

Air pollution in Punjab

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Table of contents

1	Air Environment	5
2	Drivers and Pressures.....	5
2.1	Population and Economic Growth	5
2.2	Industries.....	6
2.3	Transport.....	7
2.4	Agricultural residue burning	7
3	Baseline Emissions	7
4	State of air quality	8
5	Impact.....	10
6	Response.....	11
7	Barriers	13
8	Conclusion and Future Recommendations	13
7.1	Transport	14
7.2	Open Burning.....	15
7.3	Industries	15
9	References	16

List of Tables

Table 1: Air quality monitoring stations in Punjab under NAMP.....	8
Table 2: Different pollutants and their impact on human health	10
Table 3: Air quality and impact studies in Punjab	11
Table 4: Interventions taken to curb air pollution in Punjab	12
Table 5: Auto Fuel Policy for India 2002.....	14

List of Figures

Figure 1: Growth of Population (1961-2011), Per Capita income and Net State Domestic Product (NSDP) at current prices for Punjab	5
Figure 2: Percentage Distribution of NSDP at factor cost by sectors in Punjab at current prices	6
Figure 3: Growth of Industrial sector (Small scale, Medium & Large scale industries) in Punjab	6
Figure 4: a) Growth of Vehicles b) Modal share of vehicles in Punjab	7
Figure 5: Sector-wise emissions for criteria pollutants from different sources in Punjab in 2010.....	8
Figure 6: For Punjab, Annual average of RSPM SO ₂ and NO _x concentration for different cities during 2007-2012	10
Figure 7: Sector-wise predicted emissions for criteria pollutants from different sources in Punjab in 2030 and 2047	14

1 Air Environment

Punjab, predominately an agrarian state is also well known for its rapid industrialization in the post-independence period. There were only few industrial units mainly food grains, cotton grinning and brick kilns before independence era (Planning Commission, 2002). But with the advent of green revolution and process of liberalization and economic reforms, manufacturing sector geared up in Punjab. Majority of these industries use coal as a main fuel which correspondingly resulted into increase in the levels of air pollution in the state over the time period. RSPM (Respirable Suspended Particulate Matter) levels are above the maximum permissible limits by CPCB in almost all the cities of Punjab. This chapter briefly discusses the drivers and pressures responsible for the increasing levels of air pollutants in the state and the status of air quality, its impacts and the steps/interventions taken to curb this environmental issue.

2 Drivers and Pressures

Major sources of air pollution in Punjab include industries, vehicular sector and agricultural burning (CPCB, 2010; Envis Punjab, 2015). However, growth of population and various developmental activities in the state are the driving forces behind the deteriorated air quality of the state.

2.1 Population and Economic Growth

Population in Punjab has grown over 2.5 times in past 50 years (Figure 1). While the rate of population growth has stabilized over the years, the Net State Domestic Product (NSDP) for Punjab has increased three fold during 2004-05 to 2012-13. Correspondingly per capita income of the state at current prices has increased from INR 33103 in 2004-05 to INR 84526 in 2012-13. However, growing population base exerts huge demands on manufacturing sector which in turn put pressures on quality of land, air and water resources.

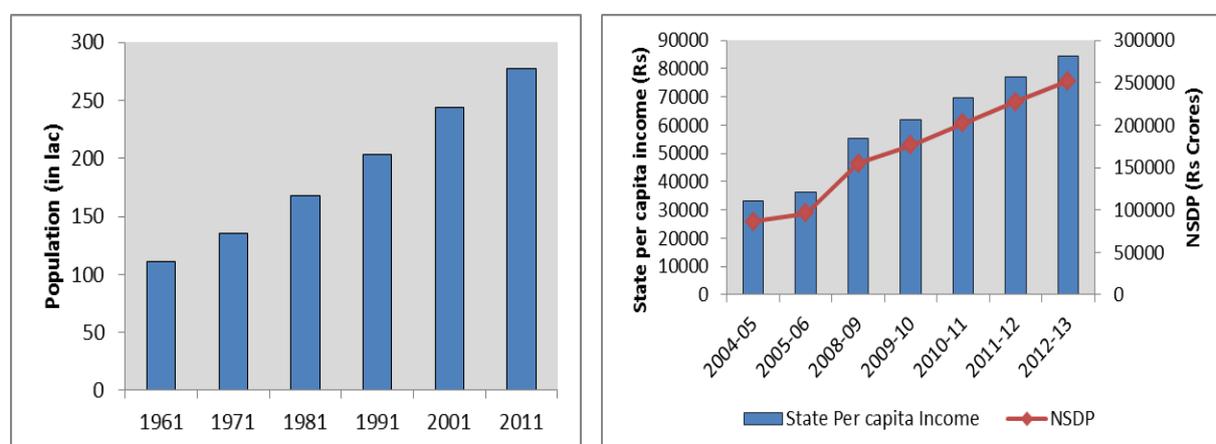


Figure 1: Growth of Population (1961-2011), Per Capita income and Net State Domestic Product (NSDP) at current prices for Punjab

Source: Statistical Abstract Punjab (2013)

Punjab has one of the highest per capita incomes in the country. However, tertiary sector has now surpassed the primary sector in their contributions to the overall NSDP of the state (Figure 2).

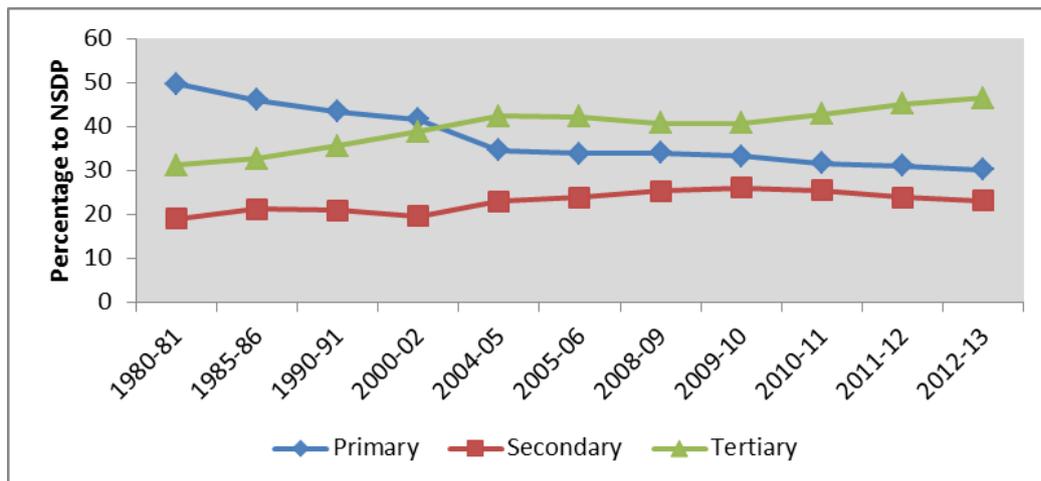


Figure 2: Percentage Distribution of NSDP at factor cost by sectors in Punjab at current prices

Source: Statistical Abstract Punjab (2013)

2.2 Industries

Industries are significant contributors for the deterioration of air quality in Punjab. In 2011-12, around 13070 industrial units in Punjab were put under red category (highly polluting) industries by the central government. Around 1.68 million small scale industries and 425 large and medium scale industries are presently functioning in Punjab (GoP, Env. Statistics, 2011). Figure 3 shows the growth of small and medium/large scale industries in the state. Decrease in the number is due to closure of some units in past few years. However the number is significant in terms of functional units in the country.

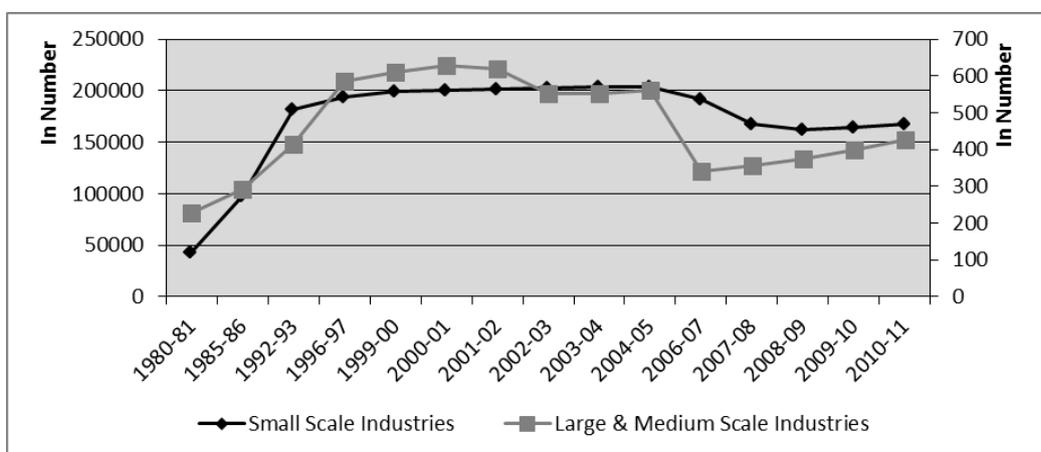


Figure 3: Growth of Industrial sector (Small scale, Medium & Large scale industries) in Punjab

Source: GoP, Env. Statistics, 2011, Deptt. Of Industries 2006, Planning Commission (2002), Punjab

2.3 Transport

Transport sector is one of the most important contributors to air pollution more specifically in the urban areas. Figure 4a shows that number of registered vehicles in the State has reached to approximately 63 lakhs in 2012 which is almost double of the figure a decade ago. (29 lac to 63 lac). Cars and two wheelers are contributing the most in this growth of vehicular fleet (Figure 4 b). In terms of vehicular population in 2012, Punjab is among the top ten states in the country.

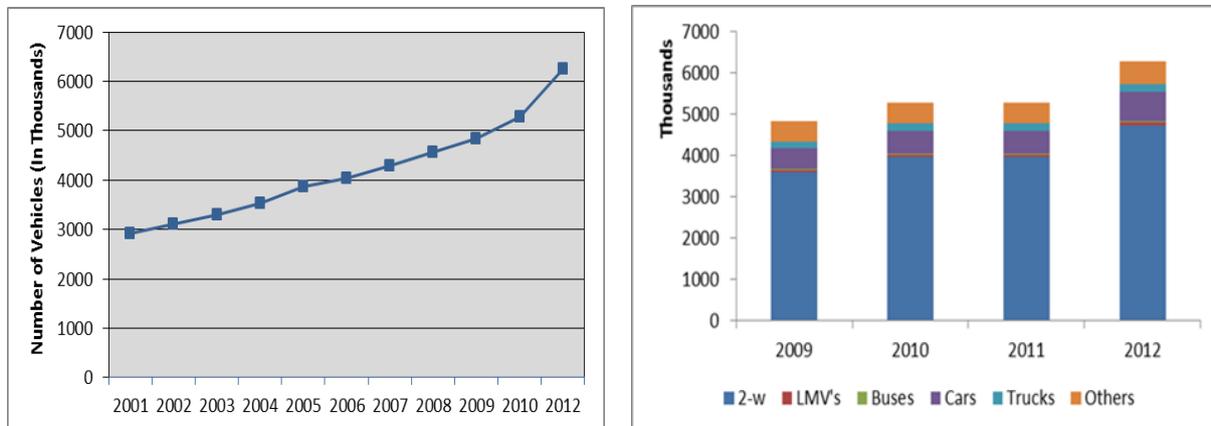


Figure 4: a) Growth of Vehicles b) Modal share of vehicles in Punjab

Source: MoPNG 2013

2.4 Agricultural residue burning

Air pollution through agricultural residue burning during the months of Mar-Apr and Oct-Nov largely affects both the states of Punjab and Haryana. Around 16 million tonnes of paddy and 8 million tonnes of wheat straw are burnt in the agricultural fields every year leading to air pollution in the state and nearby areas (Envis Centre, 2014).

3 Baseline Emissions

Statewise emission assessment study (TERI, 2015) shows sector-wise emissions for the Punjab state (Figure 5). Industrial combustion contributes 47% of the PM₁₀ emissions followed by brick and open burning. Almost 56 % of NO_x emissions are contributed by transport sector in Punjab including both road transport and mode of transportation used during agricultural activities.

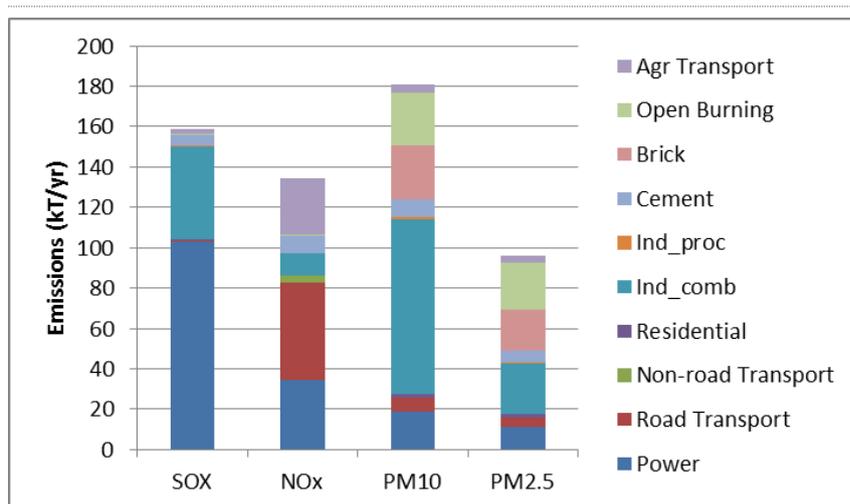


Figure 5: Sector-wise emissions for criteria pollutants from different sources in Punjab in 2010

4 State of air quality

Currently Punjab has 24 air quality monitoring stations in 11 cities under the National ambient air quality Programme (NAMP) of CPCB (CPCB, 2014) as shown in Table 1. There are 12 monitoring station each in industrial and residential areas.

Table 1: Air quality monitoring stations in Punjab under NAMP

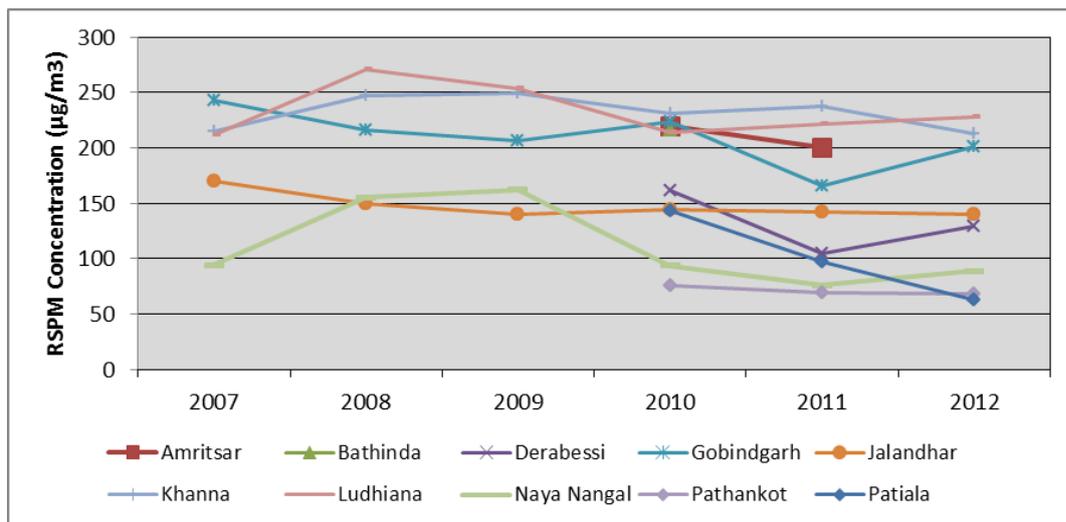
Cities in Punjab	Location	Residential (R)/ Industrial(I)
Amritsar	R.O. Focal Point	Industrial
	A-1,Platers	Residential
Bhatinda	Bathinda Milk Producers, Dabwali Road	Industrial
Dera Bassi	Punjab Chem and Crop Protection, Bhanakarpur Rd	Industrial
	Winsome Yarns Ltd., Barwala Road	Industrial
Pathankot/Dera Baba	C-PYTE Building	Residential
Gobindgarh	Modi Oil and General Mills, Mandi	Residential
	Raj Steel Rolling Mills, Mandi	Industrial
	United Rolling Mills, Mandi Gobindgarh	Residential
Jalandhar	Municipal Council Tubewell No. 27	Residential
	Regional Office	Residential
	Punjab Maltex , Kapurthala Road	Industrial
	Focal Point	Industrial
Khanna	Markfed Vanaspati, Khanna	Industrial
	AS School, Khanna	Residential
Ludhiana	Bharat Nagar Chowk	Residential
	Nahar Spining Mills, Dholewal Chowk	Industrial
	Ludhiana Coop. Milk Producer, Ferozpur Rd	Industrial
	PPCB Office Building, Vishavkarma Chowk	Residential
Naya Nangal	Punjab Alkalis & Chemicals Ltd	Residential

Patiala	M/s NFL Guest House, Naya Nangal	Residential
	Ceylon Industries, Factory Area, Patiala	Industrial
Batala	Fire Brigade Station, Bahera Road, Patiala	Residential
	Regional Office, PPCB	Industrial

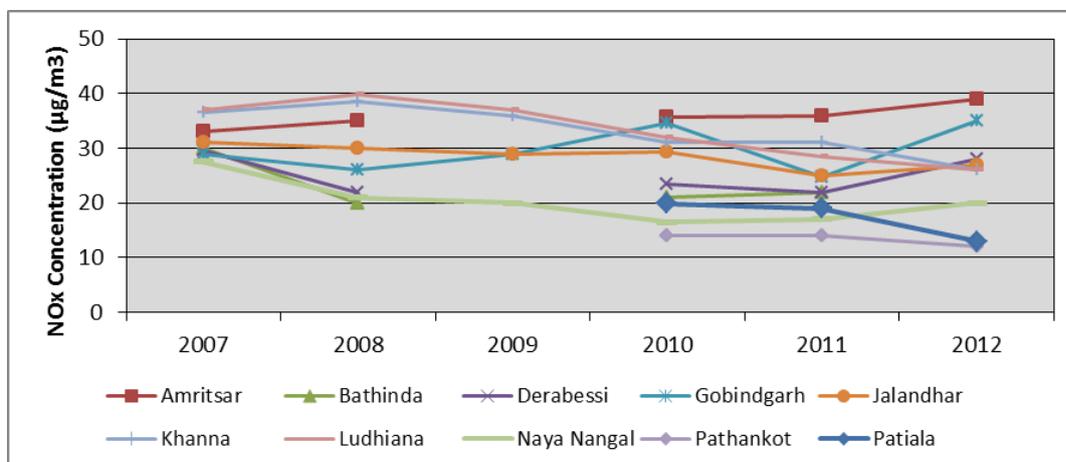
Source: CPCB, 2014

Figure 6 shows annual average concentration of RSPM, NOx and SO₂ during 2007-2012 across different cities in Punjab.

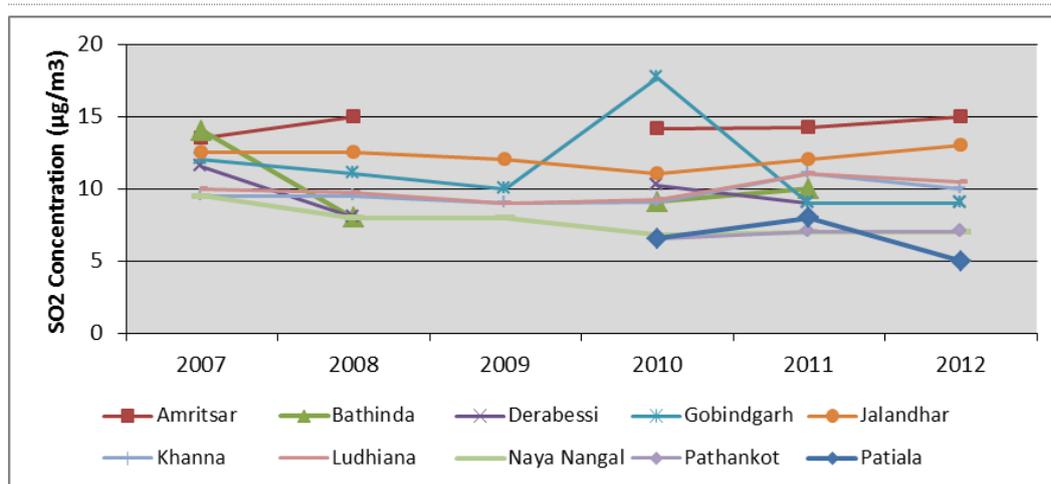
It is evident that at all the air quality monitoring stations, RSPM is above the annual average standard of 60 µg/m³ prescribed by CPCB. Ludhiana, Amritsar, Gobindgarh and Khanna cities show RSPM concentrations more than 180 µg/m³, which is thrice the prescribed standard. SO₂ and NOx concentration in Punjab are well below the standards prescribed by CPCB.



Annual Average Standard: 60 µg/m³



Annual Average Standard: 40 µg/m³



Annual Average Standard: 50 µg/m³

Figure 6: For Punjab, Annual average of RSPM SO₂ and NO_x concentration for different cities during 2007-2012

Source: CPCB, 2014; CPCB, 2012; CPCB, 2009; CPCB, 2007

5 Impact

Air pollution has been known to have significant impacts on human health and the nearby environment. It increases an individual’s medical expenditure and affects his /her working capacity too. The widely known impacts of various air pollutants are given in Table 2.

Table 1: Different pollutants and their impact on human health

Pollutant	Impact on Human Health
Particulate Matter	Respiratory problems, Cardiovascular problems, Throat and eye irritation, skin diseases, Cancer
NO _x	Respiratory problems
CO	At 15 µg/m ³ central nervous system get affected
SO ₂	Throat irritation at 8-12 mg/m ³ , eye irritation at 10mg/m ³ and immediate coughing at 20 mg/m ³

Source: Envis Centre, Punjab

A number of epidemiological studies have been carried out worldwide to study the relationships between air pollution and mortality rates. In Punjab also, following studies (Table 3) have been carried out to study the impact of air pollution on human health and visibility.

Table 2: Air quality and impact studies in Punjab

Study	Result
Kumar R., et al., 2015	<p>The association between air quality in Ludhiana city of Punjab as indicated by visibility (haze) and daily mortality was found to be statistically significant.</p> <p>For every 1 km decrease in visibility at midday, mortality due to natural causes increased by 2.4%.</p>
Kumar et al., 2012	Total annual welfare loss in terms of health damages due to air pollution caused by burning of rice straw in rural Punjab amounts to 76 million.
Gupta S., et al., 2013	<p>There exists a significant correlation between air pollution and respiratory, heart, skin, and TB diseases in both urban areas of Mandi Gobindgarh and nearby rural area.</p> <p>The effect of pollution is more pronounced in urban areas of mandi-Gobindgarh.</p> <p>One among every ten persons is affected by one of these above mentioned disease.</p>
Nautiyal J. et al., 2007	The population in Gobindgarh (Industrial town) shows a higher prevalence of symptoms of angina and cardiovascular disease considered in the study as compared to Morinda (Non-Industrial) area. This result is attributed to higher levels of PM levels.

These studies show that air quality in Punjab is strongly related to increasing health problems. However, studies are mainly concentrated on Mandi-Gobindgarh (second big industrial town in Punjab), but cover a wide range of respiratory diseases and their relationship with deteriorating air quality.

6 Response

Various interventions have been taken by Punjab government, Central Government, different Ministries at different time periods in order to control air pollution in Punjab. They are put in chronological order in Table 4

Table 3: Interventions taken to curb air pollution in Punjab

Year	Interventions
2013	<p>GoP declared whole state of Punjab as “Air Pollution Control Area under section 19(1) of Air Act 1981”.</p> <p>Under this Govt has prohibited the indiscriminate burning of left over paddy and wheat straw as air pollution caused by these activities have established co-relation with the increase in eye irritation, respiratory diseases and one’s working capacity</p> <p>Formulation of “Policy for Management and Utilization of Paddy straw in Punjab 2013”. Under this policy, utilization of paddy straw for power generation as a renewable resource has been suggested.</p> <p>Punjab Pollution Control Board persuaded major air pollution source viz. Rolling mills and forging units in Mandi Gobindgarh and Khanna to switch over to greener fuels such as CNG/ RLNG. More than 200 units have taken this initiative.</p>
2012	<p>Implementation of Bharat Stage III fuel norms for passenger cars, heavy diesel vehicles and 2/3 wheelers</p> <p>421 PUC (Pollution Checking Centers) have been set up by Transport Department</p>
2009	<p>Revision of air quality standards by CPCB-</p> <p>The earlier standards for residential areas have been uniformly applied for industrial areas also for PM10, carbon monoxide and ammonia.</p> <p>More stringent limits have been set for SO₂ and NO_x for residential areas also.</p> <p>Fine particulate matter (PM_{2.5}) has been introduced being more relevant for public health</p>
2005-10	Introduction of PET coke as an authorized fuel for use in boiler furnaces
2004-05	<p>On the basis of NAMP data, CPCB has identified Gobindgarh, Ludhiana and Jalandar cities of Punjab as polluted cities with major pollutant of concern are particulate matter both PM10 and PM2.5.</p> <p>Action plans have been formulated for Ludhiana and Mandi Gobindgarh cities</p>
2000	Introduction of lead free petrol
1996	Emission standards for brick kilns
1995	Banning of burning of rice husk in boiler furnaces in loose form (except in Fluidized Bed Combustion System)
1994	<p>Banning of rubber burning, process wastes containing sulfur and toxic substances in any form</p> <p>National Ambient Air Quality Standards(NAAQS), Issued by CPCB vide Gazette Notification of April</p>
1986	<p>Initiation of air quality monitoring at 5 locations</p> <p>Implementation of Environment Act 1986, Motor Vehicles Act 2000 in Punjab</p>
1981	Implementation of Air Act 1981
1975	Establishment of PPCB (Punjab, Pollution Control Board)

Source: Envis Centre, 2014;

Apart from these steps, a lot of other measures are been taken in Punjab to curb the pollution levels. Pulverized coal and furnace oil is promoted mainly in these highly polluting areas. A regular check on installation of air pollution control equipment (APCE) for old and newly constructed units is carried out. All the large and medium category industries have APCE. For small scale industries, 925 units were running without APCE in 2002-03 which has now reduced to only 84. CNG has been introduced as an alternative fuel

in autorickshaw especially in Amritsar, Jalandhar and Punjab. Awareness programs have been conducted by the Punjab government for different target groups time to time.

7 Barriers

Air pollution from natural sources was evident since the beginning in Punjab majorly from open burning activities but has become an alarming problem in past few decades due to industrialization in the state. Although control measures have been introduced in the state from time to time to combat the pollution levels but the pace at which the emission levels have increased is very high compared to that of control measures. There are financial and technological barriers for this slow pace of control actions. In case of emissions from open agricultural burning, farmers are not left with any other option than burning the left over paddy and wheat as they do not have enough money to buy better technology equipment.

Air pollution control equipment (APCE) have been made mandatory for all industries but there are lot of small scale industries like brick kilns which are held accountable due to their mobile nature. Government is promoting to put advanced fixed structure technologies in the state. But better technologies like tunnel kiln and VSBK (Vertical shaft Brick Kilns) are not economically viable to be installed across the entire state. Capacity of vigilance authorities to keep a check on the efficiencies of the equipment in other industries is not enough. Moreover, awareness regarding importance of protecting environment is still very less among the common people. People prefer luxury and comfort by travelling in personal vehicles than public transport which has eventually increased the number of vehicles on road.

8 Conclusion and Future Recommendations

Transport sector, industrial combustion and open burning are major contributors of deteriorated air quality in state of Punjab. Nearly all the cities of Punjab are violating the particulate matter levels as prescribed by Central Pollution Control Board. These high pollutant concentrations are posing health impacts to the public. Thus, it is imperative to control pollution levels in the state by controlling emissions from the respective sources.

In the business as usual (BAU) scenario, the future emissions from these sectors will grow manifold (Figure 7) if proper stringent measures are not being taken on time. In 2030, it is predicted that NO_x emissions from road transport sector will increase four times the current emissions. Also, particulate emissions, especially PM_{2.5} would increase majorly from brick, open burning and transport sector. Further, in 2047, total emissions for all the pollutants are expected to increase three fold. Particulate emissions from brick sector are going to increase five times. This is mainly because of the high growth rate of construction sector and use of old technologies of firing bricks with no air pollution control equipment.

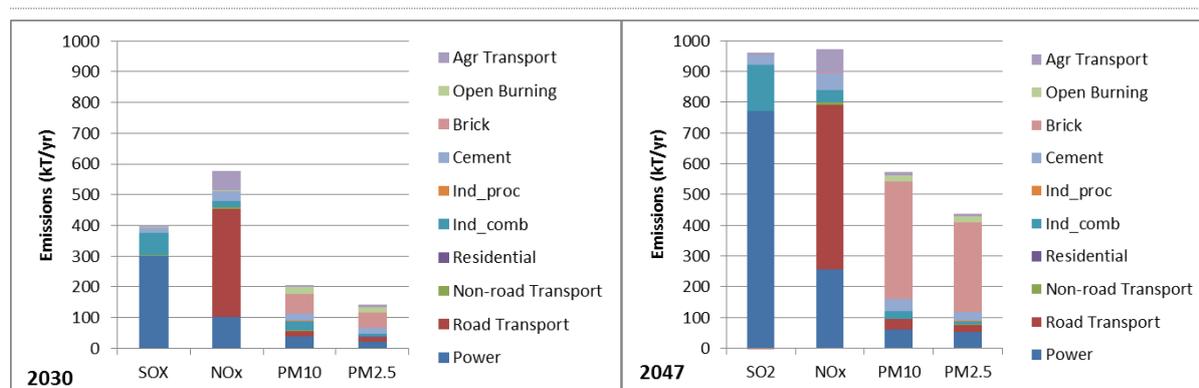


Figure 7: Sector-wise predicted emissions for criteria pollutants from different sources in Punjab in 2030 and 2047

Source: TERI, 2015

Following recommendations are provided for major polluting sectors of Punjab-

7.1 Transport

In transport sector, one of the methods to control air pollution is to have stringent norms for emissions and fuel quality.

- An Auto Fuel Policy was formulated in the year 2002 (Table 5), to lay down a roadmap for introduction of cleaner fuels and vehicles.

Table 5: Auto Fuel Policy for India 2002

Coverage	Passenger cars, light commercial vehicles and heavy duty vehicles	2/3 wheelers
Entire Country	Bharat Stage (BS) II – 1.4.2005	BS II – 1.4.2005
	BS III – 1.4.2010	BSIII preferably from
13 cities	BS II- 1.4.2003	1.4.2008 but not later than
	BS III – 1.4.2005	1.4.2010
	BS IV – 1.4.2010	

Source: MOPNG (2002)

- Following this roadmap, 13 selected cities were moved to BS-IV norms in 2010 and rest of the country on BS III norms. But this is ambiguous since same NAAQS standards are followed throughout the country but different fuel quality standards are prescribed.
- Recently auto fuel vision committee was set up in 2013 to recommend the future roadmap on advancement of fuel quality and vehicular emission standards 2025. It has recommended introduction of BS-IV by 2017, BS-V by 2020 and BS-VI by 2024 across the country (TERI, 2014).
- However, looking at the growth rate of vehicular sector, more stringent steps should be taken. Instead of following chronological order for the norms, BS-V fuels should be considered by enabling the Indian refineries to leapfrog from BS-II to BS-V.

- An effective inspection and maintenance system should be enforced by the Government in the state.
- Old vehicles should be banned in the state.
- Government should conduct programs at community level to sensitize the public about the growing levels of the pollution due to vehicles and promote public transport systems.

7.2 Open Burning

Open Burning from left over paddy and wheat straw is a major concern for Punjab state as air pollution caused by these activities is found to be correlated with the increase in eye irritation and respiratory diseases in the state.

- Government should ensure regular vigilance of open burning activities. Some penalty should be enforced in order to bring out this step in action.
- New sustainable technologies should be introduced in the state.

7.3 Industries

In this sector, industrial combustion is mainly contributing to the emissions in the state.

- Cleaner fuels should be used to curb the emission levels.
- Instalment of APCEs in all industrial units should be made mandatory for all the industries.
- Efficiency of installed APCE's should be checked at regular levels.
- In order to have more regular control, number of air quality monitoring stations in the state should be increased.
- In brick sector, government should emphasize on adoption of cleaner technologies like Vertical Shaft Brick Kiln (VSBK) and tunnel kilns.
- Registration of brick kilns should be made mandatory as due to the mobile nature of few brick making technologies, the exact number of brick kilns is never accurate.

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About TERI

A unique developing country institution, TERI is deeply committed to every aspect of sustainable development. From providing environment-friendly solutions to rural energy problems to helping shape the development of the Indian oil and gas sector; from tackling global climate change issues across many continents to enhancing forest conservation efforts among local communities; from advancing solutions to growing urban transport and air pollution problems to promoting energy efficiency in the Indian industry, the emphasis has always been on finding innovative solutions to make the world a better place to live in. However, while TERI's vision is global, its roots are firmly entrenched in Indian soil. All activities in TERI move from formulating local- and national-level strategies to suggesting global solutions to critical energy and environment-related issues. TERI has grown to establish a presence in not only different corners and regions of India, but is perhaps the only developing country institution to have established a presence in North America and Europe and on the Asian continent in Japan, Malaysia, and the Gulf.

TERI possesses rich and varied experience in the electricity/energy sector in India and abroad, and has been providing assistance on a range of activities to public, private, and international clients. It offers invaluable expertise in the fields of power, coal and hydrocarbons and has extensive experience on regulatory and tariff issues, policy and institutional issues. TERI has been at the forefront in providing expertise and professional services to national and international clients. TERI has been closely working with utilities, regulatory commissions, government, bilateral and multilateral organizations (The World Bank, ADB, JBIC, DFID, and USAID, among many others) in the past. This has been possible since TERI has multidisciplinary expertise comprising of economist, technical, social, environmental, and management.



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