ASSESSMENT OF INDUSTRIAL AIR POLLUTION IN JAIPUR DISTRICT

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Centre for Science and Environment

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1. Introduction

Jaipur, the capital of Rajasthan, has earned universal renown as the 'Pink City', but the city is not in the pink of health. According to the WHO global urban ambient air pollution database updated in 2018, out of 4000 cities in 108 countries surveyed across the world, five cities of Rajasthan were among the most polluted cities which did not meet the WHO air quality standards. Jaipur was one of them.[1]

There are many reasons for air pollution in the city. In this report we are focusing on rapid industrialization. A report by the Central Pollution Control Board (CPCB) shows that out of six National Ambient Monitoring Program (NAMP) stations installed in Jaipur city, the two stations which are located in the industrial areas of the city show moderate to poor air quality level.[2] The Rajasthan State Pollution Control Board (RSPCB) released the data collected by pollution surveillance centers in eight cities of the state in 2018. According to the data, Vishwakarma Industrial Area (VKIA) of Jaipur has highest PM_{10} concentration (301µg/m^3) in the state. This level of air pollution is associated with increased risk of acute and chronic health problems. Thus, it is important to identify all the hotspots with respect to air pollution and to take necessary steps to curb it.

Industrial areas in Jaipur district

According to the Ministry of Micro, Small and Medium Enterprises (MSME), there are more than 37,756 registered large, medium, and small-scale industrial units in Jaipur district, spread across 48 designated industrial areas.[3] Sitapura (North), Vishwakarma (North), and Kaladera are among the major industrial clusters of the region, with each located in different parts of the district. Industrial areas in Rajasthan are managed by Rajasthan State Industrial Development and Investment Corporation (RIICO), which provides infrastructure facilities like roads, street lights, drains, energy, and water, apart from building and maintaining the necessary infrastructure for residential, social, and commercial facilities.

RIICO is playing an important role in accelerating industrial growth in Rajasthan by providing assistance to entrepreneurs in the form of underwriting of public issues, and grant of term-loans, seed capital, interest free loans in lieu of sales tax, etc.[4] They encourage, assist, and ensure the promotion of industries in consonance with the state government's policies.

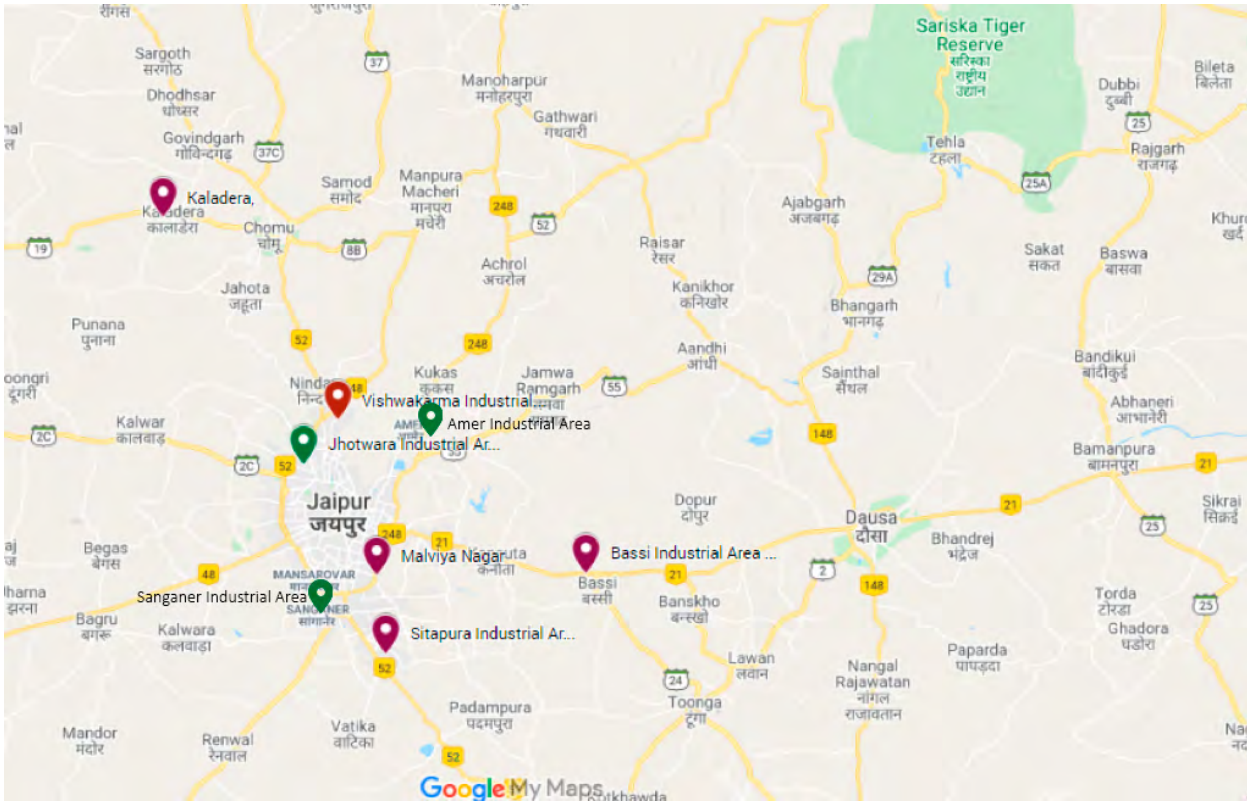
Jaipur district is primarily comprised of a large services sector including IT & telecom, tourism & hospitality (hotels and restaurants), and export services. The major manufacturing industries in the district include jewelry, steel, textiles, and stone and mineral-based industries.

Table 1: Industrial areas in Jaipur district

Sr. no.	Name of industrial area	Land acquired (in hectare)	Land developed (in hectare)	No. of plots
1.	Sitapura Phase I,II, III, IV EPIP, SEZ I-II, Institution Area, Ramchandrapura	2,143.66	1,221.72	2,304
2.	VKIA	1,399.34	998.20	1,300
3.	VKIA Ext.	73.54	44.45	165
4.	Badharna	11.10	7.25	36
5.	Jhotwara	422.60	332.55	272
6.	Jhotwara Ext.-I	144.36	90.56	246
7.	Jhotwara Ext.-II	126.16	75.20	549
8.	Bindayaka	178.85	102.39	261
9.	Kartarpura	27.60	19.78	241
10.	Sudarshanpura	35.94	23.74	269
11.	Bais Godam	17.70	12.30	184
12.	Malviya Nagar	164.75	108.58	289
13.	Heerawala	149.17	107.87	209
14.	Mansarovar	135.59	95.48	292
15.	Apparel Park, Sitapura	156.16	70.16	204
16.	Gem Park, Sitapura	104.63	1.97	2
17.	Jaitpura	114.66	66.16	191
18.	Renwal	66.68	36.32	155
19.	Kaladera	356.46	234.29	270
20.	Akeda Doonger	63.75	63.75	180
21.	Phulera	28.87	20.60	68
22.	Kanakpura	50.63	50.63	4
23.	Bagru Old	55.45	39.50	150
24.	Bagru Ext.	193.90	131.51	235
25.	Bagru Ext.-II	165.16	165.16	225
26.	Bagru Chitroli	284.62	109.13	293
27.	Shahpura	93.75	63.78	203
28.	Dudu	32.25	18.45	80
29.	Manpura Machedi	81.31	39.37	52
30.	Kukas	164.78	119.50	51
31.	Kant Kalwar	364.57	267.49	19
32.	Kilkipura	24.50	18.52	6
33.	Manda	333.62	252.90	235
34.	Bagrana	22.91	22.91	3
35.	Bassi	223.04	145.43	265

Source: MSME, Govt of India, 2015–2016

Map 1: Major industrial areas of Jaipur district

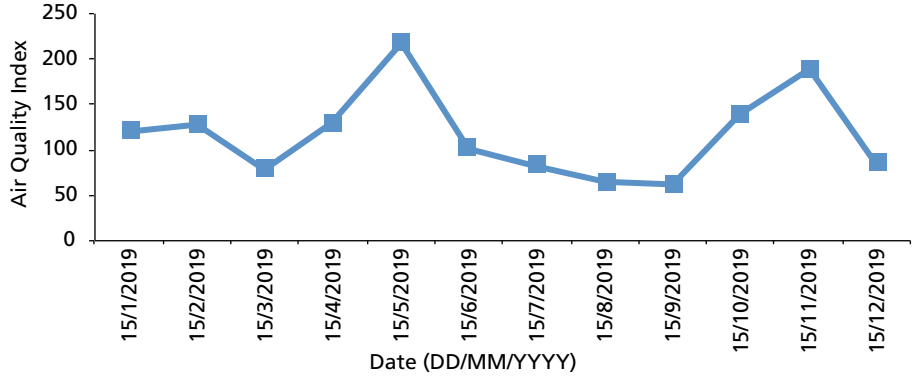


Source: Google Maps. CSE 2019–2020

Air pollution in Jaipur district

There are three continuous ambient air quality monitoring stations within Jaipur District—Adarsh Nagar, Police Commissioner Office, and Shastri Nagar. At these stations particulate matter (PM_{10} and $PM_{2.5}$), gaseous pollutants—SO_2, NO_X, O_3, CO, VOCs, and NH_3—and meteorological parameters like temperature, relative humidity, wind speed, wind direction, pressure, solar radiation, etc. are measured continuously. The Air Quality Index (AQI) for Jaipur city ranged between 62 and 218 in the year 2019. The AQI for Jaipur city peaked on 15 May and 15 November 2019.

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



Source: CPCB, 2019

As per the report published by CPCB, the AQI of Jaipur city from 2010–2016 has been moderate to poor in most places for most of the time (see *Table 2: Air quality Index of Jaipur city based on pollution category and class of area*).

Table 2: Air Quality Index of Jaipur city based on pollution category and class of area (2010–2016)

Station code	Location details	Class of area	Pollution category in area					
			2010	2011	2012	2013	2014	2015
298	RSPCB Office, Jhalana Doongri	Residential	Moderate	Satisfactory	Moderate	Moderate	Satisfactory	Moderate
410	RIICO Office, Jaipur	Industrial	Moderate	Satisfactory	Moderate	Moderate	Moderate	Moderate
296	PHD Office, Ajmeri Gate	Residential	Poor	Moderate	Moderate	Poor	Poor	Moderate
408	Office of the District Educational Officer, Chandpole	Residential	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
409	RSPCB, RO, Vidyadhar Nagar	Residential	Moderate	Moderate	Poor	Moderate	Moderate	Poor
297	VKIA, Jaipur (Road no. 6)	Industrial	Poor	Moderate	Moderate	Poor	Moderate	Poor

Source: CPCB

2. Profile of Jaipur industrial cluster

There are around 2,760 industries in Jaipur district, out of which approximately 1,261 industries are air polluting (industrial units with stack-based emissions or DG sets) in nature. There are 710 stone-work units (89 units in Bassi, 60 units in Phulera, 85 units in Dudu, and 38 units in Vishwakarma), 166 brick kilns, and 160 mineral-based industries (manufacturing masonry stone, Cheja Patthar, lime stone, calcite powder, feldspar, stone grit, etc.).

The Jaipur industrial cluster consists of 11 major industrial areas: Sitapura, Jaipur Rural, VKIA, Amer, Kotputli, Jhotwara, Bassi, Kaladera, Malviya Nagar, and Sanganer. There are a lot of other air polluting industries which are not inside a specific industrial area.

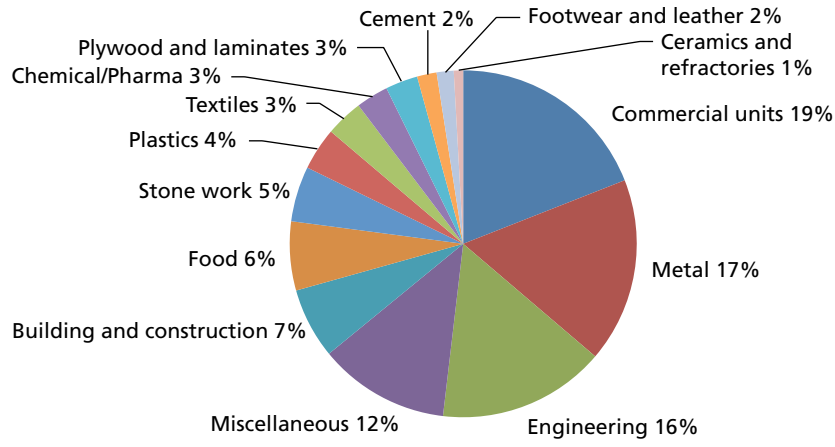
Table 3: Industrial sectors in major industrial areas of Jaipur district

Industrial sector	Jhot-wara	Malviya Nagar	Amer	Bassi	Jaipur Rural	Kaladera	Kotputli	Others	Sanganer	Sita-pura	VKIA
Building and construction	1	1	3	1				7	42	1	27
Cement	1	2	1		6	2		1	2	4	4
Ceramics and refractories				1	1	2	1				6
Chemical/ pharmaceutical		1	2	3	8	2	5	2	5	5	5
Commercial units	4	14	22				2	14	11	3	170
Engineering	10	9	11	7	21	4	15	16	26	6	72
Food	3	2		10	17	12	4	6	3	10	14
Footwear and leather	1		1	7		3				1	7
Metal	32	1	3	3	31	24		11	8	4	100
Miscellaneous	6	7	5	10	25	12	6	10	12	26	35
Plastics	7			3	13	4	2	2	4	4	11
Plywood and laminates				19	2	8		4	3	1	1
Stone-work			11	4	10		26	8	3		3
Textiles		8		1	11		3	1	3	9	8
No. of units	65	45	59	69	145	73	64	82	122	74	463
Total no. of Units*	1261										

*Industrial units with stacks or DG sets

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

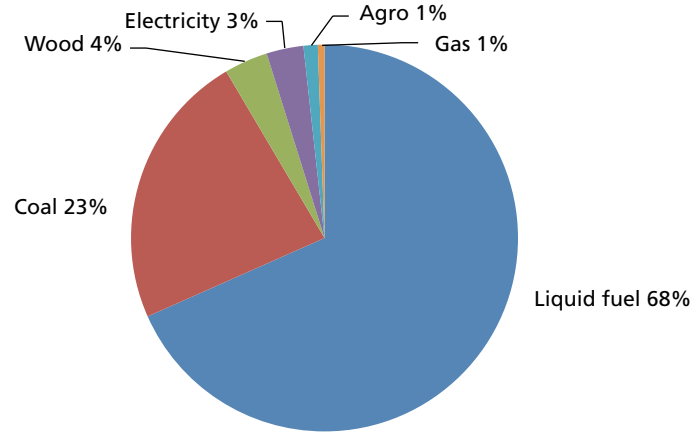
Figure 2: Share of industrial sectors in Jaipur district



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

Data analyzed by CSE shows that liquid fuel is used in about 68 per cent of the industries in the district and its annual consumption is about 228,792 tonnes. Approximately one per cent of the units are using agro residue as fuel and its consumption is around 141,147 tonnes per year. Coal is being used as a fuel by 23 per cent of the industries with total annual consumption of 616,383 tonnes. Wood is used by four per cent of the industries and the quantity consumed is about 59,874 tonnes per year. Only one per cent of the industries are using PNG and the quantity of PNG being consumed is 3,525 tonnes per year. Only three per cent of the industries are operating on electricity (see *Figure 3: Fuel usage in Jaipur district*).

Figure 3: Fuel usage in Jaipur district

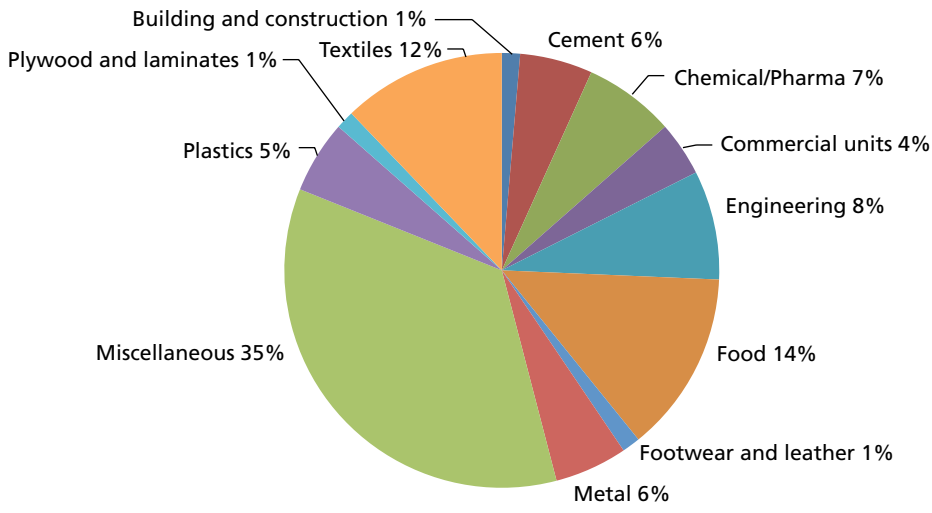


Source: CSE 2019–2020 (based on RSPCB data)

I. Sitapura Industrial Area

This industrial area was set up by RIICO in four phases from 1996–2003 covering a total of about 2,000 acres of land. The area is situated along National Highway (NH) 12 or the Tonk Road. It is well developed with quality infrastructural facilities like roads, underground water supply, electricity supply, etc. There are about 74 air polluting industries operating in the Sitapura Industrial Area, out of which 35 per cent fall in the miscellaneous sector, mostly jewelry but also some automobile units. The food sector comprises 14 per cent of the total air polluting industries, textile units (mainly stitching of garments) comprise 12 per cent, and the engineering sector (transformers DG sets, PVC doors, and window manufacturing units) comprises eight per cent.

Figure 4: Industrial sectors in Sitapura Industrial Area

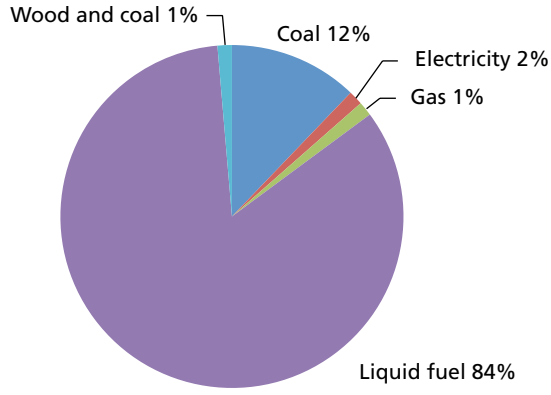


Source: CSE 2019–2020 (based on RSPCB data)

Fuel usage in Sitapura Industrial Area

Out of the 74 air polluting industries, 84 per cent are using liquid fuel, 12 per cent are using coal, two per cent are using electricity, one per cent is using natural gas, and one per cent is using wood and coal as a fuel.

Figure 5: Fuel usage in Sitapura Industrial Area



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

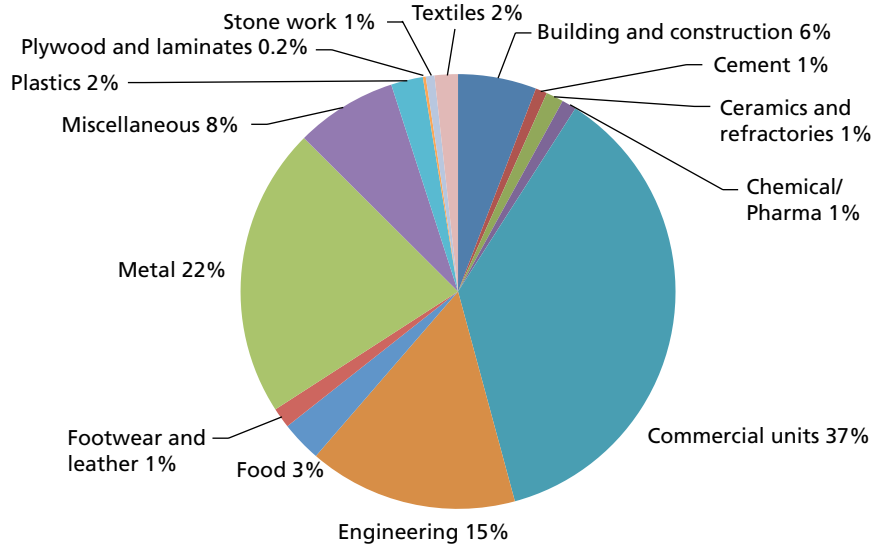
II. Vishwakarma Industrial Area

This area was set up by RIICO in 1970 on 1,400 acres of land. The area is well developed with quality infrastructural facilities. It is connected to NH 11 and a state highway, has a Public Health Engineering Department (PHED) and RIICO water supply, gets electricity from Jaipur Vidyut Vitran Nigam Limited (JVVNL), has working streetlights, etc. Although, the team observed that some of the internal roads of the area were not in a good condition.

Some renowned industries operating in VKIA are: Bharat Pottery, Clay Craft, Mangla Sariya, Poddar Rubber Industries, Bairathi Rubber Industries, Agarwal Marbles, Ultra Tech, Rajasthan Transformers, Bajrang Wire, Gem Electro, Rajasthan Cylinder, Rochees Watches, Tijaria Pipes, Annapoorna Cold Storage, SR Marble, Techno Hind Marble, Autopal, International Furniture, etc.

There are about 463 air polluting industries operating in this area. Around 37 per cent are commercial units like hotels and hospitals, 22 per cent are metal units (mostly casting), and 15 per cent engineering units (mostly DG set manufacturing).

Figure 6: Industrial sectors in VKIA

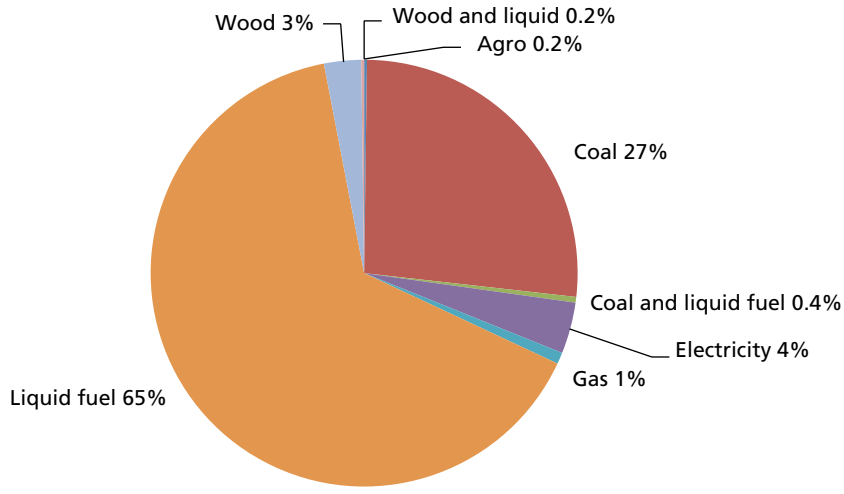


Source: CSE 2019–2020 (based on RSPCB data)

Fuel usage in VKIA

Out of 463 air polluting industries about 65 per cent are using liquid fuel, 27 per cent are using coal, four per cent are using electricity, three per cent are using wood, and only one per cent of the industries are using natural gas as fuel. Only one unit uses agriculture residue as fuel.

Figure 7: Fuel usage in VKIA



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

Table 4: Average values of $PM_{2.5}$ and PM_{10} recorded at two locations in VKIA

GPS location (lat/long)	Date of monitoring	Average values of PM emissions	
		$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)
26.985441, 75.784606	27 November 2019	119	482
26.984838, 75.780407	27 November 2019	74	255

Source: CSE 2019

Image 1: Stack emissions in VKIA

Image 2: Solid waste dumping in VKIA

Image 3: Poor road conditions in VKIA.

Source: CSE 2019

III. Jhotwara Industrial Area

Situated in Jaipur district, it was transferred to RIICO from the Government of Rajasthan. The area is well developed with quality infrastructural facilities just like VKIA. It is connected to national and state highways, has PHED water supply, gets electricity from JVVNL, has working streetlights, etc.

Some of the industries running in the industrial area are: Krishna Sariya (rolling mill), Maya Metal, Sharma Sariya, Kamani Industries, Anand Lamps, etc. The industrial area is well connected to major cities, through both rail and road transport. The PM values recorded by the CSE team in Jhotwara Industrial Area are shown in Table 5.

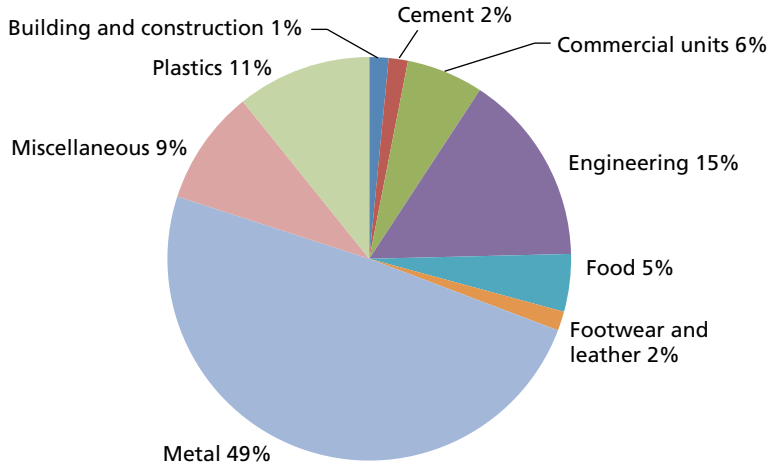
Table 5: Average values of $PM_{2.5}$ and PM_{10} as recorded in Jhotwara Industrial Area

GPS location (lat/long)	Date of monitoring	Average values of PM emissions	
		$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)
26.955298, 75.749799	27 November 2019	153	495

Source: CSE 2019

There are about 65 air polluting industrial units operating in the area, of which 49 per cent are metal processing units (mostly metal casting), 15 per cent are engineering industries (including DG sets and automobile manufacturing), and 11 per cent are plastic units. Apart from this, there are commercial, food, construction, cement, and leather industries in the area.

Figure 8: Industrial sectors in Jhotwara Industrial Area

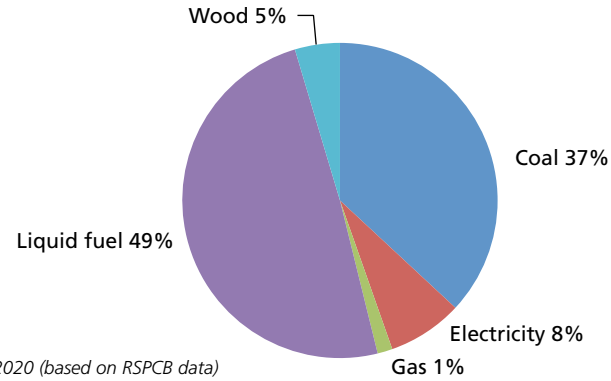


Source: CSE 2019–2020 (based on RSPCB data)

Fuel usage in Jhotwara Industrial Area

Out of the 65 industries in Jhotwara Industrial Area, 49 per cent are using liquid fuel, 37 per cent are using coal, eight per cent are using electricity, five per cent are using wood, and only one per cent of the industries are using natural gas as fuel.

Figure 9: Fuel usage in Jhotwara Industrial Area

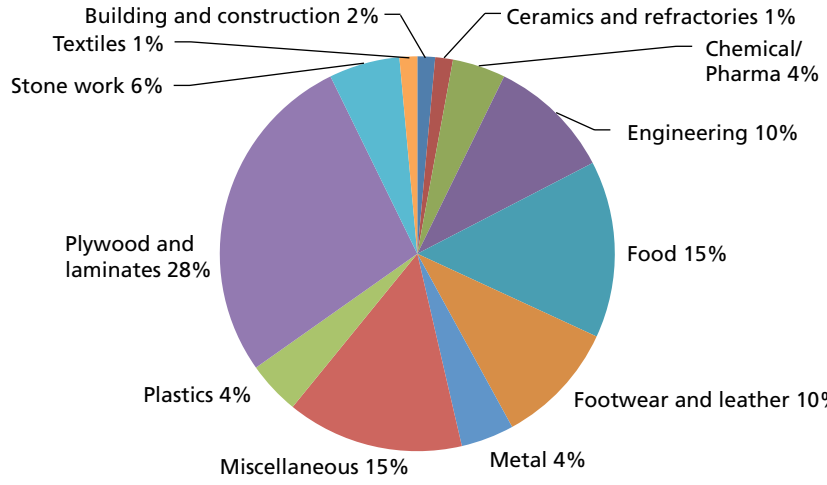


Source: CSE 2019–2020 (based on RSPCB data)

IV. Bassi Industrial Area

There are approximately 69 air polluting industries in Bassi Industrial Area, of which 28 per cent are plywood manufacturing units, 15 per cent are food processing units (mustard oil, besan, meat, butter, etc.), 10 per cent are leather and footwear units, 10 per cent are engineering units, and 15 per cent are miscellaneous units like furnace oil manufacturing and seat manufacturing. Apart from this, there are stone-work, chemical/pharmaceutical, plastic, and textile industries.

Figure 10: Industrial sectors in Bassi Industrial Area



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

Observations from a visit to plywood manufacturing industries in Bassi

The plywood manufacturing unit visited by the CSE team operates a single boiler with a daily production capacity of 300 pieces. This boiler requires three to five tonnes of wood as fuel per day for generating steam in the plant.

The emissions from combustion of fuel in plywood industries are the major cause of air pollution in Bassi. All of these industrial units use wood as fuel and have boilers as the pollution source.

RIICO Industrial Area in Bassi was found to be significant in terms of stack emissions while there was no significant dust emission. Most of the units operate boilers and produce stack emissions. The general condition of roads and other infrastructure in the industrial area appeared to be satisfactory and no waste burning sites were found.

Image 4: Wood waste used as 'fuel' in boilers in Bassi Industrial Area

Image 5: Wood fired steam boiler, required for steam generation which is used for pressing of veneers

Image 6: Stack emission from plywood manufacturing unit in Bassi Industrial Area

Source: CSE 2019–2020

Table 6: Average values of $PM_{2.5}$ and PM_{10} as recorded in Bassi Industrial Area

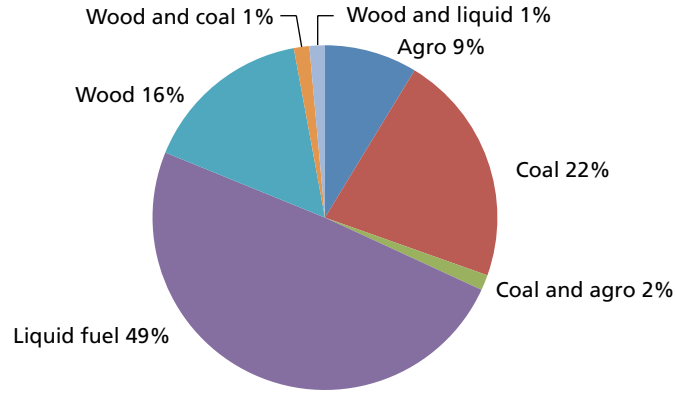
Place	GPS location (lat/long)	Date of monitoring	Average values of PM emissions	
			$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)
RIICO Industrial Area, Bassi	26.8566644, 76.0346768	11 December 2019	152.8933	326.9867

Source: CSE 2019–2020

Fuel usage in Bassi Industrial Area

Out of the 69 air polluting industries in the Bassi Industrial Area, 49 per cent are using liquid fuel, 22 per cent are using coal, 17 per cent are using wood, nine per cent are using agro residue, and two per cent of the industries are using both coal and agro residue as fuel. Liquid fuel is the most consumed fuel in this area as well.

Figure 11: Fuel usage in Bassi Industrial Area



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

V. RIICO Industrial Area, Malviya Nagar

RIICO Industrial Area, Malviya Nagar is located in Jaipur city. The area is very well maintained with clean roads. However, some municipal solid waste was found dumped near the units.

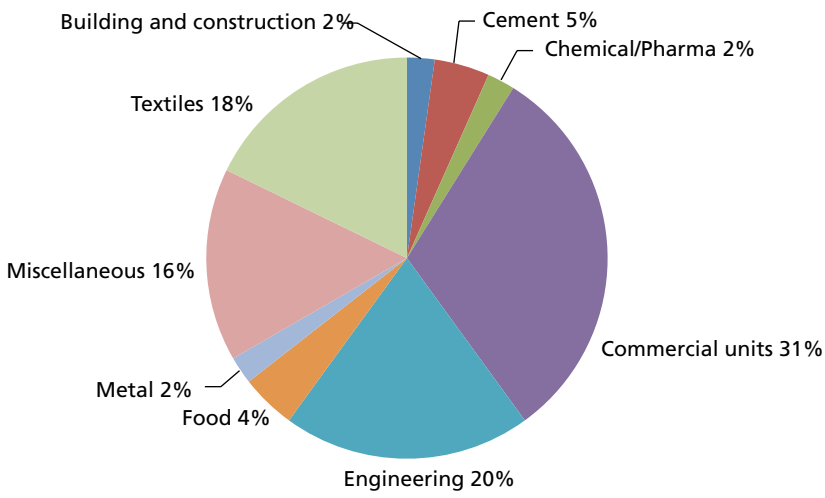
Out of 45 air polluting industries in this area, 31 per cent are from the commercial sector (mostly hotels and hospitals), 20 per cent are engineering industries (DG sets manufacturing, and assembling of LED panels and transformers), 18 per cent are textile industries (stitching and readymade garments), five per cent are cement industries, four per cent are food industries, and 16 per cent are miscellaneous industries like warehouses, call centres, and detergent manufacturing units.

Table 7: PM recorded in RIICO Industrial Area, Malviya Nagar

GPS Location (lat/long)	Date of monitoring	Average values of PM emissions	
		$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)
26.8550839, 75.8287773	11December 2019	104.88	248.2067

Source: CSE 2019–2020

Figure 12: Industrial sectors in RIICO Industrial Area, Malviya Nagar

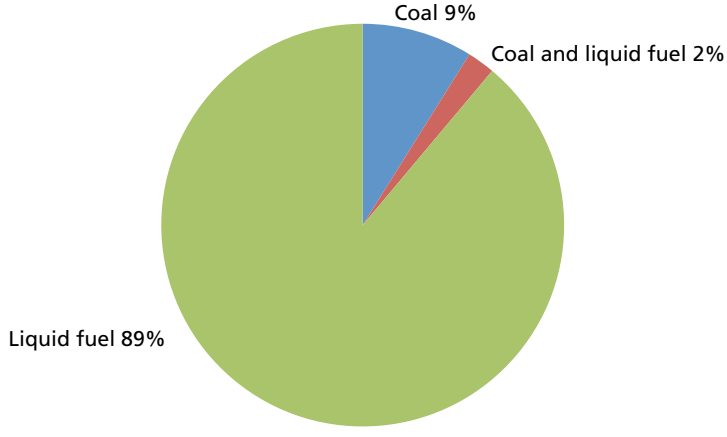


Source: CSE 2019–2020 (based on RSPCB data)

Fuel usage in RIICO Industrial Area, Malviya Nagar

Out of the 45 air polluting industries 89 per cent are using liquid fuel, nine per cent are using coal, and two per cent of the industries are using both coal and liquid fuel. None of the industries are using agro residue or natural gas in RIICO Industrial Area, Malviya Nagar.

Figure 13: Fuel usage in RIICO Industrial Area, Malviya Nagar

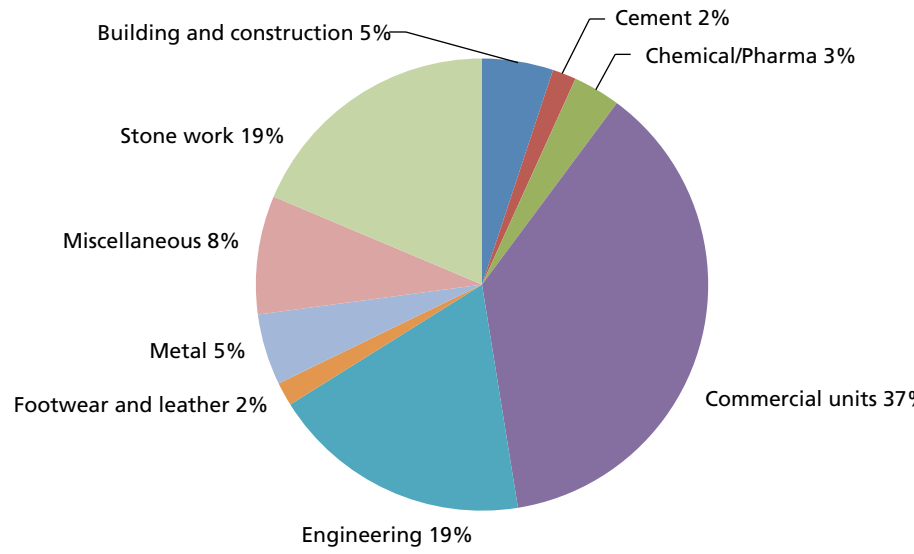


Source: CSE 2019–2020 (based on RSPCB data)

VI. Amer Industrial Area

There are 59 air polluting units in Amer Industrial Area, out of which 37 per cent belong to the commercial sector (mostly hotels and some hospitals), 19 per cent belong to the engineering sector (manufacturing DG sets), 19 per cent are stone-work industries (manufacturing stone grit and dust), and 19 per cent are miscellaneous industries like warehouses, automobile assembly plants, and compost manufacturing. Apart from these, there are building and construction units, metal processing units, chemical/pharmaceutical manufacturing units, and cement industries.

Figure 14: Industrial sectors in Amer Industrial Area

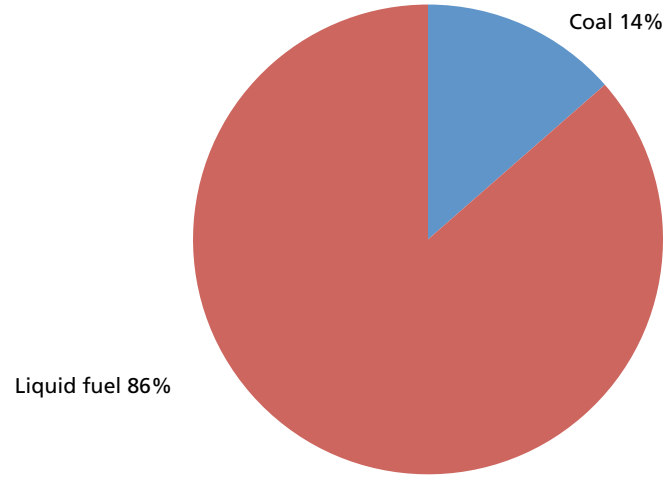


Source: CSE 2019–2020 (based on RSPCB data)

Fuel usage in Amer Industrial Area

Out of the 59 air polluting industries 86 per cent are using liquid fuel, and 14 per cent are using coal.

Figure 15: Fuel usage in Amer Industrial Area

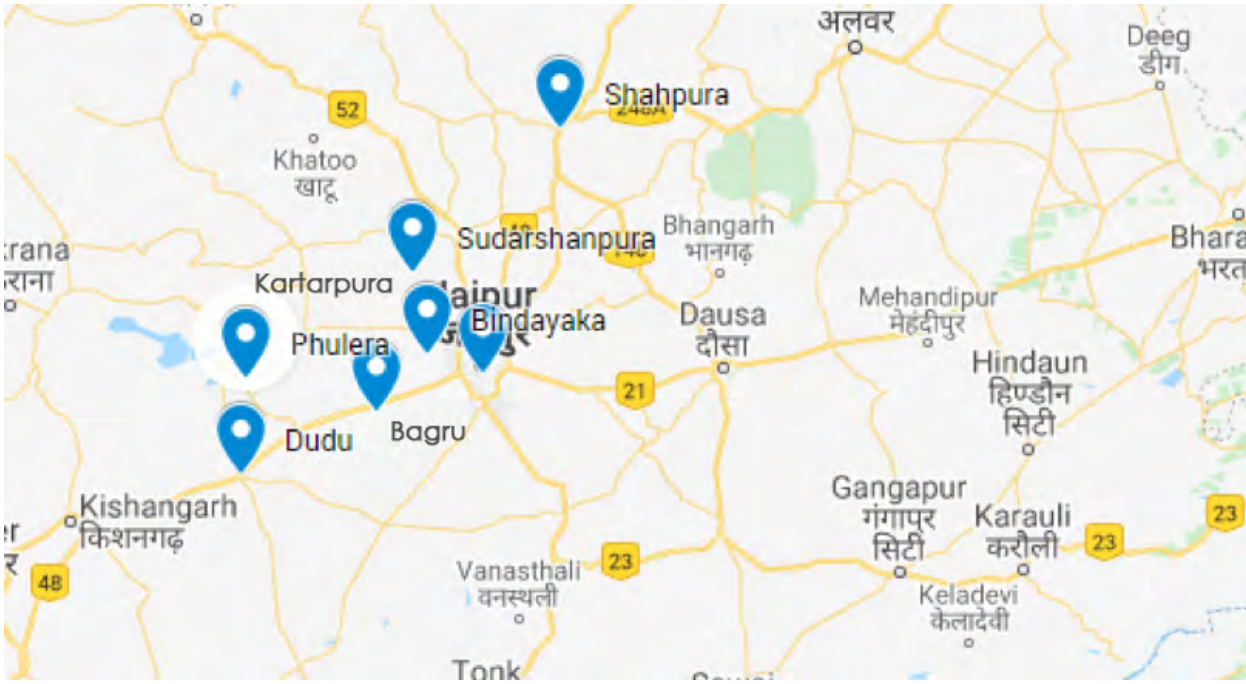


Source: CSE 2019–2020 (based on RSPCB data)

VII. Jaipur Rural Industrial Area

There are 145 air polluting units in the categorization of Jaipur Rural Industrial Area. This category includes seven smaller industrial areas—Bagru, Bindayaka, Dudu, Kartarpura, Phulera, Shahpura, and Sudarshanpur. The maximum number of industries (74) are located in Bagru Industrial Area.

Map 2: Industrial areas in Jaipur Rural Industrial Areas category



Source: Google Maps. CSE 2019–2020

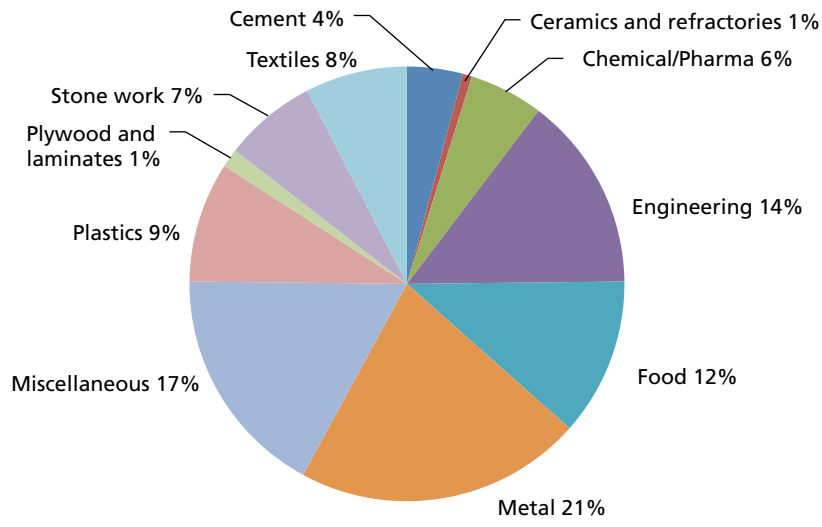
Table 8: Industrial sectors in Jaipur rural industrial area

Industrial sectors	Bagru	Bindayaka	Dudu	Kartarpura	Phulera	Shahpura	Sudarshanpura
Cement	1	1	4	-	-	-	-
Ceramics and refractories	1		-	-	-	-	-
Chemical/pharmaceutical	8	-	-	-	-	-	
Engineering	2	2	5	1	8	3	-
Food	6	5	1	1	1	3	-
Metal	26	2	1				2
Miscellaneous	12	1	5	2	2	2	1
Plastics	5	2	2	1	1	2	-
Plywood and laminates	1	-	1		2		-
Stone-work	2	-	6	-	-	-	-
Textiles	10	1			-		-
Total	74	14	25	5	14	10	3

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

Out of 145 air polluting industries 21 per cent are metal processing units, 14 per cent are DG manufacturing units, 12 per cent are food processing units, and 17 per cent are distributed between miscellaneous sectors like furnace oil, surgical cottons, and perfume.

Figure 16: Industrial sectors in Jaipur Rural Industrial Area

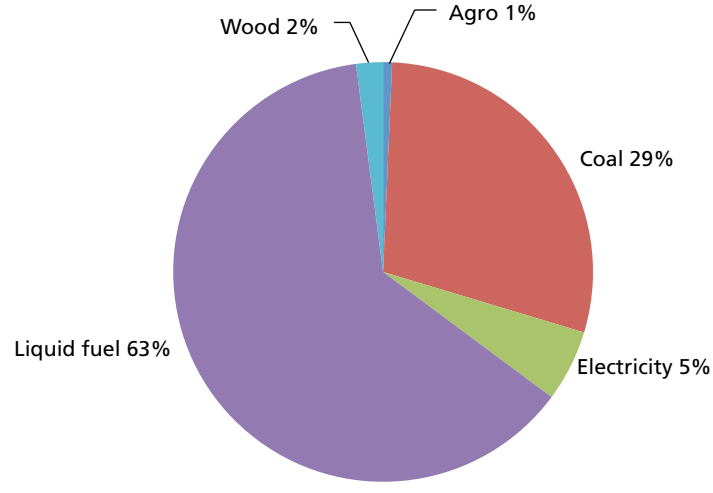


Source: CSE 2019–2020 (based on RSPCB data)

Fuel usage in Jaipur Rural Industrial Area

Out of the 145 air polluting industries in Jaipur Rural Industrial Area, 63 per cent are using liquid fuel, 29 per cent are using coal, five per cent are using electricity, two per cent are using wood, and one per cent of the industries are using agro residue as fuel.

Figure 17: Fuel usage in Jaipur Rural Industrial Area

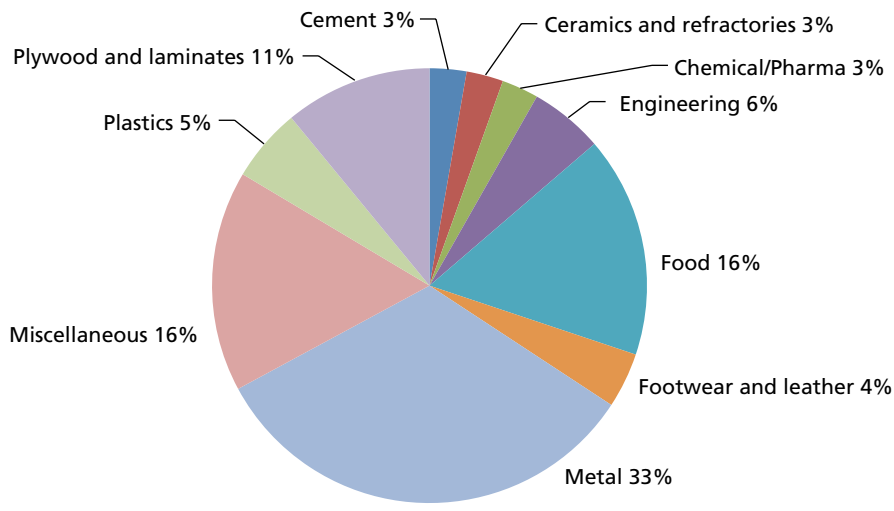


Source: CSE 2019–2020 (based on RSPCB data)

VIII. Kaladera Industrial Area

There are 73 air polluting industries in this area, out of which 33 per cent are metal processing units (mostly casting), 16 per cent are food processing units (dairy, mustard oil, and cattle feed), and 16 per cent are miscellaneous units like paper-based industries, quartz powder, sanitary wares, and re-refining of used oil.

Figure 18: Industrial sectors in Kaladera Industrial Area

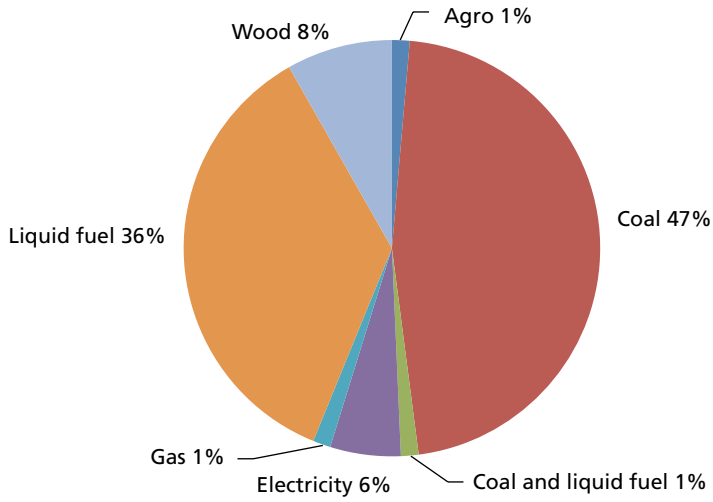


Source: CSE 2019–2020 (based on RSPCB data)

Fuel usage in Kaladera Industrial Area

Out of the 73 air polluting industries in Kaladera Industrial Area, 47 per cent are using coal, 36 per cent are using liquid fuel, eight per cent are using wood, six per cent are using electricity, one per cent are using agro waste, one per cent are using natural gas as fuel, and remaining one per cent are using both coal and liquid fuel.

Figure 19: Fuel usage in Kaladera Industrial Area

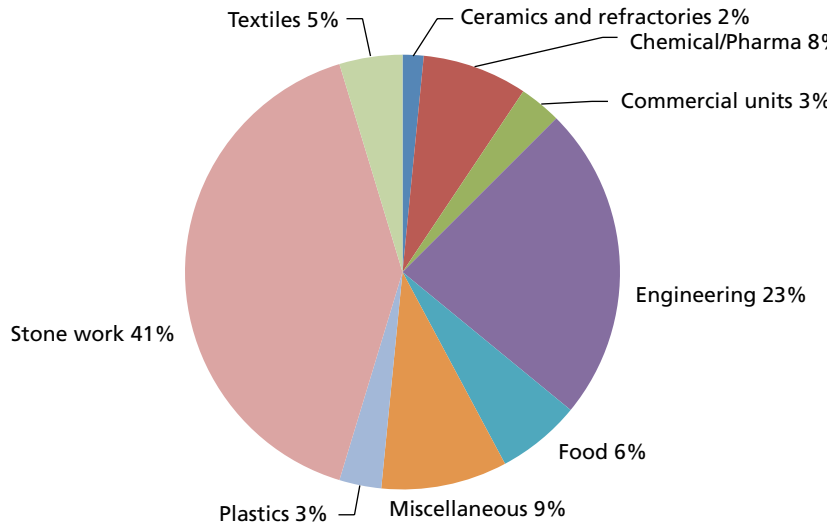


Source: CSE 2019–2020 (based on RSPCB data)

IX. Kotputli Industrial Area

There are 64 air polluting industries in this area, out of which 41 per cent are stone-works (manufacturing stone grit and dust), 23 per cent are manufacturers of DG sets, eight per cent are chemical/pharmaceutical industries, and nine per cent are miscellaneous units like paper-based industry, china clay washing plant, and fuel oil manufacturing industries.

Figure 20: Industrial sectors in Kotputli Industrial Area

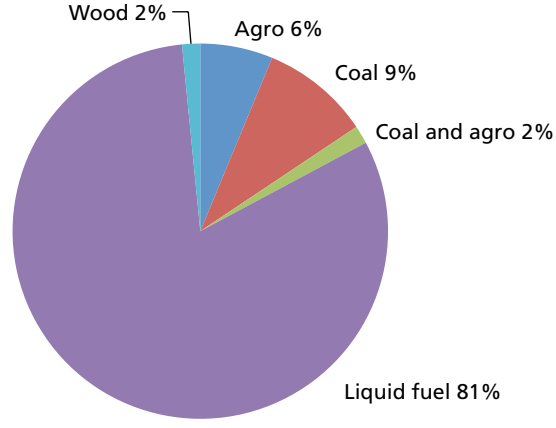


Source: CSE 2019–2020 (based on RSPCB data)

Fuel usage in Kotputli Industrial Area

Out of the 64 air polluting industries in Kotputli Industrial Area, 81 per cent are using liquid fuel, nine per cent are using coal, six per cent are using agro residue, two per cent are using both coal and agro residue, and two per cent of the industries are using wood as fuel.

Figure 21: Fuel usage in Kotputli Industrial Area

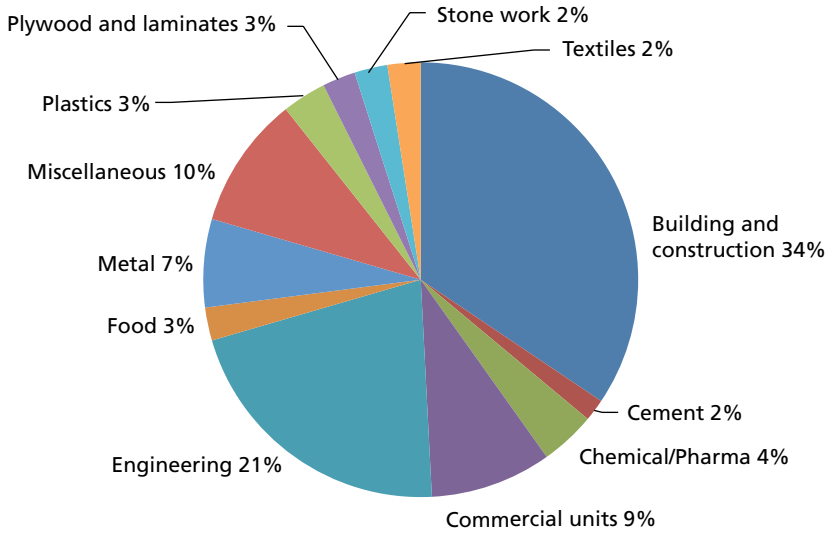


Source: CSE 2019–2020 (based on RSPCB data)

X. Sanganer Industrial Area

There are 122 air polluting industries in Sanganer Industrial Area, out of which 34 per cent belong to the building and construction sector, 21 per cent belong to the engineering sector (DG set manufacturing units, electric power generation, and transformer and lead battery manufacturing units), seven per cent belong to the metal processing sector, ten per cent belong to the miscellaneous sector (paper-based industry and soap manufacturing units), and nine per cent belong to the commercial sector (mostly hotel and hospitals).

Figure 22: Industrial sectors in Sanganer Industrial Area

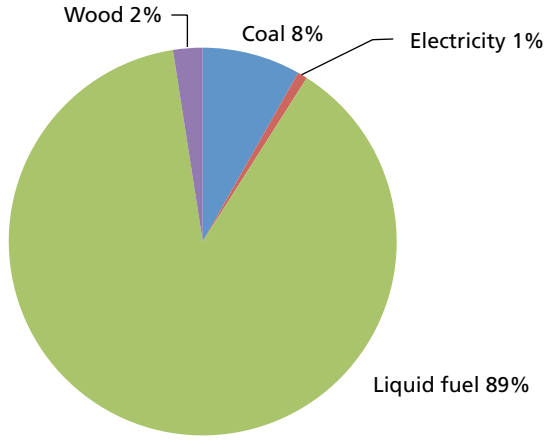


Source: CSE 2019–2020 (based on RSPCB data)

Fuel usage in Sanganer Industrial Area

Out of the 122 air polluting industries in Sanganer Industrial Area, 89 per cent are using liquid fuel, eight per cent are using coal, two per cent are using wood, and one per cent of the industries are using electricity as a fuel.

Figure 23: Fuel usage in Sanganer Industrial Area

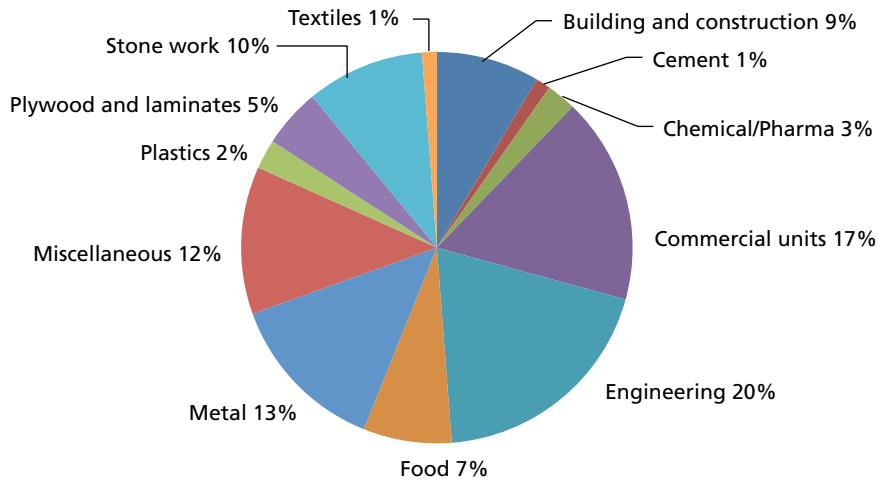


Source: CSE 2019–2020 (based on RSPCB data)

XI. Other industrial areas

There are a total of 82 air polluting units under the category of other industrial areas. This category consists of small industrial areas and industries which are not located in any specific industrial area. One of the major industrial clusters under this category is the Chomu Industrial Area with 28 units. The predominant industry in Chomu Industrial Area is steel casting. Out of 82 units in other industrial areas, 20 per cent are engineering units (manufacturing DG sets), 17 per cent are commercial units (mostly hotels), 13 per cent are metal processing units (mostly casting units), and 10 per cent are stone grit and dust manufacturing units.

Figure 24: Industrial sectors in other industrial areas



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

The CSE team visited one steel recycling plant in Chomu Industrial Area. The plant uses iron pipe scrap as a raw material in the iron and steel recycling plant. This plant operates two days in a week as they have just started operations recently. It uses about 25 kilograms of coal, in addition to 12 kilograms of stone (used for removing waste from the scrap iron in furnace), for the production of 300 kilograms of iron. The plant's production capacity is 10–12 tonnes per day.

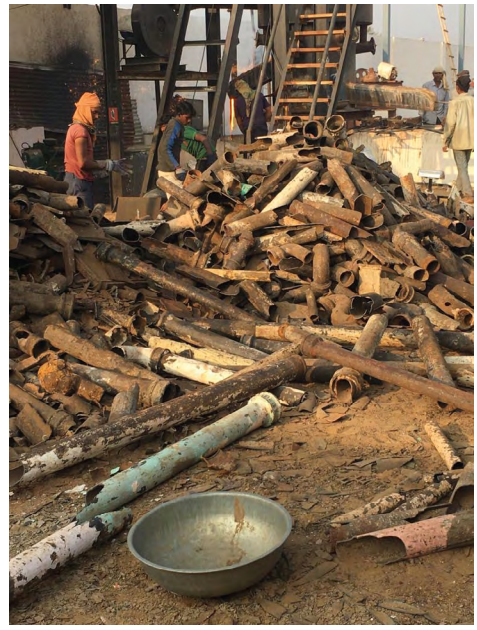


Image 7: Steel scrap used as raw material in steel casting industries in Chomu Industrial Area

Image 8: Steel recycling plant in Chomu Industrial A rea

Source: CSE 2019–2020

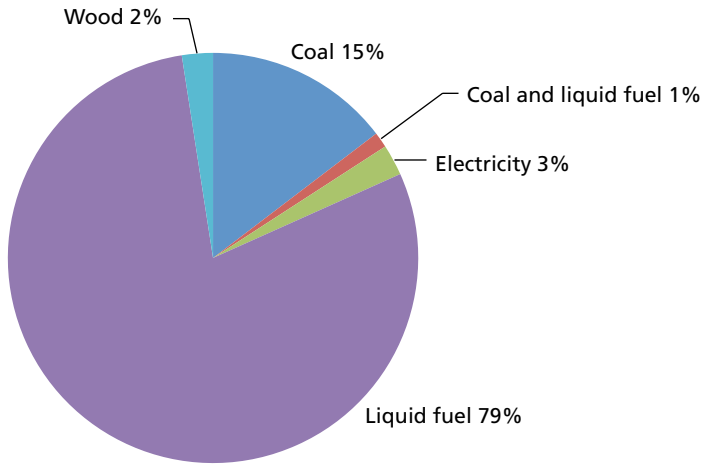
Predominant industries in Chomu Industrial Area with significant stack emissions are steel casting industries. Smoke emitted from such industries is

the major cause of air pollution in this industrial area. The general condition of roads and other infrastructure in the industrial area is satisfactory.

Fuel usage in other industrial areas

Out of the 82 air polluting industries in other industrial areas, 79 per cent are using liquid fuel, 15 per cent are using coal, two per cent are using wood, three per cent are using electricity, and one per cent is using both coal and liquid fuel.

Figure 25: Fuel usage in other industrial areas



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

Box: Brick kilns in Jaipur district are a major source of air pollution

The state of Rajasthan has more than 1500 brick kilns with around 168 legally operating brick kilns in the district of Jaipur. None of them have converted to zigzag technology and there are a number of illegal kilns operating in the state and in the Jaipur district. These issues have been raised by the Comptroller and Auditor General of India (CAG) and the National Green Tribunal (NGT).

33 brick kilns operating illegally in Jaipur

TNN | Updated: Feb 28, 2018, 10:09 IST

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JAIPUR: The CAG report expresses alarm over the illegal operation of 33 brick kilns in Jaipur.

The documents express surprise that no concrete steps were taken by Rajasthan State Pollution Control Board (RSPCB) against these units. "Out of 33, three were found to have been running regularly during inspection carried out by the officials. Even the closure notice issued to them six years ago went unheard."

Source: Times of India. https://timesofindia.indiatimes.com/city/jaipur/33-brick-kilns-operating-illegally-in-city/articleshow/63101770.cms

NGT notice to state govt over illegal brick kilns

TNN | Updated: Feb 10, 2018, 12:46 IST

Ad
Dell Precision - Work at the speed of thought
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National Green Tribunal

JAIPUR: The National Green Tribunal (NGT) on February 7 issued notices to Union environment ministry and the governments of Rajasthan, Uttar Pradesh and Haryana over illegal operation of brick kilns.

State pollution control board has been directed to inspect the brickfields and examine if they are complying with the environmental norms. The brick kilns that have come in the line of fire in the NGT order in Rajasthan are located in Alwar and Bharatpur.

Source: Times of India. https://timesofindia.indiatimes.com/city/jaipur/ngt-notice-to-state-govt-over-illegal-brick-kilns/articleshow/62856861.cms

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 data in the case of Jaipur district has been extracted from the online consent to operate (CTO) forms uploaded on the RSPCB website. The data extracted from the CTO forms did not have the quantity of fuel being used by each industry; therefore, the process of load estimation under scenario 2 in the methodology (see *Annexure 1*) was adopted. Details of the combustion equipment in industries and the fuel type are used to calculate the fuel consumption by various industrial clusters of the district. The major combustion equipment being used in the district are furnaces, boilers, and thermic fluid heaters (TFHs). Liquid fuel and coal are the most widely used fuels by industries in Jaipur district.

Table 9: Overall number and capacity ranges of combustion equipment operating in the industries of Jaipur district

Industrial combustion equipment in Jaipur district					
Furnaces		**Boilers**		**TFH**	
Capacity range (in tonnes per hour)	**Number**	**Capacity range (in tonnes per hour)**	**Number**	**Capacity range (in lakh kcal/ hr)**	**Number**
Below 3	173	Below 3	197	Below 5	63
3 to 10	21	3 to 10	11	5 to 10	11
Above 10	12	Above 10	11	Above 10	11
Total	206	Total	222	Total	87

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

Fuel Usage in industrial areas of Jaipur district

Although a larger share of industries in Jaipur district consumes liquid fuel, the largest quantity of fuel being consumed is coal. More than 0.6 million tonnes of coal is being consumed by the industries in the district and VKIA is the largest coal consumer (0.17 million tonnes per year) followed by Kaladera and Kotputli industrial areas. VKIA is also the largest consumer of liquid fuel (0.11 million tonnes) in the district. The quantity of agro-based fuel being consumed in the district is also significant, although the consumption of gas as a fuel is still very low.

Table 10: Quantity of fuel used in different industrial areas of Jaipur district (in tonnes per year)

Industrial area	Coal (tonnes per year)	Agro residue (tonnes per year)	Liquid fuel (tonnes per year)	Wood (tonnes per year)	Gas (tonnes per year)
Jhotwara	46,270		2,739	1,828	14
Malviya Nagar	13,223		7,349	0	
Bassi	39,165	39,870	3,891	17,150	
Jaipur Rural	117,530	17,107	8,203	4,435	
Kaladera	77,361	6,415	3,745	7,392	950
Others	33,376		21,994	7,484	
Sitapura	8,356		7,903	1,861	14
VKIA	178,534	5,346	113,510	14,971	2,546
Amer	15,041		37,126		
Kotputli	76,543	72,409	7,075	475	
Sanganer	10,983		15,257	4,277	
Total	616,383	141,147	228,792	59,874	3,525

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

Pollution loading from industrial areas of Jaipur district

VKIA, one of the largest industrial areas of the Jaipur cluster, contributes about 33 per cent to the overall industrial pollution load of the district, followed by Rural Industrial Area (14 per cent), and Kotputli Industrial Area (12 per cent).

Table 11: Pollution load in different industrial areas of Jaipur district

Industrial cluster	Pollutant (tonnes per year)						Avg. % share in total loading
	Controlled			Uncontrolled			
	PM	SO_2	NO_x	PM	SO_2	NO_x	
Jhotwara	203	135	190	509	426	508	5%
Malviya Nagar	72	79	84	176	358	176	2%
Bassi	329	247	352	725	421	528	7%
Jaipur Rural	559	384	537	1,401	1,128	1,307	14%
Kaladera	368	246	351	899	684	868	9%
Others	217	244	260	482	1029	493	7%
Sitapura	60	76	77	132	344	135	2%
VKIA	1,072	1,216	1,277	2,517	5,352	2,513	33%
Amer	151	275	234	338	1,443	344	6%
Kotputli	509	374	527	1,281	796	886	12%
Sanganer	97	137	132	203	628	210	3%
Total	3,637	3,414	4,019	8,664	12,609	7,969	

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

The estimation of total uncontrolled PM load for Jaipur district is 8,664 tonnes per year, SO_2 load is 12,609 tonnes per year, and NO_X load is 7,969 tonnes per year. Controlled PM load is approximately 60 per cent less than the uncontrolled PM load; controlled SO_2 and NO_X are approximately 70 per cent and 50 per cent less than the uncontrolled SO_2 and NO_X loads respectively.

Sector-wise pollution load estimation

The annual consumption of fuel for each industrial sector is calculated from the data available and the pollution load is estimated for the sectors consuming significant quantity of fuel resources. The largest amount of liquid fuel is being burnt in DG sets by the commercial units which comprise of hotels, hospitals, etc. Metal industry consumes the most liquid fuel after the commercial sector. The largest consumer of coal as a fuel is also the metal industry, which consumes somewhere around two lakh tonnes of coal per year. Food processing industry is the biggest consumer of agriculture-based fuel, while the plywood and laminates industry is the largest consumer of wood as a fuel.

Table 12: Annual fuel consumption in different industrial sectors of Jaipur district (tonnes per year)

Sector	Coal (tonnes per year)	Agro residue (tonnes per year)	Wood (tonnes per year)	Gas (tonnes per year)	Liquid fuel (tonnes per year)
Building and construction	-	-	-	-	15,434
Cement	4,673	-	-	-	1,910
Ceramics and refractories	54,886	1,810	-	-	1,344
Chemical/pharmaceuticals	12,189	-	634	-	2,321
Engineering	10,969	8,019	-	1,782	7,802
Food	101,338	89,321	18,648	-	21,479
Footwear and leather	10,211	-	158	-	1,408
Metal	197,812	-	-	371	51,759
Miscellaneous	80,932	39,798	10,501	371	45,321
Plastics	9,451	-	-	950	3,919
Plywood and laminates	25,102	2,199	20,740	-	1,669
Stone-work		-	-	-	4,761
Textiles	35,148	-	-	-	3,194
Commercial units	73,674	-	9,194	52	66,470
Total	616,383	141,147	59,874	3,525	228,792

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

The metal and food processing industries are the top-most polluting sectors and are together responsible for almost 44 per cent of the overall pollution load in the district. Some other significant polluting sectors in Jaipur district are ceramics and refractories (six per cent), commercial units (16 per cent), plywood and laminates (four per cent) and textile industry (four per cent).

Table 13: 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
Building and construction	2%	37	99	74	74	556	77
Cement	1%	24	24	26	59	102	59
Ceramics and refractories	6%	233	146	212	599	437	585
Chemical/pharmaceutical	2%	58	46	58	142	170	143
Engineering	2%	83	92	101	202	358	159
Food	18%	752	612	814	1,770	1,494	1,306
Footwear and leather	1%	46	34	45	115	123	123
Metal	26%	936	813	971	2,346	3,262	2,341
Miscellaneous	16%	576	595	675	1,347	2,206	1,147
Plastics	1.4%	48	48	53	119	208	119
Plywood and laminates	4%	186	135	195	350	242	362
Stone-work	1%	11	31	23	23	171	24
Textiles	4%	152	106	144	388	364	386
Commercial units	16%	495	632	628	1,129	2,916	1,147

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

4. Findings and recommendations

1. As per the estimates, **metal industry, food industry, and commercial units are found to be contributing about 60 per cent of the overall pollution load in the district**. Of these, **the metal industry alone accounts for 26 per cent of the loading**. These sectors should be surveyed for updates and improvements in the technology involved, fuel usage, air pollution control devices, and overall resource management.

2. **VKIA contributes about 33 per cent to the overall pollution load**, since **it has the highest number of industries**. **Only one per cent of the industries in VKIA have switched to PNG** till now. Regulatory bodies should make it mandatory for industries to switch to cleaner fuels within prescribed timelines.

3. **More than 90 per cent of the industries** in the cluster are **using coal, liquid fuel (HSD, LDO, LSHS), wood, or agro-based fuel**. **Overall, only one per cent of the total industries have switched to PNG**. There are no PNG-based industries in Bassi, Malviya Nagar, Amer, Kotputli, and Sanganer industrial areas.

4. Vishwakarma and Jhotwara are the major polluting industrial areas in the whole of Jaipur district. They are also located in close vicinity of Jaipur city. But, **the action plan prepared for the city of Jaipur** by the RSPCB **does not mention any specific steps or actions with respect to these industrial areas or the highly polluting metal industry in these areas.**

5. There are around **764 stone-based industries along with 168 mineral grinding industries** which are major sources of fugitive emissions. The **guidelines** released by RSPCB for both these sectors need to be implemented. The **non-implementation of these guidelines may also point towards the non-feasibility of these guidelines**, which may need improvements or a better implementation mechanism.

6. There are **around 168 brick kilns in the district of Jaipur and none of them have converted to zigzag technology,** which makes them a prominent source of visible pollution.

7. **Improper waste management** is a problem in most of the industrial areas of Jaipur. VKIA, the biggest industrial area in Jaipur, did not seem to have any proper system for industrial waste management, and multiple sites of waste dumping and waste burning could be seen in the area.

8. The **road network** in different industrial areas, even the ones which were located inside Jaipur city, was **not in the best condition**. The internal roads in VKIA and Jhotwara were in especially poor condition.

5. Industrial air pollution action plan for Jaipur district

Action plan table

Sr. no.	Action points	Responsible agencies	Timeline	Existing scenario
SECTORAL ACTIONS				
1.	Implementation of fuel change to natural gas or electricity on a priority basis for all stack-based industries throughout the district. Areas like Vishwakarma, Jhotwara, Kotputli, Kaladera, Bassi, and Bagru should be prioritized. 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 the above mentioned industrial areas. • Prepare a plan of action on how all the stack-based industries (especially in the prioritized areas) will be convinced to switch to cleaner fuel. • Preparation of an advocacy plan to engage with the Petroleum and Natural Gas Regulatory Board (PNGRB) and other relevant stakeholders 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.	RSPCB, RIICO, and local industrial associations (LIAs)	-Three months for current status report on gas pipeline network and the plan of action for the completion of the network. -Three months for preparing an advocacy action plan for bringing natural gas under GST, to contain price fluctuations, and present the plan to all stake holders on completion.	-The prioritized industrial areas are responsible for almost 70 per cent of the overall pollution load of the whole district. -Non-inclusion of natural gas under GST and regular price fluctuations make it a non-preferred fuel compared to the others.
Stone-works				
2	Prepare an implementation plan for strict implementation of Stone Crusher Guidelines by RSPCB for all stone crusher units in Jaipur district. The plan should include at least five key steps that all stone crushers would have to implement in their units to prevent closure. The provision of personal protective gear to all workers in these units should be made compulsory and strictly implemented.	RSPCB and Association of Stone Work Units	Three months	Around 764 stone-work units operate in the district and are 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	

Sr. no.	Action points	Responsible agencies	Timeline	Existing scenario
4	Preparation of guidelines for all other stone-work units which have fugitive emissions apart from stone crushers. Some of these are units that prepare stone-based railings, jali, statues, lamps, and other items. CNC stone cutting machines which use water to avoid emissions can be recommended for such units although they are expensive. Cheaper technologies can be found to be recommended in the guidelines.	RSPCB	Three months	
Mineral grinding industry				
5	Prepare a plan for strict implementation of Mineral Grinding Guidelines by RSPCB for all mineral grinding industries in Jaipur district. The plan should include at least five 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 units should be made compulsory and strictly implemented.	RSPCB and Association of Mineral Grinding Industries	Three months	Around 168 mineral grinding units operate in the district and are responsible for high amounts of fugitive emissions.
6	Conduct a stakeholder meeting for immediate roll out of the implementation plan.	RSPCB	Immediately after preparation of implementation plan	
Metal industry				
7	Prepare an implementation plan to shift all metal industries in the district (especially the prioritized areas) towards cleaner fuel (especially electrical induction furnaces).	RSPCB and Metal Industries Associations of different industrial areas	Six months	The metal industry is responsible for almost 33 per cent of the overall pollution load and has been identified as the most polluting sector in the district.
8	Conduct a stakeholder meeting in all key industrial areas with respect to metal industry (especially VKIA and Jhotwara Industrial Area) for immediate roll out of the implementation plan.	RSPCB	Immediately after preparation of implementation plan	
Food processing industry				
9	Prepare a stage-wise implementation plan and guidelines for food processing industries to switch from other fuels to natural gas. They can shift to agriculture-based fuel until gas is available in their area.	RSPCB and Food Processing Industrial Associations in different areas	Three months for action plan and guidelines	The food processing industries are responsible for 18 per cent of the overall pollution load and have been identified as the second most polluting sector in the district.
10	Conduct a stakeholder meeting for immediate roll out of the implementation plan.	RSPCB	Immediately after preparation of implementation plan	

Sr. no.	Action points	Responsible agencies	Timeline	Existing scenario
Commercial units				
11	Feasibility of gas-based generators replacing diesel-based generators should be checked immediately and an implementation plan to replace DG sets with gas based generators should be prepared and accordingly implemented. The replacement timeline should be in synch with gas supply pipeline in the area.	RSPCB and Associations of Commercial Units	One month for checking feasibility, the next two months to prepare the implementation plan, and the next six months for implementation on the ground.	
Brick kilns				
12	Make an inventory of all illegal brick kilns. Mandatory conversion of all brick kilns in the district to zigzag technology and closure of all illegal brick kilns.	RSPCB	Make inventory in one month and push for immediate technology conversion.	Currently 168 brick kilns are operating legally in Jaipur district which have not converted to zigzag technology. There are a number of illegal kilns in the district as well.
OTHER ACTIONS				
13	Formation of committees 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 responsible entities for each management plan and their schedule of implementation.	The committee shall include representatives from RSPCB, RIICO, LIAs, 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 condition of roads, waste management, housekeeping, and plantations is poor in majority of the industrial areas. That needs to improve to control fugitive emissions in the area.
14	Setting up of waste management facility for non-hazardous waste on a land allotted by RIICO in every industrial area.	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	The continuous movement of heavy diesel vehicles on roads with poor condition accelerates the PM10 levels in the area immensely.
16	Increasing capacity of regional offices of the pollution control board by : - Hiring more technical personnel - Strengthening the capacity of their labs and equipment - Conducting trainings for their employees - Hiring more credible third party organizations for monitoring and compliance	RSPCB	Hiring 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.

Annexure 1: Methodology for estimation of pollution load

Before going into the detailed methodology, it is important to understand the various dataset and other necessary information required for estimating the pollution load of an industrial area. The most authentic source of this data can be the state regulatory body, i.e. SPCBs of the respective states. The data set could also be sourced from any credible research organization or any other credible stakeholder agency.

1. Details of the industrial data required

The industrial pollution load can be calculated using the following data:

1. Any one of the following dataset:
   - Yearly average of stack emissions, velocity of flue gas, and stack diameter of each industry.
   - Yearly average fuel consumption data of industries.
   - Capacity of the various combustion equipment installed in the industry along with type of fuel used.

2. Applicable emission norms (for PM, SO_2, and NO_X) for the combustion equipment, various industrial sectors, and type of fuel used.

3. Specification of different fuels used in the industry, for ex. calorific values, theoretical air requirement for combustion of one kg of fuel, and ash or sulphur content in some cases.

4. Emission factors for different pollutants with respect to different fuels.

2. Controlled and uncontrolled pollution load

The pollution load is calculated in two scenarios, controlled and uncontrolled, as defined below:

1. *Controlled pollution load:* This load has been calculated considering equipment installed and fuel used in all the industrial sectors. Emission standards are taken to estimate the controlled pollution load for PM, SO_2 and NO_X. It is assumed that all the industries operating are in compliance with norms and have proper air pollution control devices.

2. *Uncontrolled pollution load*: This load has been calculated considering that there are minimal air pollution control technologies installed in the industries. An emission factor for each fuel is taken from AP-42 (USEPA, 2000)[5], considering the different types of combustion equipment installed in the industries in all the study areas.

CSE could not get the emission data of the industries from any of the study areas. Therefore, pollution loading is done based on either the fuel consumption data of the industries, received from the RSPCB, or by using combustion equipment details, provided by RSPCB or extracted from the CTO forms of the industries available in the public domain. Based on the data available, the load has been estimated for both controlled and uncontrolled scenarios. The different data availability and their respective methodologies for load calculation have been explained below:

A. **Scenario 1: If fuel consumption data is available for the industries in an industrial area, the following steps have been followed :**

1. Fuel consumption figures might be available in different units like kg per hour, tonnes per day, litres per day, etc. It is required to streamline the fuel consumption data and extrapolate the same to annual consumption figures in tonnes per year. (Considering 330 working days and daily hours of operation between 8–24 hours based on the industrial sector).

2. Compilation of the annual consumption figure for different fuels.

3. For controlled pollution load estimation, the emission standards and theoretical combustion air requirement of fuel is considered.

4. For uncontrolled pollution load, emission factors are taken from AP-42 (USEPA, 2000) for each fuel. Sulphur and ash content are considered as per the fuel properties given in Energy Efficiency in Thermal Utilities, Bureau of Energy Efficiency (BEE) handbook, 2015.

B. **Scenario 2: If data on details of combustion equipment and the type of fuel used is available for the industries in an industrial area, the following steps have been followed:**

Fuel consumption figures to be estimated for different equipment
For estimating the fuel usage in different equipment, factors have been worked out based on the different parameters of equipment installed and fuel used. Boilers, furnaces, and TFH are the major equipment and coal, wood, fuel oil, agro residue, and gas are the main fuels used in the industries.

- **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 equipment are used to calculate the said ratio. The detailed table on boilers using different fuels and their respective factors for the estimation of fuel consumption is given below.

Table: 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	

- **Furnace**: 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 detailed table on furnaces using different fuels and their respective factors for the estimation of fuel consumption is given below.

Formula used for the calculation of fuel used per tonne of metal melt 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 (one tonne)
Sp heat $_{stock}$= Specific heat of stock (taken for MS scrap)
Latent $heat_{stock}$= Latent heat of stock (taken for MS scrap)
T_{final}= Final temperature of stock
$T_{initial}$= Initial temperature of stock
Eff_{furn}= Furnace efficiency[6]
Cal. value $_{fuel}$ = Calorific value of fuel

Table: 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	Ambient temp 25–40
Final temp. of stock (°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	
Factor	0.27	0.10	0.31	0.23	0.09	Calculation above

- **TFH:** For estimation of fuel consumed in TFH, following calculation process has been followed:

  A coal fired TFH capacity = 1,500,000 kcal/hr
  Calorific value of fuel used—Coal = 4,000 kcal/kg
  Efficiency[7]= 80%
  Fuel consumption in TFH = ((Capacity (kcal/hr)/Cal. value)*Eff.)/1000*Operating hours
  = (((1500000/4000)*0.8)/1000)*12 hrs/day
  = 3.6 tonnes/day

- **Diesel generator:** Where the rating of DG sets is available, fuel consumption by the DG set is calculated as given below:

  Fuel consumption for DG = (KVA*Eff_{motor}*Power factor)*Sp. fuel cons.*Optg. hours)/1000
  DG rating = 750 KVA
  Fuel consumption = ((750*0.9*0.9)*0.28*3)/1000
  = 0.51 tonnes per day

Fuel consumption is calculated using the above factors and considering 330 working days in a year and daily hours of operation between 8–24 based on the industrial sector. For DG sets, hours of operation are considered as three hours per day.

Once the annual fuel consumption was calculated, the same process as mentioned in scenario 1 above was used to calculate controlled and uncontrolled pollution load.

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Air quality standards in Jaipur are one of the worst in the world. While there are many reasons for air pollution in the city, this report identifies prominent industrial hotspots and the major industrial sectors in Jaipur district that are responsible for a majority of this pollution. 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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