CHAPTER FOUR

ATMOSPHERE

4.1 Introduction

4.1.1 The atmosphere of Earth is a layer of gases surrounding the planet Earth that is retained by Earth's gravity. The atmosphere protects life on Earth by absorbing ultraviolet solar radiation, warming the surface through heat retention (greenhouse effect), and reducing temperature extremes between day and night.

,	TABLE 4.1.1 : AVERAGE GASEOUS COMPOSITION OF DRY AIR IN THE TROPOSPHERE						
Sl. No.	Gas	Percent by Volume	Parts PerMillion (ppm)				
1	2	3	4				
1	Nitrogen	78.080000	780840.00				
2	Oxygen	20.946000	209460.00				
3	Argon	0.934000	9340.00				
4	Carbon dioxide	0.039000	390.00				
5	Neon	0.001818	18.18				
6	Helium	0.000524	5.24				
7	Methane	0.000179	1.79				
8	Kryton	0.000114	1.14				
9	Hydrogen	0.000055	0.55				
10	Xenon	0.000009	0.09				
11	Ozone	Variable	~0.001- 0.3 (variable)				

Source : Envis centre of Indian Institute of Tropical Meterology, Pune.

4.2 Atmospheric Pollution – Main Sources

4.2.1 The atmosphere consists of a mixture of gases that completely surround the earth. It extends to an altitude of 800 to 1000 kms above the earth's surface, but is deeper at the equator and shallow at the poles. About 99.9% of the mass occurs below 50 Km and 0.0997% between 50 and 100 km altitude. Major polluting gases/ particles are confined to the lowermost layer of atmosphere known as Troposphere that extends between 8 and 16 Kms above the earth surface.

4.2.2 The primary aim of the ambient air quality standards is to provide a basis for protecting public health from adverse effects of air pollution and for eliminating or reducing to a minimum, those contaminants of air that are known or likely to be hazardous to human being, animals, vegetation and historical monuments. The national ambient air quality standards (NAAQS) is available in table 4.2.1 at annexure 4.

4.2.3 The **main sources of atmospheric pollution** may be summarized as follows:

- a) The combustion of fuels to produce energy for heating and power generation both in the domestic sector as well as in the industrial sector.
- b) The exhaust emissions from the transport vehicles that use petrol, diesel oil, etc.
- c) Waste gases, dust and heat from many industrial sites including chemical manufacturers, electrical power generating stations, etc.
- 4.2.4 **National Air Quality Monitoring Programme:** Central Pollution Control Board has laid down national air quality monitoring network with the help of State Pollution Control Boards. The network is consisting of 346 stations covering 130 Cities, 26 States and 4 Union Territories. The parameters are Sulpher Dioxide, Oxides of Nitrogen and Respirable Suspended Particulate Matter. It is expected that there will be 104 observations in a year taken twice a week, 24 hourly at uniform level.
- 4.2.5 Summary of the Observations are as follows:
 - With respect to Sulpher di-oxide it is observed that annual average is well within the limit in all States. There are some occasional pulses in the States of Andhra Pradesh, Maharashtra, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal.
 - With respect to NO2 Values, the annual average are well with in limit except in some Cases. The maximum value indicates that of Andhra Pradesh, Delhi, Bihar, Maharashtra, Tamil Nadu and West Bengal are higher.
 - In case of RSPM average value indicates that except few States such as Goa, Kerala, Mizoram, and Pondicherry, Tamil Nadu all are exceeding the limit. The maximum value indicates that except Mizoram all are high. States like Rajasthan also is high as 829 micro gram per metre cube.
 - With respect to industrial area sulpher di-oxide are again within the limit and so is the with Nitrogen Oxide.
 - With respect to RSPM the trend shows that 13 States are exceeding the limits.

The details of State level air quality monitored under National Ambient Air Quality Monitoring Programme (NAMP) during 2008 in residential areas is presented in table 4.2.2.

	UNDER NATIONAL AMBIENT AIR QUALITY MONITORING PROGRAMME (NAMP) DURING 2008.										
SI	Name of the State	SO ₂ µg/m ³			N	O₂ µg/	m³	RSPM µq/m ³			
			(Annual)			(Ann	ual)		(Annual)		
		Max	Min	Avg.	Max	Min	Avg.	Max	Min	Avg.	
1	Andhra Pradesh	74	2	8	108	7	26	425	12	85	
2	Assam	21	2	6	33	5	13	450	16	89	
3	Bihar	14	2	7	93	8	39	402	25	120	
4	Chandigarh	2	2	2	49	5	14	217	21	89	
5	Chhattisgarh	28	3	16	63	13	28	261	68	126	
6	Delhi	31	2	5	138	23	55	630	18	209	
7	Goa	11	2	2	30	4.5	13	197	14	57	
8	Gujarat	45	4	12	40	4.5	18	293	33	83	
9	Haryana	24	4	9	36	5	13	293	45	121	
10	Himachal Pradesh	20	2	2	25	5	12	218	15	71	
11	Jharkhand	30	11	19	66	20	38	454	31	152	
12	Karnataka	49	2	10.5	66	8	27	381	28	77	
13	Kerala	31	2	5	72	5	20	280	11	48	
14	Madhya Pradesh	38	2	9	47	5	19	609	7	110	
15	Maharashtra	90	2	16	159	5	31	579	3	101	
16	Meghalaya	22	2	2	37	5	34	113	29	73	
17	Mizoram	2	2	2	10	5	15	61	15	37	
18	Manipur	6	2	3	38	14	19	125	34	84	
19	Nagaland	5	2	2	62	7	14	133	16	72	
20	Orissa	13	2	4	41	6	16	203	14	80	
21	Punjab	64	5	10	57	158	30	387	62	193	
22	Puducherry	10	2	4	21	5	10	182	25	45	
23	Rajasthan	18	2	7	74	5	28	829	10	122	
24	Tamil Nadu	80	2	12	106	5	20	302	11	58	
25	Uttar Pradesh	68	4	12	64	5	30	442	50	170	
26	Uttarakhand	61	21	27	31	23	28	159	73	126	
27	West Bengal	70	2	9	137	5	66	514	6	101	

TABLE 122 · STATE WISE LEVEL OF SO, NO, AND RSPM IN RESIDENTIAL AREAS

Source : Central Pollution Control Board

Note : Data available as on date 15.04.09

4.3 Industrial Emissions

4.3.1 Air borne emissions emitted from various industries are a cause of major concern. These emissions are of two forms, viz. solid particles (SPM) and gaseous emissions (SO₂, NO_x, CO, etc.). Liquid effluents, generated from certain industries, containing organic and toxic pollutants are also a cause of concern. Heavily polluting industries were identified which are included under the 17 categories of highly polluting industries for the purpose of monitoring and regulating pollution from them. The Ministry of Environment and Forests has, developed standards for regulating emissions from various industries and emission standards for all the polluting industries including thermal power stations, iron and steel plants, cement plants, fertilizer plants, oil refineries, pulp and paper, petrochemicals, sugar, distilleries and tanneries have been prescribed. The industrial units in India are largely located in the States of Gujarat, Maharashtra, Uttar Pradesh, Bihar, West Bengal and Madhya Pradesh. The highest concentration of sulpher dioxide and oxides of nitrogen is, therefore, often found in cities located in these states. Some other industrial estates in Delhi, Punjab, Rajasthan and Andhra Pradesh are also becoming critical.

The table 4.3.1 depicts the details of air quality in Industrial areas National Ambient air Quality Monitoring Programme during 2008.

	TABLE 4.3.1: STATE WISE LEVEL OF SO ₂ , NO ₂ AND RSPM IN INDUSTRIAL AREAS UNDER NATIONAL AMBIENT AIR QUALITY MONITORING PROGRAMME (NAMP) DURING 2008.									
Sl	Name of the State $SO_2 \mu g/m^3$ $NO_2 \mu g/m^3$ RSPM $\mu g/m^3$								g/m ³	
			(Anni	ual)		(Annu	ual)	(Annual)		
		Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.
1	Andhra Pradesh	2	83	6	6	121	27	9	493	87
2	Chandigarh	2	5	2	4.5	52	20	22	254	123
3	Chhattisgarh	12	22	17	33	51	42	129	288	212
4	Delhi	2	66	8	20	139	61	49	633	225
5	Goa	2	11	3	4.5	28	11	10	212	52
6	Gujarat	9	30	16	12	89	26	43	598	127
7	Haryana	7	23	15	12	89	28	102	598	267
8	Himachal Pradesh	2	6	2	4.5	21	12	17	649	134
9	Jharkhand	12	78	28	30	71	47	44	517	170
10	Karnataka	2	20	10	4.5	69	25	7	442	85
11	Kerala	2	43	6	4.5	48	11	6	320	45
12	Maharashtra	2	104	24	4.5	121	41	3	802	108
13	Madhya Pradesh	2	52	15	4.5	47	18	16	507	160
14	Orissa	2	21	8	10	37	21	19	276	95
15	Punjab	48	35	11	11	66	35	99	666	229
16	Puducherry	3	10	6	4.5	18	13	33	95	54
17	Rajasthan	4	24	8	11	72	31	10	538	135
18	Tamil Nadu	2	90	13	4.5	73	21	14	364	81
19	Uttar Pradesh	5	71	17	4.5	75	27	60	575	197
20	Uttarakhand	16	21	20	19	27	21	88	98	93
21	West Bengal	2	65	10	4.5	162	73	16	604	119

Source : Central Pollution Control Board Note : Data available as on date 15.04.09

Table 4.3.2 : Ambient Air Quality in Major cities (2004)						
				(µg/m3)		
City	SO_2	NO _x	SPM	RSPM		
Ahmedabad	15.7	24.3	244	152		
Banglore	8.5	51.8	153	69		
Chennai	12.2	16.8	136	60		
Delhi	9.89	46.1	374	149		
Hyderabad	5.63	30.3	196	71		
Kolkata	9.33	59.7	266	134		
Mumbai	6.67	18.3	247	78		

The ambient air quality in major cities is presented at table 4.3.2.

SPM : Suspended particulate matter; RSPM : Respirable suspended particulate matter SO_2 : Sulphur dioxide No_x : Oxides of nitrogen

The trend in ambient air quality in major cities (pollutant wise) over time is presented in table 4.3.3 at annexure 4.

4.3.2 **Industries and Air pollution:** Industrialization and urbanization have resulted in a profound deterioration of India's air quality. Of the 3 million premature deaths in the world that occur each year due to outdoor and indoor air pollution, the highest number are assessed to occur in India. Sources of air pollution, India's most severe environmental problem, come in several forms, including vehicular emissions and untreated industrial smoke. Apart from rapid industrialization, urbanization has resulted in the emergence of industrial centers without a corresponding growth in civic amenities and pollution control mechanisms.

4.3.3 There is a growth of 42.68 % in the number of registered factories in India from 1987-88 to 2007-08. **The details of registered factories sector wise are in Table 4.3.4**.

	Γ	1			
Sl. No.	Year	Manufacturing	Electricity, Gas & Water	Repair Services & Cold Storage	All Activities
1	2	3	4	5	6
1	1987-88	98379	458	3759	102596
2	1988-89	99724	481	3872	104077
3	1989-90	103373	493	4126	107992
4	1990-91	105511	518	4150	110179
5	1991-92	107454	505	4327	112286
6	1992-93	113890	961	4643	119494
7	1993-94	116227	542	4825	121594
8	1994-95	117564	554	4892	123010
9	1995-96	125281	4013	5277	134571
10	1996-97	125166	4160	5230	134556
11	1997-98	126272	3856	5423	135551
12	1998-99*	130222	143	1341	131706
13	1999-2000*	130035	158	1365	131558
14	2000-01*	127036	163	4069	131268
15	2001-02*	124099	170	4279	128548
16	2002-03*	123401	182	4374	127957
17	2003-04	124277	219	4578	129074
18	2004-05	131232	275	4846	136353
19	2005-06	134669	259	5232	140160
20	2006-07	138968	313	5429	144710
21	2007-08	140355	385	5645	146385

TABLE 4.3.4 : NUMBER OF REGISTERED FACTORIES BY MANUFACTURING
INDUSTRIES

Source : Central Statistics Office

* : From 1998-99, all electricity undertakings other than Captive Units have been kept outside the purview of ASI

Note: Factories registered under Factory Act 1948

	TABLE 4.3.5 : MAXIMUM	I PERMISSIBLE	E LIMITS FOR	INDUSTRIAL	
SI	Porometer	Into Inland	Into Public	Onland for	(mg/Litre) Marina
51. No.	rarameter	Surface Waters Indian Standards 2490 (1974)	Sewers Indian Standards: 3306 (1974)	Irrigation Indian Standards: 3307 (1974)	Coastal Area
1	2	3	4	5	6
1	pH	5.5-9.0	5.5-9.0	5.5-9.0	5.5-9.1
2	Biological oxygen demand (for 5 days at 20°C)	30.00	350.00	100.00	100.00
3	Chemical oxygen demand	250.00	-	-	250
4	Suspended solids	100.00	600.00	200.00	
5	Total dissolved solids (inorganic)	2100.00	2100.00	2100.00	-
6	Temperature (°C)	40.00	45.00	-	45.00
7	Oil and grease	10.00	20.00	10.00	20.00
8	Phenolic Compounds	1.00	5.00	-	5.00
9	Cyanides	0.20	2.00	0.20	0.20
10	Sulphides	2.00	-	-	5.00
11	Fluorides	2.00	15.00	-	15.00
12	Total residual chlorine	1.00	-	-	1.00
13	Pesticides	-	-	-	-
14	Arsenic	0.20	0.20	0.20	0.20
15	Cadmium	2.00	1.00	-	2.00
16	Chromium (hexavalent)	0.10	2.00	-	1.00
17	copper	3.00	3.00	-	3.00
18	Lead	0.10	1.00	-	1.00
19	Mercury	0.01	0.01	-	0.01
20	Nickel	3.00	3.00	-	5.00
21	Selenium	0.05	0.05	-	0.05
22	Zinc	5.00	15.00	-	15.00
23	Chlorides	1000.00	1000.00	600.00	-
24	Boron	2.00	2.00	2.00	-
25	Sulphates	1000.00	1000.00	1000.00	-
26	Sodium (%)	-	60.00	60.00	-
27	Ammoniacal nitrogen	50.00	50.00	-	50
28	Radioactive materials				
20	Alpha emitters (milli curie/millilitre)	10-7	10 ⁻⁷	10 ⁻⁸	10 ⁻⁷
29	Bata amittars (11 auria/millilitra)	10 ⁻⁶	10 ⁻⁶	10-7	10 ⁻⁶
50	Deta ennuers (µ curie/inninitie)	10	10	10	10

4.3.4 The detail of Indian standards for maximum permissible limits for Industrial effluent discharges is shown in the table 4.3.5.

Source : Central Pollution Control Board

4.4 Important industries and the effluent standards in India

4.4.1 Sugar industry: India has been known as the original home of sugar and sugarcane. Indian mythology supports the above fact as it contains legends showing the origin of sugarcane. India is the second largest producer of sugarcane next to Brazil. Presently, about 4 million hectares of land is under sugarcane cultivation with an average yield of 70 tonnes per hectare. **The effluent standards for sugar industry is at table 4.4.1**.

	TABLE 4.4.1 : EFFLUENT STANDARDS FOR SUGAR INDUSTRY						
Sl.	Sl. Permissible Limits (mg/Litres)						
No.	Farameter	Disposal on Land	Disposal in Surface Water				
1	2	3	4				
	Biological Oxygen						
1	Demand (5 days at						
	20°C)	100	30				
2	Suspended Solids	100	30				

Source : Central Pollution Control Board

4.4.2 Paper Industry: The Indian Paper Industry is among the top 15 global players today. **The existing effluent for large pulp and paper industries is available at table 4.4.2.**

TABLE 4.4.2 : EFFLUENT STANDARDS FOR LARGE PULP AND PAPERINDUSTRIES						
Capacity (Tonnes						
a year)	Parameter	Permissible Limits				
1	2	3				
Above 24,000	рН	7.0-8.5				
	Biological Oxygen Demand at					
	20^{0} C	30 mg/litre				
	Chemical Oxygen Demand	350 mg/litre				
	Suspended solids	50 mg/litre				
		2.0 kg/tonne of paper				
	Total organic chloride	produced				
	Flow (total waste water					
	discharge)					
		200 m ³ /tonne of paper				
	Large pulp and paper ^a	produced				
		150 m ³ /tonne of paper				
	Large rayon grade newsprint	produced				

Source : Central Pollution Control Board

a : the standards with respect to total waste water discharge for large pulp and paper mills

established from 1992 will meet the standards of 100 m³/tonne of paper produced

4.4.3 Oil Refineries: As of July, 2005 there are a total of 18 oil refineries in the country comprising 17 in the Public Sector, one in the private sector in India. The following table presents the elluent standards for oil refineries.

	TABLE 4.4.3 : EFFLUE	NT STANDARDS FOR OI	L REFINERIES (<i>Mg/Litre</i>)
Sl. No.	Parameter	Permissible Limit	Quantum (Kg/Thousand Tonnes of Crude Processed)
1	2	3	4
1	Oil and grease	10.0	7.00
2	Phenol	1.0	0.70
3	Sulphide	0.5	0.35
4	Biological Oxygen Demand (5 days at 20° C)	15.0	10.50
5	Suspended Solids	20.0	14.00
6	pH		6.00-8.50

Source : Central Pollution Control Board

4.4.4 Aluminum Industry: Aluminum industry is one of the leading metal industries in the Indian economy. The effluent standards for aluminum in India are shown in table 4.4.4.

	TABLE 4.4.4 : EFFLUENT STANDARDS FOR ALUMINIUM INDUSTRY						
Sl.	Plant	Parameters	Permissible Limits				
No.							
1	2	3	4				
1	Alumina Plant						
	Raw material	Primary and secondary	150 mg/m ³				
	handling	crusher particulate matter					
	Precipitation area : calcination	Particulate matter	250 mg/m ³				
		Carbon Mono-oxide	1 % maximum				
		Stack Height ^a					
2	Smelter plant						
	Green anode shop	Particulate matter	150 mg/m ³				
	Anode bake oven	Particulate matter	150 mg/m ³				
		Total fluoride	0.3kg/tonne at Al				
3	Potroom	Particulate matter	150 mg/m ³				
		Total fluoride					
		Vertical stud soderberg	4.7 kg/tonne of Al produced				
		Horizontal stud soderberg	6.0 kg/tonne of Al produced				
		Prebacked side worked	2.5 kg/tonne of Al produced				
		Prebacked centre worked	1.0 kg/tonne of Al produced				
		Stack Height ^a					

Source : Central Pollution Control Board

a $H = 14 Q^{0.3}$, where Q is the emission rate of sulphur dioxide in Kg/h and H is the stack height in meters.

4.4.5 Petro chemical Industry: The petrochemical industry in India has been one of the fastest growing industries in the country. This industry also has immense importance in the growth of economy of the country and the growth and development of manufacturing industry as well. It provides the foundation for manufacturing industries like construction, packaging, pharmaceuticals, agriculture, textiles etc. The effluent standards for Petro – Chemical industries in India is shown at 4.4.5.

	TABLE 4.4.5 : EFFLUENT STANDARDS FOR PETRO-CHEMICAL (BASIC & INTERMEDIATES) INDUSTRY						
	(Mg/Litre)						
Sl. No.	Parameter	Permissible Limit					
1	2	3					
1	рН	6.5-8.5					
2	Biological Oxygen Demand (5 days at 20 ⁰ C) ^a	50.0					
3	Phenol ^b	5.0					
4	Sulphide (as S)	2.0					
5	Chemical Oxygen Demand	250.0					
6	Cyanide (as CN)	0.2					
7	Fluoride (as F) ^c	15.0					
8	Total Suspended Solids	1000.0					
9	Hexavalent Chromium	0.1					
10	Total Chromium (as Cr) ^d	2.0					

Source : Central Pollution Control Board

- **a**: The state board may prescribe the biological oxygen demand value of 30 mg/l if the recipient system so demands.
- **b** : The limit for phenol shall be confirmed at the outlet of effluent treatment of phenol plant. However, at the final disposal point, the limit shall be less than 1 mg/l
- **c** : The limit for fluoride shall be confirmed at the outlet of the chrome removal unit. However, at the disposal point, fluoride concentration shall be lower than 5 mg/l
- **d**: The limits for total and hexavalent chromium shall be confirmed at the outlet of the chromate removal. This implies that in the final treated effluent total, and hexavalent chromium shall be lower than prescribed herein

4.4.6 The compliance status of industries to the norms set up for pollution control can be assessed from the following tables. At all India level, nearly 72.56% of the medium and large scale units of 17 categories of industries are having adequate facilities to comply with the standards.

TABLE 4.4.6: STATE-WISE SUMMARY STATUS OF THE POLLUTION CONTROL INMEDIUM AND LARGE SCALE UNITS OF 17 CATEGORIES OF INDUSTRIES

as on JUNE,2007

Sl.	State/UT	Complying#	Status (No. of Units)			
No.		- r 7 8	Defaulting	Closed	Total	
1	2	3	4	5	6	
	States					
1	Andhra Pradesh	243	90	34	367	
2	Arunachal Pradesh	0	0	0	0	
3	Assam	10	3	5	18	
4	Bihar	25	4	19	48	
5	Chhattisgarh	18	5	2	25	
6	Goa	10	0	1	11	
7	Gujarat	263	61	21	345	
8	Haryana	73	31	23	127	
9	Himachal Pradesh	14	3	2	19	
10	Jammu and Kashmir	8	0	3	11	
11	Jharkhand	8	7	6	21	
12	Karnataka	98	5	40	143	
13	Kerala	23	11	15	49	
14	Madhya Pradesh	60	4	15	79	
15	Maharashtra	454	42	69	565	
16	Manipur	0	0	0	0	
17	Meghalaya	8	0	0	8	
18	Mizoram	0	0	0	0	
19	Nagaland	0	0	0	0	
20	Orissa	38	12	2	52	
21	Punjab	53	31	17	101	
22	Rajasthan	94	9	8	111	
23	Sikkim	0	0	0	0	
24	Tamil Nadu	175	42	3	220	
25	Tripura	10	0	0	10	
26	Uttaranchal	16	18	2	36	
27	Uttar Pradesh	234	13	27	274	
28	West Bengal	49	18	20	87	
29	Chandigarh	0	0	1	1	
30	Daman	1	2	0	3	
31	Delhi	2	3	0	5	
32	Pondicherry	4	0	4	8	
33	Andaman & Nicobar	0	0	0	0	
34	Lakshadweep	0	0	0	0	
	Total	1991	414	339	2744	

Source : Ministry of Environment Forest. (Central Pollution Control Board, MOEF)

:Having Adequate facilities to comply with the standards

(As on	(As on June,2010)					
Sr.	Industrial Category	Complying	Defaulting	Closed	Total	
No						
1	Aluminium	8	-	-	8	
2	Cement					
	Large(<200T/D)	63	5	8	76	
	Medium & Small (<200 T/D)	112	17	72	201	
3	Chlor-Alkali	27	1	4	32	
4	Copper	5	-	-	5	
5	Distillery	176	29	34	239	
6	Dyes & Intermediates	62	3	30	95	
7	Fertilizer	79	7	35	121	
8	Iron & Steel					
	Integrated Iron & Steel	10	2	4	16	
	Sponge Iron	46	1	6	53	
9	Oil Refineries	19	-	3	22	
10	Pesticides	61	18	26	105	
11	Petrochemicals	44	1	11	56	
12	Pharmaceuticals	291	32	75	398	
13	Pulp & Paper	104	33	47	184	
14	Sugar	377	69	66	512	
15	Tannery	103	8	38	149	
16	Thermal Power Plant	180	25	19	224	
	Capative Thermal Power Plant	18	2	-	20	
17	Zinc	6	-	-	6	
	Total	1791	253	478	2522	

TABLE 4.4.7 : STATUS OF 17 CATEGORY INDUSTRIES

Source : Central Pollution control Board. MOEF.

It is pertinent to mention that, the above data reveals that nearly 10 % of the total industries in the 17 categories are found defaulting with respect to pollution control.

4.5 In addition to air pollution, industries cause water pollution also. The table 4.5.1shows that at all India level, 68.14% grossly polluting industries discharging their effluents into rivers and lakes are complying with the norms.

TABLE 4.5.1: SUMMARY STATUS OF POLLUTION CONTROL IN GROSSLY POLLUTING INDUSTRIES DISCHARGING THEIR EFFLUENTS INTO RIVERS AND LAKES

(As on 31.03.2010)

Sl. No.	Name of the State/Union Territory	Total	Complying	Closed	Defaulting
1	2	3	4	5	6
1	Andhra Pradesh	17	11	6	0
2	Assam	9	9	0	0
3	Bihar	22	16	6	0
4	Chattisgarh	1	1	0	0
5	Gujarat	17	12	4	1
6	Haryana	76	71	1	4
7	Jharkhand	38	38	0	0
8	Karnataka	10	8	1	1
9	Kerala	36	18	7	11
10	Madhya Pradesh	1	0	0	1
11	Maharashtra	214	139	2	13
12	Orissa	20	6	5	9
13	Pondicherry	1	0	0	1
14	Punjab	20	9	4	7
15	Tamil Nadu	366	248	118	0
16	Uttar Pradesh	432	294	89	49
17	Uttarakhand	45	25	4	76
18	West Bengal	31	19	3	9
19	Daman Diu & Dadar Nagar Haveli	2	2	0	0
	Total	1356	924	250	182

Source : Ministry of Environment & Forests,(CPCB)

Note: The status of Maharashtra, Madhya Pradesh, Gujarat, Kerala and Tamil Nadu is based on previous available data.

4.6 Measures Taken for Controlling Air Pollution from Industries

4.6.1 The measures taken for controlling air pollution from industries are as follows:

- a. Emission standards have been notified under the Environment (Protection) Act, 1986 to check pollution
- b. Industries have been directed to install necessary pollution control equipment in a time bound manner and legal action has been initiated against the defaulting units.
- c. 24 critically polluted areas have been identified. Action Plan have been formulated for restoration of environmental quality in these areas.
- d. Environmental guidelines have evolved for siting of industries.
- e. Environmental clearance is made compulsory for 29 categories of development projects involving public hearing/NGO participation as an important component of Environmental Impact Assessment process.
- f. Environmental audit in the form of environmental statement has been made mandatory for all polluting industries.
- g. Preparation of zoning Atlas for setting of industries based on environmental considerations in various districts of the country has been taken up.
- h. Power plants (coal based) located beyond 1000 kms from the pit-head are required to use low ash content coal (not exceeding 34%) with effect from 1.6.2002. Power plants located in the sensitive areas are also required to use low ash coal irrespective of their distance from the pit head.

.4.6.2 Up-coming initiatives

a. Monitoring using automatic analysers is being initiated in 16 polluted cities identified by Hon'ble Supreme Court.

b. Action Plan are being formulated and implemented by the Central/ States Pollution Control Boards in 16 cities identified by Hon'ble Supreme Court as polluted cities.

c. Road map given by Auto fuel policy for vehicular pollution control is being implemented.

d. Corporate Responsibility for Environmental protection (CREP) is being implemented by industries for controlling industrial pollution.

e. Source apportionment studies have been imitated and it is planned to carry out such studies initially in six cities.

f. Monitoring of hazardous air pollutants such as benzene, PAHs etc. has been initiated and it is proposed to carry out there monitoring in other cities also.

4.7 Road Transport

4.7.1 Road vehicles are the second major source of pollution. They emit CO, HCs, NO_X , SO_2 , and other toxic substances such as TSP and lead. Diesel engines are much less polluting than petrol engines. Both types of engines are not very efficient converters of fuel energy. However, diesel types with a conversion efficiency of around 30% must be more efficient and use less fuel than petrol types with a 15-20% conversion efficiency. Both types of engines have incomplete combustion of fuel, so the major pollutant is CO, amounting to 91% by weight of all vehicle emissions. The primary pollutants produced in vehicle emissions undergo a series of complex interrelated chemical reactions in the troposphere and lower stratosphere to form secondary products.

4.7.2 Four factors make pollution from the vehicles more serious in developing countries.

(i) Poor quality of vehicles creating more particulates and burning fuels inefficiently.

- (ii) Lower quality of fuel being used leads to far greater quantities of pollutants.
- (iii) Concentration of motor vehicles in a few large cities.
- (iv) Exposure of a larger percentage of population that lives and moves in the open.

4.7.3 With the increasing urbanization and industrialization, the transport demand has also increased consequently. Out of the total number of more than 7 croes registered vehicles in India, including both transport and non-transport, more than 2 crores are concentrated in the 23 metropolitan cities. This has increased the vehicular pollution in manifold. The different factors of the pollution are the types of engines used, the age of the vehicles, poor road conditions and congested traffic. The principal vehicular pollutants are Carbon Monoxide, Oxides of Nitrogen, Hydrocarbons, suspended and particulate matters, a varying amount of Sulphur Dioxide depending on the Sulphur content of the fuel and lead compounds.

4.7.4 The quantum of road transport is an indicator of pollution caused by vehicles.

The details of total registered motor vehicles in India by State/ UT for 2005 & 2006 are available in table 4.7.1, 4.7.2at annexure 4.

4.7.3 TOTAL REGISTERED MOTOR VEHICLES IN						
METROPOLITAN CITIES OF INDIA						
Sl. No.	Name of City					
		Total	Total	Total		
		Transport	Non-			
			Transport			
1	2	3	4	5		
1	Ahmedabad	180102	1600126	1780228		
2	Bengaluru	253709	2363656	2617365		
3	Bhopal	33927	441777	475704		
4	Chennai	283601	2054871	2338472		
6	Coimbatore	26023	724408	750431		
7	Delhi	262507	4224905	4487412		
8	Hyderabad	136587	1385812	1522399		
9	Indore	74637	696488	771125		
10	Jaipur	84755	965751	1050506		
11	Kanpur*	NA	NA	NA		
5	Kochi *	NA	NA	NA		
12	Kolkata	138531	809395	947926		
13	Lucknow*	NA	NA	NA		
14	Ludhiana	NA	NA	NA		
15	Madurai	30171	333514	363685		
16	Mumbai	234441	1159206	1393647		
17	Nagpur	47965	775950	823915		
18	Patna*	61685	343533	405218		
19	Pune	108938	765471	874409		
20	Surat	NA	NA	NA		
21	Vadodara	NA	NA	NA		
22	Varanasi	NA	NA	NA		
23	Visakhapatnam	38420	424075	462495		
	Total	1995999	19068938	21064937		

NA -data not available

The category wise details of motor vehicles in major metropolitan cities of India is available in table 4.7.4 at annexure 4.

A glance at the working of State Transport undertaking in various States and all India (time series) can be obtained in table 4.7.5 at annexure 4.

4.8 Harmful Effects of Emissions

4.8.1 The high concentration of particulates in the atmosphere over large urban and industrial areas can produce a number of general effects. Smoke and fumes can increase the atmospheric turbidity and reduce the amount of solar radiation reaching the ground. The overall effect of air pollution upon the biosphere and the built environment can be broadly considered under 3 headings: The effect upon-

- (i) buildings and materials,
- (ii) soil, vegetation, crops and animal life,
- (iii) human beings.
- i) **Buildings and Materials**: The fabric of buildings that are surrounded by heavily polluted air for years undergo chemical changes. Gradual erosion takes place and this is only too evident when grimy upper surface is removed. A good example is that of the famous historical monument 'Taj Mahal' at Agra, which, on account of reaction of Sulphur-di-oxide, emitted from neighbouring industries, with the limestone has slowly, started turning yellow. As a result, on Court's directives, a number of measures have been taken to protect our national heritage monument, e.g. closure of neighbouring heavy polluting industries, operation of only non-polluting vehicles like battery buses, tonga, in the vicinity of Taj Mahal.
- ii) **Soil, vegetation and Animal Life:** The presence of gaseous pollutants in the air and deposition of particulates on to the soil can effect plants. It can effect the cattle and animals too as they have been found to develop breathing difficulties and suffer from low yield of milk, lameness and joint stiffness in a polluted environment.
- iii) Human beings: Smoke and SO₂ cause the general and most widespread effects of air pollution on people. Atmospheric smoke contains potentially carcinogenic organic compounds similar to those that occur in cigarette tobacco smoke. The CO affects the cardiovascular system, NO_xs affect the respiratory system, Ozone causes increased sensitivity to infections, lung diseases, irritation in eyes, nose and throat, etc.

4.9 Areas of Concern

a) Air pollution is existed in major cities where vehicles are the major sources.

b) There are 24 critically polluted areas where industrial pollution is predominant. Action plan have been formulated and implemented by the Central/ States Pollution Control Board in these problem areas.

4.10 Non-attainment Cities

CPCB has identified list of polluted cities in which the prescribed National Ambient Air Quality Standards (NAAQS) are violated. Action plans are being formulated and implemented to control air pollution in non-attainment cities by respective states.

4.11 Measures taken for Control of Air Pollution from Vehicles

A) Vehicular Emission Norms

The vehicle emission norms in India are detailed below.

- a) During 1990-91 India for the first time notified mass emission norms for the vehicles at the manufacturing stage as well as for in-use vehicles. These norms were notified under EPA, more vehicles rules and Air Act.
- b) b. The emission norms introduced in 1996 have been crucial in controlling vehicular pollution because of stringency of emission norms along with specifications on fuel quality in 1996. for the first time crankcase emission norms and evaporative emission norms were introduced.
- c) From April 1995 passenger cars were allowed to register only if they are fitted with a catalytic converter in four metros-Delhi, Mumbai, Kolkata and Chennai. Emission norms for such vehicles were stricter by 50 percent compared to 1996 norms.
- d) The testing method for passenger car norms were changed from hot start to cold start, which is also a stringent measure, compared to the earlier one.
- e) More stringent norms were introduced for the year 2000. These norms were notified under Motor Vehicle Rules during 1997. Automobile manufacturers have to undergo major modification to meet these norms.
- f) As per Hon'ble Supreme Court's directors only private vehicles confirming to at lease EURO-1 norms are being registered. In Mumbai Euro-II norms for private vehicles (4 wheelers) was applicable from 2001. In Mumbai Euro-II norms for private vehicles (4 wheelers) was applicable from 2001. In Kolkata, India-2000 norms (Euro-I) have been made applicable from November 1999.
- g) From 1st October 1999, emission norms for agricultural tractors were introduced throughout the country. Bharat Stage-II and Bharat Stage-III emission norms for tractors have been scheduled to be implemented from 2003 and 2005 respectively.
- h) The Bharat Stage-II norms for new 4-wheeler private non-commercial vehicle were introduced in Mumbai from January 2001 and in Kolkata and Chennai from July 2001 to 24th October, 2001.
- i) Only those taxies are being registered in Delhi, which are meeting Bharat Stage-II norms.
- j) Bharat State-II norms for Diesel 4 wheeler transport vehicles were introduced in NCT from 24th October, 2001, in Greater Mumbai, Kolkata & Chennai from 31.10.2001.

k) The expert committee on Auto Oil Policy was constituted during September 2001. The interim report of the committee was submitted to Govt. on 1.1.2000, recommending Bharat Stage-III emission norms for all category of 4-whellers in 7 mega cities from 2005 and rest of the country by 2010. Final report of the committee has been submitted in September 2002 which includes road map for control of vehicular pollution up to 2010.

1) Final report of the inter-Ministerial Task Force constituted by Ministry of Petroleum & Natural Gases at the instance of the Committee of Secretaries to evolve a long term policy for vehicular emission and auto fuel policy has been submitted which recommended introduction of Bharat Stage-II norms for 4-wheelers and next stage emission norms for 2/3 wheelers throughout the country from 2005 and introduction of Bharat stage III norms for four wheelers in 7-mega cities from 2005.

B) Fuel Quality Specifications

For the first time diesel and gasoline fuel quality with respect to environment related parameters has been notified under EPA during April 1996.

C) Lubricants Quality:

Specifications of 2T oil for two stroke engine with respect to smoke has been notified under EPA during September 1998 for implementation from 1.4.1999 throughout the country. Pre-mix 2T oil dispenser has been installed at all petrol filling stations in Delhi so that excessive oil is not being used by the vehicle owners. Sale of loose 2T oil has been banned from December 1998 in Delhi.

D) Alternate Fuels:

- a) All Govt. vehicles were required to compulsorily fit CNG kit or catalytic converter by December 1996.
- b) Custom duly on CNG kit has been excepted for promotion of CNG vehicles.
- c) Emission norms for CNG vehicles have been notified under Motor Vehicles Rule Vide GSR 853 (E) dated 19.11.2001.
- d) LPG is now being used as alternate fuel for motor vehicles after making amendments in CMVR. Emission norms for LPG vehicles have been notified vide GSR 284 (E) dated 24.4.2001.
- e) Battery driven vehicles have been introduced in few corridors in Delhi

E) Restriction of Grossly polluting Vehicles

a. Registration of new auto rickshaws with conventional engine has been banned from May 1996 from May 1996 and registration of Defense Service and Govt. auctioned vehicles has been banned from April 1994 in Delhi.

- b. 20 years old commercial vehicles were phased out from October 1998, 17 year old commercial vehicles has been phased out from November 1998 and 15 year old commercial vehicle from December 1998 in Delhi.
- c. Registration on alternation of vehicles by replacing petrol engine with diesel has been banned from 1.4.1998 in Delhi.

F) Traffic Management

- a. Restriction has been imposed on goods vehicles during day time from August 1999 in Delhi.
- b. Left lane has been made exclusive to buses and other HMV in Delhi.
- c. Time clocks have been installed in important red lights to enable the drivers to switch off their vehicles depending on the time left in the time clocks.
- d. More fly over and subways have been constructed and T-Junctions have been closed for better traffic flow.

G) Public Transport Systems:

- a. Number of buses has been increased to discourage use of individual vehicles by allowing private sectors for operation.
- b. Metro Rail Project for Shahdara Tri Nagar has been commissioned.

H) Technology

- a. Fitment of catalytic converter for new petrol passenger cars has been made compulsory from 1.4.1995 in four metros and 45 cities from 1.9.1998.
- b. Two wheeler scooters with four stroke engine are being introduced in the market from October 1998.
- c. Registration of only rear engine auto rickshaws is being allowed from May 1996 onwards.
- d. More four stroke two wheelers are being registered in Delhi.

I) Mass Awareness

a. Messages/articles related to vehicular emissions are disseminated through newsletters, pamphlets, newspapers, magazines, Television, Radio, internet, Workshops and Summer Exhibitions.

- b. Display of ambient air quality data through display system near ITO, Newspapers, daily news and internet.
- c. NGOs working on vehicular pollution control are being encouraged for mass awareness companies.

The phased tightening of exhaust emission standards for Indian Automobiles is elaborated in table 4.11.1 at annexure 4.

4.12 Environment Pollution due to Energy Use

4.12.1 A considerable amount of air pollution results from burning of fossil fuels. Fuels are primarily derived from fossilized plant material and consist mainly of carbon and/or its compounds. The household sector is the largest consumer of energy in India. More than 60 percent of Indian households depend on traditional sources of energy like fuel wood, dung and crop residue for meeting their cooking and heating needs. Out of total rural energy consumption about 65 per cent is met from fuel wood. Fuel wood consumption during 2001-02 is estimated at 223 million tones, 180 millions tones of which is for household consumption and the balance for cottage industry, big hotels etc. Burning of traditional fuels introduces large quantities of CO_2 when the combustion is complete, but if there is incomplete combustion and oxidation then Carbon monoxide (CO) is produced, in addition to hydrocarbons. Incomplete combustion of coal produces smoke consisting of particles of soot or carbon, tarry droplets of unburnt hydrocarbons and CO. Fossil fuels also contain 0.5–4.0% of sulphur which is oxidized to SO_2 during combustion.

4.12.2 The environmental effects of various fuels, namely, coal, oil, nuclear etc. are of growing concern owing to increasing consumption levels. The combustion of these fuels in industries and vehicles has been a major source of pollution. Coal production through opencast mining, its supply to and consumption in power stations, and industrial boilers leads to particulate and gaseous pollution which can cause pneumoconiosis, bronchitis, and respiratory diseases. Another major impact of coal mining is land degradation, especially of forest areas.

4.12.3 In India, Lignite production is mainly in Tamil nadu, Gujrat and Rajasthan. Coal is the most abundant source of commercial energy in India. Coal resources are continually assessed by the Geological Survey of India through regional mapping and exploratory drilling. The State wise Lignite and Coal production over the last ten years is presented in table 4.12.1at annexure 4.

4.12.4 The State wise inventory of geological reserves of coal is in table 4.12.2 according to types over a period from 2003- 2010 at annexure 4.

4.12.5 The State wise production of raw coal by types (coking, non - coking) over the years is depicted in table 4.12.3 at annexure 4.

4.12.6 Coal production increased rapidly after the nationalisation of coal mines. From about 296.7 million ton in 1997-98, it raised to 492.9 million ton in 2008-2009 making India the one of the major coal producers of the world. The increase is predominantly in non-coking coal production.

4.12.7 One of the major constraints on the profitability of the coal sector is the low productivity levels in underground mines. The underground mines employ 80% of manpower, but contribute to only 30% of the total output. **The productivity in Coal mines in the year 2007 can be viewed in Table 4.12.4 at annexure 4.**

4.12.8 Since the nationalisation of the coal industry, India's mine planners have chosen opencast mining over underground methods, to enhance productivity and meet production targets. The drawback of extracting the majority of the coal with opencast methods is that its quality is unavoidably affected by contamination of overburden mixes into the coal. The detail of production of Coal and Lignite from opencast working by mechanization and overburden removed during the year 2007 is presented in table 4.12.5 at annexure 4.

4.12.9 The consumption of petroleum products in vehicles, industries and domestic cooking activities results in the emission of pollutants in large quantities. The domestic production of Petroleum Products in India from 1970-71 to 2008-09 is in table 4.12.6 at annexure 4.

In addition to the domestic production, Crude oil and Petroleum products are imported also, the details of which over the years is shown in table 4.12.7 at annexure 4.

4.12.10 Natural gas is also an important fuel in India as evident from the following table **4.12.8**.

TABLE	4.12.8 : GROS	S AND NET	F PRODUC	TION & UTILISATION OF			
		NATURAL	GAS IN IN	NDIA			
(Million cubic metre)							
Year	Gross Production	Re- injected	Flarred	Net Production (Utilisation)			
2	3	4	5	6			
2000-01	29477	0	1617	27860			
2001-02	29714	0	1677	28037			
2002-03	31389	0	1426	29963			
2003-04	31962	0	1056	30906			
2004-05	31763	0	988	30775			
2005-06	32202	0	877	31325			
2006-07	31747	0	956	30791			
2007-08	32417	0	924	31493			
2008-09(P)	32845	0	1099	31746			

The details of production and utilization of Natural Gas in India from 1970-71 to 2008-09 is depicted in Table 4.12.9 annexure 4.

As evident from the chart 4.12.1 in India, 38.2% of natural gas is being utilized by power generation sector followed by fertilizer industry (27.53%) and as industrial fuel (17.92%).



The time series data of Industry wise off –take of Natural gas in India is available in table 4.12.10 at annexure 4.

4. 13 Power Sector

4.13.1 Though electricity is a major factor of development in all sectors, the role of power generating plants on environmental pollution can not be ignored at all. In the following sections, data depicting the growth of power generation sector in India are discussed.

4.13.2 The State /UT wise installed capacity of power utilities (thermal, nuclear, hydro renewable, Renewable Energy Sources) in India as on 31st March 2009 is exhibited in Table 4.13.1 at annexure 4. The table 4.13.2 shows the electricity generation in Public and Private Sector over the years.

TABLE 4.13.2 : GENERATING CAPACITY AND ELECTRICITY GENERATION						
Electricity Generation **						
Parameter	Parameter 2004-05 2005-06 2006-07 2007-08 2008-09					
Total (Utilities)	594456.20	623819.53	670654.16	722625.50	740867.36	
Public sector	535839.94	562056.45	603851.13	641693.47	651069.69	
Private sector	58616.26	61763.08	66803.03	80932.03	89797.67	

Source : Central Electricity Authority

** : in gigawatts-hours





4.13.4 The growth of installed power generating capacity (hydro, thermal, nuclear and **RES**) over the years can be seen in table 4.13.3 at annexure 4.

4.13.5 It is well known that, India is facing power shortage problem. The region /state wise data of requirement and availability of electricity is presented in table 4.13.4 at annexure 4. The time series data of annual gross generation of power by source is available in table 4.13.5 at annexure 4.

4.13.6 Significant efforts have gone into improving the power generation and electrification of villages in India since independence. The progress achieved in various five year plans is depicted in table 4.13.6 at annexure 4.

The Plan wise growth of installed capacity of power plants in India is exhibited in Chart 4.13.2.



Chart 4.13.2 -Plan wise growth of Installed capacity in India

The progress of village electrification over the years can be assed from the table 4.13.7. TABLE 4.13.7 : PLAN WISE PROGRESS OF VILLAGE ELECTRIFICATION

	No of villages electrified
Period	upto the period ending
Upto August 1947	1500
Upto August 1951	3061
First Plan (1951-56	7294
Second Plan (1956-61)	21754
Third Plan (1961-66)	45148
Annual Plan (1996-69)	73739
Fourth Plan (1969-74	156729
Fifth Plan (1974-78)	216863
Annual Plan (1978-80)	249799
Sixth Plan (1980-85)	370332
Seventh Plan (1985-90)	470838
Annual Plan (1990-91)	481124
Annual Plan (1991-92)	487170
Eight Plan (1992-97)	498836\$
Ninth Plan (1997-2002)	489699*
Tenth Plan (2002-2007)	482864#
31.03.2008 11th Plan (2007-2012)	488436
31.03.2009 11th Plan (2007-2012)	496365
31.03.2010 11th Plan (2007-2012))	497950

* : Cummulative achievement were recast as per definition of village electrification notified by Govt. of India in October,1997. As a result there has been a downward revision from the earlier figure of 512245 (Which was based on old definition)to 489699

: Cummulative achievement of villagtes electrified has been revised as per list of villages as per 2001 census and new definition.

\$: Cummulative achievement of villages electrifieid has been revised as per list of villages as per 1991 census from the earliar figure of 505674 to 489699.

The State /UT wise details of Towns and villages electrified is presented in table 4.13.8 annexure 4.

4.13.7 The generation of electric power produces more pollution than any other single industry. The energy sources most commonly used for electricity production – fossil fuels such as coal, oil and natural gas –are known as non-renewable resources. They take millions of years to be formed in the crust of the earth by natural processes. Once burned to produce electricity, they are gone forever. Burning fossil fuels such as coal or oil creates unwelcome by-products that pollute when released into our environment, changing the planet's climate and harming ecosystems.

The table 4.13.9 (a), (b) & (c) depict the enormous situation of harmful emissions by power sector.

TABLE 4.13.9 a: TOTAL ABSOLUTE EMISSIONS of CO2 FROM THEPOWER SECTOR BY REGION FOR THE YEAR 2005-06 TO 2008-09						
	Absolute Emissions Total (Million tCO_2)					
Grid	2005-06	2006-07	2007-08	2008-09		
NEWNE	368.2	385.70	406.90	430.40		
Southern	thern 101.6 109.00 113.60 117.90					
India	469.7	494.7	520.5	548.3		

Source : Central Electricity Authority

TABLE 4.13.9 (b):EMISSION FACTORS OF CO2 FOR 2008-09					
(in tCO ₂ /MWh)					
Grid	Average	OM	BM	СМ	
NEWNE	0.83	1.01	0.68	0.84	
Southern	0.76	0.97	0.82	0.90	
India	0.82	1.01	0.71	0.86	

Source : Central Electricity Authority

Note: Average is the average emission of all stations in the grid, weighted by net generation. OM is the average emission from all stations excluding the low cost/must run sources. BM is the average emission of the 20% (by net generation) most recent capacity addition in the grid.

CM is a weighted average of the OM and BM (here weighted 50:50)

OM: operating margin

BM: build margin

CM: combined margin

TABLE 4.13.9 (c): SPECIFIC EMISSIONS (WEIGHTED AVERAGE)OF CO2 FOR FOSSIL FUEL-FIRED STATIONS IN 2008-09						
(tCO_2/MWh)						
Grid	Coal	Diesel	Gas	Lignite	Naphtha	Oil
NEWNE	1.11	0.00	0.46	1.43	0.41	0.78
Southern	1.00	0.63	0.47	1.44	0.60	0.64
India	1.09	0.63	0.47	1.44	0.44	0.73

Source : Central Electricity

Authority

Note: NEWNE Grid : Integrated Grid of Northern, Eastern, Western and North Eastern Region.

4.13.8 Carbon dioxide and other air polluting particles are collecting in the atmosphere like a thickening blanket trapping the Sun's heat and causing the earth to warm up. The table 4.13.10 at annexure 4 presents the details of global average temperature and atmospheric concentrations of CO₂.

4.14 Renewable energy

4.14.1 Renewable energy sources are important to tackle the pollution as well the exhaustion problems of other energy sources. Radioactive emissions from nuclear power plants are of grave concern as they can cause serious impact both in terms of spatial and inter-generational concerns. In addition, two key problems are long-term waste disposal and the eventual decommissioning of plants. Due to limited reserves of petroleum, main emphasis needs to be given to non-conventional energy sources such as wind energy, solar energy and ocean energy. The estimated potential and cumulative achievements of various renewable energy programmes in India is depicted in table 4.14.1 at annexure 4.

4.14.2 Wind Power: The development of wind power in India began in the 1990s, and has significantly increased in the last few years. Although a relative newcomer to the wind industry compared with Denmark or the US, India has the fifth largest installed wind power capacity in the world. The worldwide installed capacity of wind power reached 157,899 MW by the end of 2009. USA (35,159 MW), Germany (25,777 MW), Spain (19,149 MW) and China (25,104 MW) are ahead of India in fifth position. The short gestation periods for installing wind turbines, and the increasing reliability and performance of wind energy machines has made wind power a favored choice for capacity addition in India. In India, wind power plants are mainly spread in 9 States.

TAB	TABLE 4.14.2 : STATE-WISE WIND POWER INSTALLED CAPACITY (MW)			
Sl	State			
No.		as on 31-12-09		
1	2	3		
1	Andhra Pradesh	122.5		
2	Gujarat	1711.8		
3	Karnataka	1390.6		
4	Kerala	27.0		
5	Madhya Pradesh	212.8		
6	Maharashtra	2004.4		
7	Rajasthan	855.4		
8	Tamil Nadu	4596.2		
9	West Bengal	1.1		
10	Others	3.2		
	Total	10925.0		

The State wise wind power installed capacity over the years is presented in table 4.14.2.

Source : Ministry of New And Renewable Energy, Annual report 2009

4.14.3 Bio mass Power Plants

In India, Grid interactive Bio mass power plants are installed in 11 States. The total installed capacity of bio mass plants are 1101.83 MW.

TABLE 4.14.3 : THE STATUS OF BIOMASS PROJECTS							
Sl. No.	Project Status	Biomass Cogeneratio		eration	Total		
		Power					
		MW	Nos	MW	Nos	MW	Nos
1	2	3	4	5	6	7	8
1	Commissioned	290	52	437	57	727	109
2	Under implementation	284	41	323	35	607	76

Source :Ministry of New and Renewable Energy

The State wise Grid – interactive biomass power installed capacity can be seen in Table 4.14.4.

Table 4.14.4 State wise Grid interactive biomass power installedCapacity(AS ON 31 12 2006)			
Sr. No	State	Cumulative Installed Capacity (MW)	
1	Andhra Pradesh	301.25	
2	Chattisgarh	88.52	
3	Gujarat	50.00	
4	Haryana	6.00	
5	Karnataka	254.28	
6	Madhya Pradesh	1.00	
7	Maharashtra	52.00	
8	Punjab	28.00	
9	Rajasthan	23.30	
10	Tamil Nadu	215.50	
11	Uttar Pradesh	121.50	
	Total	1101.83	

Source: Ministry of New and Renewable Energy

4.14.4 **Small Hydro power Projects:** In India, nearly 611 small hydro power projects (capacity upto 25 MW) have been already set up and 225 are under implementation. The total capacity of the existing power plants is nearly 2045.61 MW and the total capacity of the

projects under implementation is 668.86 MW. The State wise details of small hydro power projects set up and under implementation are shown in table 4.14.5 at annexure 4. 4.14.5 The total capacity of all the grid interactive renewable power projects (small hydro power, wind power, bio power and solar power) installed in India is approximately 16817.04 MW. The State- wise details of cumulative installed capacity of grid interactive renewable power projects in India is depicted in table 4.14.6 and the details of grid interactive renewable power installed during 2009-10 is in table 4.14.7 at annexure 4.

The details of decentralized / off –grid renewable systems devices installed in various States of India is depicted in table 4.14.8 annexure 4.

4.14.5 Bio –gas plants: Bio gas plants are a very viable and suitable fuel generating technology for households in Indian villages. The bio gas plants are cost effective and reduce the indoor pollution in households.

The distribution of family –type biogas plants in various States of India are exhibited in Table 4.14.9 at annexure 4.

4.14.6 Energy Parks: Energy parks are set up to demonstrate the applications and after sale services of various renewable energy devices. In India, there are 476 energy parks at district level and 25 at State level. The State wise details of energy parks is shown below in table 4.14.10.

No.	State/UT	Energy Parks in Nos.		
		District Level	State Level	
1	Andhra Pradesh	30]	
2	Arunachal Pradesh	6]	
3	Assam	15]	
4	Bihar	5		
5	Chhattisgarh	11	1	
6	Delhi	9		
7	Goa	2		
8	Gujarat	14		
9	Haryana	22		
10	Himachal Pradesh	12		
11	Jammu & Kashmir	7		
12	Jharkhand	15		
13	Karnataka	26		
14	Kerala	16		
15	Madhya Pradesh	23		
16	Maharashtra	52		
17	Manipur	10		
18	Meghalaya	7		
19	Mizoram	7		
20	Nagaland	6		
21	Orissa	9		
22	Punjab	19		
23	Rajasthan	12		
24	Sikkim	5		
25	Tamil Nadu	45		
26	Tripura	10		
27	Uttar Pradesh	52		
28	Uttarakhand	11		
29	West Bengal	8		
30	A&N Islands	8		
31	Chandigarh	3		
32	Pondicherry	2		
	Total	476	2	

4.14.7 **Renewable energy clubs** are set up in India to create awareness about new and renewable sources of energy among students especially Engineering students. There are 481 renewable energy clubs functioning in all over India. **The State wise detail of Energy clubs is presented below in 4.14.11.**

Table 4.14.11 : State wise Renewable Energy Clubs			
S. No	State	No. of Renewable	
		Energy Clubs	
1	Andhra Pradesh	40	
2	Chandigarh Administration	4	
3	Chhattisgarh	8	
4	Haryana	9	
5	Himachal Pradesh	2	
6	Jammu & Kashmir	4	
7	Karnataka	60	
8	Madhya Pradesh	31	
9	Maharashtra	67	
10	Orissa	13	
11	Pondicherry	5	
12	Punjab	15	
13	Rajasthan	12	
14	Tamil Nadu	123	
15	Uttar Pradesh	64	
16	West Bengal	24	
	Total	481	

Source : Ministry of New and Renewable Energy

4.15 Noise Pollution

4.15.1 Of late, noise has been recognized as a pollutant which until recently was considered only as a nuisance. According to study on occupational hazards, even short exposures to intense noise can shift upward the hearing threshold while prolonged exposure or intermittent exposure over a long period produces a damaging effect on hearing resulting in a permanent threshold shift. Accordingly, the Central Pollution Control Board (CPCB) has notified the ambient noise standards in 1987 under section 20 of the Air (Prevention and Control of Pollution) Act, 1981.

4.15.2 The noise standards are specified separately for Industrial Commercial, Residential and Silent zones for Day and Night time. Table 4.15.1shows the ambient air quality standards in respects of noise.

TABLE 4.15.1 : AMBIENT AIR QUALITY STANDARDS IN RESPECT OFNOISE					
Sl.	Area		Limits in dB(A)L _{eq} *		
No.		Day Time	Night Time		
1	2	3	4		
1	Industrial Area	75	70		
2	Commercial Area	65	55		
3	Residential Area	55	45		
4	Silence Zone	50	40		
Sour	ce : Central Pollution Control Board				
Note	s:				
1	Day Time 06.00 hour to 22.00 hour (16 hours)				
2	Night time22.00 hour to 06.00 hour (08 hours)				
3	Areas upto 100 metres around certain premises like ho	ospitals, educa	ational		
	institutions and courts, religious places or any other ar	ea which is d	eclared as		
	silence zones by the competent authority.				
4	Mixed categories of areas may be declared as one of fe	our aforesaid	categories		
	by the competent Authority.				
	$* dB (A) L_{eq}$ denotes the time weighted average of the level of sound in				
decibels					
	on scale A which is relatable to human hearing.				
	A "decibel" is a unit in which noise is measured.				
	"-" "A", in dB (A) L_{eq} denotes the frequency weighting in the measurement of				
noise					
	and corresponds to frequency response characteristics of the human ear.				
	L_{eq} . It is an energy mean of the noise level over a specified period.				

4.15.3 The increasing noise pollution may be attributed to increase in no. of vehicles, urbanization and industrialization. The noise pollution has already reached at a high level in most of the metropolitan cities in all the residential, commercial, industrial and silence zones as evident from table 4.15.2.

TABLE 4.15.2 : AVERAGE NOISE LEVELS IN VARIOUS METROPOLITAN CITIES						
						(dB[A])
SI. No.	Metropolitan Cities	Day/ Night	Industrial Area	Commercial Area	Residential Area	Silence Area
	2					
1		3	4	5	6	7
1	Kolkata	Day Night	78 67	82 75	79 65	79 65
2	Mumbai	Day Night	76 65	75 66	70 62	66 52
3	Chennai	Day Night	71 66	78 71	66 48	63 49
4	Bangalore	Day Night	78 53	76 57	67 50	67
5	Hardwar*	Day Night	-	77 75	66 58	71 66
6	Kanpur*	Day Night	-	79 78	75 72	75 66

Source : Central Polution Control Board

* : 2003 Figures

4.15.4 Effects of noise pollution Table 4.15.3 presents the harmful effects of noise pollution on human health.

TABLE 4.15.3 : EFFECTS OF NOISE POLLUTION ON HUMAN HEALTH				
A. Noise Hazard	S	B. Noise Nuisances		
Stage : I	Stage : II	Stage III	Stage IV	
Threat to	Causing Injury	Curbing Efficient	Diluting Comfort	
Survival	(a) Neural -	Performance	and Enjoyment	
(a)	humoral stress	(a) Mental	(a) Invasion of	
Communication	response	Stress	Privacy	
interference	(b) Temporary	(b) (b) Task	(b) Disruption of	
(b) Permanent	hearing loss	Interference	Social	
hearing loss	(c) Permanent hearing	(c) (c) Sleep	Interaction	
	loss	Interference	(c) Hearing Loss	

4.16 Green House Gases and Their Effects

4.16.1 The greenhouse effect plays a crucial role in regulating the heat balance of the earth. It allows the incoming short-wave solar radiation to pass through the atmosphere relatively unimpeded; but the long-wave terrestrial radiation emitted by the earth's surface is partially absorbed and then re-emitted by a number of trace gases in the atmosphere. These gases known as Greenhouse Gases (GHGs) are: water vapor, carbon dioxide, methane, nitrous oxide and ozone in the troposphere and in the stratosphere. This natural greenhouse effect warms the lower atmosphere.

4.16.2 If the atmosphere were transparent to the outgoing long wave radiation emanating from the earth's surface, the equilibrium mean temperature of the earth's surface would be considerably lower and probably below the freezing point of water. Mere incidence of GHG's in the atmosphere, by itself, is no concern. What is more important is that their concentration should stay within reasonable limits so that global ecosystem is not unduly affected. However, by increasing the concentrations of natural GHG's and by adding new GHG's like chloro-flouro carbons, the global average and the annual mean surface-air temperature (referred to as the global temperature) can be raised, although the rate at which it will occur is uncertain. This is the enhanced greenhouse effect, which is over and above that occurring due to natural greenhouse concentration. Such a rise in the atmospheric concentration of GHG's has led to an upward trend in global temperature.



Source : Central Pollution Control Board

4.16.3 While it is required to follow the general commitments under the Framework Convention on Climate Change, India is not required to adopt any GHG reduction targets. Irrespective of international commitments, it seems prudent to be ready with

- Inventory of sinks and sources of GHG emission
- Predict the cumulative impact of national and international GHG emissions to plan for temperature and sea level rise
- Devise land use plans for the coastal areas likely to be affected
- Devise water and land management strategies especially agricultural sector.

4.17 Ozone Depletion

- 4.17.1 Ozone depletion describes two distinct, but related observations: a slow, steady decline of about 4% per decade in the total volume of ozone in Earth's stratosphere (the ozone layer) since the late 1970s, and a much larger, but seasonal, decrease in stratospheric ozone over Earth's polar regions during the same period. The latter phenomenon is commonly referred to as the ozone hole. CFCs and other contributory substances are commonly referred to as ozone-depleting substances (ODS). Since the ozone layer prevents most harmful UVB wavelengths (280–315 nm) of ultraviolet light (UV light) from passing through the Earth's atmosphere, observed and projected decreases in ozone have generated worldwide concern leading to adoption of the Montreal Protocol that bans the production of CFCs and halons as well as related ozone depleting chemicals such as carbon tetrachloride and trichloroethane. It is suspected that a variety of biological consequences such as increases in skin cancer, cataracts, damage to plants, and reduction of plankton populations in the ocean's photic zone may result from the increased UV exposure due to ozone depletion.
- 4.17.2 Table 4.17.1 at annexure 4 depicts the production of Ozone depleting substances in India and 4.17.2 annexure 4 presents the total consumption of Ozone depleting substances over the years.

4.18 Action Plan to combat Air Pollution

A brief of the action plans implemented in major cities of India is discussed in the following session.

4.18.1 Major City Specific Action Plan in Delhi

A) Vehicular Pollution Control

- a. Public transport (buses, auto, taxis) in Delhi has been converted to CNG mode.
- b. Sulphur content in diesel has been reduced in a phased manner.
- c. The lead content in petrol has been progressively reduced to make it unleaded.

- d. Bharat Stage-III norms have been implemented in Delhi.
- e. Pre-mix 2T oil dispensers have been installed at all petrol filling stations.
- f. Grossly polluting old commercial vehicles have been phased out .
- g. Restriction has been made on plying of goods commercial vehicles during day time.
- h. Metro rail has been introduced to have a more efficient public transport system.

(B) Industrial Pollution Control

(i) Directions under Section 5 of E(P)A, 1986 have been issued on April 1996 and July 1996 to all the three power plants located in Delhi for completing the following in a time bound manner.

- > Comply with emission and liquid effluent standard.
- Submission of action plan for switching over the beneficiated coal with an ash content of not more than 34%.
- Submission of action plan to achieve 20% utilization of fly-ash by Dec. 1997.
- > Installation of opacity meter in all units to ensure compliance with the standards.
- Coverage of abandoned ash ponds with top soil.
- (ii) All stone crushers have been closed down in Delhi and shifted to Pali in Rajasthan.
- (iii) All the hot mix plants have been closed down and shifted to other states.

(iv) As per the directions of Hon'ble Supreme Court, 168 hazardous industries have been closed down in Delhi.

4.18.2 Major City Specific Action Plan in Mumbai

- > Bhatart Stage-III norms have been implemented in Mumbai.
- > Unleaded gasoline and low sulphur diesel are being supplied in Mumbai.
- Visits are made to petrol pump as per guidelines prescribed to check/inspect adulteration/malpractices in diesel and petrol under Central Govt. vide order The Motor Spirit and High Diesel (Regulation of Supply and Distribution and Prevention of Malpractices), 1998. Defaulter petrol pumps are legally prosecuted under Essential Commodities Act, 1955.
- Licence and 'End Use Certificate' is made compulsory to persons who store Naptha and Solvents which are also used as adulterants in petrol and diesel.

- > Pollution under Control certificate has been made mandatory for every vehicle owner.
- Implementation of rigorous inspection and maintenance measures periodically for all types of vehicles, involving vehicle manufacturers.
- From 15.10.99 'No Pollution Under Certificate- No Petrol' scheme is launched in Mumbai Metropolitan Region (MMR)
- ▶ Buses, taxis, autos are on CNG mode.
- Mass awareness Programme are being organized for creating awareness in public.
- The Transport Commissioner's Office has increased vigilance in checking polluting vehicles in Mumbai by increasing number of exhaust monitors for petrol and diesel driven vehicles.
- Auto exhaust checking are also done at entry points to Maharashtra State to check compliance to norms fixed under Central Motor Vehicles Act, 1989.

4.18.3 Major City Specific Action Plan in Ahmedabad

A) Vehicular Pollution Control

The measures include following

- (i) Banning of old buses of more than 15 years old
- (ii) Bharat Stage- III norms have been introduced in Ahmedabad.
- (iii) Banning of diesel run rickshaw within city limits.

(iv) Diversion of heavy vehicles such as trucks/luxury buses/trailers/tankers/tractors/lorries, etc. aw ay from the city.

 (v) Improvement of road condition and making the roads pucca upto the footpath not leaving any uncovered space on either sides of the roads.
 Strict enforcement of smoke test/vehicle test protocol

(vii) Surveillance of vehicles with higher black smoke emission

(viii) Third party audits of PUC Centres including calibration audits

(ix) To launch a drive to stop usage of kerosene in vehicles particularly three wheelers and commercial vehicles.

(B) Industrial Pollution Control

The measures include following

(i) Intensifying monitoring by special vigilance squad under the Air Act, 1981.

(ii) Determining efficacy of APC system & taking remedial action(s) including upgradation of existing Air Pollution Control Measures wherever needed.

(iii) Implementation of CREP Action Plan for highly pollution industries as decided by MOEF.

(iv) Ban on burning of off specification materials/wastes by scrap traders.

4.18.3 Major City Specific Action plan in Bangalore

- To reduce traffic congestion, 108 roads have been converted to one way, 5 flyovers completed, 3 railway under pass on Quter rind road (ORR) limit completed, 2 railway over bridges completed and 206 Km of road has been asphalted.
- Low sulphur diesel (Green Diesel) and Green Petrol (Sulphur 0.05%) is being supplied in Bangalore ORR area from 1.4.2003.
- > Bharat Stage III norms have been introduced in Bangalore.
- Out of 70,131 (as on 31.07.2003) auto rickshaws registered in Bangalore city, 35000 auto rickshaws are running on LPG
- ➢ 6 Auto LPG dispensing stations (ALDS) are operating
- Transport department has approved Bajaj 4 stroke (rear engine) LPG auto rickshaw in Bi- fuel mode
- ▶ 5% ethanol blended petrol is being supplied in all districts from 01.10.2003.
- Regular check on adulteration of fuel is being conducted by Food and Civil Supplies Department.
- Goods vehicles carrying construction materials are allowed within ORR only during 10 PM to 6AM for unloading.
- Modernization of Emission testing Centers for issue of "Pollution Under Control" Certificate bearing photograph of the tested vehicle using Web camera by the Transport Department.
- Karnataka State Pollution Control Board to take action to promote use of cleaner fuels used by major industries in Generator sets and boilers.

4.18.4 Major City Specific Action Plan in Chennai

- > Bharat Stage III norms have been introduced in Chennai.
- > Unleaded gasoline and low sulphur diesel are being supplied in Chennai.
- > Pollution Under Constrol Certificate has been made mandatory.
- Pre mixed 2T oil dispensers have been installed in most of the retail outlets in Chennai City.
- The Motor Spirit and High Speed Diesel (Regulation & Supply and Distribution and Prevention of malpractices) order 1998 has been republished by the Government of Tamilnadu with the intention to curb malpractices such as adulteration, pilferation etc.,
- LPG supply is being implemented by oil companies, Oil companies have promised to setup 28 Auto ALP dispensing station (ALDS). Presently five ALDS are functioning.
- Mass Rapid Transit System (MRTS) and electric trains are operated by Southern Railways.
- > Power plants have been insisted to provide scrubber for the control of emissions
- For all the process emission sources and boiler of higher capacity air pollution control measures such as dust collectors and wet scrubbers are insisted by Tamil Nadu Pollution Control Board.
- The industrial units are also insisted to switch over to cleaner fuels such as LSHS, LDO etc., to control the SO₂ emission.

4.18.5 Major City Specific Action Plan in Kolkata

A) Vehicular Pollution Control

- i.Bharat State -III norms have been introduced in Kolkata
- ii.Supply, Distribution and Selling of Loose 2T oil in Kolkata Metropolitan Area (KMA) has been Banned from 01.10.2001 and Selling of Premixed Fuel oil made Mandatory within KMA from 15.11.2001.
- iii. Unleaded Petrol and Low Sulphur Petrol and Diesel made available within Kolkata and Howrah and adjoining agglomeration.

- iv. Availability of Cleaner Automotive Fuel like LPG ensured in Kolkata.
- v. Introduced Upgraded Auto Emission Testing Centre (PUC Centre)B) Industrial Pollution Control
- i. Stricter Locational Policy for New Industrial Units
- ii.Ensuring Regulatory Compliance by Grossly Polluting Industries
- iii.Introduction of Stricter Emission Standard for Boilers, Ceramic, Kilns, Foundries and Rolling Mills operating within Kolkata Metropolitan Areas.
- iv.Mandatory Use of Cleaner Fuel in Small Boilers, Ceramic Kilns and Rolling Mills operating within Kolkata Metropolitan Area.
- v.Discontinuance of Coal Supply to the industries which have been ordered to discontinue the use of coal.

vi.Environmental compliance by Cluster of Small Scale Industries is also ensured

4.18.6 Major City Specific Action Plan in Hyderabad

The measures include following

• Upgradation of existing Pollution under Control (PUC) centers with computer testing facility

- Unleaded gasoline and low sulphur diesel are being supplied in Hyderabad
- Introduction of mobile task forces to monitor the visibly polluting vehicles.
- Bharat Stage-III norms have been introduced in Hyderabad
- Ban on sale of loose 2T oil. Shall be dispensed through premixed dispensing stations
- Establishment of LPG dispensing stations
- Constitution of task forces to check the adulteration of oil and fuel
- Introduction of multi model transport system

 \circ Urban Greening by Hyderabad Urban Development Authority (HUDA) is being carried out

• Open space plantation by Municipal Corporation of Hyderabad (MCH) is being carried out
