Inventory and Future Emissions from India:
Analysis Using AIM Local Model

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Overview

- India Emission Inventory
- India Future Emissions
  - Large Point Sources (LPS)
  - Area Sources
- District Ahmedabad

India Emission Inventory

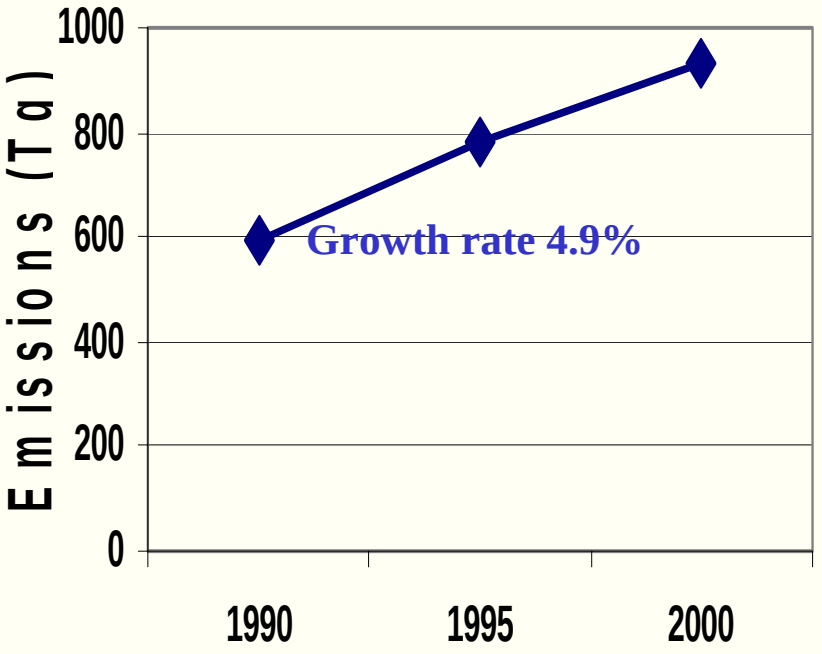
Emissions Inventory for India

Emissions (Tg)	1990	1995	2000	CAGR *
Carbon dioxide	593	778	935	4.9
Methane	17.050	18.050	19.100	1.2
N_2O	0.213	0.251	0.308	3.8
SO_2	3.540	4.640	5.940	5.3
NO_X	2.640	3.460	4.300	5.0
CO_2 equivalent GHG	1016	1234	1432	3.5

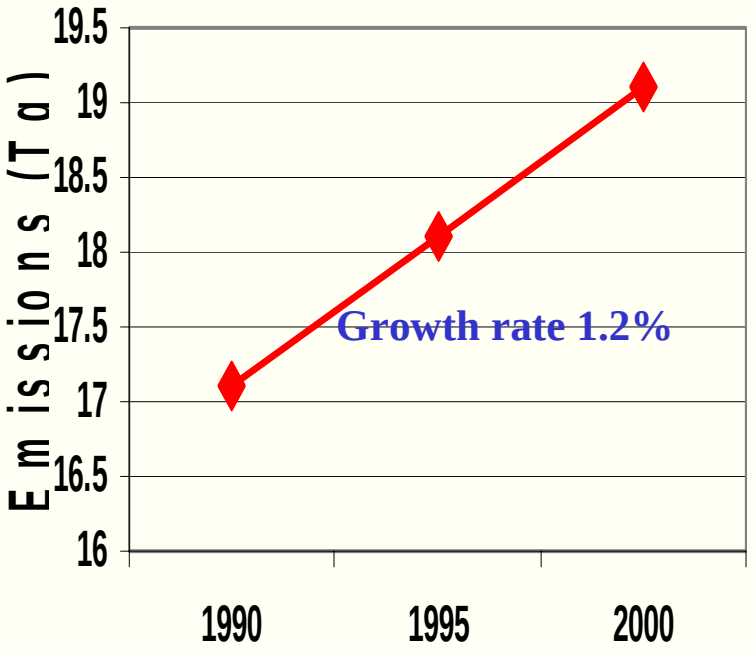
* Compounded Annual Growth Rate over 1990-2000 (%)

India Emission Trends (Tg)

Carbon dioxide

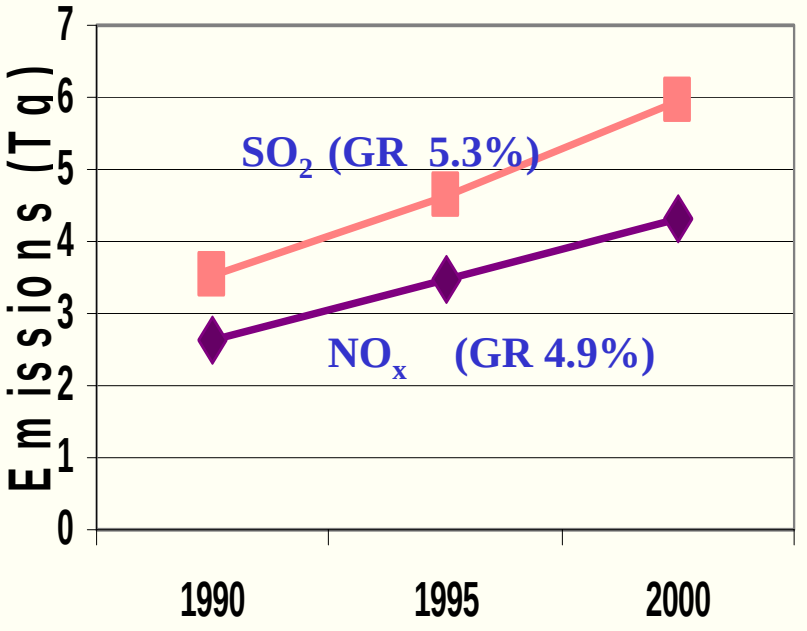


Methane

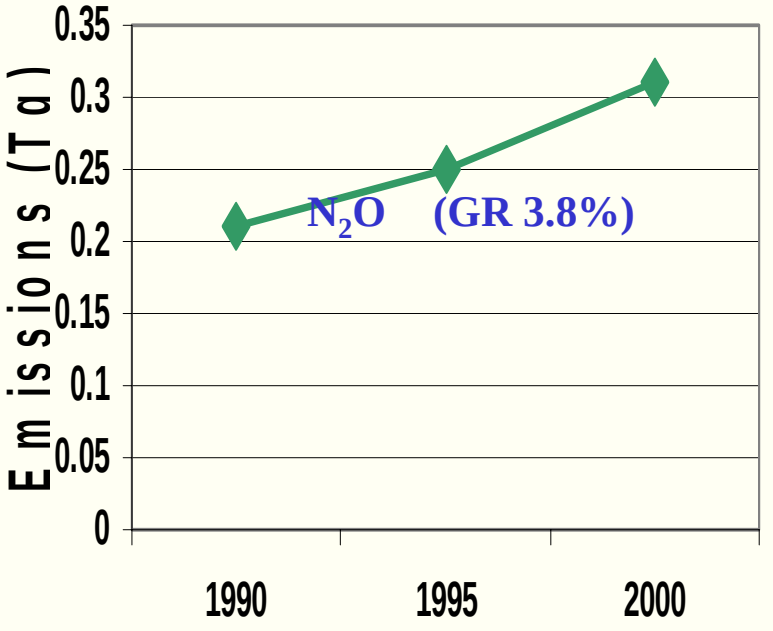


India Emission Trends (Tg)

SO_2 and NO_x



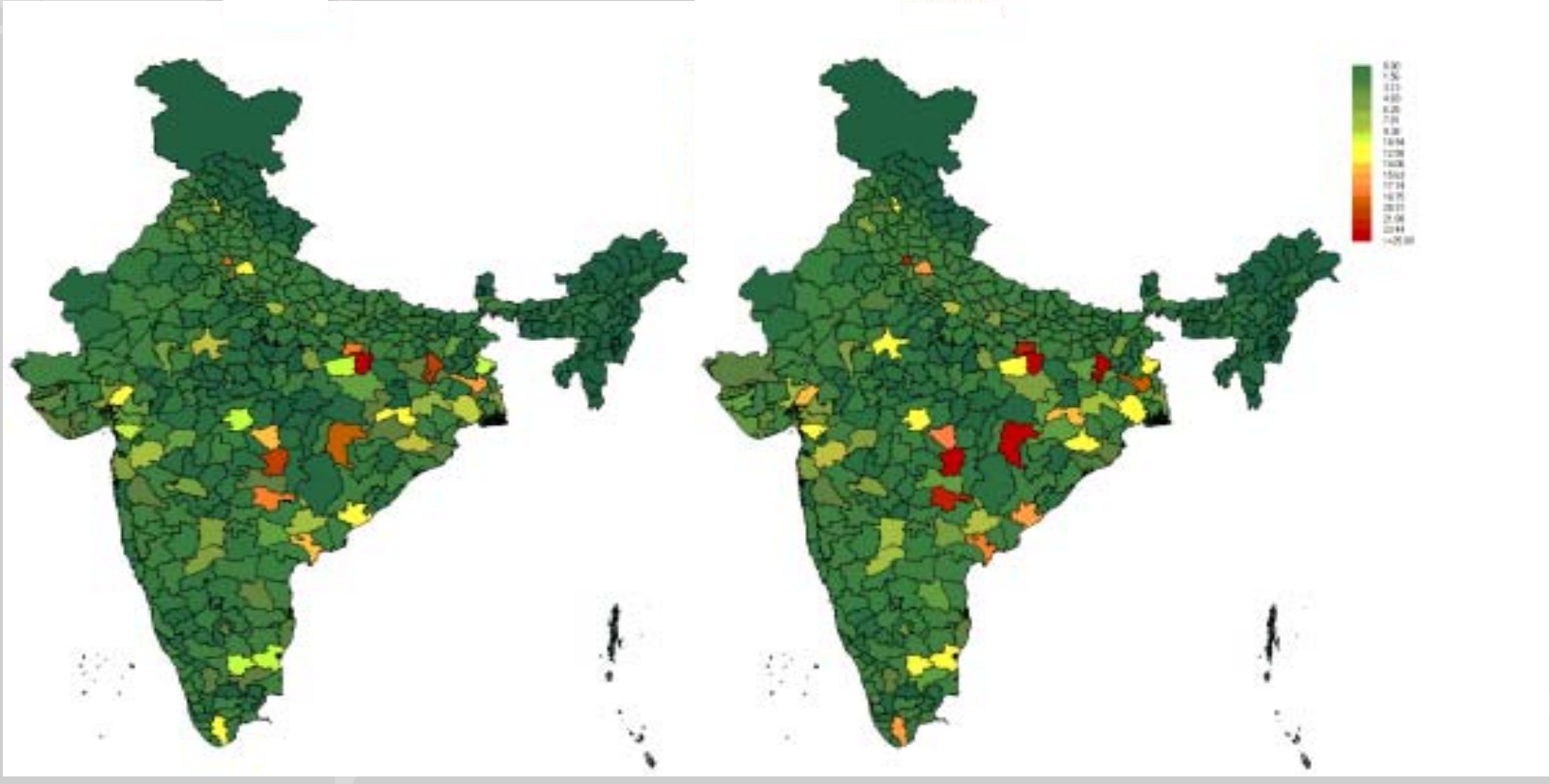
N_2O



Emission Inventory: 466 Districts of India

CO_2 Emission Distribution

1995 2000



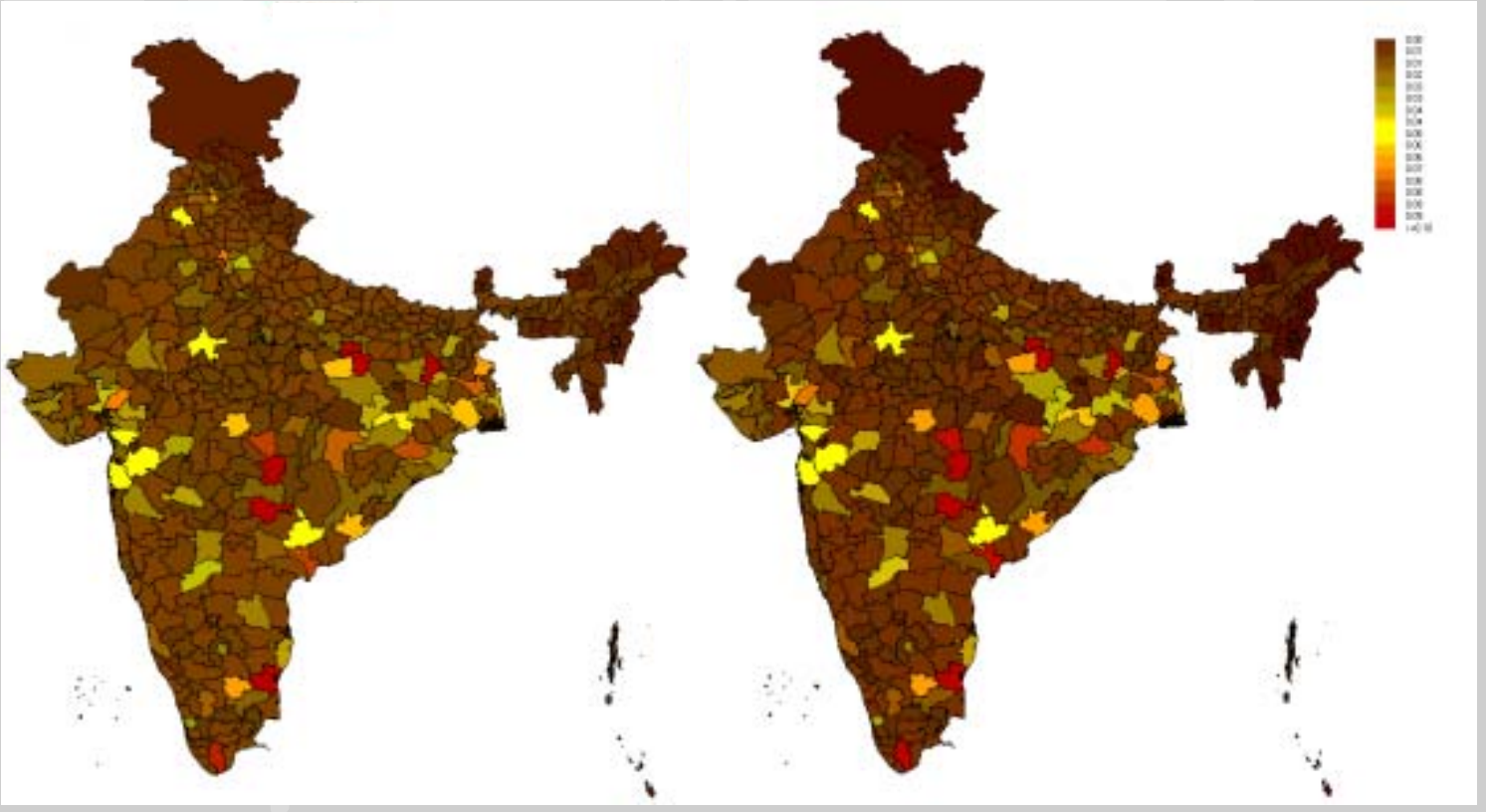
CO_2 Emission Distribution

- Coal mainstay- hot-spots have high correlation with coal consumption
- Thermal power plants (Coal), large cities (Oil) and industrial towns – main hot-spots
- Electricity generation dominates the hot-spots

No of Largest emitter districts	Percentage of total emission	
	1995	2000
1-5	16.1	15.8
1-15	36.7	36.9
1-25	50.3	56.4
1-47	67.4	73.6
1-233	95.3	95.9
All India	100	100

SO_2 Emission Distribution

1995 2000

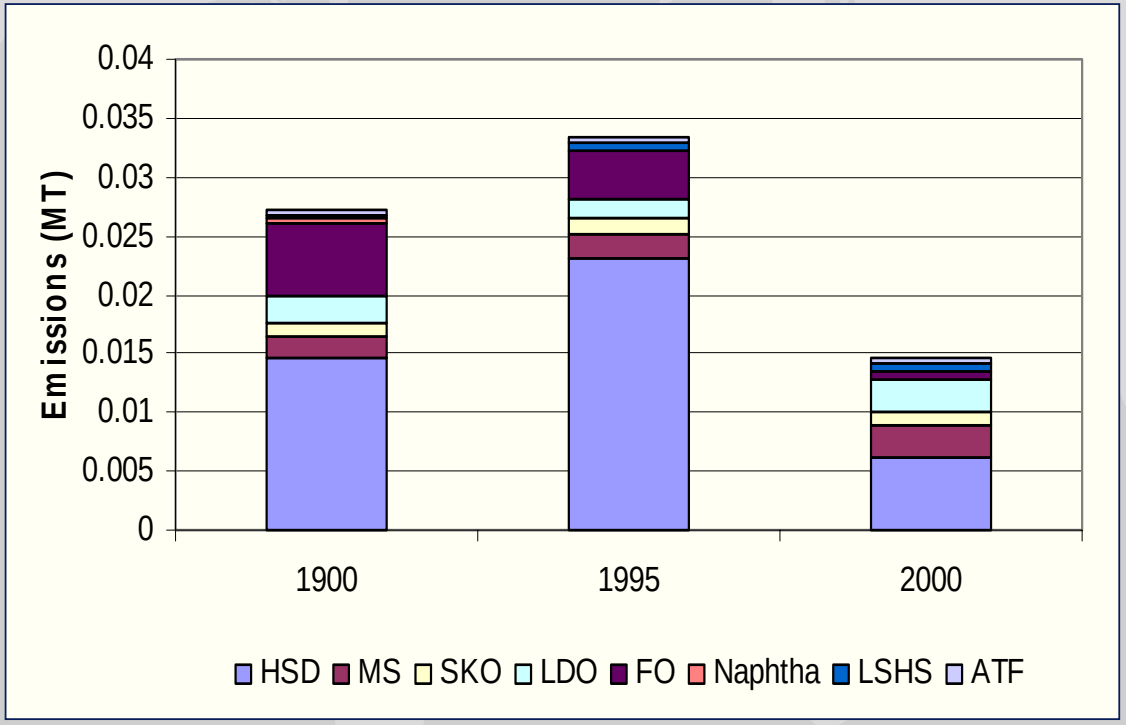


SO_2 Emission Distribution

- Hot-spots have high co-relation with CO2 emissions
- Top 20 districts growth rate higher than national average
- Least 400 contribution decreased but emissions marginally increased

No of Largest emitter districts	Percentage of total emission	
	1995	2000
1-5	15.5	16.1
1-15	33.4	36.2
1-25	46.5	50.1
1-47	63.8	68.5
1-233	94.3	94.8
All India	100	100

Delhi SO_2 Emissions from Oil



SO_2 Co-efficient decrease from 0.02 to 0.005 for Diesel over 1995-2000 has resulted in substantial SO_2 emission reduction in case of Delhi

Future Emissions

Emission projections for India

Emissions (Tg)	1995	2000	2010	2020	2030	CAGR*
CO_2	778	935	1507	2097	2482	3.37
Methane	18.05	19.10	21.5	23.2	24.83	0.91
N_2O	0.25	0.31	0.40	0.61	0.75	3.18
SO_2	4.64	5.94	6.46	8.09	7.62	1.42
NO_X	3.46	4.30	6.08	7.64	8.48	2.59
CO_2 equivalent GHG	1234	1432	2063	2752	3233	2.79

*Compounded Annual Growth Rate over 1995-2030 (%)

LPS Future Emissions

LPS Database

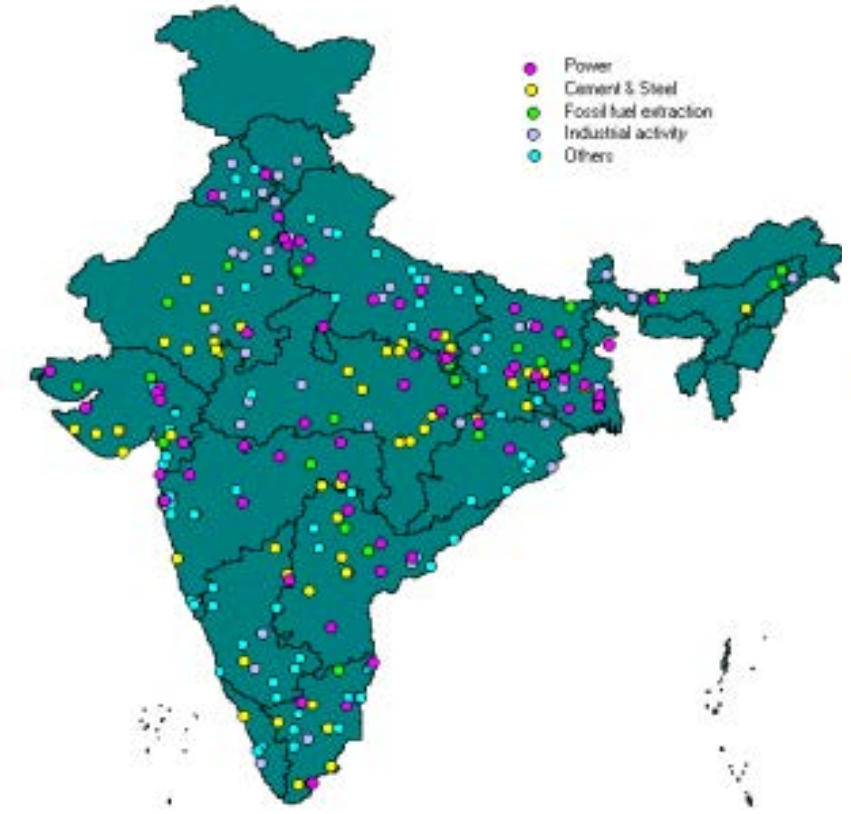
- Data for increasing numbers of LPS
- Coverage of gases:
  - CO_2 and SO_2
- Emissions factors for India
- Projections up to year 2030

LPS Coverage for India

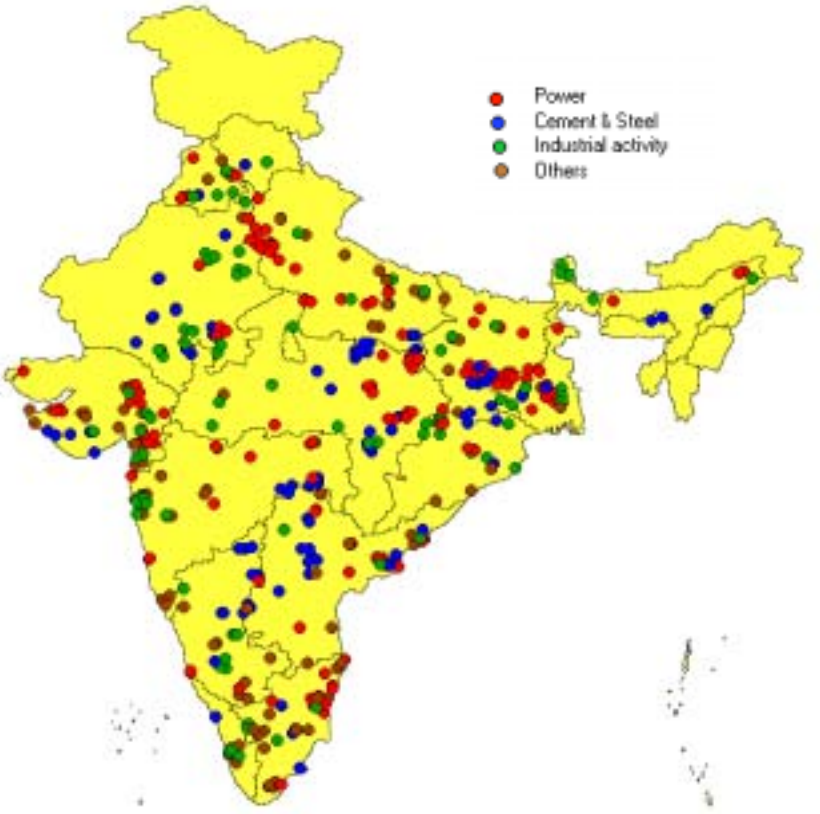
Sector	Subsectors	LPS covered			
		2000	2010	2020	2030
Energy	Power (coal & Oil)	82	111	131	150
	Power (natural gas)	12	17	20	23
	Steel	11	17	23	29
	Cement *	85	98	110	123
	Fertilizer	31	41	52	62
	Paper	33	38	43	48
	Sugar	28	28	29	30
	Caustic Soda	19	21	23	26
Industrial processes	H_2SO_4 manufacturing	63	64	66	68
	Aluminium (Al)	3	4	5	5
	Copper ore smelting (Cu)	8	9	10	11
	Lead ore smelting (Pb)	5	6	7	8
	Zinc ore smelting (Zn)	3	4	5	5
Total		**383**	**458**	**524**	**588**

LPS Locations

2000



2030

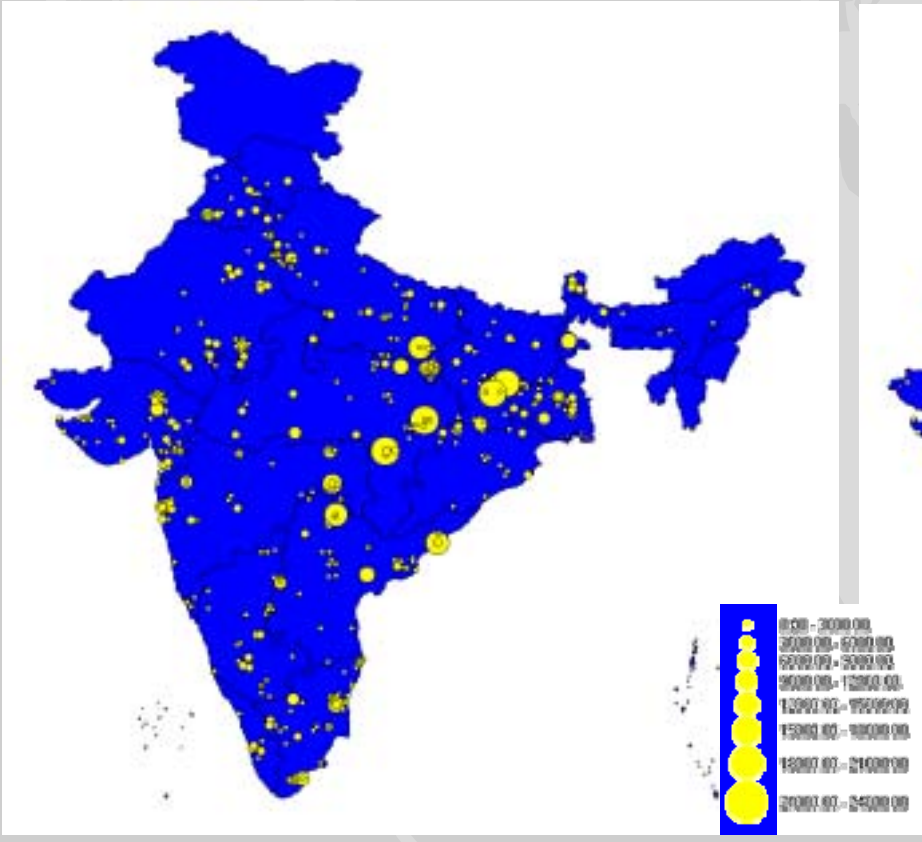


Database Generation

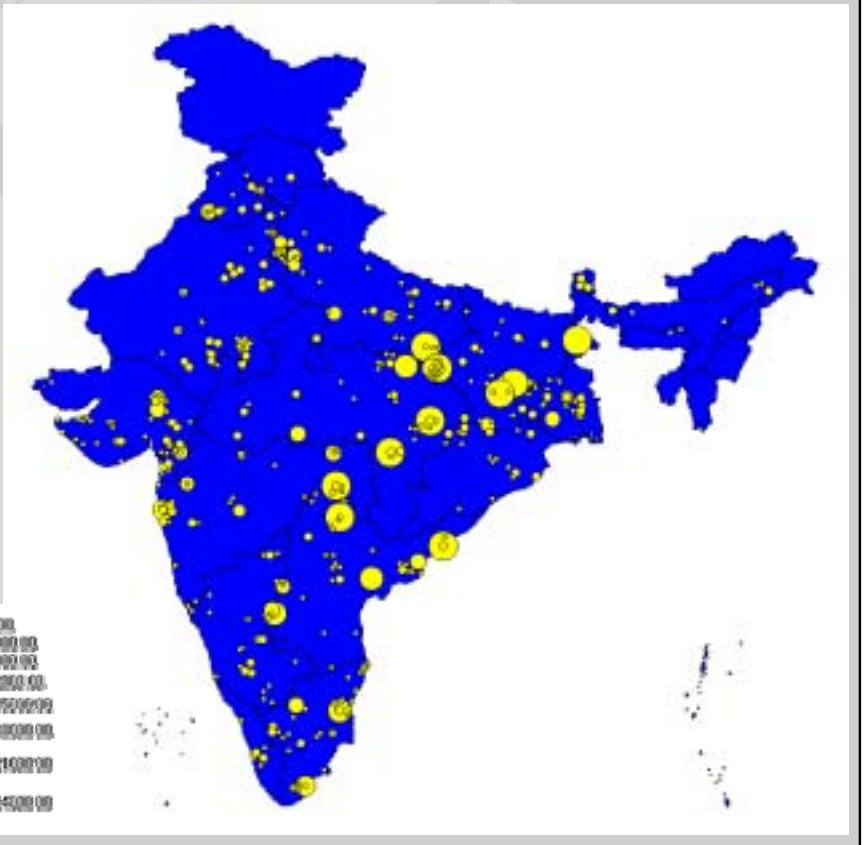
- Sectoral demand projections on the basis of macro-economic parameters
  - Thirty year time series GDP
  - Government projections
  - Expert opinion
- LPS demand on the basis of sectoral demand elasticity and past production trends
- Demand over and above LPS capacities assigned to Area Sources

CO_2 from LPS

2000



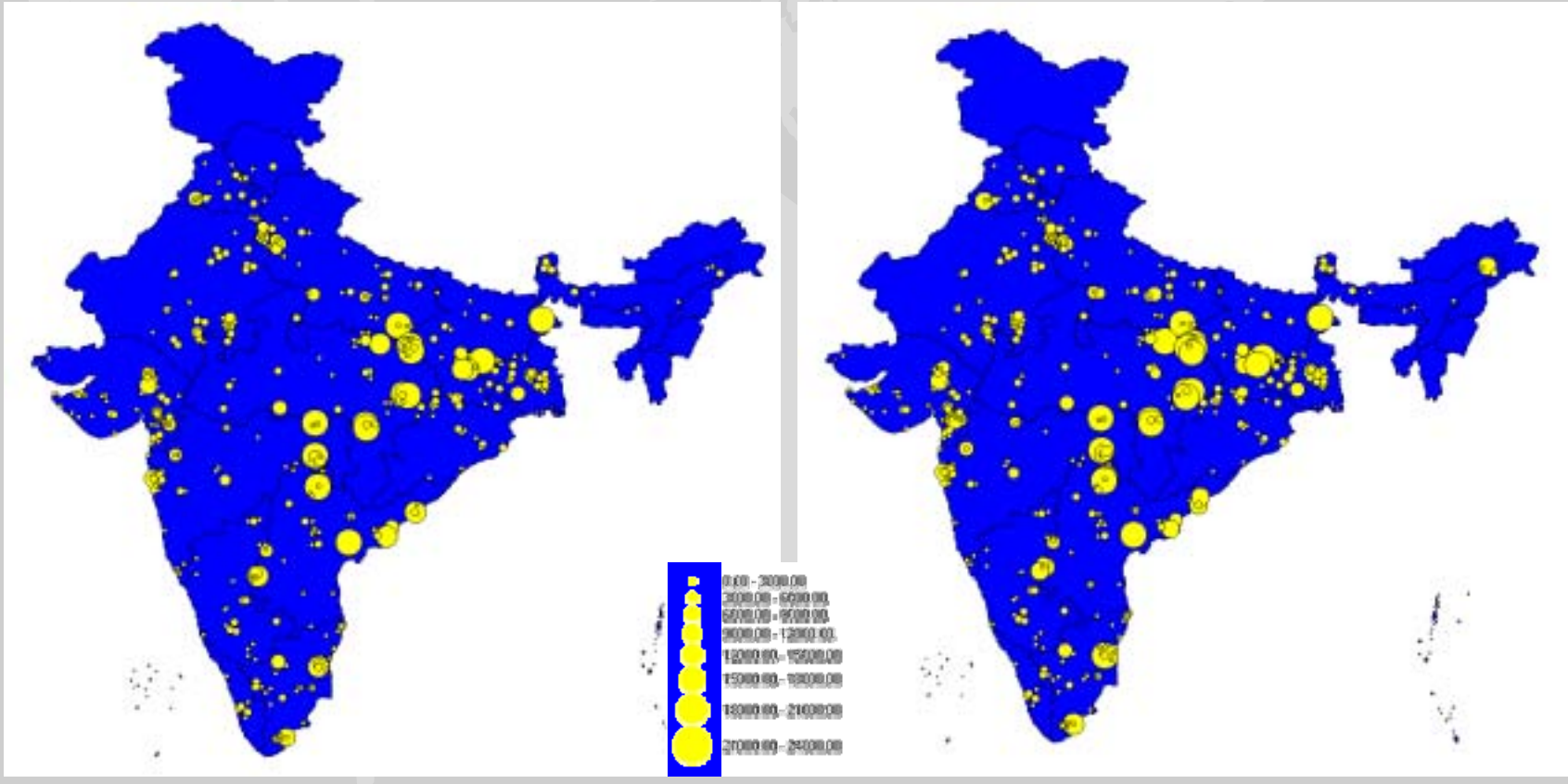
2010



IIM Ahmedabad

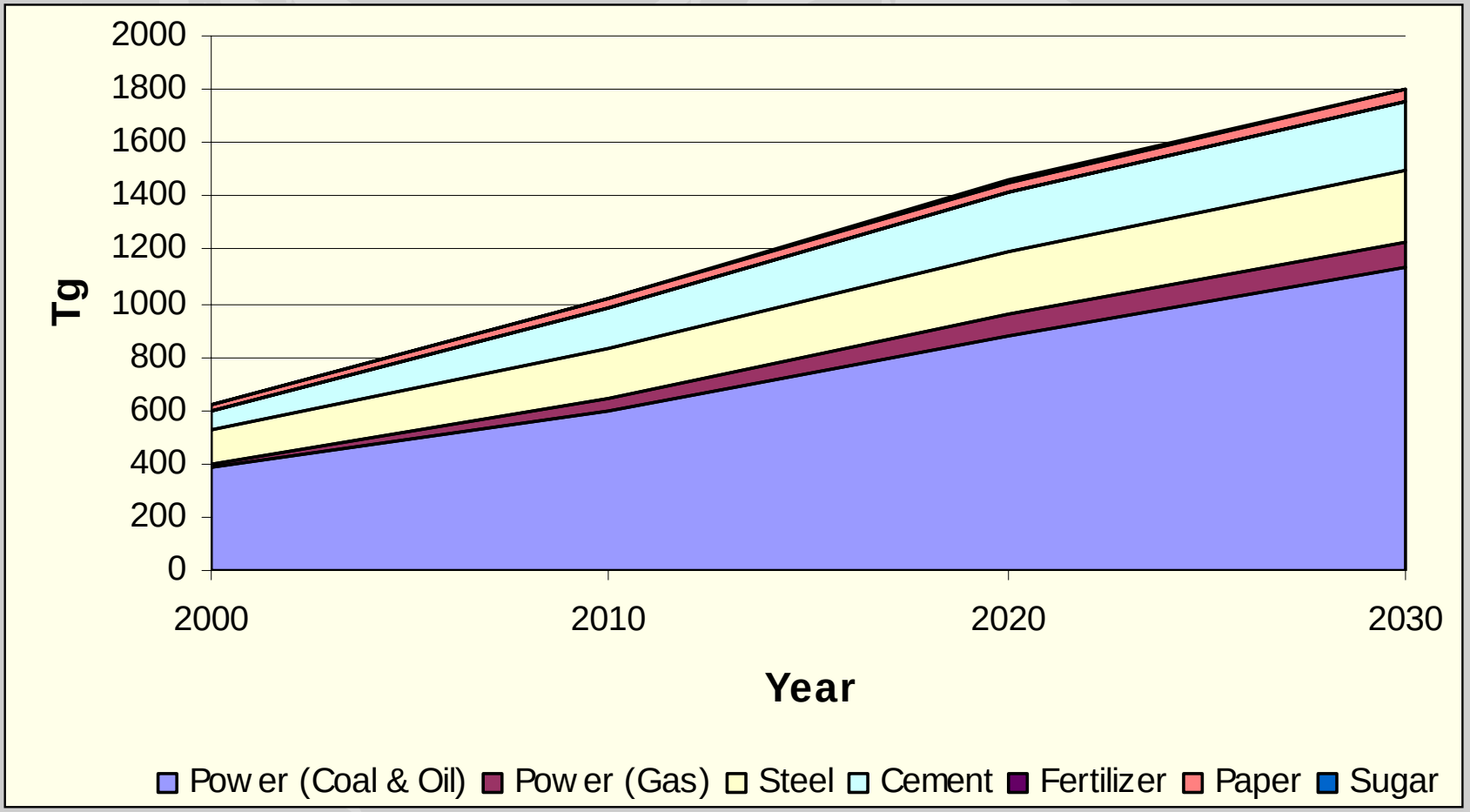
CO_2 from LPS

2020

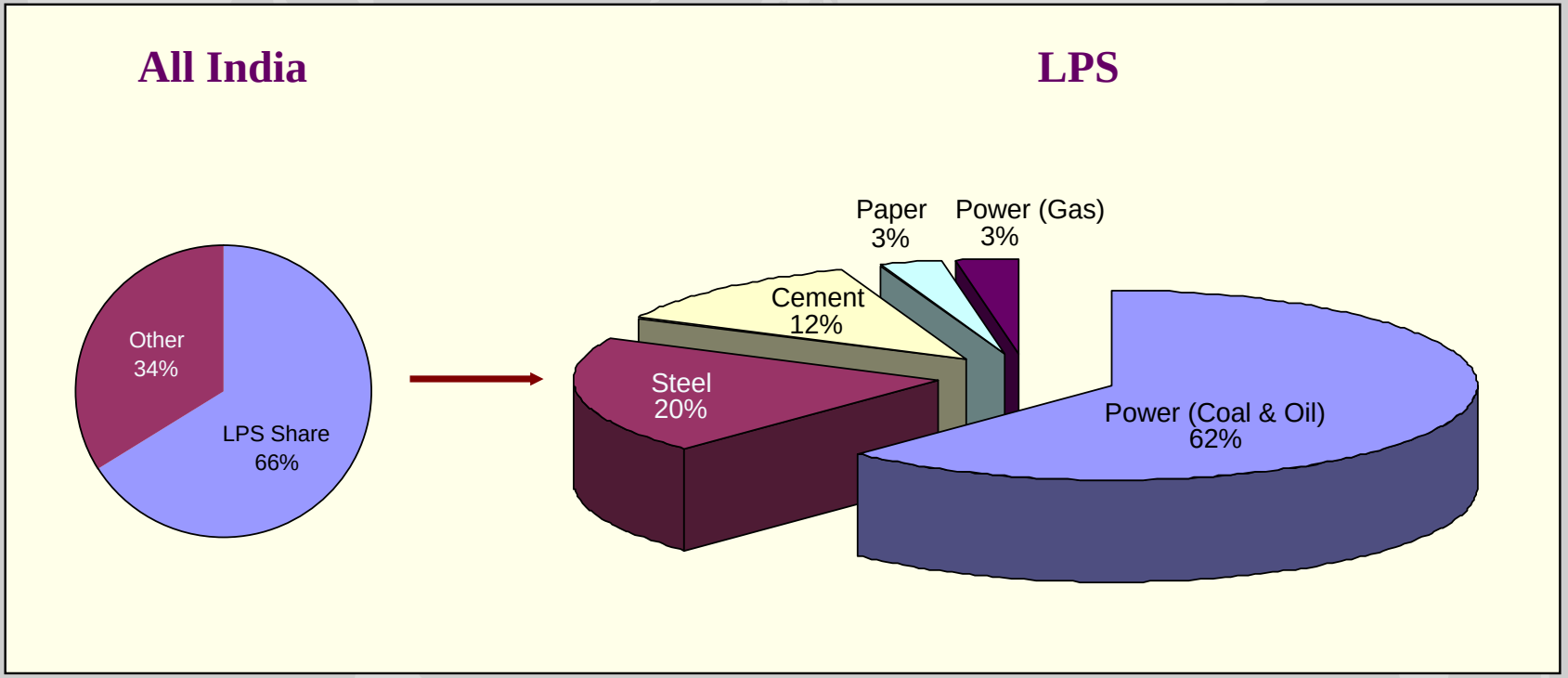


2030

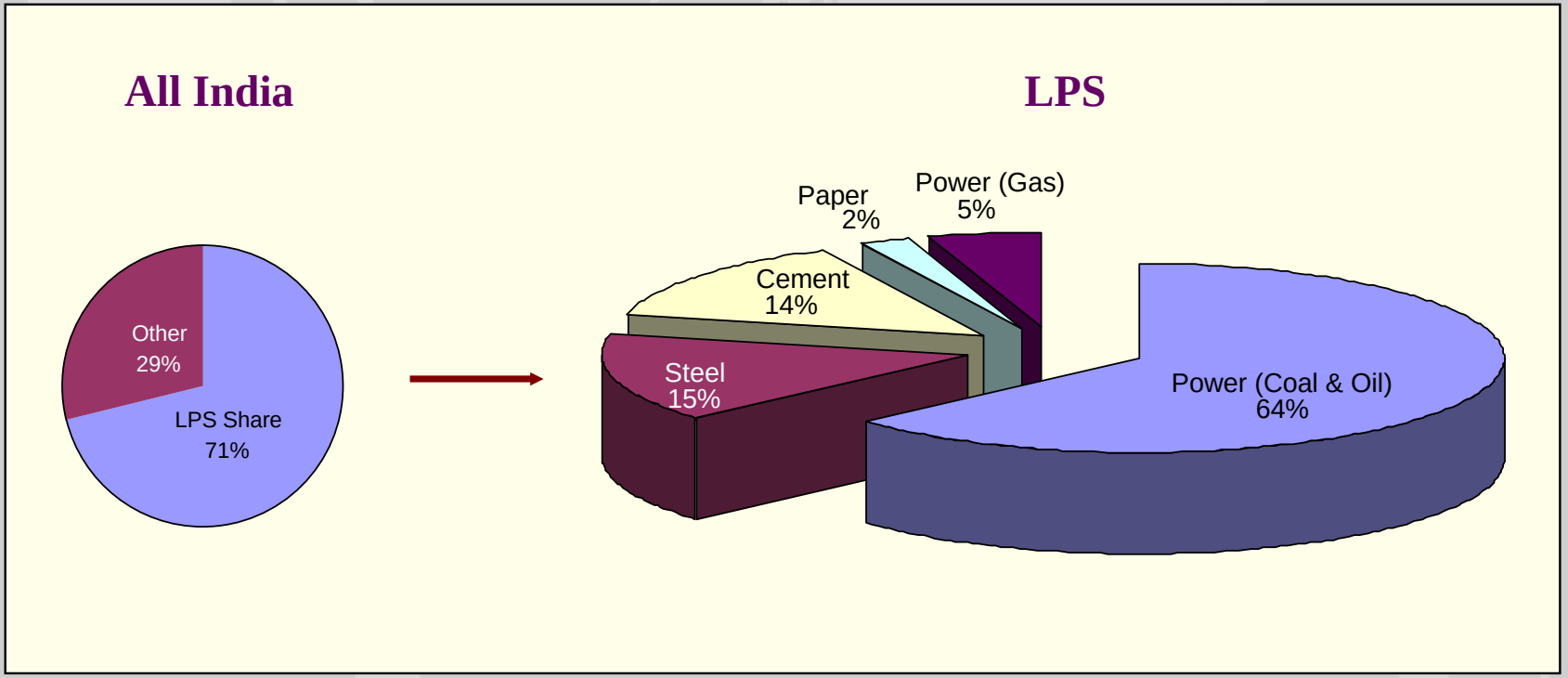
CO_2 from Energy Sector LPS



Sectoral LPS share for CO_2 2000

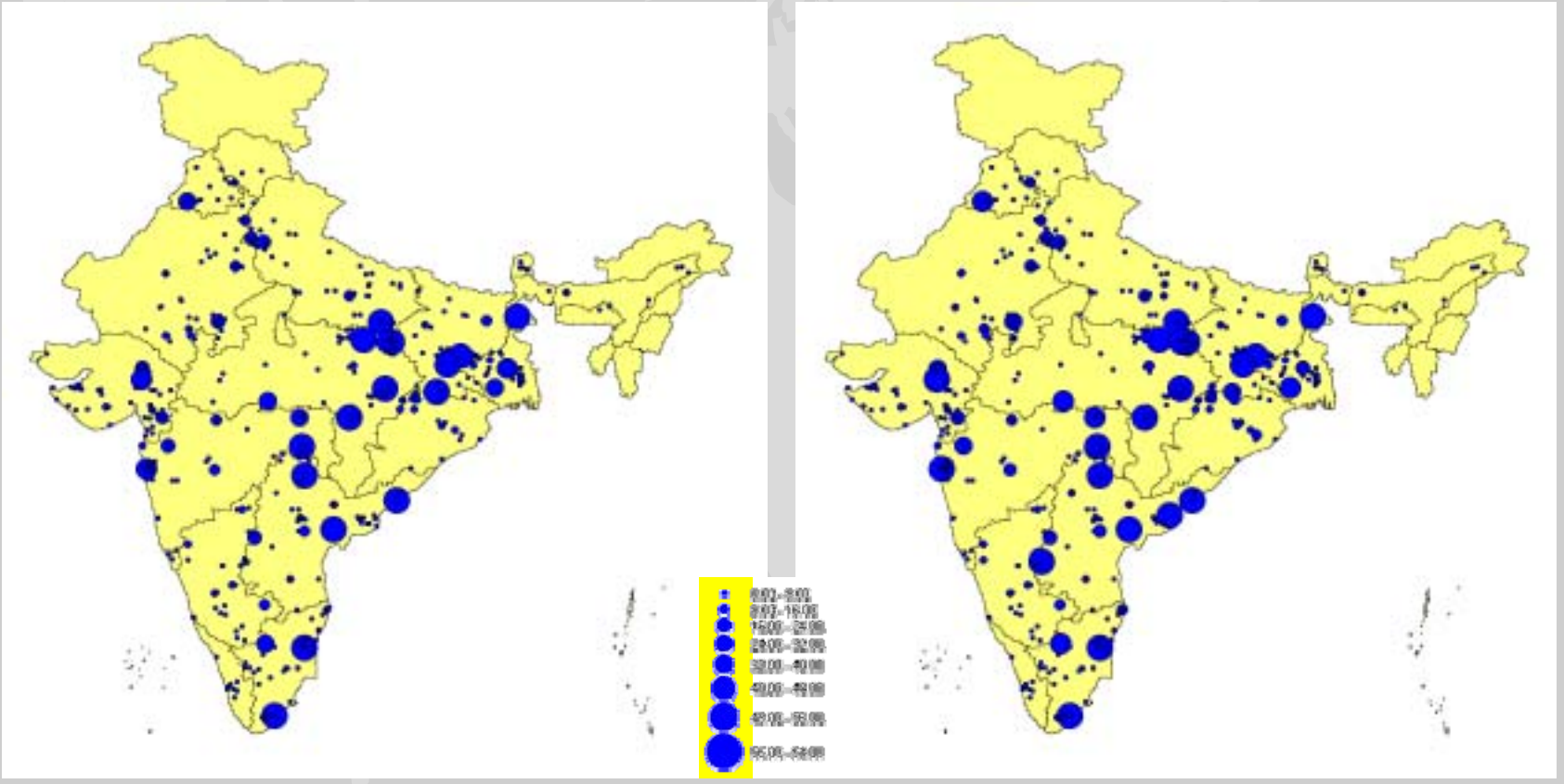


Sectoral LPS share for CO_2 2030



SO_2 from LPS

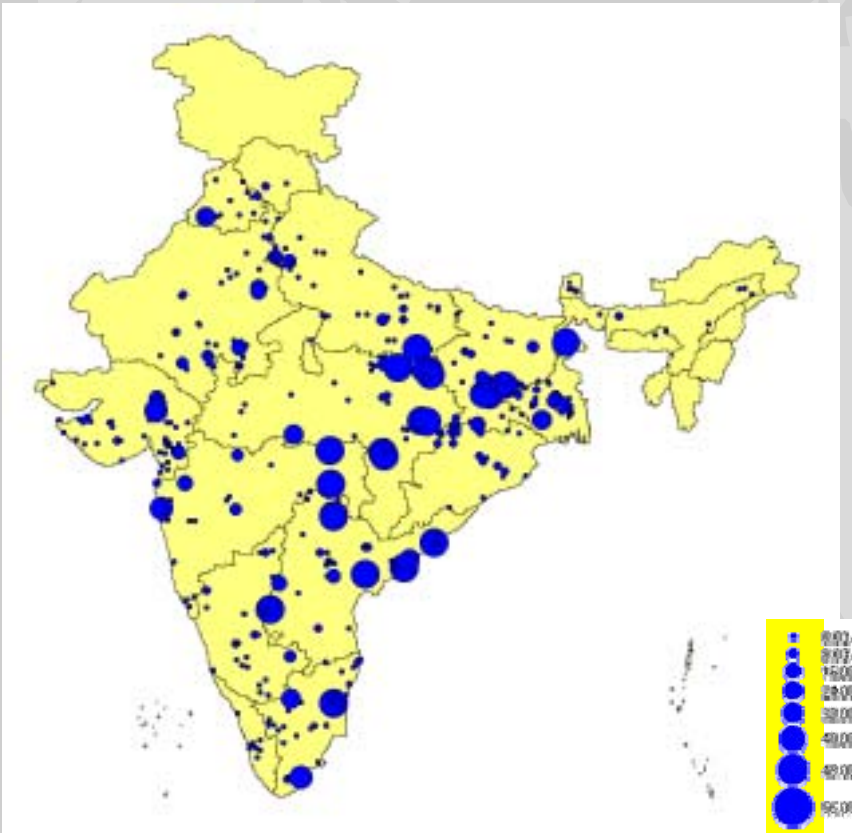
2000



2010

SO_2 from LPS

2020



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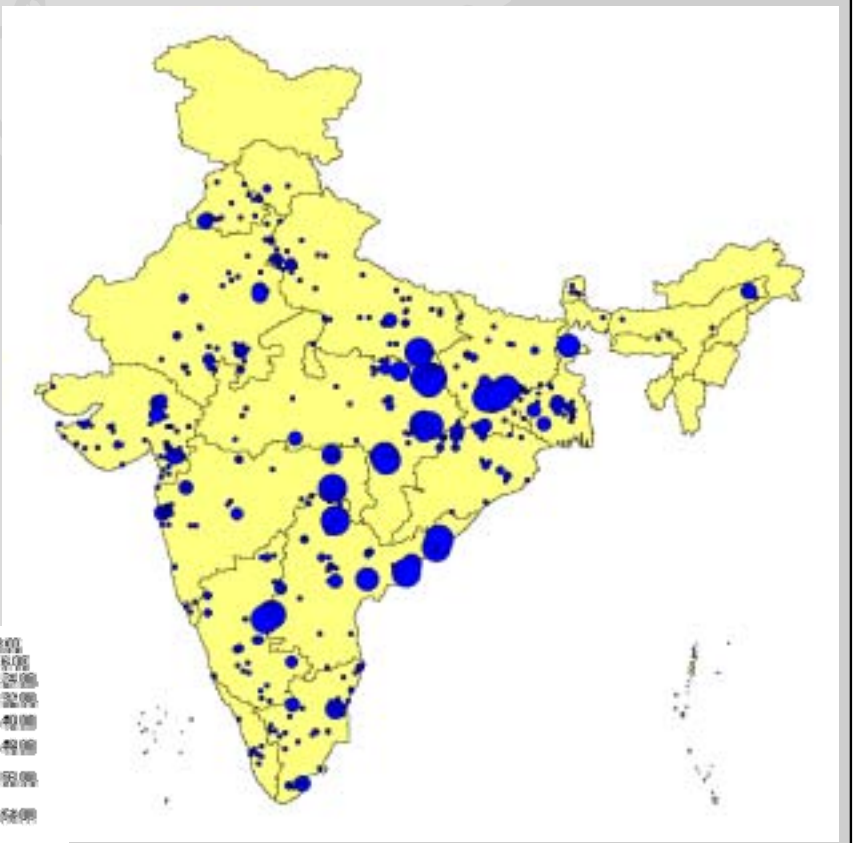
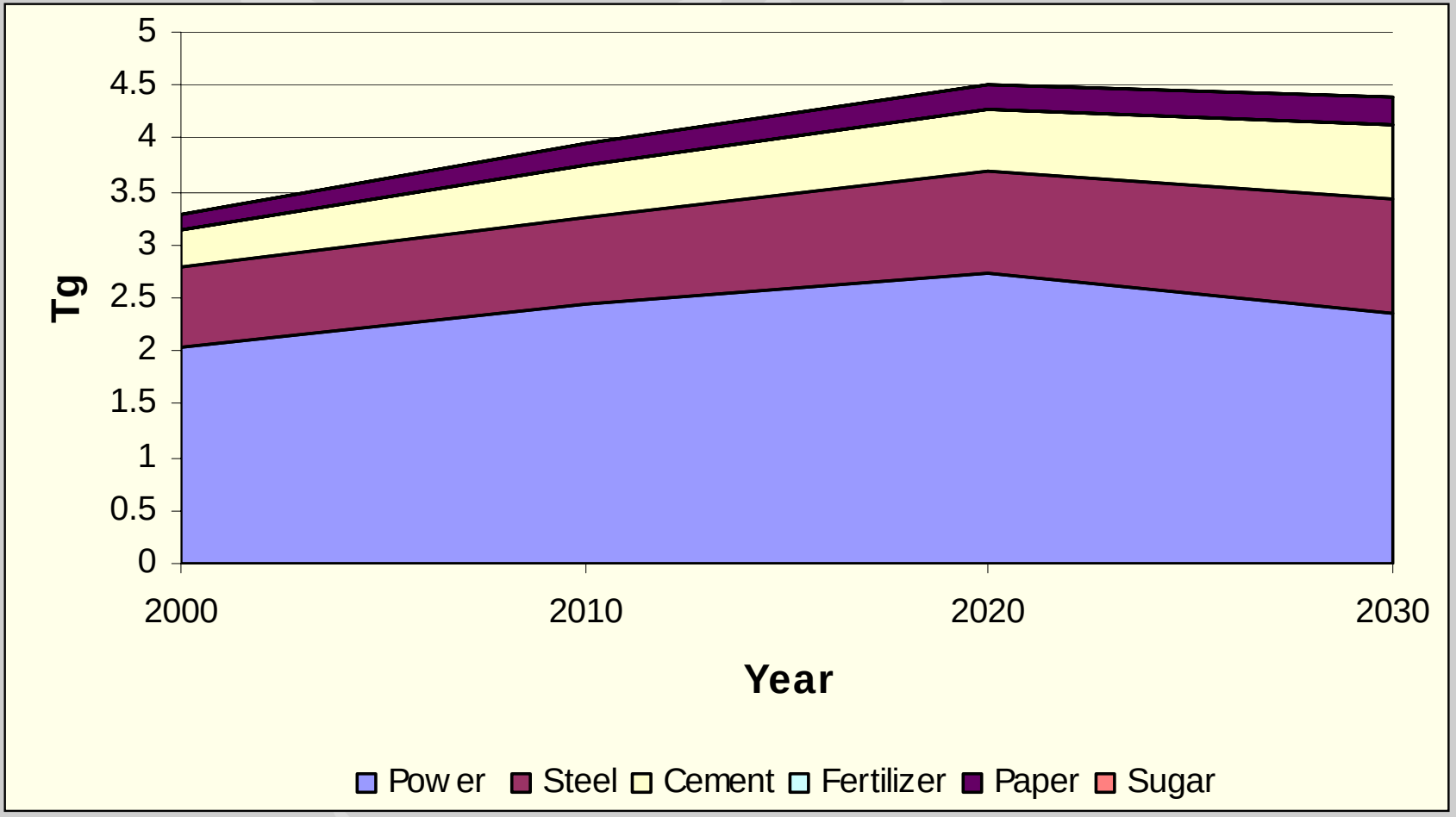
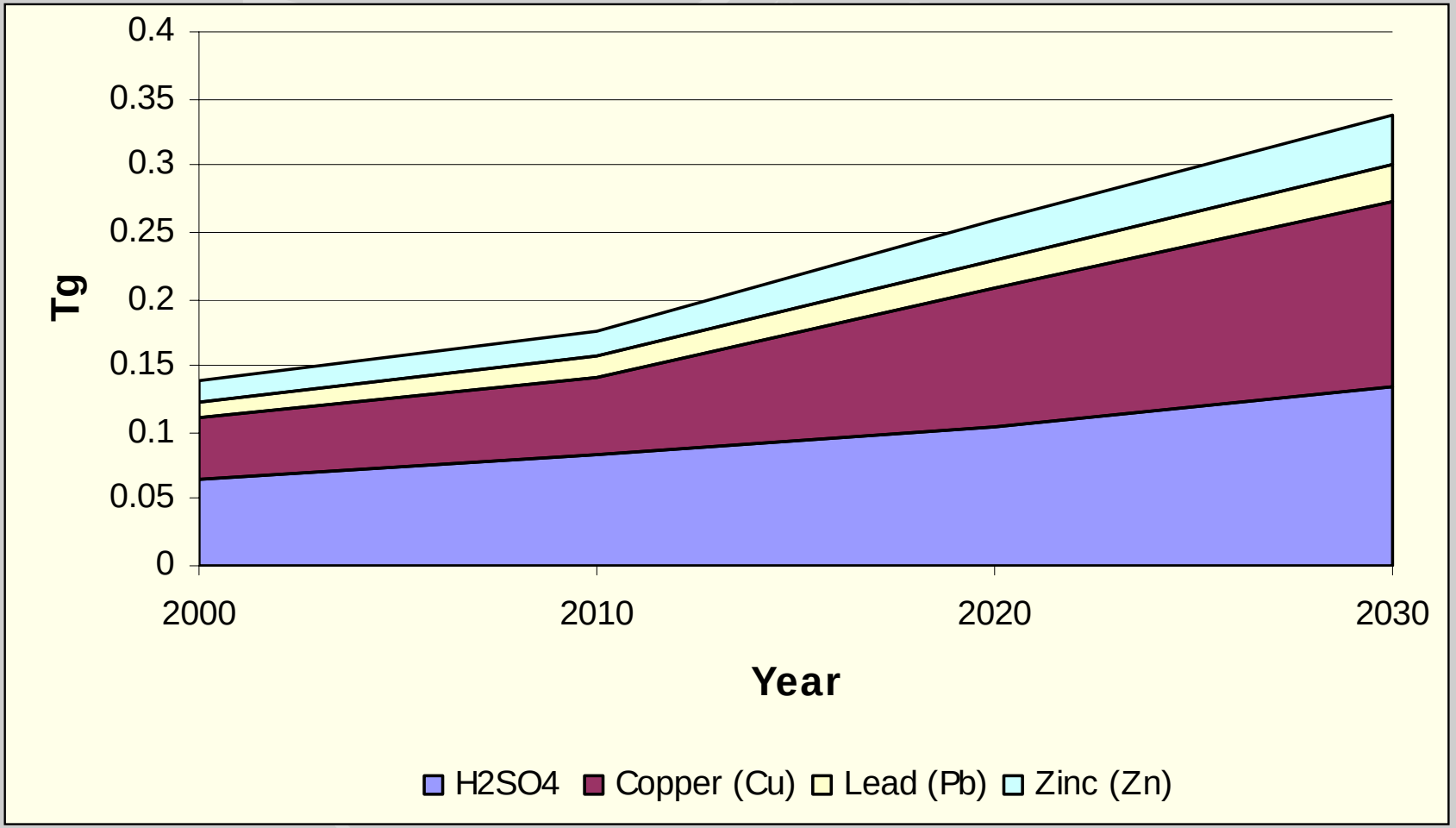


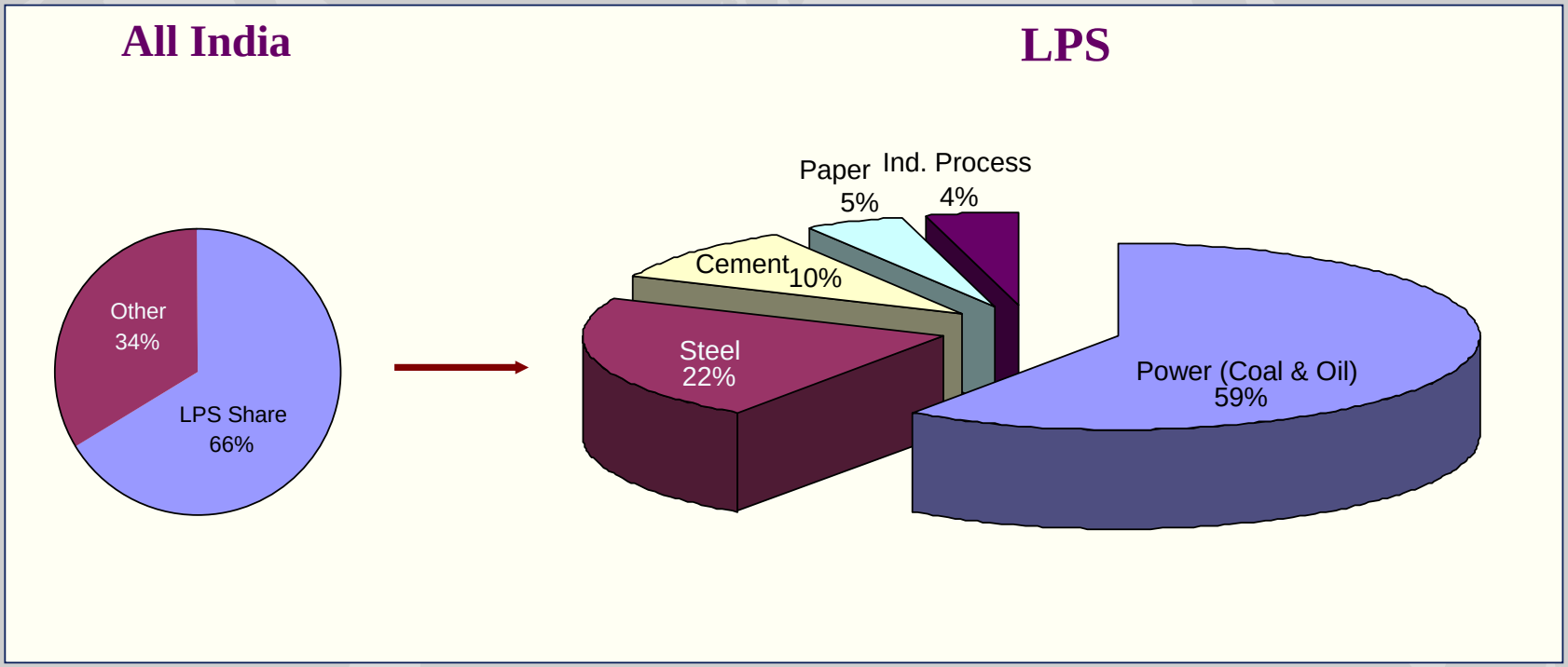
SO_2 from Energy Sector LPS



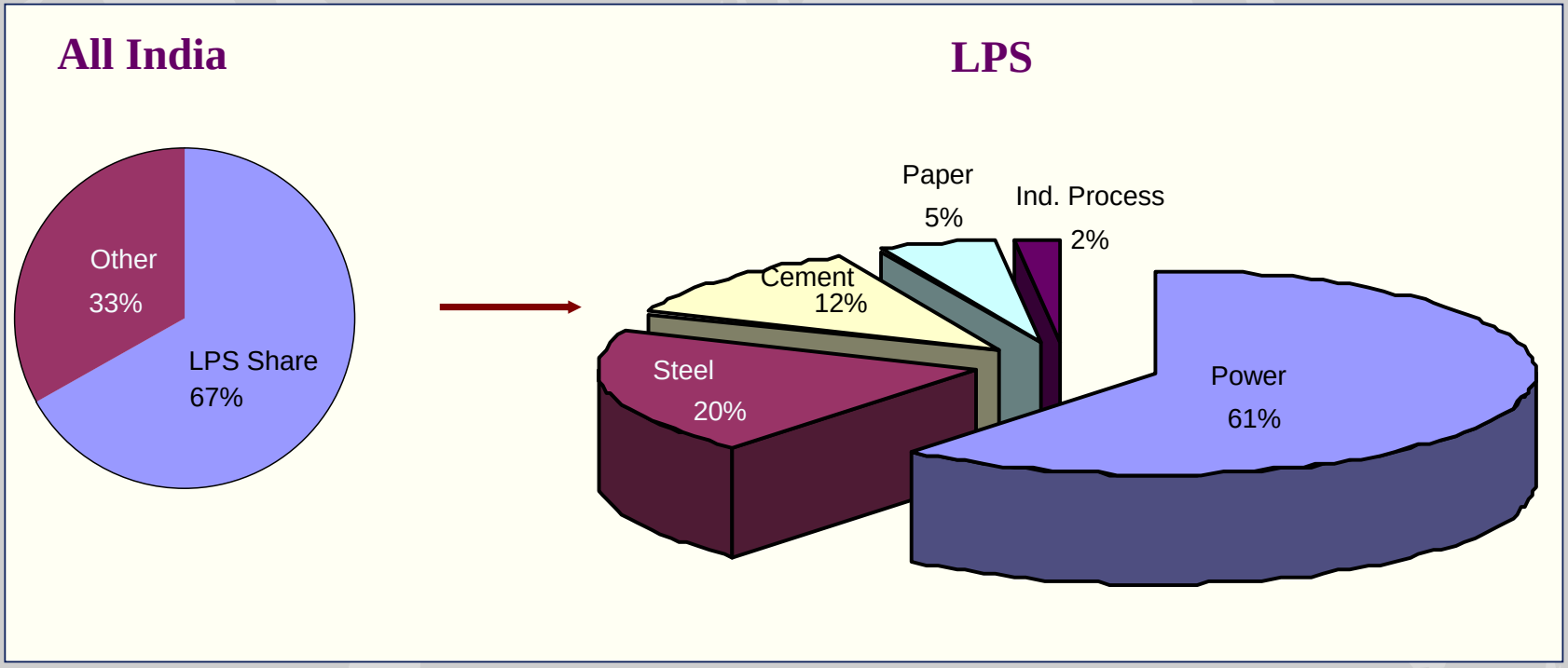
SO_2 from Industrial Processes LPS



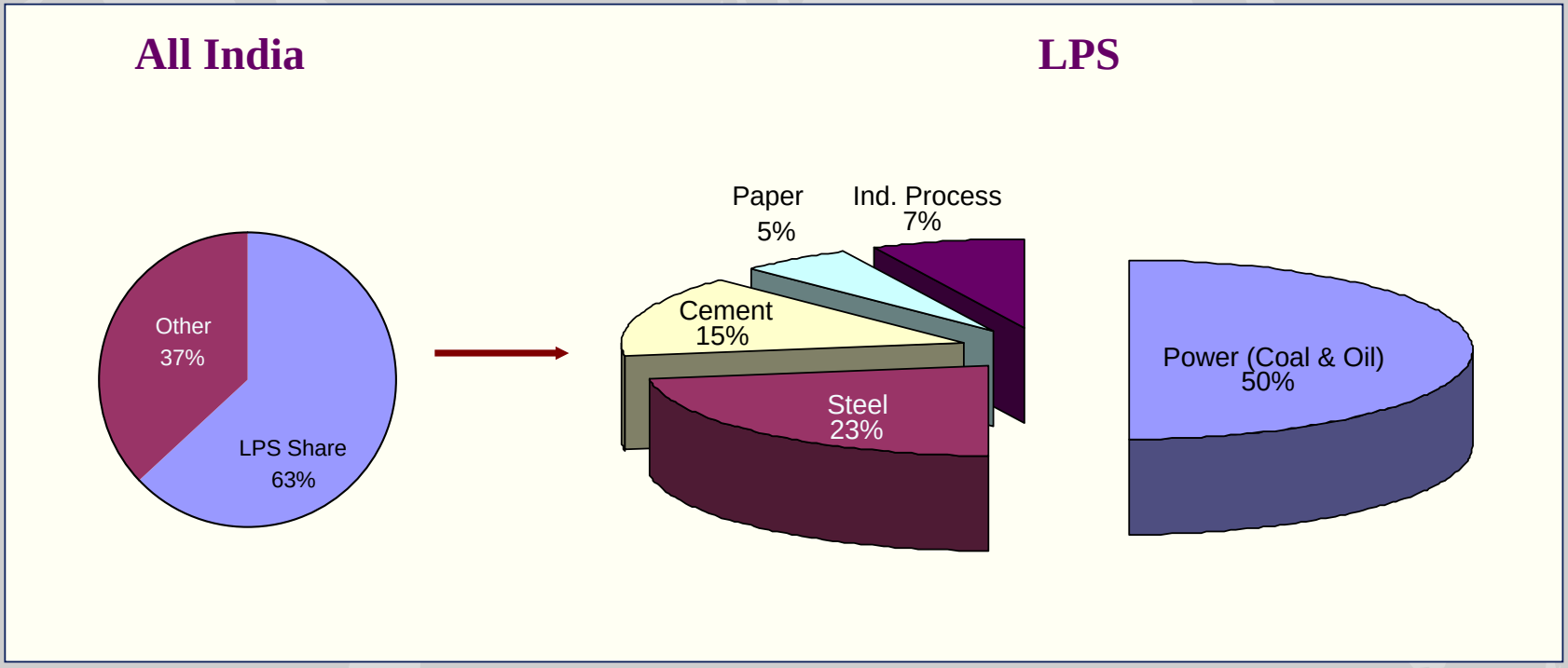
Sectoral LPS share for SO_2 2000



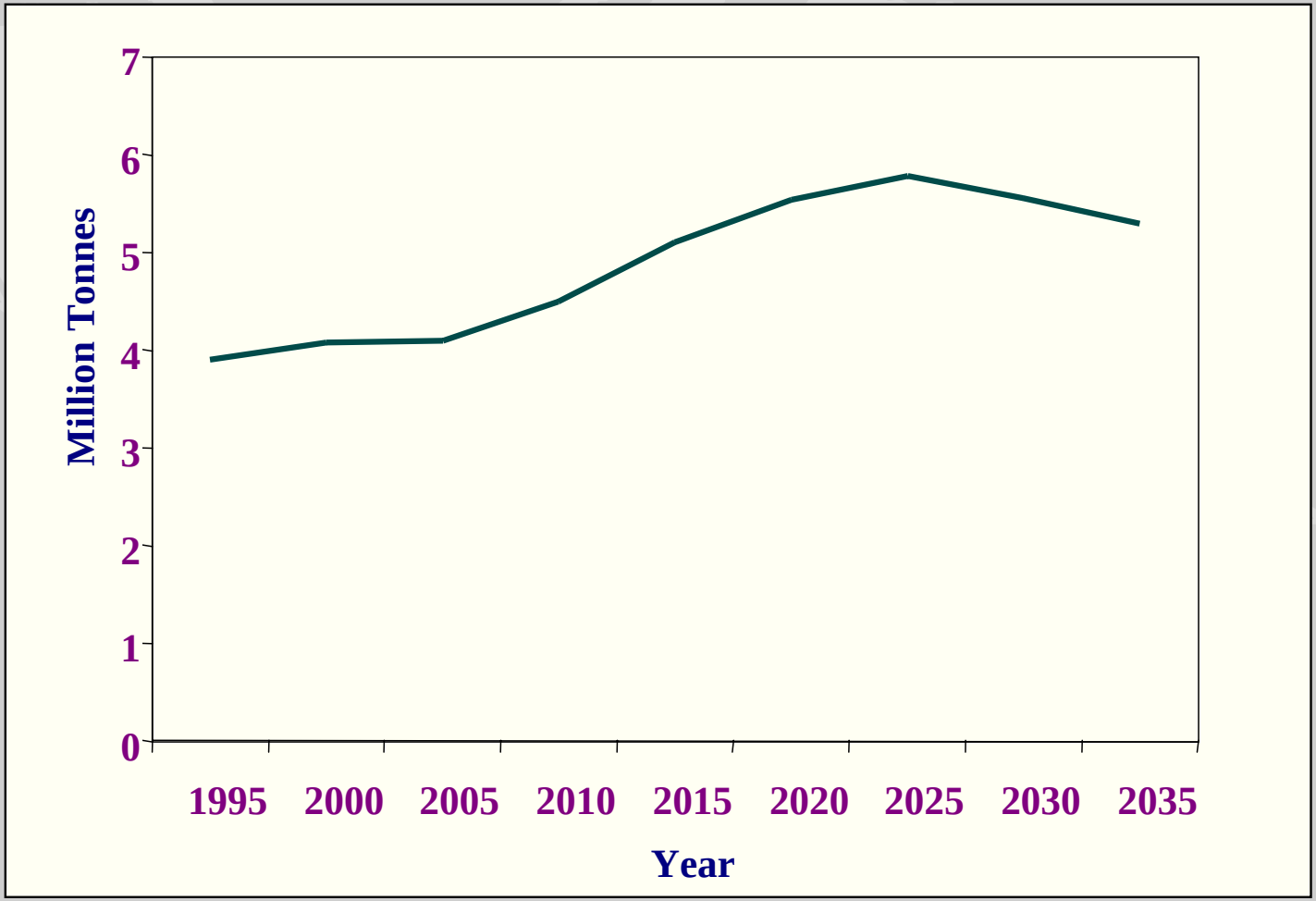
Sectoral LPS share for SO_2 2010



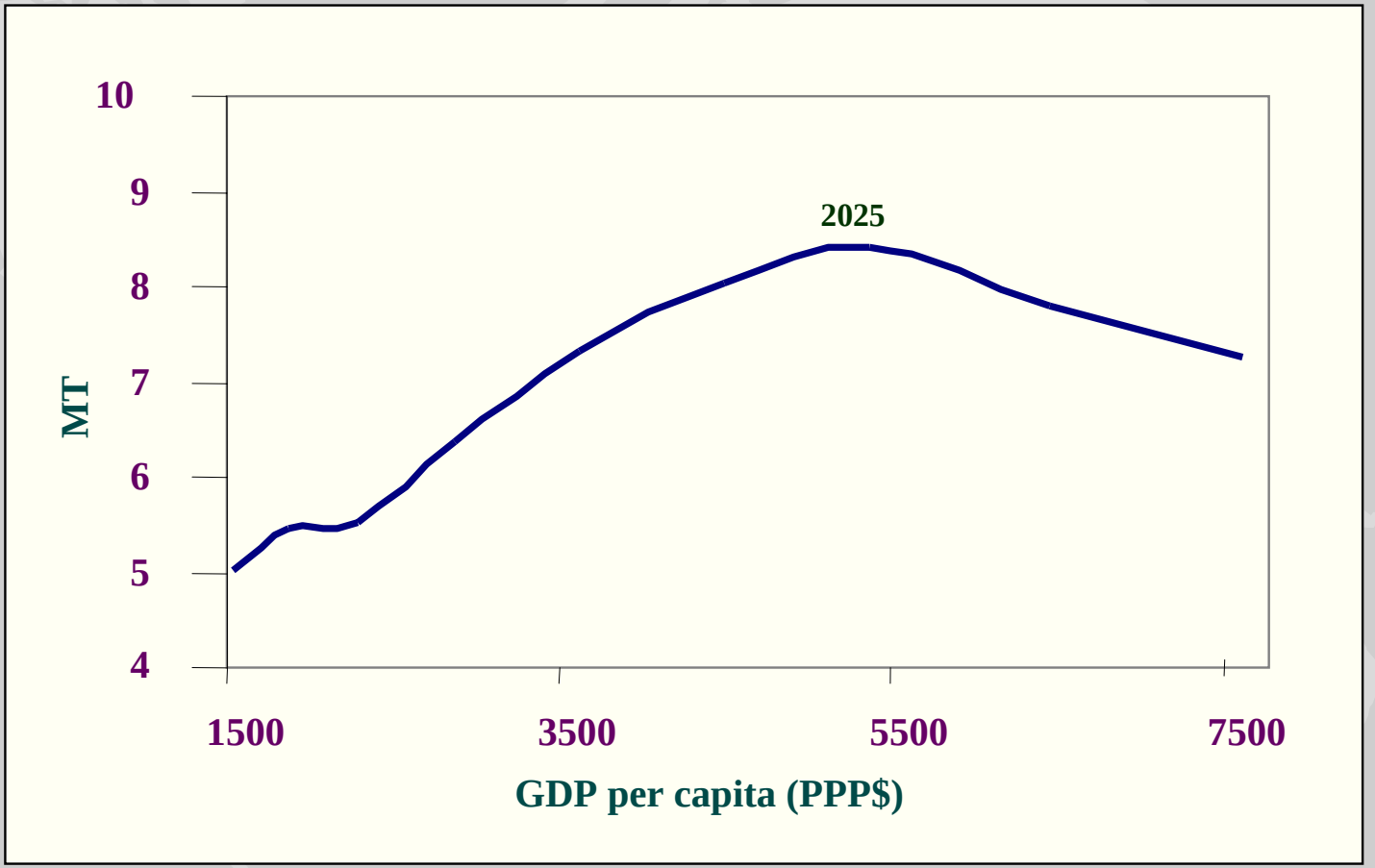
Sectoral LPS share for SO_2 2030



SO2 Emissions in India

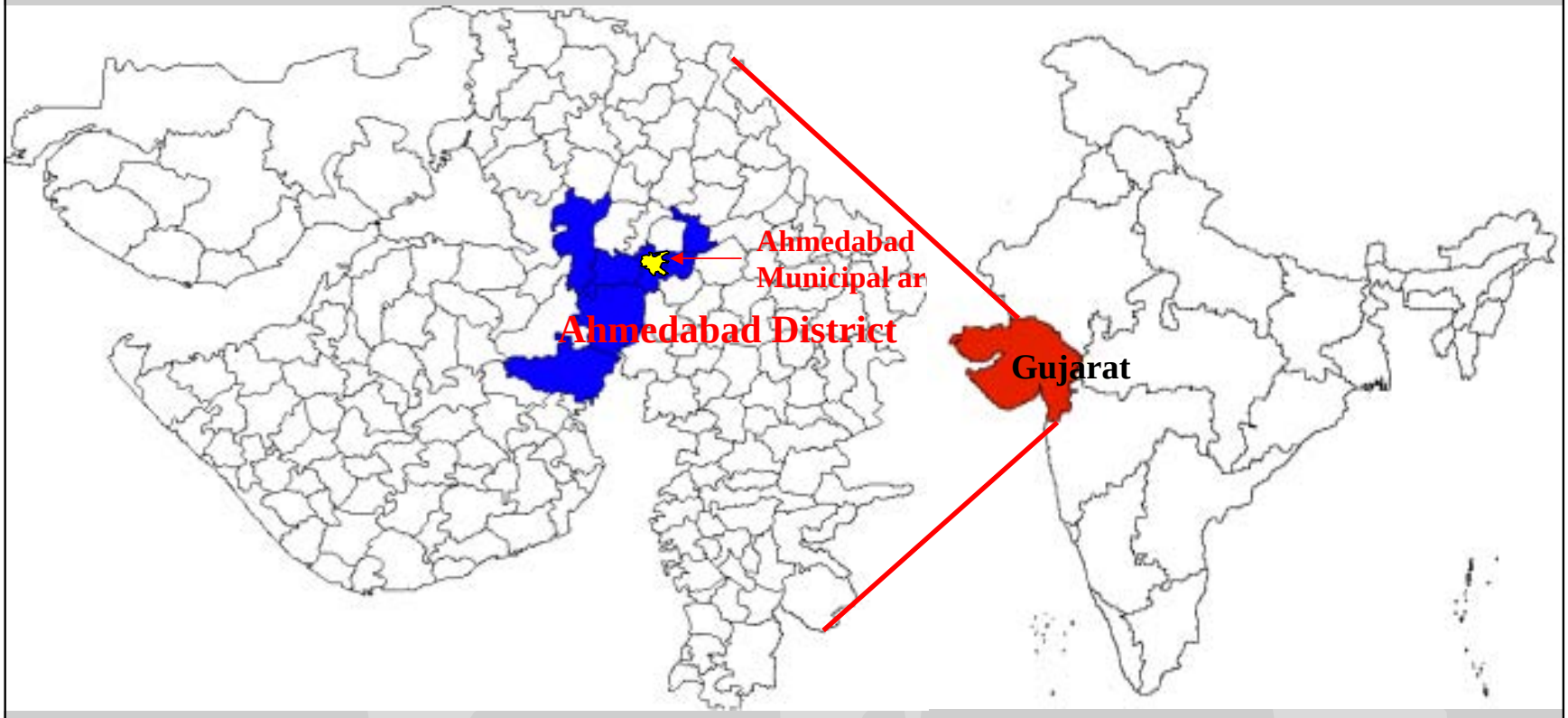


Kuznets' Analysis - SO2 Emissions



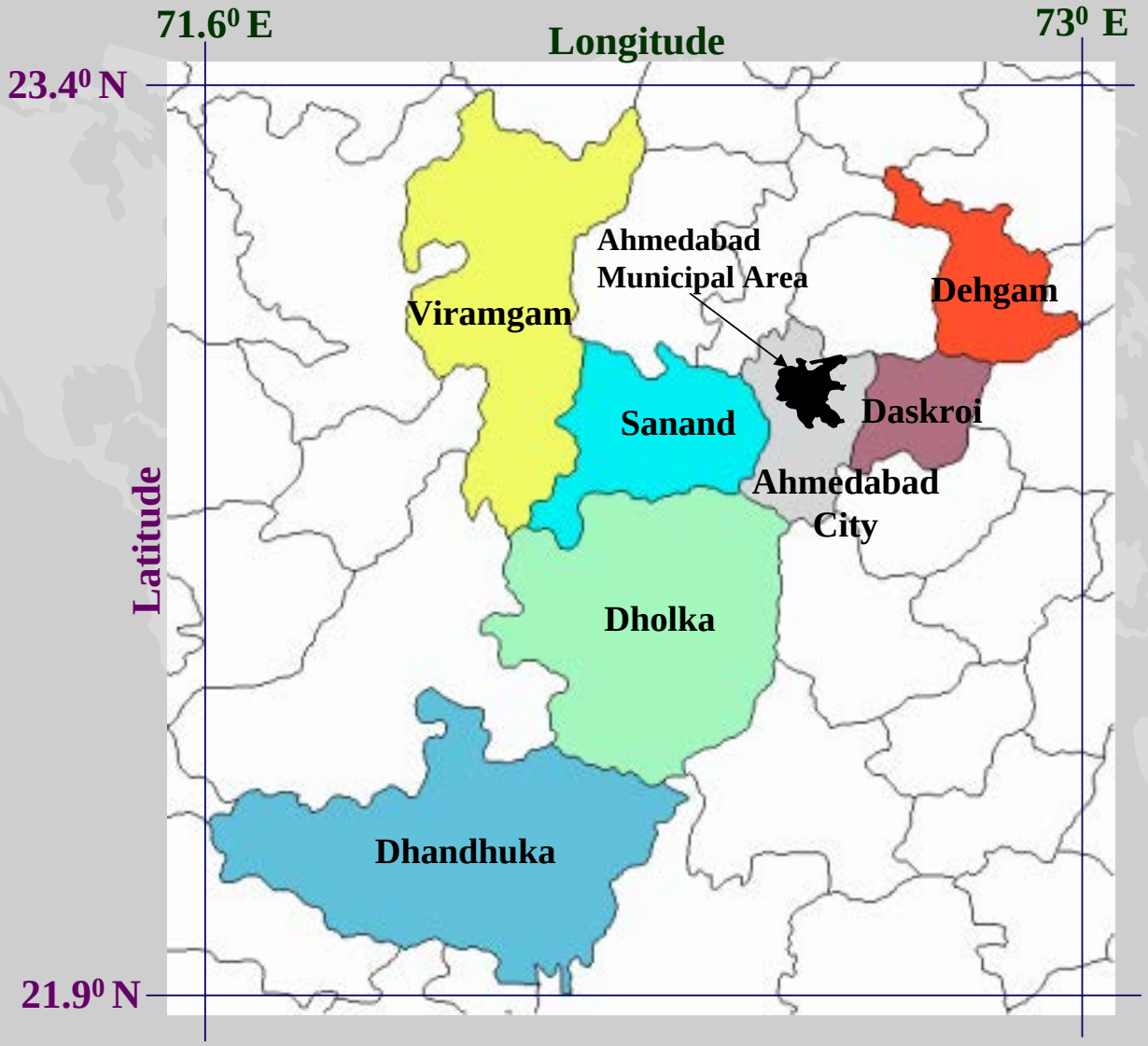
AIM Local Model
Ahmedabad District

Gujarat State & Ahmedabad District



	Villages	Taluka	Area	Population
			Sq. Km.	Thousands
Gujarat	18509	184	196024 (3)	41310 (34)
Ahmedabad Dist.	648	7	8707 (6)	4802 (75)

Ahmedabad District



Ahmedabad District Profile

Taluka	Area Sq. Kms.	Population Thousands	Households Thousands
Ahmedabad City	292 (83)	3250 (99)	629 (99)
Daskroi	664 (5)	338 (28)	68 (29)
Dholka	1788 (2)	307 (26)	57 (25)
Dhandhuka	2683 (4)	252 (21)	42 (22)
Sanand	791 (5)	162 (16)	30 (16)
Viramgam	1714 (4)	278 (22)	54 (22)
Dehgam	620 (4)	214 (15)	41 (15)

Note: Figures in brackets show % Urban share

Ahmedabad Industries

Industrial Area	Number of Industries
Vatva	283
Rakhial/Odhav	233
Naroda	345
Narol	40
Dudheshwar	66
Danilimda/Chandola lake	64
Saraspur/Bapunagar	59
Amraiwadi	25
Bavla	11
Dhandhuka	5
Daskroi	18
Sanand	108
Dholka	23
Isanpur	28

Vehicles in Ahmedabad District

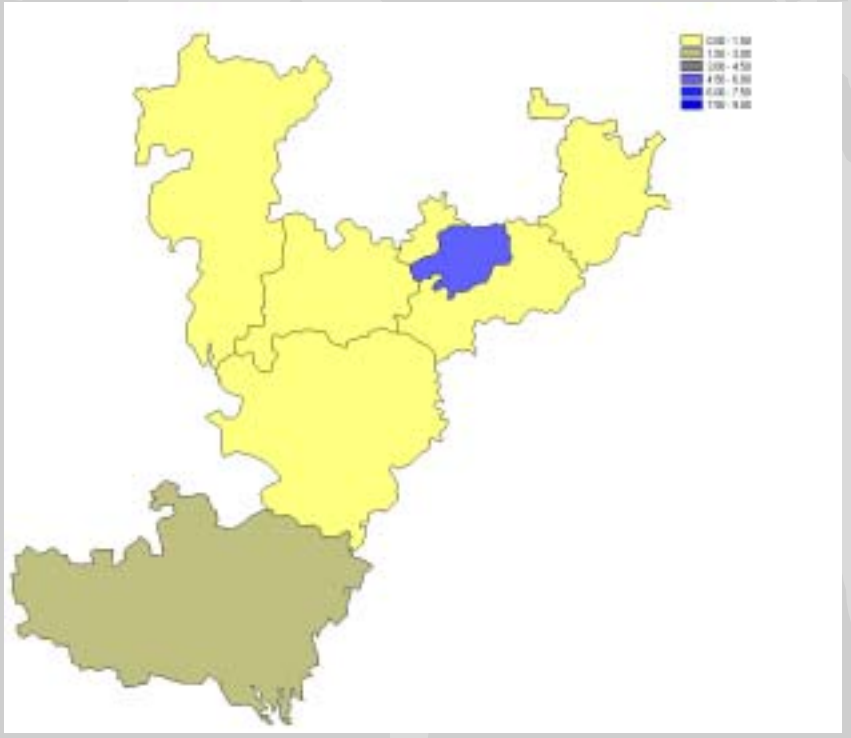
Class of Vehicles	1980	1990	2000 (Estimate)
Motor Cycle	241165	1257826	3100130
Auto Rickshaw	31053	98917	201790
Jeep	14328	33798	79623
Motor Cars (3 and 4 wheelers)	52817	141584	357612
Taxi Cabs	2896	9069	55487
Buses	11203	20011	36264
Trucks and Goods Vehicles	44392	119461	319182
Tractors	32492	85386	206912
Others	28158	107982	118584
All Vehicles	458504	1874034	4475584

LPS Coverage for Ahmedabad

Industry	LPS Covered	Major Emissions
Chemicals Manufacturing	66	CO_2, SO_2, NO_x
Dyes Manufacturing	25	CO_2, SO_2
Others Industries	9	CO_2, SO_2
Pharmaceuticals	2	CO_2, SO_2, NO_x
Steel Foundries and Fabrication	94	CO_2, SO_2
Textile Mills	4	CO_2, SO_2, NO_x
Textile Processing and Dyeing	17	CO_2, SO_2

CO_2 Emissions

2000



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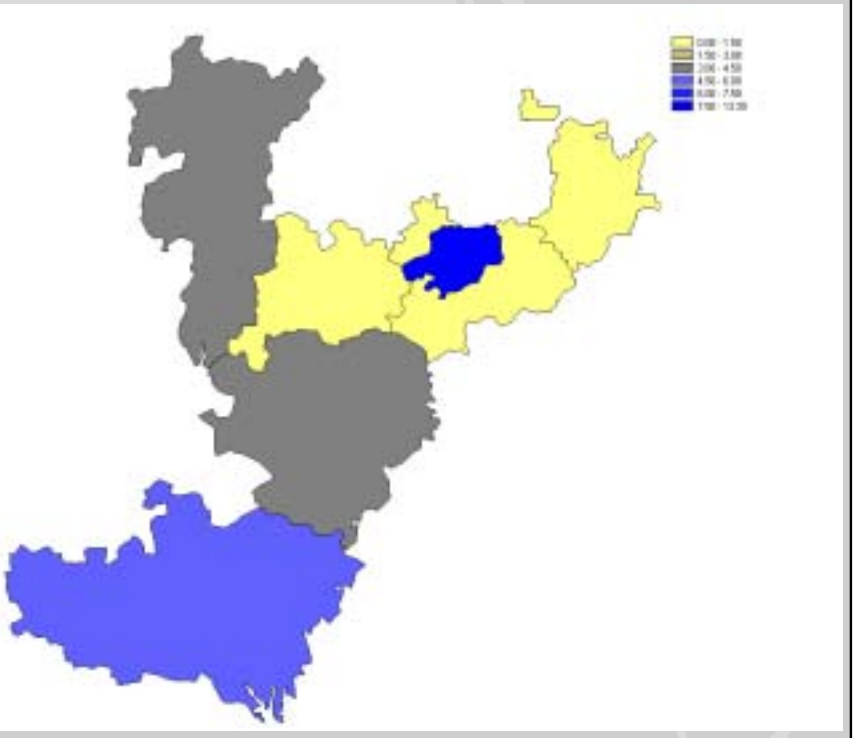
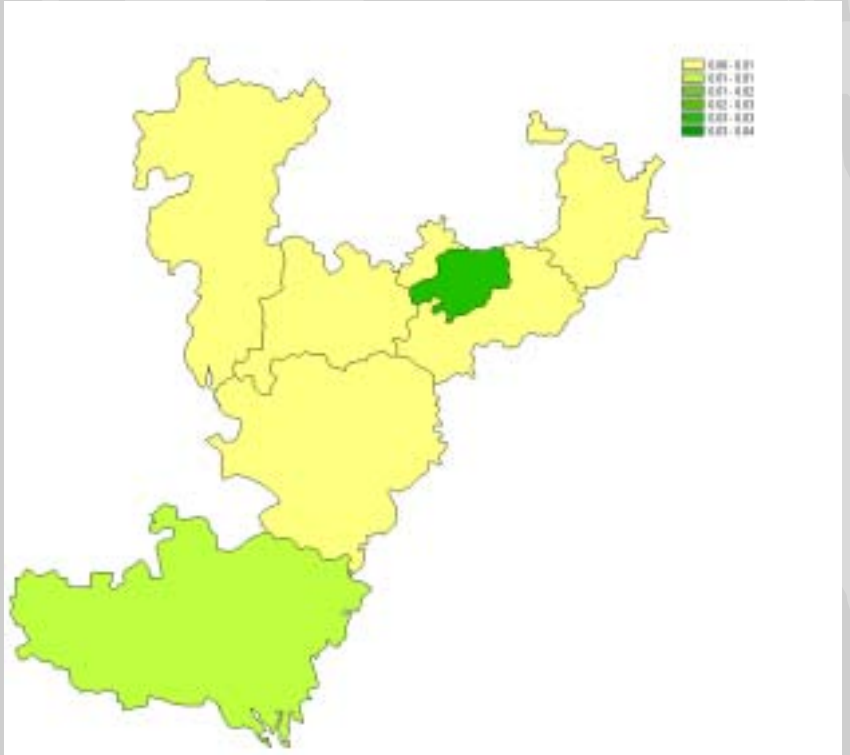


SO_2 Emissions

2000



2030