **Use of natural gas:** The key suggestion submitted in 2015 in the CEPI action plan to reduce pollution was shifting of fuel from coal to natural gas. However, half a decade has passed and there has been no transformation on the ground as it is seen as an expensive fuel due to higher taxation. The usage of natural gas in handlooms and textile industries in India started in Surat district. But the model is not spreading because:

    - **Fluctuating price:** The price of natural gas is not steady, it varies every 15 days and its price is unregulated on a daily basis. A fuel price fluctuation in the range of five to seven per cent can be borne by industrialists; however, there is even wider variation in the market.

- **Not under GST:** Natural gas is not covered under the ambit of GST. In Panipat, the industries pay 36 per cent value added tax (VAT) on natural gas: Gujarat—12 per cent at landing port, Uttar Pradesh—18 per cent at tapping point, Haryana—six per cent now (previously 12 per cent and risk remains that it can be increased/overturned by the government any time). As a result, industries pay as much as Rs 36/ standard cubic metre (SCM) in some areas while in cities like Agra, gas is priced at Rs 14/SCM. With removal of VAT, factories estimate production of steam using natural gas can be cheaper than coal.

Table 59: Cost of steam generation with various fuels

Cost difference between coal and gas is hindering fuel switch

Fuel	Price of steam in Rs/kg
Coal	1.6–1.7
Furnace oil	1.8–1.9
Natural gas	2.2–2.3
HSD/LDO	3.9–4.1

Source: Nestle Inc., 2019

Switching to natural gas in textile factories requires complete redesign of process machinery. The industrialists are willing to switch provided VAT on natural gas is removed. The demand for natural gas if all the units convert to gas would vary between five and 14 lakh SCM/day, higher than the demand of industrial units in Delhi state. Industrial units in Delhi consume 1.5 lakh SCM/day.

2. **Common boilers:** Factories are closely placed and are medium pressure using units. They prefer purchasing steam from a common industrial utility boiler in the area, like they use common effluent treatment systems. According to Thermax, a boiler utility manufacturer, techno-economically it is viable to generate and transport steam up to a two km radius. The respective state industrial zone development authorities can consider working models similar to common effluent treatment plants for utility boilers which can supply steam to industrial units. Such boilers can be equipped with the latest pollution control equipment.

3. **Use of biomass:** Coal-based industries were shut in Panipat during winter. Few coal-based industries during the winter shutdown in Panipat were experimenting use of biomass-based fuel. Biomass used in the region includes briquettes of saw dust, groundnut, and mustard. Currently, HSPCB has only PM norms for agro-based industries which is 150mg/Nm^3. Around 70–80 per cent reduction in SO_2 load is estimated, and 40–60 per cent reduction in NO_X load if coal based industries shift to biomass.

5. Industrial air pollution action plan for Panipat

Sr. No.	Action points	Responsible agencies	Timeline	Existing scenario
SECTORAL ACTIONS				
Textile industry				
1	A centralized boiler system with latest pollution control equipment has to be established for the replacement of boilers up to the capacity of three TPH: • Hire consultants/experts and come up with a feasibility and implementation plan • Conduct meeting with all stakeholders	HSPCB, HSIIDC and local industrial associations	Three months for preparation of implementation plan and stakeholder meeting immediately after that to begin implementation.	Currently there are 118 boilers with capacity up to three TPH being used in different industrial areas of the district.
2	Implementation of fuel change to natural gas (as mentioned in CEPI action plan). Following activities should be pursued to accomplish implementation: • Provision of gas pipelines and gas supply in the whole district. Submit a report on current status of gas pipeline network and connections, prepare a plan of action to complete the pipeline network. • Advocacy plan of action for bringing natural gas under GST. • Advocacy plan of action to regulate price fluctuations of natural gas. • Conduct a meeting with PNGRB for GST inclusion, control on price fluctuations and completion of pipeline network in Panipat.	HSPCB, HSIIDC & local industrial associations	- Three months for current status report on gas pipeline network and the plan of action for the completion of network. -Two months for meeting with PNGRB. -Three months for preparing an advocacy action plan for bringing natural gas under GST and to contain price fluctuations. Plan should be presented to all stake holders immediately after three months.	CEPI action plan mentions fuel switch to natural gas but till now only four factories are using natural gas. The consumption of coal as a fuel is rampant. The fluctuating prices and high cost of natural gas is making factory owners reluctant in switching fuel.
3	Submit a report on emissions profile of agriculture waste when used as a fuel in industries. Based on the results, preparation of guidelines for the use of agriculture waste as a short term alternative fuel in industries. Also submit a plan for continuous availability of agro waste in the areas along with a price regulation mechanism.	HSPCB	Three months for report on emissions profile.	Few industries in Panipat have been experimenting with agro waste as fuel during the winter shutdown. Briquettes of saw dust, ground nut, and mustard along with loose rice husk are being used.
Sugar industry				
4	Preparation of a monthly monitoring plan to keep a check on emissions of the two sugar industry units in the district.	HSPCB	Three months	The sugar industry is responsible for 25 per cent of the industrial pollution load of the whole district.

Sr. No.	Action points	Responsible agencies	Timeline	Existing scenario
Brick kilns				
5	Make an inventory of all illegal brick kilns. Mandatory conversion of all brick kilns in the district to zigzag technology with immediate effect—non-complying brick kilns should be closed.	HSPCB	Inventory in one month and immediate conversion to zigzag technology	Currently 112 registered brick kilns operate in the district. The number of illegal brick kilns is unknown.
OTHER ACTIONS				
6	Formation of a committee for the management of industrial areas which would prepare area-wise management plans for • Industrial waste management • Road quality and maintenance • Housekeeping • Plantation The committee shall also fix the responsible entities for each management plan and their schedule of implementation.	HSPCB, HSIIDC, and local industrial associations	Formation of committee in two months and preparation of area-wise management plan for all four topics within three months post the formation of the committee.	The condition of roads, waste management, housekeeping, and plantations is poor in the industrial areas. It needs to be made better to control fugitive emissions in the area.
7	Setting up of waste management facility in every industrial area for non-hazardous waste on a land allotted by HSIIDC. Conduct a feasibility study on establishing a waste to energy plant in the district.	HSPCB, HSIIDC and local industrial associations	As a part of the area-wise management plan suggested in point no. six	Rampant waste dumping was observed in the industrial areas of the district.
8	Introduction of a chargeable toll system for heavy diesel vehicles for entering different industrial areas. This would control unnecessary movement of heavy vehicles in the area thus bringing down fugitive emissions. CNG vehicles shall be exempted from the charge.	HSIIDC and local industrial associations	Within six months	The continuous movement of heavy diesel vehicles on roads with poor condition increases the PM10 levels in the area immensely.
9	Increasing the capacity of regional offices of pollution control board by: • Hiring more technical personnel • Strengthening the capacity of their labs and equipment • Conducting trainings for their employees • Involvement of credible third parties for monitoring of industries	HSPCB	Hiring and strengthening of labs in six months and conducting at least five training programmes annually.	Currently there are just three technical staff in the regional office which is far too less to inspect and monitor 540 factories in the district.

VII. Sonipat district

Contents

1. Environmental profile of Sonipat

Sonipat has four major industrial clusters spread across 2,140 acres. HSIIDC is responsible for the development and management of the industrial areas. Development of industrial areas includes development and management of roads, power, street light, water supply, drainage, etc., along with provisions of basic social infrastructure.

As per the study carried out by IQ Air Visual and Greenpeace, Sonipat has $PM_{2.5}$ levels at 80 µg/m^3.

Table 60: Ranking & $PM_{2.5}$ conc. of most polluted cities in the world in comparison to Sonipat

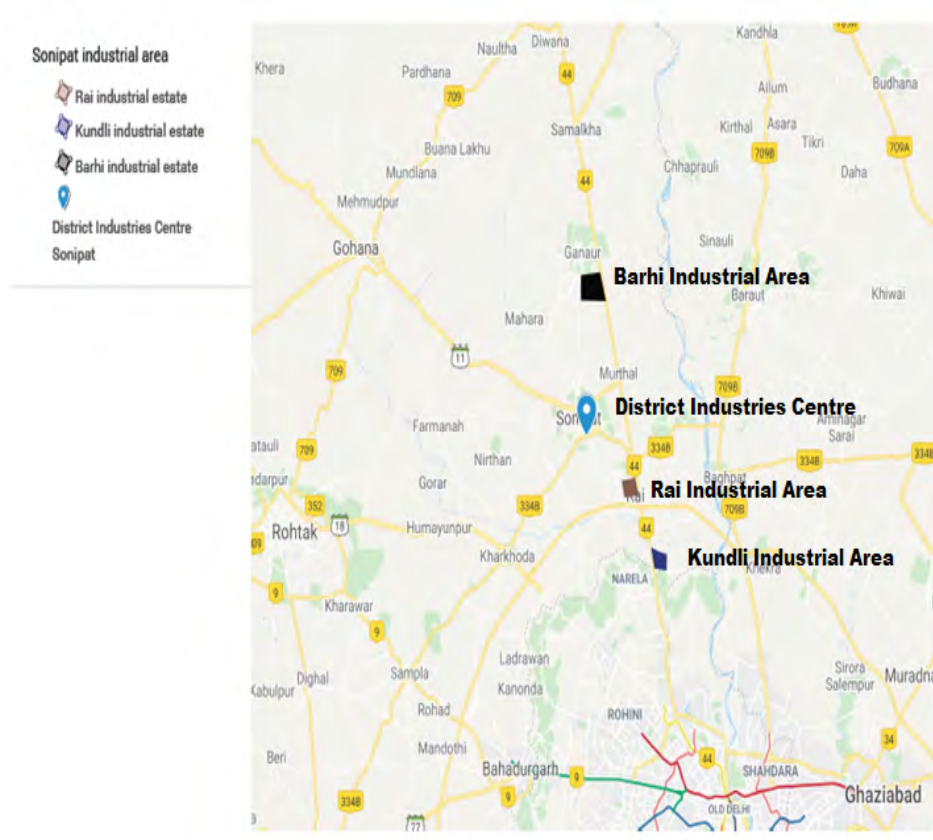
Sr. No.	City name	$PM_{2.5}$ Concentration (µg/m^3)	
		2017	2018
1.	Gurugram, India	145.6	135.8
2	Ghaziabad, India	144.6	135.2
3	Faisalabad, Pakistan		130.4
4	Faridabad, India	123	129.1
5	Bhiwadi, India		125.4
	Sonipat, India		80
CPCB Standard for $PM_{2.5}$ (µg/m^3)—60 µg/m^3 annually			

Source: World Air Quality Report $PM_{2.5}$ Ranking.[40]

2. Profile of Sonipat industrial cluster

As per the data shared by HSPCB, there are 450 industries in the Sonipat industrial cluster, although this assessment considers the data of only 390 industries as the data for the rest of the industries was not shared by HSPCB. Out of the 390 industries, 26 per cent of the factories process textiles (largely knitting units and a few dyeing units), 18 per cent are food and agro-processing units, 14 per cent are metal processing units (mostly polishing/surface treatment, and metal extraction), eight per cent are plastic industries, seven per cent each are rubber and chemical industries, five per cent energy generating units (lead acid battery manufacturing and pyrolysis units), four per cent printing industries, and the remaining two per cent are paper industry.

Map 8: Location of Sonipat industrial cluster



Source: Prepared by CSE, 2020

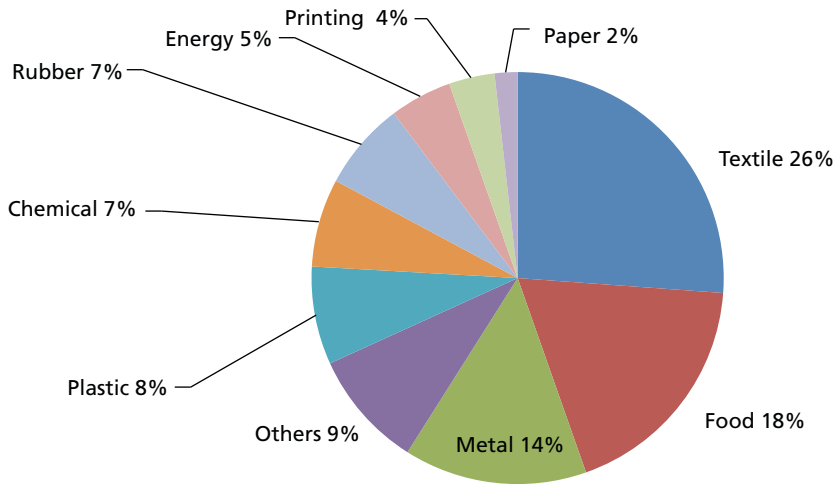
Industries located in DIC area are a mix of textile, food, metal, chemical, rubber, paper, and energy generating units (lead acid battery manufacturing and pyrolysis). Rai Industrial Area, which is closer to Delhi, has predominantly food processing units. Similarly Kundli Industrial Area, which is close to Delhi (Narela) as well, has metal, textile, and plastic processing units in large numbers. Barhi Industrial Area is on the outskirts of Sonipat and closer to Panipat. This area has a large number of textile knitting and dye units—probably due to the influence of the Panipat industrial areas which are dominated by textile units.

Table 61: Industrial sectors and their numbers in the industrial areas of Sonipat

Industry—category	Barhi	DIC*	Kundli	Rai	Total
Textile	82	6	13	1	102
Food	7	38	5	22	72
Metal	5	29	16	6	56
Others	4	20	8	4	36
Plastic	7	13	8	2	30
Chemical	5	13	4	5	27
Rubber	3	15	1	8	27
Energy	2	15	2		19
Printing	2	2	7	3	14
Paper		6		1	7
Total	117	157	64	52	390

*Units whose industrial estates are not mentioned are assumed to be under DIC area.
Source: Data from HSPCB, analysis by CSE, 2019–2020

Figure 68: Industrial sectors in Sonipat cluster

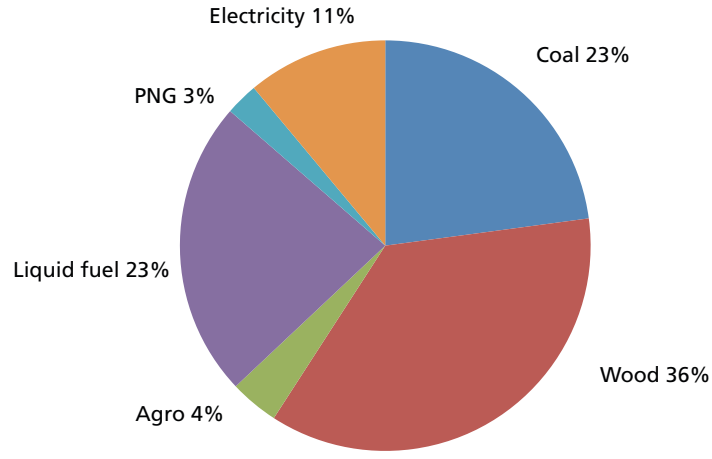


Source: Data from HSPCB, analysis by CSE, 2019–2020

Fuel usage in the cluster

Fuel is mainly used in boilers for steam generation or in Thermopacks for heating. Some industries also have furnaces for heating and melting. Most industries are at Barhi and DIC industrial areas, 60–80 per cent of the units in these industrial areas use solid fuel—largely wood and coal. In Kundli and Rai industrial areas, 50 per cent of the factories use solid fuel. Diesel is the second most preferred fuel in the whole district. Only 11 units use PNG/natural gas in Sonipat.

Figure 69: Fuel usage in Sonipat industrial cluster



Source: Data from HSPCB, analysis by CSE, 2019–2020

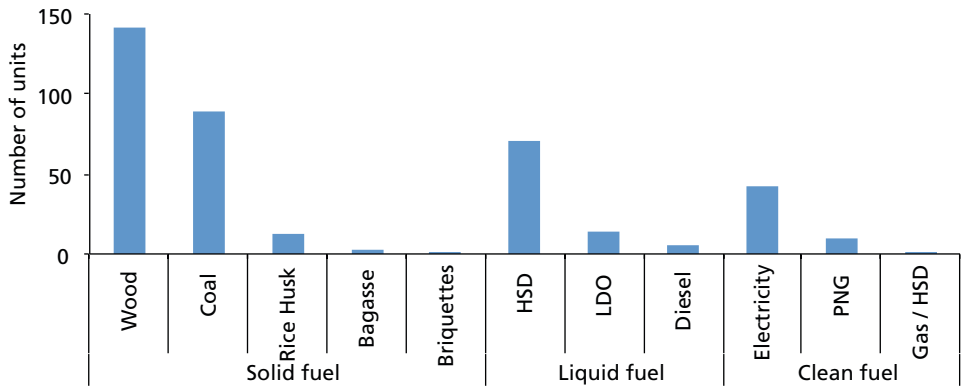
Table 62: Fuel usage in industries in Sonipat industrial cluster

Fuel category	Barhi	DIC	Kundli	Rai	Total
SOLID FUEL					
Wood	52	58	16	16	141
Coal	43	30	13	3	89
Rice husk	2	7	2		12
Briquettes	1				1
Bagasse		2			2
Total	98	97	31	19	245
LIQUID FUEL					
HSD	16	31	14	8	71
LDO		7	6	1	14
Diesel		2	3	2	6
Total	16	40	23	11	91
GAS/CLEAN FUEL					
Electricity	3	15	8	17	43
PNG		4	2	5	10
Gas/HSD		1			1
Total	3	20	10	22	54
Total Units	117	157	64	52	390

Source: Data from HSPCB, analysis by CSE, 2019–2020

M/s GAIL signed an agreement in 2008 with PNGRB to build infrastructure and distribute natural gas in Sonipat. The agreement has a validity of 25 years. According to GAIL's corporate brochure they have signed 36 gas sales agreements with industries in Sonipat, but thus far only 11 units are using gas as a fuel.

Figure 70: Fuel usage in industrial areas of Sonipat district

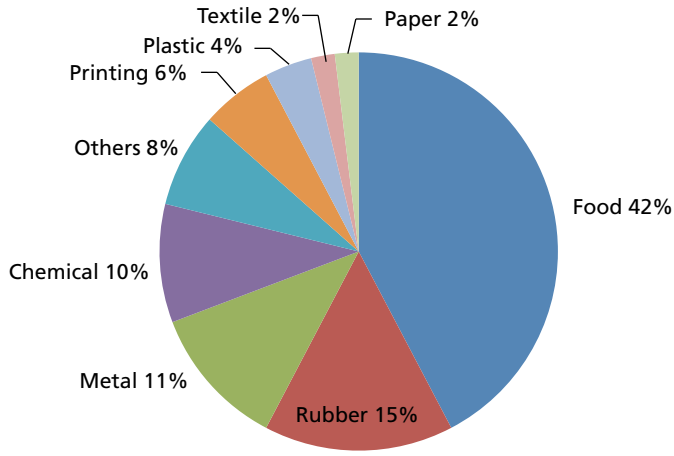


Source: Data from HSPCB, analysis by CSE, 2019–2020

2.1 Rai Industrial Area

It is located near Eastern Peripheral expressway of Delhi. As per HSPCB, there are 52 factories operating in the area, most of which are food processing units—22 units process food like dal, milk, baked goods, and confectionary. There are eight rubber units, six metal units (surface treatment and metal extraction), and five chemical units. Apart from this, there are printing, plastic, textile and other types of industries in the area as well.

Figure 71: Industrial sectors in Rai Industrial Area



Source: Data from HSPCB, analysis by CSE, 2019–2020

Fuel usage in Rai Industrial Area

Out of the 52 industries, 32 per cent are using electricity as a fuel, 30 per cent are using wood, 23 per cent are using liquid fuel, nine per cent are using natural gas, and only six per cent are using coal.

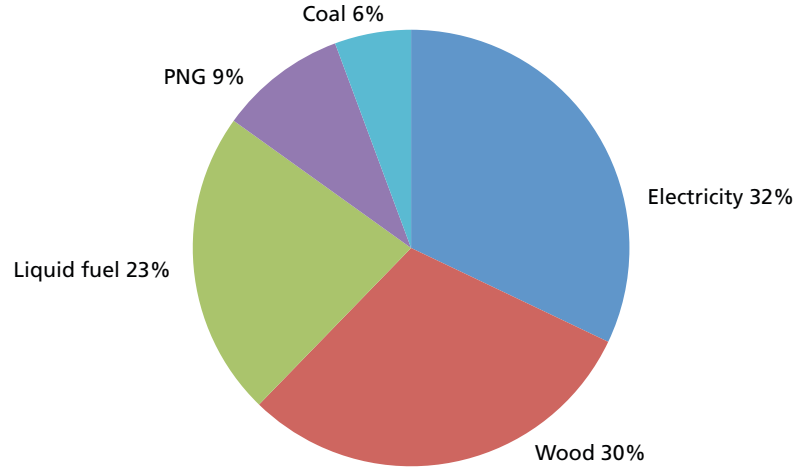
1. **Coal:** Coal is used by three units—Arihant Technopack Pvt. Ltd (printing), Forech Mining and Construction International LLP (rubber processing), and Northland Rubber Mills (manufacturers of conveyor belts). Cumulatively, they use about 8.5 tonnes of coal/day.

2. **Wood**: Wood is used as fuel by 16 units—seven are rubber processing, six are food processing, and the rest are paper and chemical processing units. The consumption mostly varies between 0.2 and 0.8 tonnes per day. Total wood consumption in the area was 7.23 tonnes of wood/day.

3. **Liquid fuel:** Twelve industrial units use diesel as fuel—3.72 tonnes per day. Out of these 12 units, four are food processing units, two each are chemical, metal and printing units, three metal and and one is a plastic unit.

4. **Clean fuel:** A.S. Industries which process leather materials for footwear and other products use significant quantity of PNG—120 tonnes per day; and Bikanervala Foods Pvt. Ltd use 113 tonnes of PNG per day. The other three units that use PNG consume less than one ton of PNG per day. Apart from this, seventeen units use electricity.

Figure 72: Fuel usage in Rai Industrial Area

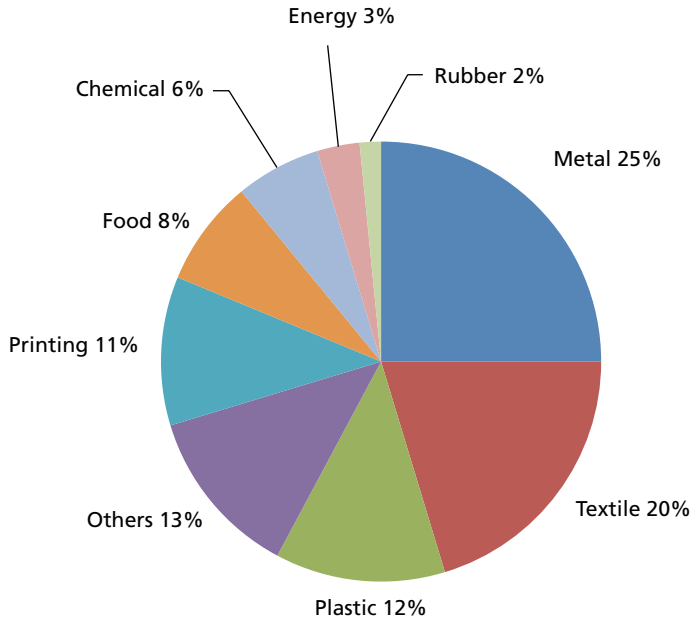


Source: Data from HSPCB, analysis by CSE, 2019–2020

2.2 Kundli Industrial Area

Kundli Industrial Area is near Narela. According to HSPCB, there are about 64 industries in this area. Majority of the factories in the area process consumables—20 per cent process textiles, 25 per cent metal, 12 per cent plastic, and 11 per cent are printing units. Most of them are small and medium-scale units.

Figure 73: Industrial sectors in Kundli Industrial Area



Source: Data from HSPCB, analysis by CSE, 2019–2020

Fuel usage in Kundli Industrial Area

Only two units are energy intensive—Universal Knitwears and Sterling Agro Industries Ltd. Most common fuel used in this area is liquid fuel, wood, and coal with shares of 36 per cent, 25 per cent, and 20 per cent respectively.

1. **Coal**: Thirteen units use around 14.5 tonnes of coal per day in the area.

2. **Wood**: Sixteen factories use around 10.55 tonnes of wood per day in this area.

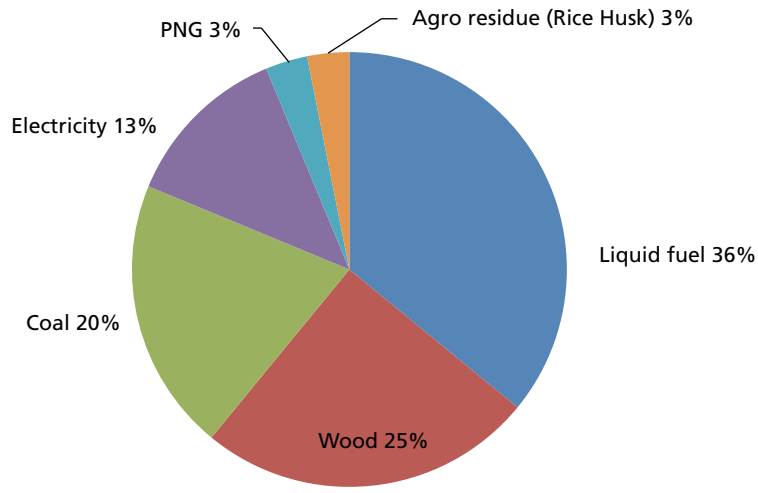
3. **Rice husk**: Sterling Agro Industries Ltd (a milk processing factory) and Kannu Aditya (India) Ltd use around 51 tonnes of rice husk per day as fuel. Out of the 51, Sterling alone uses 43 tonnes.

4. **Liquid fuel**: Twenty-three factories use 119 tonnes of HSD per day. Universal Knit Wears, a textile processing unit, uses about 130 kl of diesel per day. Rest of the units in the area consume less than one kl of diesel per day.

5. **PNG**: Only two units use about 0.425 tonnes of PNG per day: Shruti Packaging Solutions—a gravure and digital printing company; and Parveen Industries Pvt. Ltd—a metal processing unit.

6. **Electricity**: Eight industrial units use only electricity as fuel. These are mostly metal processing industrial units.

Figure 74: Fuel usage in Kundli Industrial Area

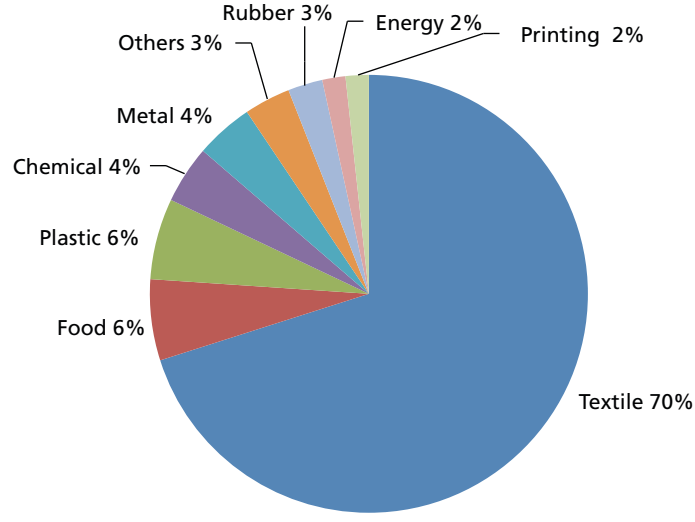


Source: Data from HSPCB, analysis by CSE, 2019–2020

2.3 Barhi Industrial Area

Barhi Industrial Area is on the outskirts of Sonipat. It is located en-route to Panipat. According to HSPCB, there are about 117 industries in this area. Around 70 per cent of the factories are in the textiles sector—dyeing and knitting units. Panipat is a textiles hub and its closeness to this area could be a potential reason for the large share of textile industries in this area. Apart from textiles, there are a few food processing units (six per cent), plastic units (six per cent), chemical units (four per cent), metal processing units (four per cent), and rubber units (three per cent).

Figure 75: Industrial sectors in Barhi Industrial Area



Source: Data from HSPCB, analysis by CSE, 2019–2020

Fuel usage in Barhi Industrial Area

A majority of the 117 industries in the area are using wood (44 per cent) as a fuel, followed by coal (37 per cent) and liquid fuel (14 per cent).

1. **Coal**: There are 43 industries using coal. Cumulatively, the area consumes 524 tonnes of coal per day. Four units which are using maximum coal in the area—Vardhman Creations, Brothers Stretch Yarn Pvt. Ltd, and Shree Sidhi Vinayak Texcolour Pvt. Ltd are textile units, while Nirmal Udyog is a rubber processing unit.

2. **Wood:** There are 52 factories cumulatively using about 833 tonnes of wood per day. Fine Dyeing Pvt. Ltd consumes 800 tonnes out of the 833 while the rest of the units consume in the range 0.2–2 tonnes per day.

3. **Agro residue:** There are three units in Barhi Industrial Area which use agro residue as a fuel.

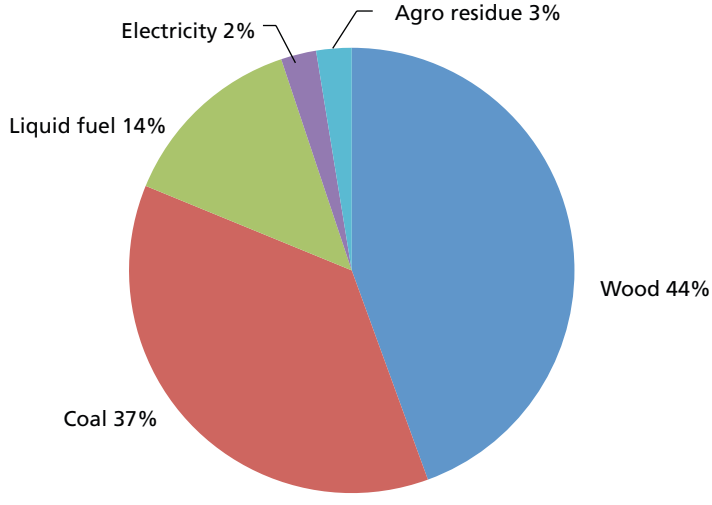
    - **Briquettes:** One food processing unit—Cargill India Pvt. Ltd uses about 1.5 tonnes of briquettes per day.

    - **Rice husk:** Two industrial units use rice husk as fuel—Value Foods uses about 10 tonnes per day and Shubhram Hospital Solutions Pvt. Ltd uses about 2.6 tonnes per day.

4. **Liquid fuel:** Sixteen industrial units use about 43 tonnes of diesel per day as a fuel. Jai Bharat Extrusion (39 tonnes per day) is the largest consumer of diesel in the area. The rest consume less than one kl/day.

5. **Electricity:** Three industrial units use electricity as a fuel—TR Foundry Private Limited (one MW/day); Camlano & Company (three MW/day); and Optimum Electromotive (100 MW/day).

Figure 76: Fuel usage in Barhi Industrial Area

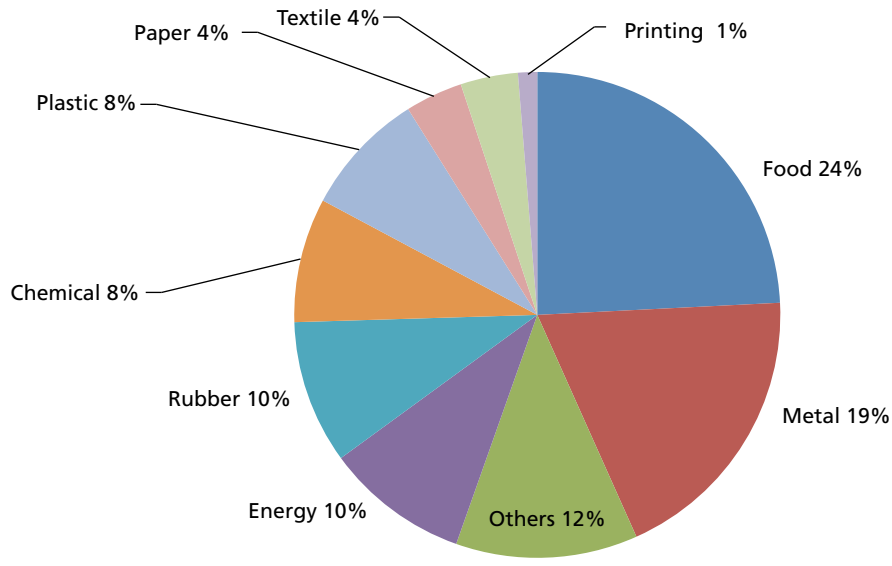


Source: Data from HSPCB, analysis by CSE, 2019–2020

2.4 DIC Industrial Area

According to HSPCB, there are about 157 industries in this area—24 per cent are food processing units, 19 per cent are metal units, 10 per cent are rubber units, 8 per cent are chemical units, and 8 per cent are plastic based units. There are also a few textile, printing and paper units.

Figure 77: Industrial sectors in DIC Industrial Area



Source: Data from HSPCB, analysis by CSE, 2019–2020

Fuel usage in DIC Industrial Area

The most common fuels used in this area are wood, liquid fuel, and coal with shares of 37 per cent, 25 per cent and, 19 per cent respectively. Only two per cent of the units are using PNG.

1. **Coal:** There are 30 coal using industries which cumulatively consume 740 tonnes of coal per day. Two units consume the maximum coal in this area—Radha Govind Industry (600 tonnes per day); and GlaxoSmithKline plc (80 tonnes per day).

2. **Wood:** Fifty-eight units consume about 63.75 tonnes of wood as fuel per day.

3. **Agro residues:** Nine units use agro residue as a fuel.

    - **Rice husk**: Seven units use 22.5 tonnes of rice husk as fuel per day.

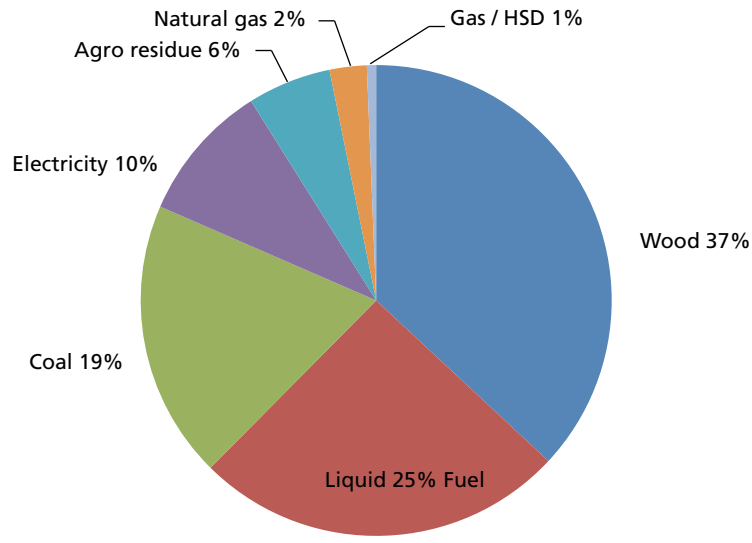
    - **Bagasse**: Two units use bagasse as fuel—Ch. Devi Lal Co-op. Sugar Mills Ltd (700 tonnes per day); and Sonipat Co-op. Sugar Mills Ltd (six tonnes per day).

4. **Electricity:** Fifteen industrial units use electricity as fuel. These are mostly metal processing industrial units.

5. **Liquid fuel:** Forty-one industrial units use 408 tonnes of diesel per day. Avdhoot Engineers (300 tonnes per day) and Soorajmull Baij Nath Industries Pvt. Ltd (100 tonnes per day) are the largest consumers of diesel fuel.

6. **PNG:** Four units use 88.95 tonnes of PNG per day as a fuel.

Figure 78: Fuel usage in DIC Industrial Area



Source: Data from HSPCB, analysis by CSE, 2019–2020

Observations from site visit

- Major contributors to air pollution in the region are industries like textile, food, and metal processing. Barhi is the largest industrial cluster in Sonipat and has large sized units (mostly textile).
- Industries in this region mainly use wood, liquid fuel, coal, and agro residue as a fuel. Only a small fraction of industries have switched to natural gas as per the regulatory requirements. Kundli, Rai and DIC industrial areas are connected with GAIL natural gas supply; only Barhi Industrial Area is not connected with a natural gas pipe-line.
- Currently, there is no solid waste management plan for the Sonipat Industrial Area. All the solid waste from industries is dumped outside on vacant plots and is often burnt as well which causes air pollution. HSIIDC has arranged a truck to collect the solid waste generated by industries.
- HSIIDC has recently developed a solid waste dumping site in Barhi Industrial Area but all the waste is still being dumped on the side of roads (see images below). A waste to energy plant is being constructed by JBM Enviro in Murthal.

Image 21: Solid waste site in Barhi

Image 22: Soild waste dumping on vacant plots in Barhi

- An Inspection was also carried out by CPCB across several locations to understand the reason behind the rise in air pollution. The maximum violations (111) were found in three cities in Haryana—Faridabad, Gurugram, and Sonipat. Sonipat recorded a 10 per cent violation of industrial waste dumping under this inspection.
- Road condition in Rai and Kundli industrial areas is very poor. The road is damaged at several locations and is always full of dust. Poor road conditions further increase fugitive dust emissions with the frequent movement of vehicles on the road (see images below). GT Karnal highway has been under construction for a long time causing traffic jams and air pollution in the area.
- Extension of industrial area—new industries are under construction thus causing a rise in air pollution.

Image 23: Waste dumping in Kundli Industrial Area

Image 24: Waste dumping in Rai Industrial Area

Image 25: Waste dumping in Barhi Industrial Area

Image 26: Roads in Sonipat Industrial Area

Source: CSE, 2019

3. Estimation of pollution load

A key indicator for assessment of air pollution in any area is loading of pollutants into the ambient environment from different sources in the area. Under this study the pollution load is estimated for three main pollutants—PM, SO_2, and NO_X from industrial sources. The detailed methodology followed for estimation of the pollution load has been discussed in the overview chapter.

3.1 Baseline data for estimating pollution load for Sonipat district

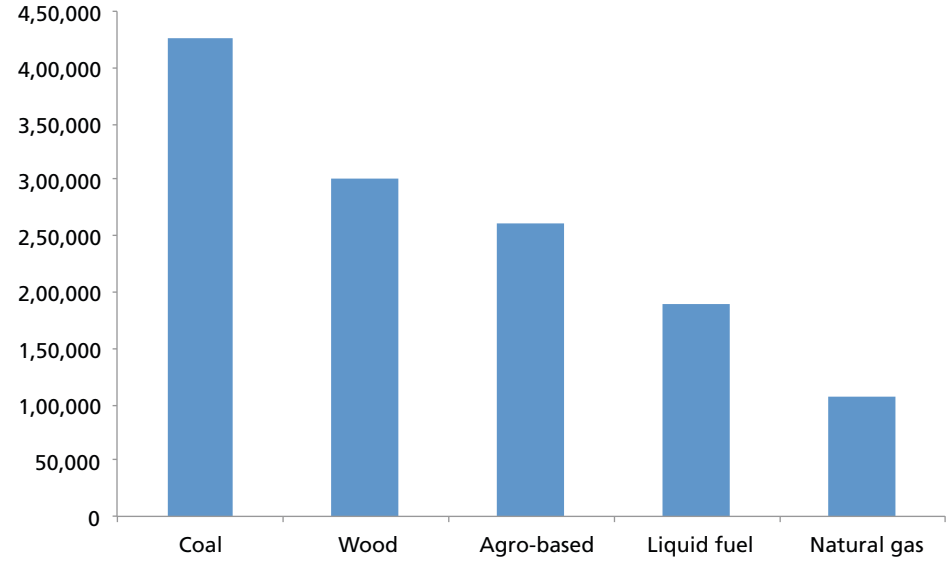
DIC Industrial Area and the industries nearby consume the most amount of coal in the whole district followed by the industries in Barhi Industrial Area. Industries in and around the DIC area are also the largest consumers of natural gas, liquid fuel, and agro-based fuel whereas Barhi Industrial Area consumes the highest amount of wood as fuel. The total fuel consumption of different kinds of fuels in the industrial areas of Sonipat is given in the table below.

Table 63: Quantity of fuel used in Sonipat industrial cluster (in tonnes per year)

Industrial area	Fuel (in tonnes/year)				
	Coal	Wood	Agro-based	Liquid fuel	Natural gas
Barhi	173,102	275,096	4,653	14,231	
DIC	244,229	21,104	240,405	134,686	29,354
Kundli	4,785	3,482	16,830	39,277	140
RIA	2,805	2,386		1,226	77,517
Total	424,921	302,068	261,888	189,420	107,011

Source: CSE 2019–2020

Figure 79: Total fuel usage in Sonipat district (by type, in tonnes per year)



Source: CSE 2019–2020

3.2 Pollution loading from Industrial areas of Sonipat district

DIC Industrial Area contributes maximum to the overall pollution load (including PM, SO_2, and NO_X) of the cluster (approximately 56 per cent), followed by Barhi Industrial Area (approximately 37 per cent), Kundli Industrial Area (approximately six per cent), and Rai Industrial Area (one per cent).

Table 64: Pollution load estimation for Sonipat industrial cluster

Industrial area	Pollutant (tonnes per year)						Avg. % share in total loading
	Controlled			Uncontrolled			
	PM	SO_2	NO_X	PM	SO_2	NO_X	
Barhi	1,737	1,307	1,891	2,763	1,797	3,060	37%
DIC	1,988	1,988	2,334	4,744	6,581	3,477	56%
Kundli	168	307	271	351	1,449	272	6%
RIA	23	22	26	43	65	46	1%
Total	3,916	3,624	4,522	7,901	9,892	6,855	

Source: CSE 2019–2020

Total uncontrolled pollution load for Sonipat cluster is 7,901 tonnes per year for PM; SO_2 load is 9,892 tonnes per year; and NO_X load is 6,855 tonnes per year. Controlled PM and NO_X load are approximately half of the uncontrolled PM and NO_X load, whereas controlled SO_2 is almost a third of the uncontrolled SO_2 load.

3.3 Fuel consumption in industrial sectors of Sonipat district

The annual consumption of fuel for each industrial sector is calculated from the data available considering 330 days of operation annually. The maximum amount of coal is consumed by the food and textile sectors, which is up to 3.6 lakh tonnes per year. The food processing sector is also the largest consumer of agro-based fuel (around 2.6 lakh tonnes per year), whereas the textile sector is the largest consumer of wood as a fuel (around 2.7 lakh tonnes per year).

Table 65: Annual fuel consumption in industrial sectors in Sonipat cluster (tonnes per year)

Sector	Fuel (in tonnes per year)				
	Coal	Wood	Agro-based	Liquid fuel	Natural gas
Food	226,380	5,768	257,730	485	38,000
Textile	142,560	274,560	858	38,280	39,600
Rubber	36,795	2,772	3,300	3,260	
Others	9,985	3,960		546	
Metal	3,597	53		142,837	28,885
Plastic	1,980	3,630		495	360
Printing	1,749	462		665	132
Energy	957	5,052		2,739	
Chemical	594	4,168		202	
Paper	330	1,568		44	

Source: CSE 2019–2020

3.4 Pollution loading from industrial sectors of Sonipat district

Based on the annual fuel consumption by various sectors, the pollution loading has been calculated. The food processing industry, textile industry, and metal industry are jointly responsible for around 92 per cent of the pollution load in the district. Food industry holds the biggest share (34.9 per cent) of the overall pollution load, closely followed by the textile industry (36.7 per cent). The metal industry stands at the third place in terms of pollution load with a share of 20.4 per cent, followed by the rubber industry with a share of 4.5 per cent.

Table 66: Pollution load—sector-wise

Sector	Avg. % share in total loading	Pollutant (tonnes/year)					
		Controlled			Uncontrolled		
		PM	SO_2	NO_x	PM	SO_2	NO_x
Food processing	34.9%	1,579	1,073	1,607	3,966	1,620	2,564
Textile	36.7%	1,659	1,378	1,882	2,530	2,447	2,854
Rubber	4.5%	177	125	171	434	378	417
Others	1.3%	56	39	56	120	91	125
Metal	20.4%	359	926	701	726	5,168	752
Plastic	0.5%	22	18	25	34	33	39
Printing	0.3%	10	10	12	23	36	36
Energy	0.8%	29	34	38	39	106	45
Chemical	0.3%	17.8	14.6	21.0	19.9	12.4	24.9
Paper	0.3%	7.1	5.6	8.1	8.4	4.2	10.3

Source: CSE 2019–2020

3.5 Limitations and assumptions of the assessment

The common limitations and assumptions of the overall pollution load assessment done in this study have been discussed in the first chapter of the report. A specific limitation in the case of Sonipat district was that the HSPCB could not provide the data for around 60 industries in the district, therefore the pollution load was calculated from the data of 390 industries which was made available by the HSPCB.

4. Findings and recommendations

1. As per the estimated PM and SO_2 pollution load, based on the data provided by HSPCB, **food, textile, and metal industries are found to be contributing about 92 per cent of the overall pollution load** in the cluster. These sectors need upgrades and improvements of technology used, more efficient fuel usage, higher efficiency of air pollution control technology, and better overall resource management.

2. **DIC Industrial Area contributes about 56 per cent of the overall pollution load**, since it has the highest number of industries, followed by **Barhi Industrial Area which contributes about 37 per cent** of the overall pollution load.

3. **Coal consumption** in Sonipat cluster is **about 424,920 tonnes per year**. However, about **302,067 tonnes of wood is also consumed per year** in the industries. **Only four per cent of the industries are using agro residue** as a fuel—261,888 tonnes per year. The industries should switch over to cleaner fuels like natural gas to reduce emissions into the ambient air, which will be favourable for environmental sustainability.

4. More than 70 per cent of the industries in the cluster are using either wood, coal, liquid fuel (HSD, LDO, and LSHS), or agro-based fuel. **Only, three per cent of the total industries have switched to PNG**. There is no PNG supply in Barhi Industrial Area.

5. During the survey, it was found that **industries are dumping their solid waste in vacant plots**. The regulatory bodies need to conduct inspection visits to ensure no industrial waste is dumped in undesignated areas and proper disposal practices are followed.

6. **The condition of roads in the industrial areas of Sonipat is very poor**, damaged at several locations and full of dust. Poor road conditions further increase dust emissions with frequent movement of vehicles on the road. Roads need to be improved.

5. Action plan for industrial air pollution in Sonipat district

Sr. no.	Action points	Responsible agencies	Timeline	Existing scenario
SECTORAL ACTIONS				
1	Implementation of fuel change to natural gas. Following activities should be pursued to accomplish implementation: • Provision of gas pipelines and gas supply in the whole district, especially Barhi Industrial Area. Prepare a report on current status of gas pipeline network and connections, prepare a plan of action to complete the pipeline network (including a prioritized proposal for Barhi Industrial Area). • Prepare a plan of action on how all the industries in Rai, DIC and Kundli industrial areas will be convinced to switch to natural gas. • Conduct a meeting with PNGRB for the inclusion of natural gas under GST, control of price fluctuations, and to ensure provision of natural gas supply through pipelines throughout the district in all industrial areas.	HSPCB, HSIIDC, and local industrial associations	- Three months for current status report on gas pipeline network and the plan of action for the completion of network along with proposal for Barhi Industrial Area. -Two months for meeting with PNGRB. -Three months for preparing an advocacy action plan for bringing natural gas under GST, to contain price fluctuations, and to present the plan to all stake holders on completion.	-Currently Barhi Industrial area does not have a gas pipeline network. Only 11 industries are operating on natural gas in the whole district. -Non-inclusion of natural gas under GST and regular price fluctuations make it a non-preferred fuel compared to others.
Food processing industry				
2	Prepare a stage wise implementation plan and guidelines (for industries) for switch from other fuels to natural gas.	HSPCB and local industrial associations	Three months for action plan and guidelines	Currently the food processing industries in Sonipat consume more than two lakh tonnes of coal annually. It is the largest coal consuming sector in the district.
3	Conduct a stakeholder meeting for immediate roll out of the implementation plan.	HSPCB	Immediately after preparation of implementation plan	
Textile industry				
4	Prepare a stage wise implementation plan for switching from other fuels to natural gas. The plan should consider switching to intermediary fuels (ex. agro waste/ liquid fuel) until the gas pipeline is made available in Barhi Industrial Area.	HSPCB and local industrial associations	Three months for preparation of implementation plan	Seventy per cent of the industries in Barhi Industrial Area are textile industries which currently do not have the availability of natural gas. The sector is consuming around 1.3 lakh tonnes of coal annually.
5	Conduct a stakeholder meeting for immediate roll out of the implementation plan.	HSPCB	Immediately after preparation of implementation plan	

Sr. no.	Action points	Responsible agencies	Timeline	Existing scenario
Metal industry				
6	Prepare an implementation plan for switching all metal-based industries from other fuels to electrical induction based processing system.	HSPCB and local industrial associations	Three months for preparation of implementation plan	Metal industries are currently responsible for 21.6 per cent of the overall pollution load as majority of the industries are using liquid fuel and some of them coal as well.
7	Conduct a stakeholder meeting for immediate roll out of the implementation plan.	HSPCB	Immediately after preparation of implementation plan	
OTHER ACTIONS				
8	Formation of a committee for the management of industrial areas which would prepare area-wise management plans for • Industrial waste management • Road quality and maintenance • Housekeeping • Plantation The committee shall also appoint the responsible entities for each management plan and their schedule of implementation.	The Committee shall include representatives from HSPCB, HSIIDC, local industrial associations, and other experts.	Formation of committee in two months and preparation of area-wise management plan for all four topics within three months post the formation of the committee.	The conditions of roads, waste management, housekeeping, and plantations are poor in the industrial areas (especially in Rai and Kundli Industrial areas). These need to improve to control fugitive emissions in the area.
9	Setting up of waste management facility in every industrial area for non-hazardous waste on a land allotted by HSIIDC.	Committee under point no. eight of the action plan	As a part of the area-wise management plan suggested in point no. eight	Rampant waste dumping and burning was observed in all the industrial areas of the district. CSE's team visited a vacant land proposed for a waste management facility in Barhi Industrial Area but the facility has not been established yet.
10	Preparation of a feasibility plan and mechanism as to how appropriate waste from all industrial areas could be transported to the waste to energy plant in Murthal (currently under construction).	Committee under point no. eight of the action plan	As a part of the area-wise management plan suggested in point no. eight	
11	Introduction of a chargeable toll system for heavy diesel vehicles for entering different industrial areas. This would control unnecessary movement of heavy vehicles in the area, thus bringing down fugitive emissions. CNG vehicles shall be exempted from the charge.	Committee under point no. eight of the action plan	Within six months	The continuous movement of heavy diesel vehicles on roads with poor condition increases the PM10 levels in the area immensely.
12	Increasing the capacity of the regional offices of pollution control board by : Hiring more technical personnel Strengthening the capacity of their labs and equipment Conducting trainings for their employees	HSPCB	Hiring and strengthening of labs in six months and conducting at least five training programmes annually	Currently there are just three technical staff in the regional office which is far too less to inspect and monitor 540 factories in the district.

Annexure 1

Continuous air pollution monitoring data of Panipat

Sr. no.	Name of station	Date	NO	NO_2	NO_x	NH_3	SO_2	CO	O_3	$PM_{2.5}$	PM_{10}	Air quality	AQI
1	Panipat	01.01.2020	439.75	67.36	387.84	36.58	16.42	0.97	38.53	179.61	411.75	Very poor	357
2	Panipat	01.12.2019	114.76	3.96	92.80	2.58	12.59	0.52	52.37	87.30	249.20	Moderate	186
3	Panipat	02.01.2020	394.91	58.89	347.45	32.19	24.98	0.86	24.77	138.34	382.55	Very poor	340
4	Panipat	02.12.2019	76.74	120.87	124.28	21.92	5.42	0.41	57.17	110.26	302.27	Poor	228
5	Panipat	03.12.2019	457.34	211.58	477.29	44.91	37.95	1.19	188.70	154.80	582.70	Poor	263
6	Panipat	04.12.2019	356.07	143.79	363.75	31.79	33.91	1.41	60.67	195.25	461.81	Very poor	319
7	Panipat	05.12.2019	224.60	117.37	241.43	27.07	34.98	0.50	41.85	213.48	550.69	Very poor	382
8	Panipat	06.12.2019	187.64	106.11	205.91	5.37	35.39	0.61	28.74	134.69	442.29	Very poor	378
9	Panipat	07.12.2019	276.02	105.11	276.22	17.00	39.65	0.61	37.22	131.82	452.96	Very poor	362
10	Panipat	08.12.2019	250.24	92.48	248.99	16.56	35.25	0.73	46.95	117.44	372.49	Very poor	329
11	Panipat	09.12.2019	231.58	88.43	231.91	13.42	37.71	0.72	48.52	130.69	408.75	Very poor	311
12	Panipat	10.12.2019	374.38	89.44	346.95	3.93	45.88	0.59	28.60	210.43	525.45	Very poor	387
13	Panipat	11.12.2019	335.60	75.66	308.65	7.80	51.63	0.64	41.71	244.73	574.40	Severe	419
14	Panipat	12.12.2019	283.19	49.76	253.10	9.48	55.77	0.46	75.56	164.23	451.08	Severe	440
15	Panipat	13.12.2019	286.91	46.25	254.23	12.97	56.84	0.34	49.24	50.63	175.33	Poor	212
16	Panipat	14.12.2019	331.63	49.71	291.91	11.63	59.95	0.32	34.46	46.59	165.78	Moderate	165
17	Panipat	15.12.2019	349.23	58.90	310.82	5.14	63.21	0.31	36.66	61.09	197.20	Moderate	161
18	Panipat	16.12.2019	243.24	44.26	218.18	17.28	55.83	0.38	37.38	60.20	204.19	Moderate	172
19	Panipat	17.12.2019	312.52	57.65	280.74	11.44	37.27	0.34	29.77	102.47	330.58	Moderate	180
20	Panipat	18.12.2019	290.35	47.63	257.73	15.30	17.38	0.44	26.09	113.00	336.10	Poor	288
21	Panipat	19.12.2019	372.51	61.97	331.12	16.36	17.22	0.66	27.19	157.84	461.37	Very poor	334
22	Panipat	20.12.2019	360.59	70.83	326.17	9.00	18.93	0.67	29.73	449.80	449.80	Very poor	321
23	Panipat	21.12.2019	365.00	65.44	326.89	12.27	9.67	0.46	19.66	127.13	384.25	Severe	406
24	Panipat	22.12.2019	355.97	76.18	325.26	1.95	5.78	0.52	22.81	98.49	286.04	Poor	243
25	Panipat	23.12.2019	265.79	57.66	243.27	18.76	42.72	0.42	17.73	166.29	456.69	Very poor	316
26	Panipat	24.12.2019	253.89	55.31	232.50	21.25	12.16	0.38	23.40	113.27	339.15	Very poor	333
27	Panipat	25.12.2019	256.82	62.14	238.42	22.33	14.29	0.33	9.35	125.98	366.99	Very poor	315
28	Panipat	26.12.2019	209.05	59.11	198.53	36.31	9.88	0.18	35.52	122.61	340.18	Poor	280
29	Panipat	27.12.2019	304.05	72.29	281.60	26.08	22.40	0.21	47.48	163.58	432.12	Very poor	341
30	Panipat	29.12.2019	304.58	85.99	289.17	14.88	67.84	0.29	25.06	174.44	434.43	Severe	404
31	Panipat	30.12.2019	241.63	60.02	225.13	31.35	18.28	0.46	19.05	142.28	389.20	Poor	288
32	Panipat	31.12.2019	425.58	79.63	382.88	33.80	30.16	0.18	38.58	172.29	410.87	Very poor	318

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Air pollution is a major cause of concern in Delhi-NCR. Data from various independent studies shows that districts in this region are some of the most polluted in the world. While some steps have been taken to reduce pollution and control the resulting deterioration of environment and health, much still needs to be done.

The scoping study on industrial air pollution has been conducted in districts with prominent industrial clusters in the vicinity of Delhi-NCR, covering states of Rajasthan, Haryana, and Uttar Pradesh—Alwar, Bhiwadi, Gurugram, Faridabad, Panipat, Sonipat and Ghaziabad—to identify pollution hotspots and major air polluting sectors. The aim of this study is to assist relevant stakeholders in preparing and implementing an effective action plan to control air pollution from the concerned industrial areas/ sectors.

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