AIM Activities: India Report

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Indian Institute of Management
Ahmedabad, India

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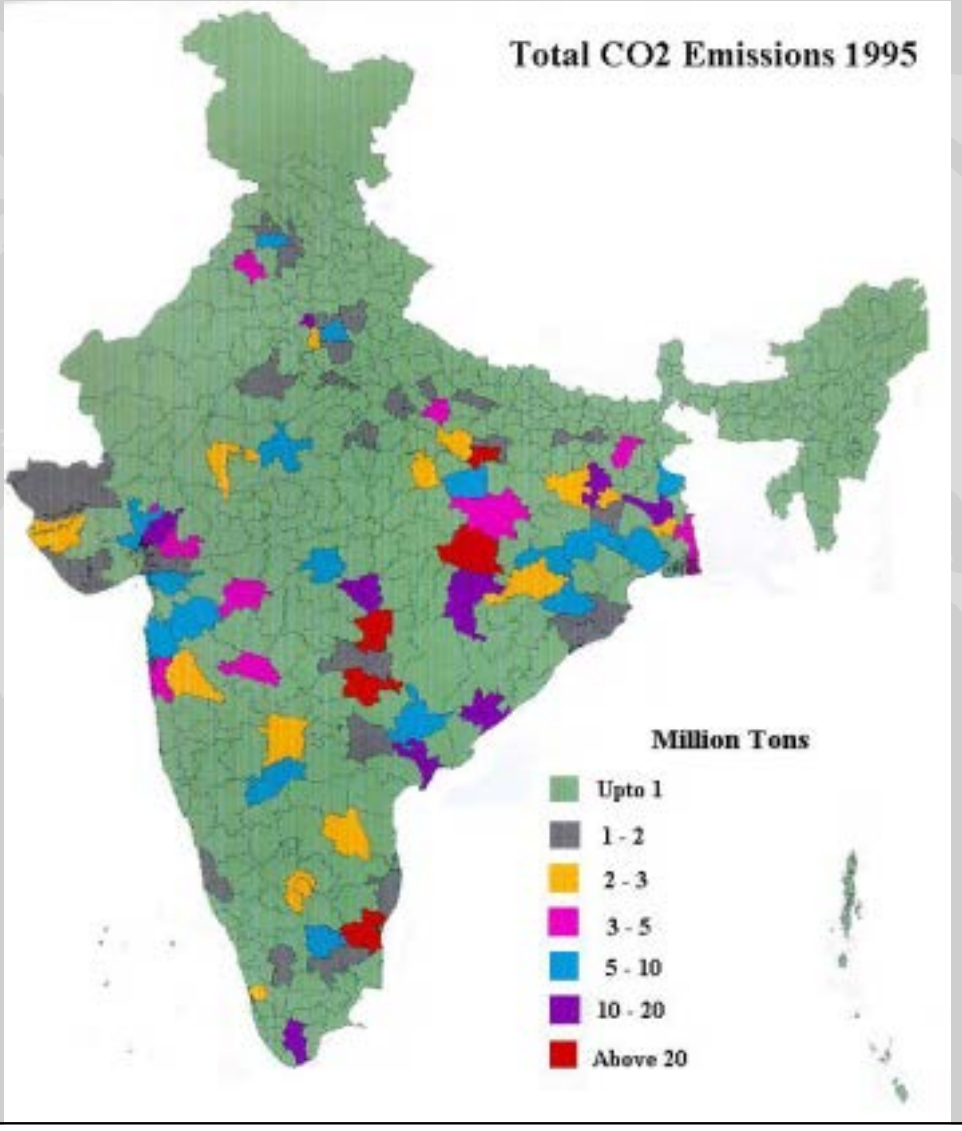
OVERVIEW: YEAR 2000

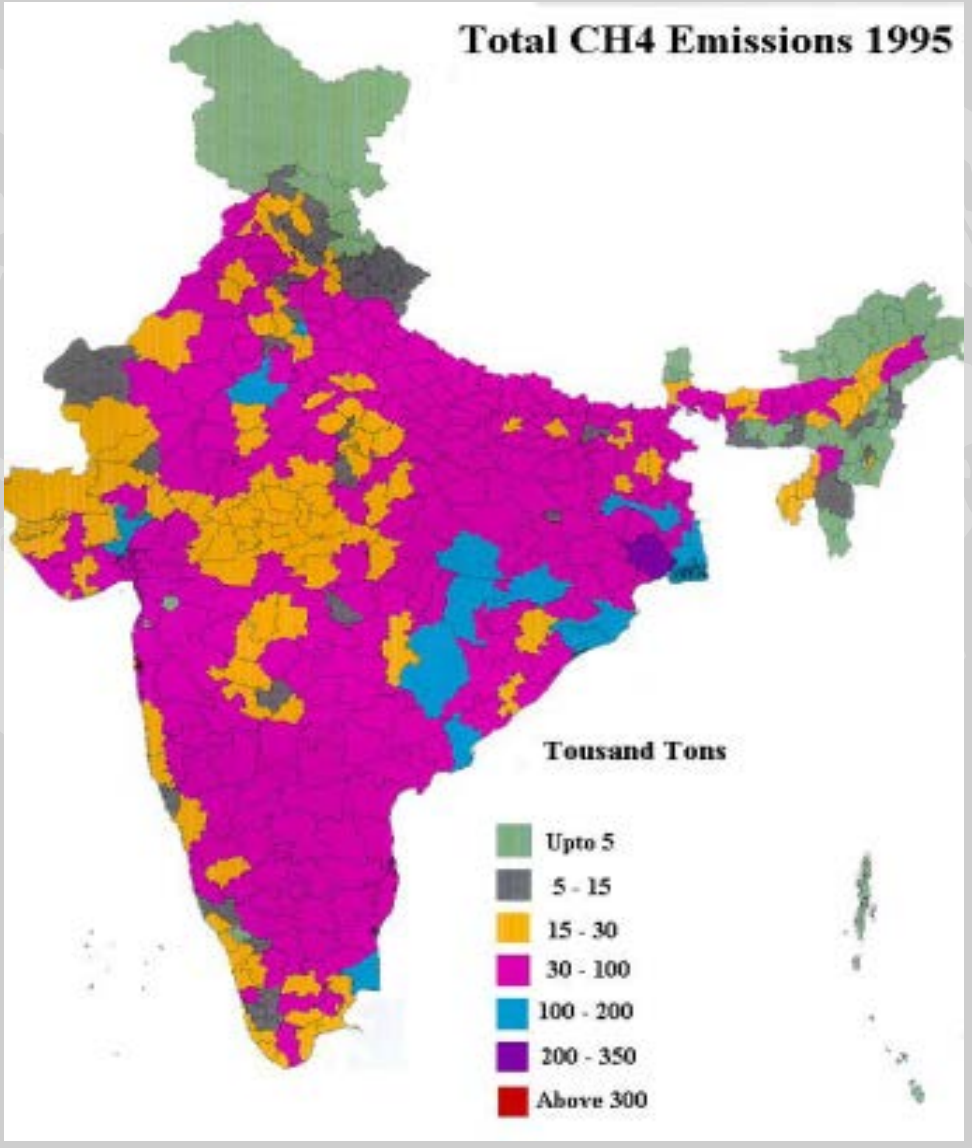
- **GHG Inventory on GIS**
- **Large Point Sources (LPS)**
- **AIM-Local Model**
- **New CGE Model**
- **AIM/ENDUSE (New Results)**

GHG Inventory:
466 Districts of India

CO2 Emission Distribution



Methane Emissions

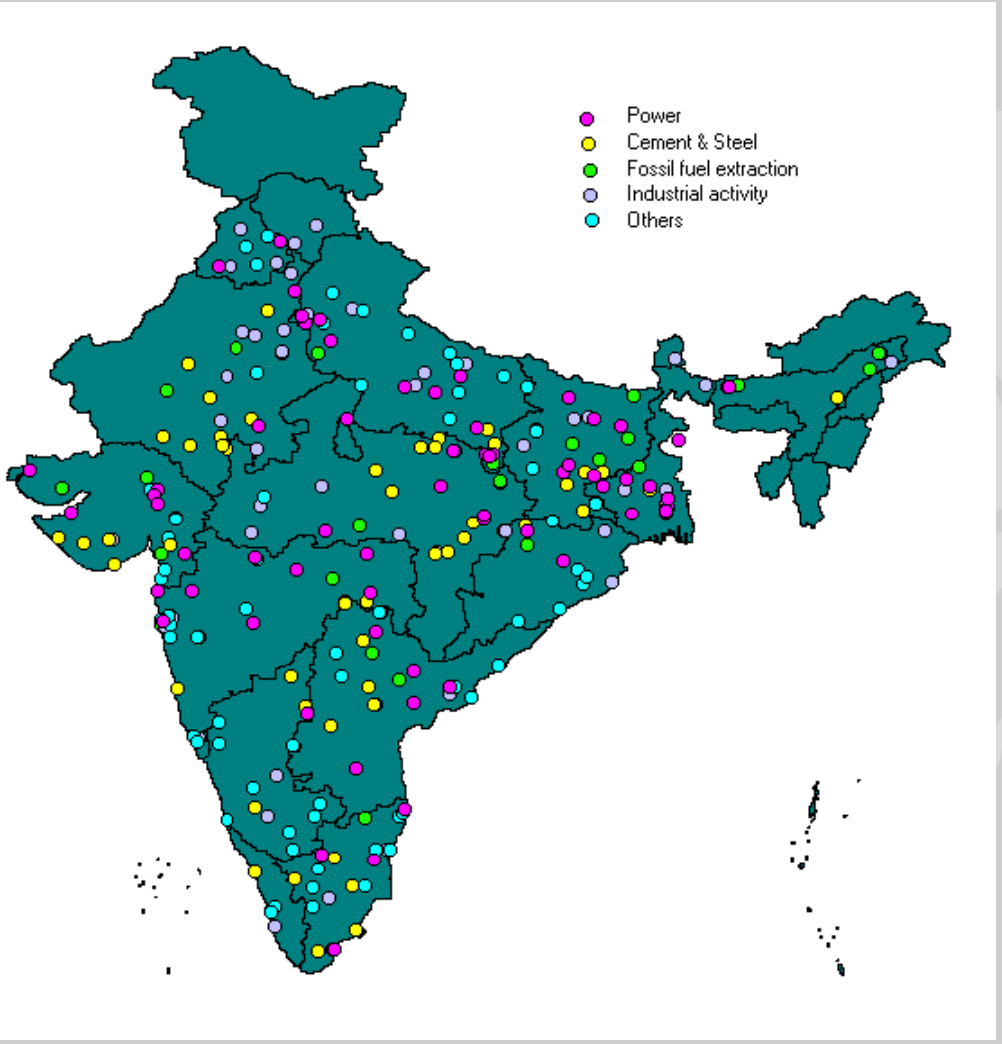


GHG Inventory from Large Point Source (LPS)

GHG Inventory from LPS

- **Data for 509 LPS**
- **Coverage of gases:**
  - ☞ **CO_2, CH_4, SO_2, N_2O, NOx**
- **Emissions factors for India**
- **Data for 1990 and 1995**

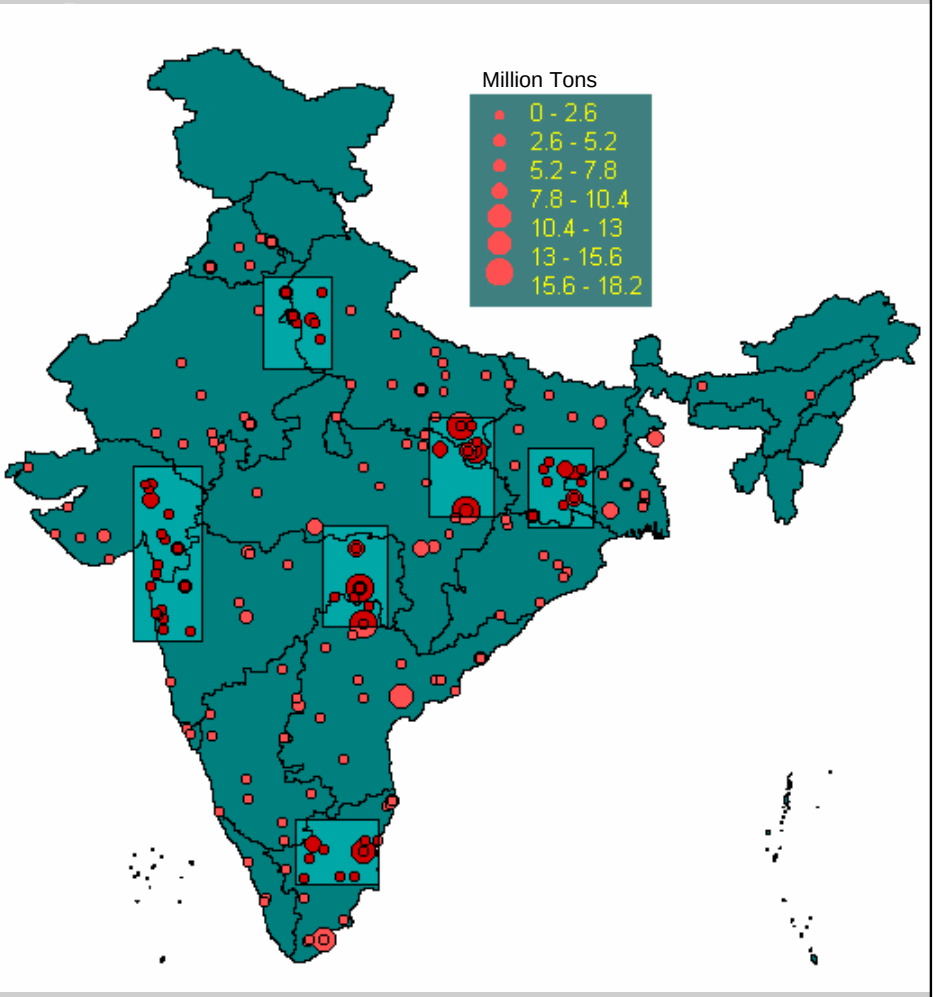
LPS Location Map



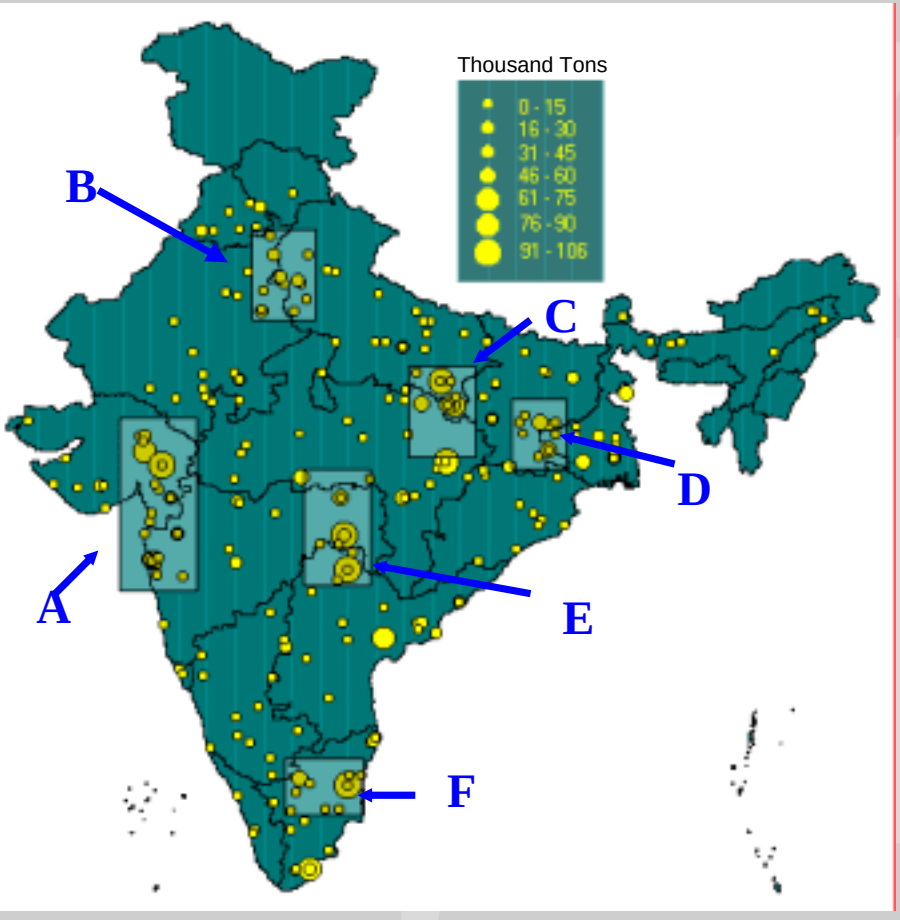
Sectors	LPS covered
Power	94
Steel	11
Cement	85
Fertilizer	31
Paper	33
Sugar	28
Caustic Soda	19
Crude refinery	12
Petrochemical	14
HNO_3 manufacturing	5
H_2SO_4 manufacturing	63
Aluminum	3
Copper smelting	8
Lead smelting	5
Zinc smelting	3
Alcohol production	14
Coal mining	32
Natural gas production	9
N. gas transportation	12
Crude oil production	7
Municipal solid waste	14
Other industries	7
Total	**509**

LPS: CO2 Emissions

Sectors	No. of LPS	CO_2 from LPS	
		Tg	% of Total
Power	94	365	47
Steel	11	48	6
Cement	85	68	9
Fertilizer	31	14	2
Sugar	28	0.7	0.1
Paper	33	2.9	0.4

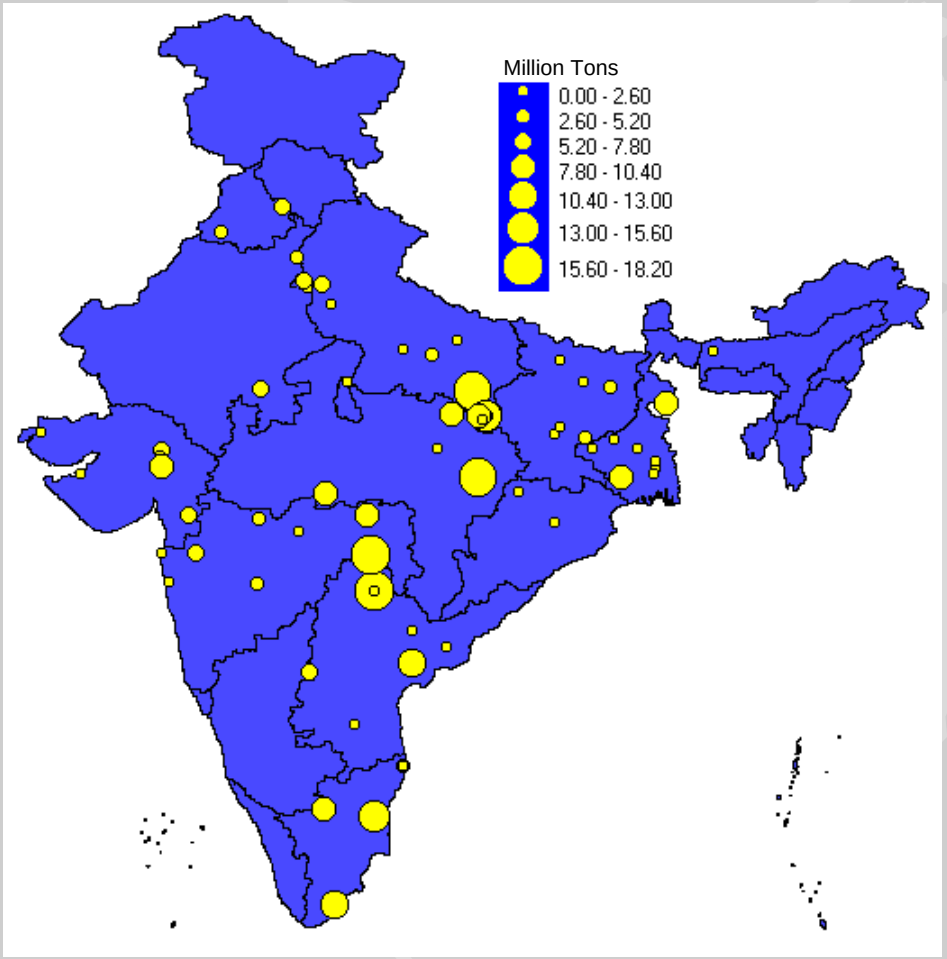


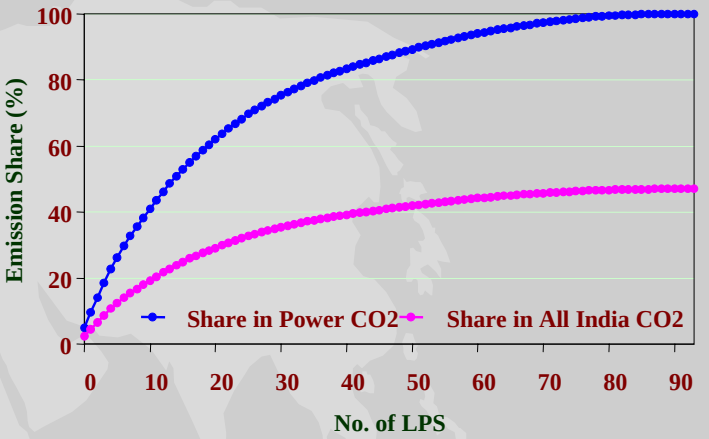
LPS: SO2 Emissions



	Region Details	No. of LPS	LPS/Total SO_2 (%)	Main Sources
A	Golden corridor	32	6.1	Power, H_2SO_4
B	Delhi	20	2.4	Power, Cement
C	Northeast India coal mine	21	7.9	Power, Cement
D	East India coal mine	18	5.5	Power, Steel, Cement
E	Central India coal mine	16	6.1	Power, Steel
F	Chennai	13	3.9	Power, Cement

CO2 from Power Plants

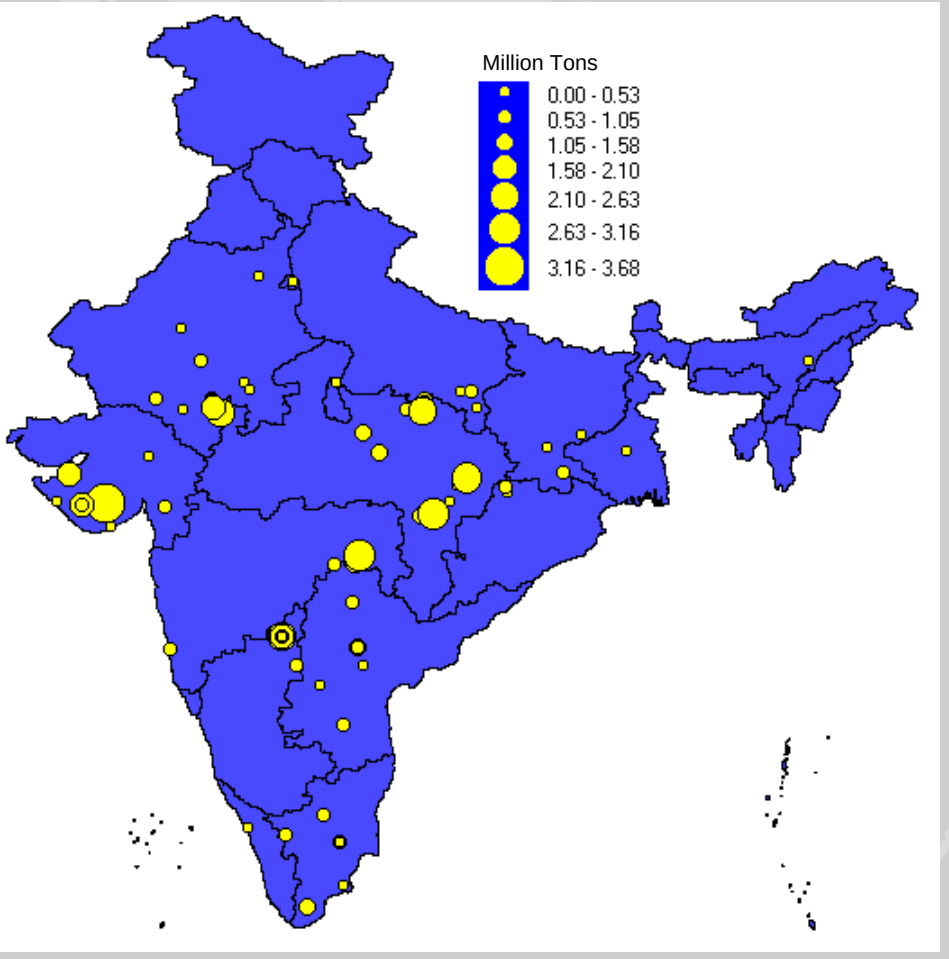




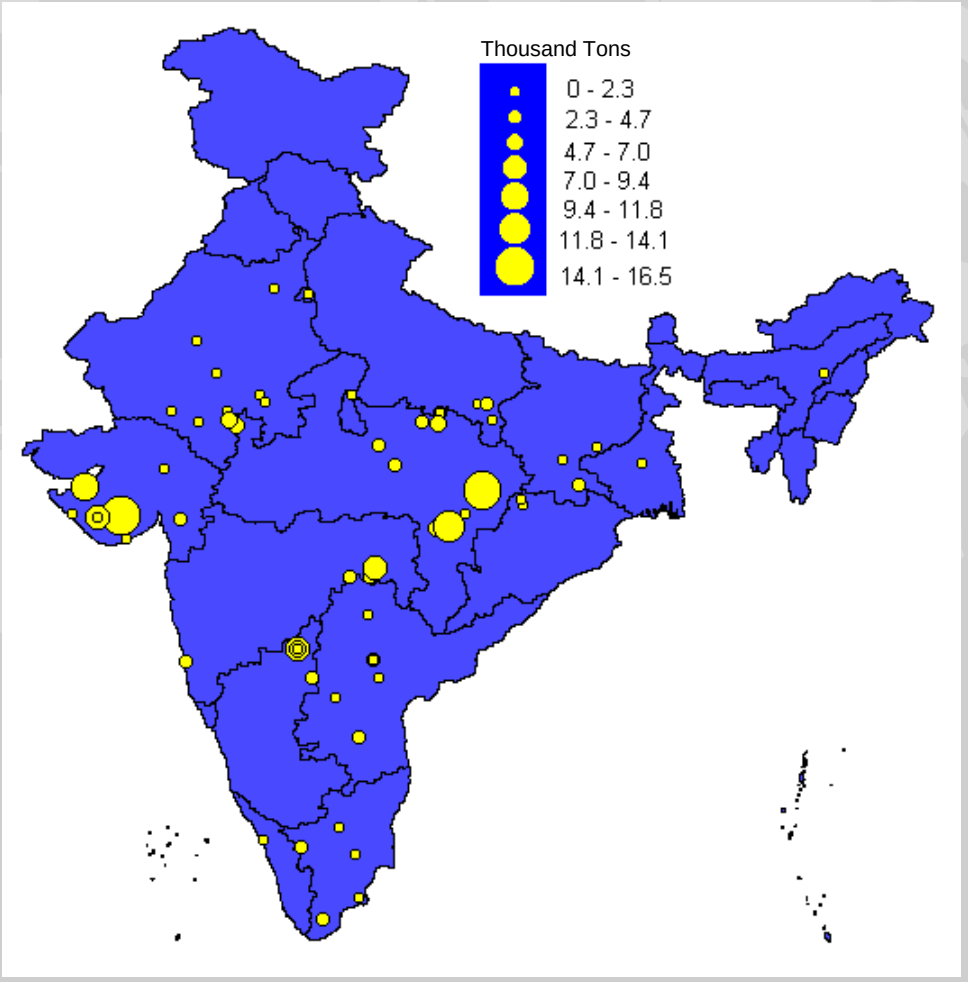
- 50 LPS emit 40% of all India CO_2
- More concentration near coal mine mouths

CO2 from Cement Plants

- **LPS are Distributed across the country**
- **Non-energy component 60%**

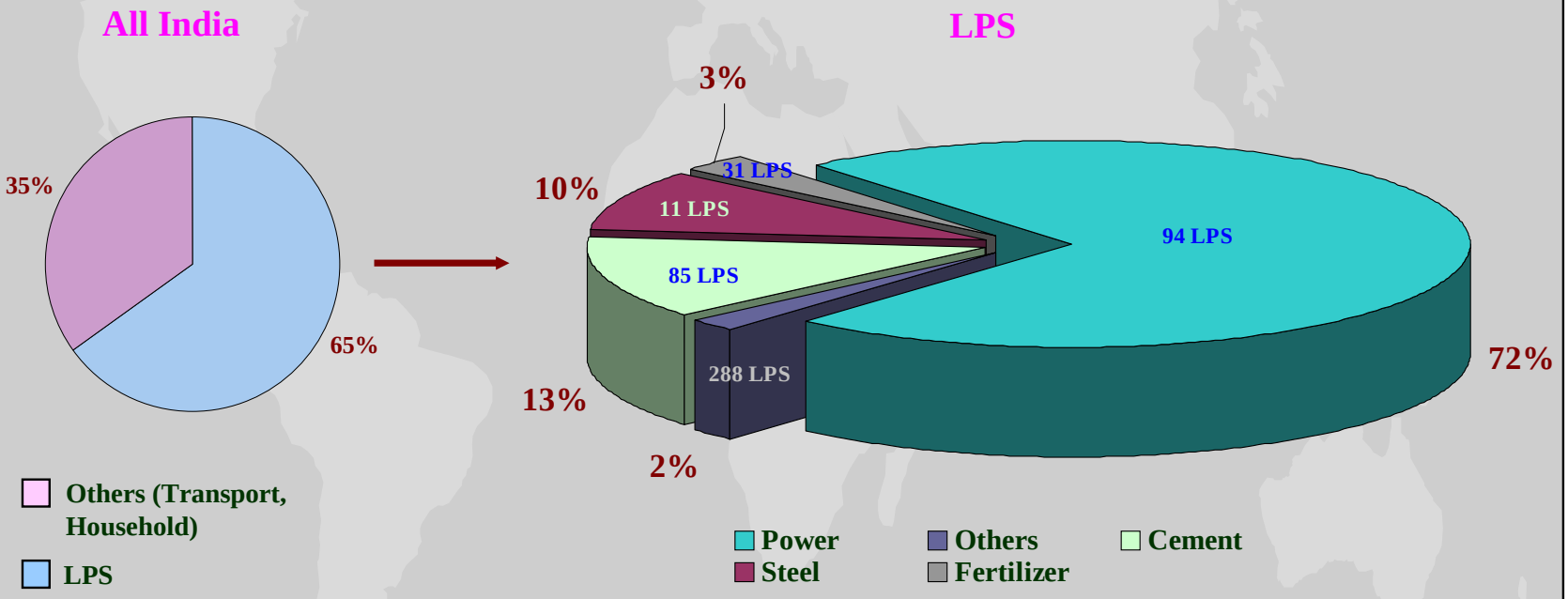


SO2 from Cement Plants



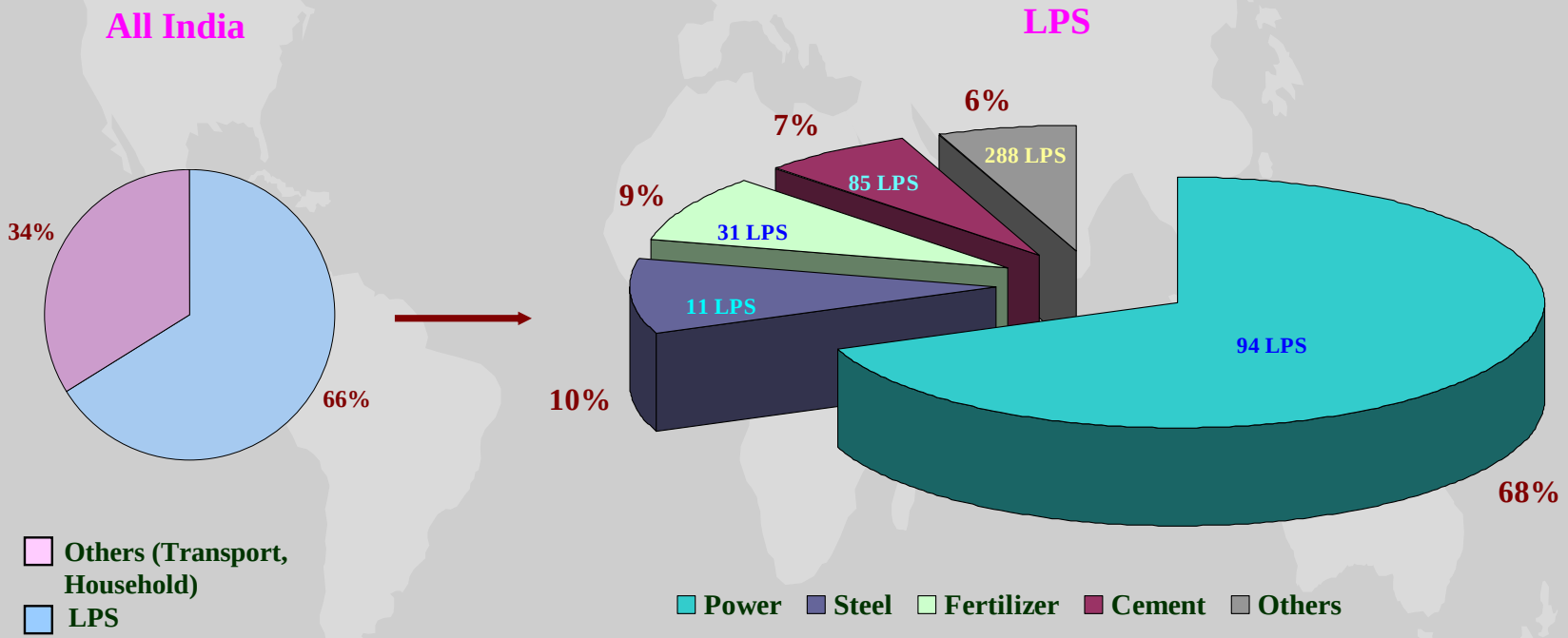
CO2 Contribution from LPS

All India Emissions = 778 MT



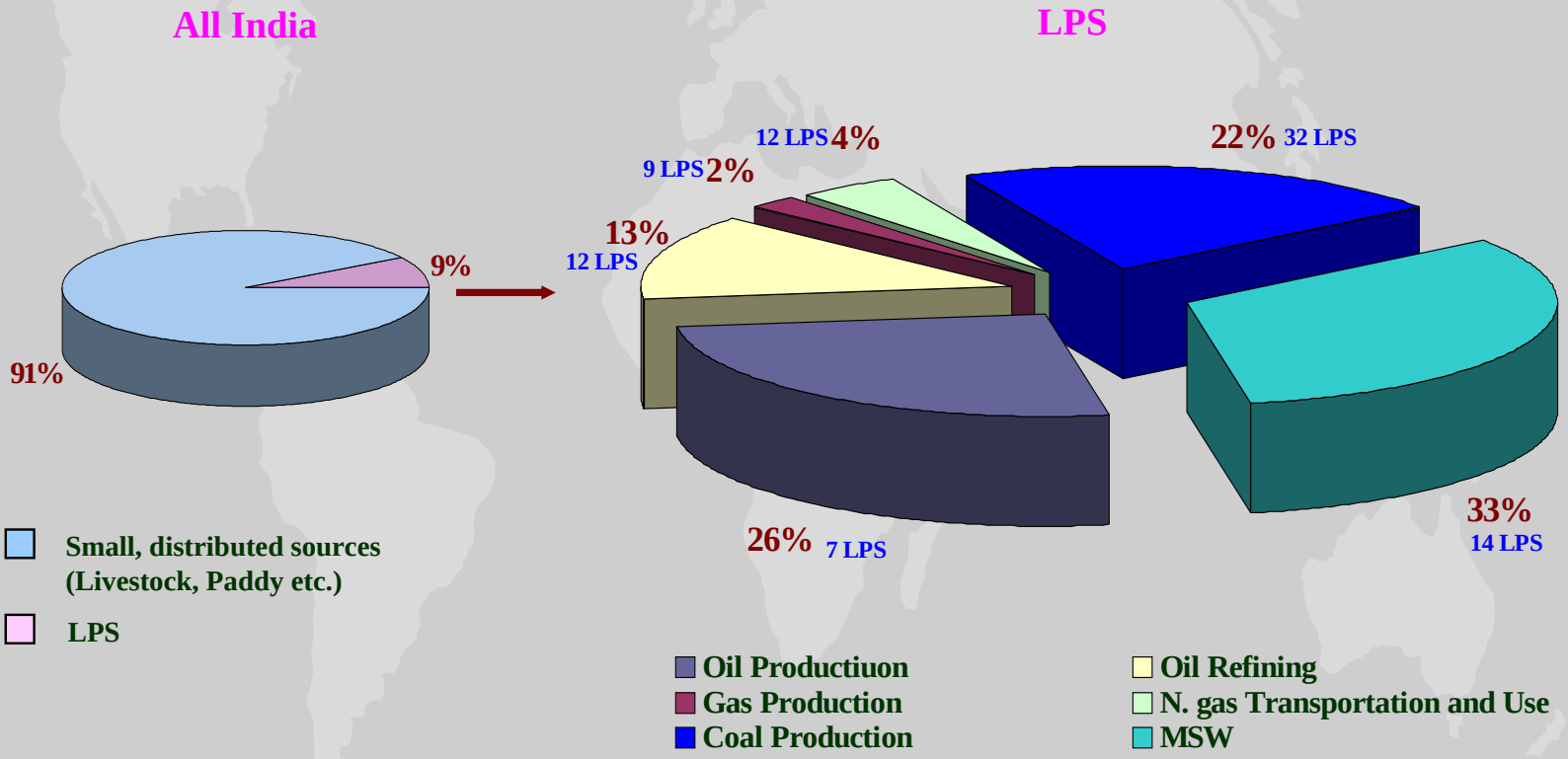
SO2 Contribution from LPS

All India Emissions = 4.64 MT



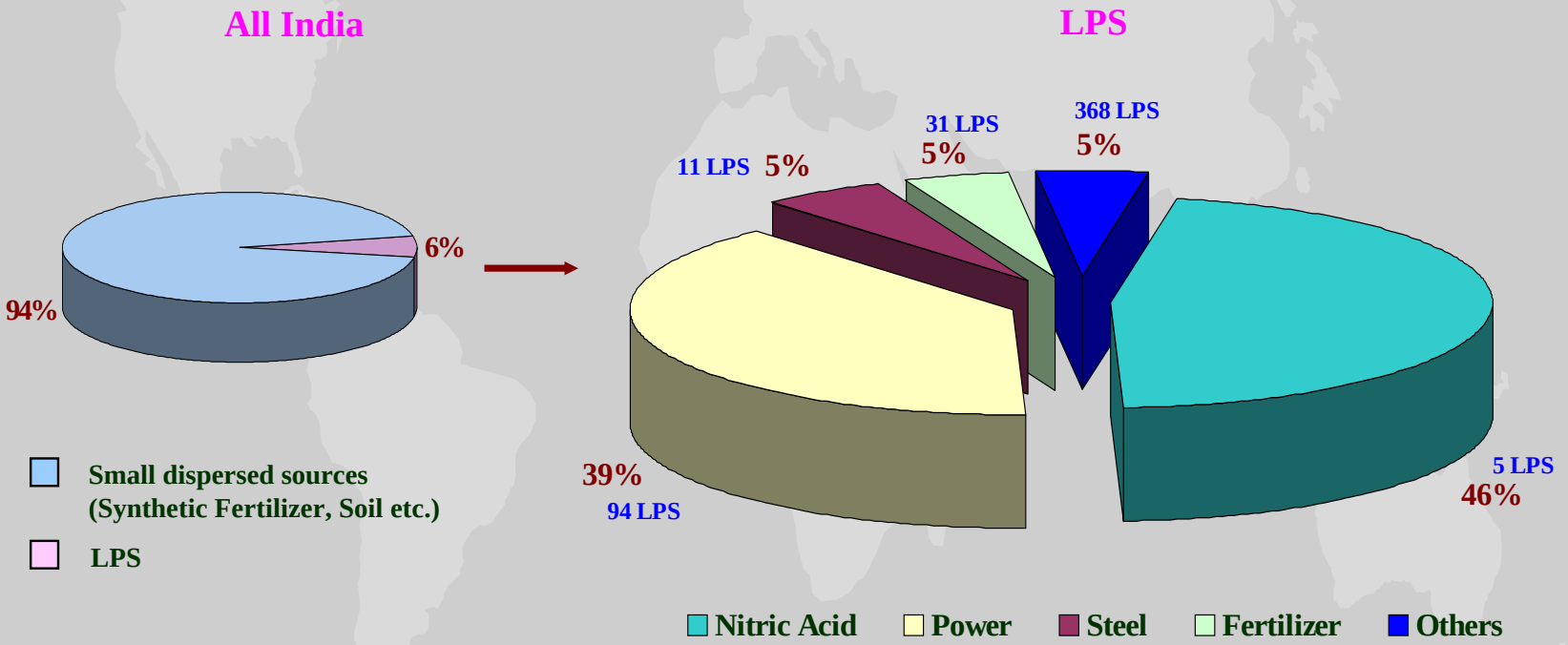
CH4 Contribution from 86 LPS

All India Emissions = 18 MT



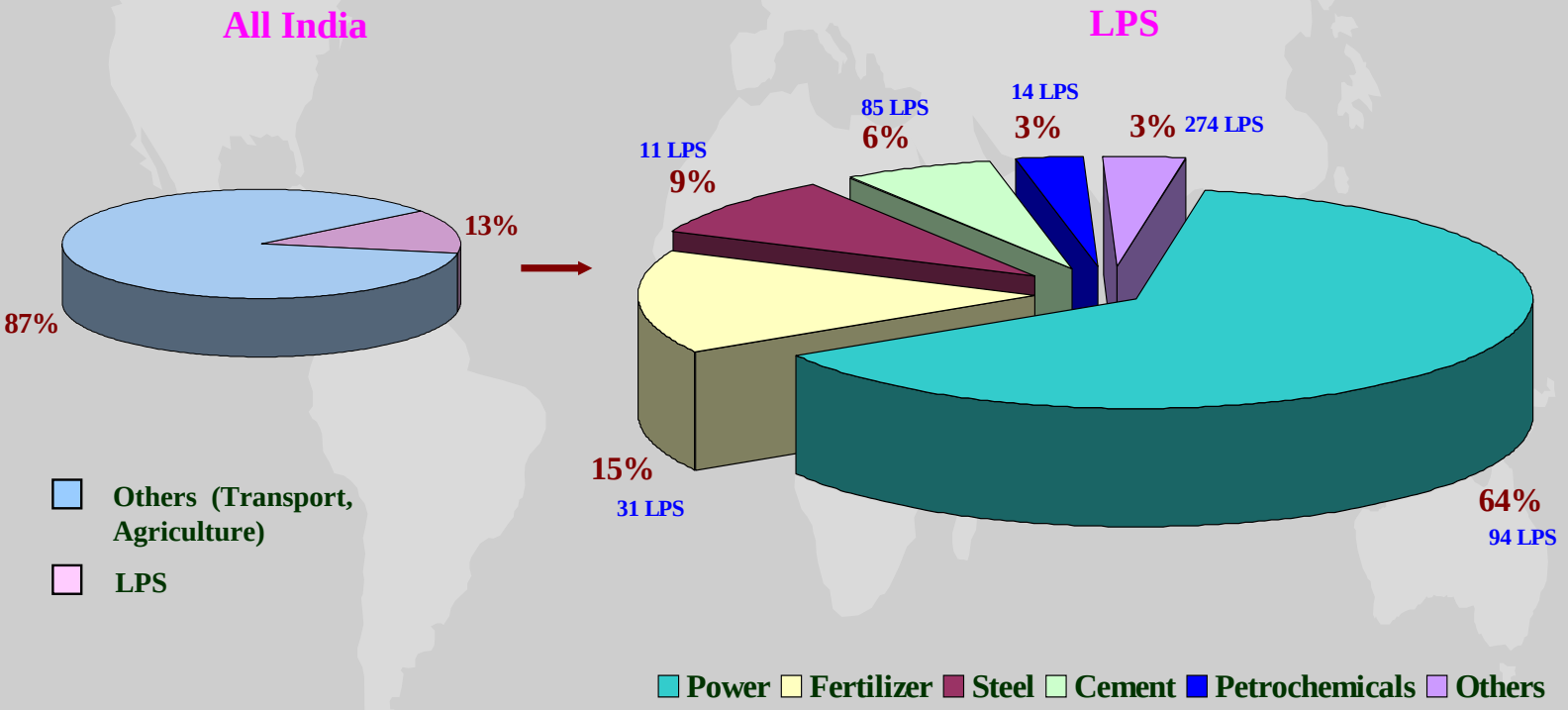
N2O Contribution from LPS

All India Emissions = 251 kT



NOX Contribution from LPS

All India Emissions = 3.46 MT

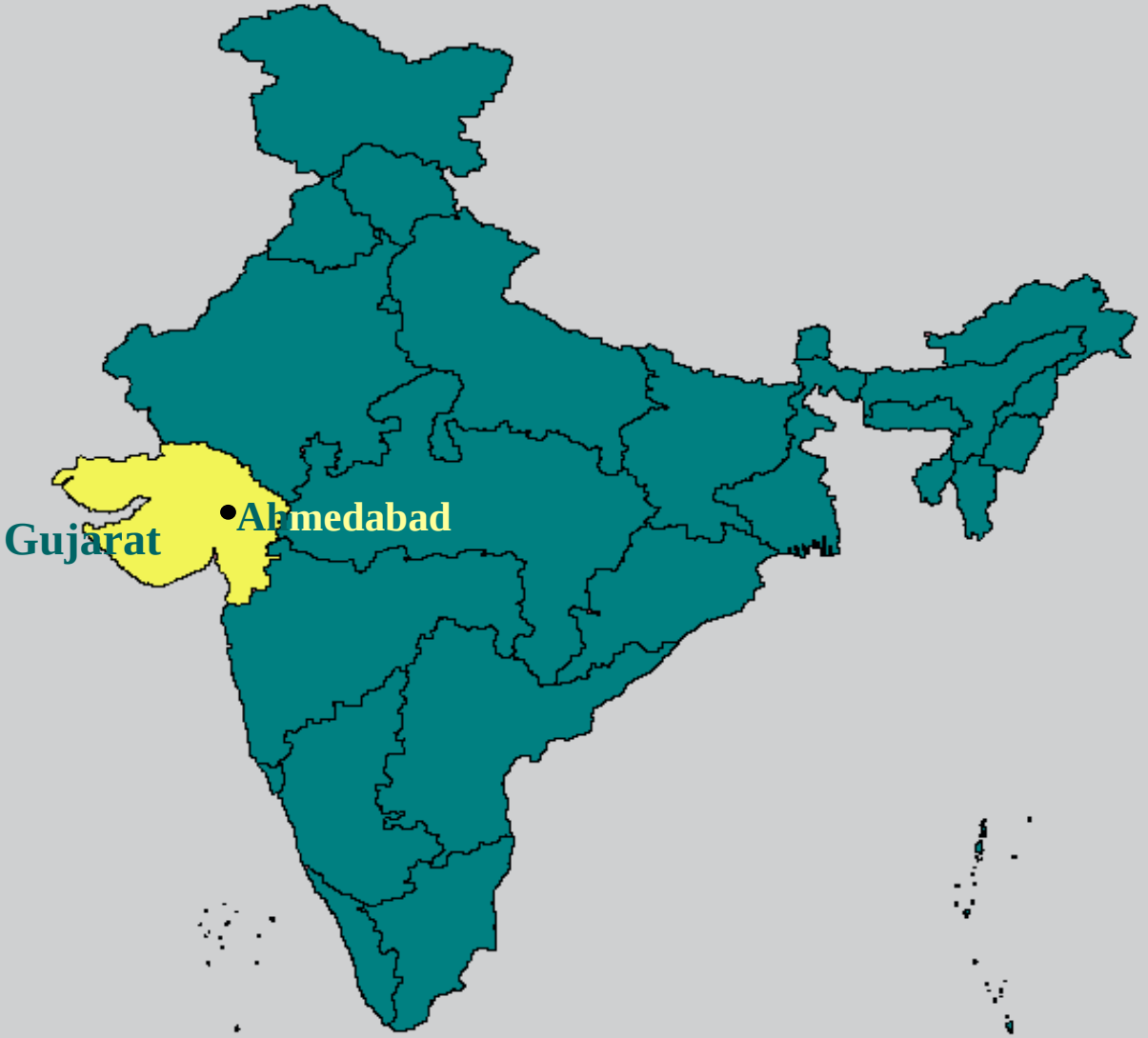


AIM Local Model

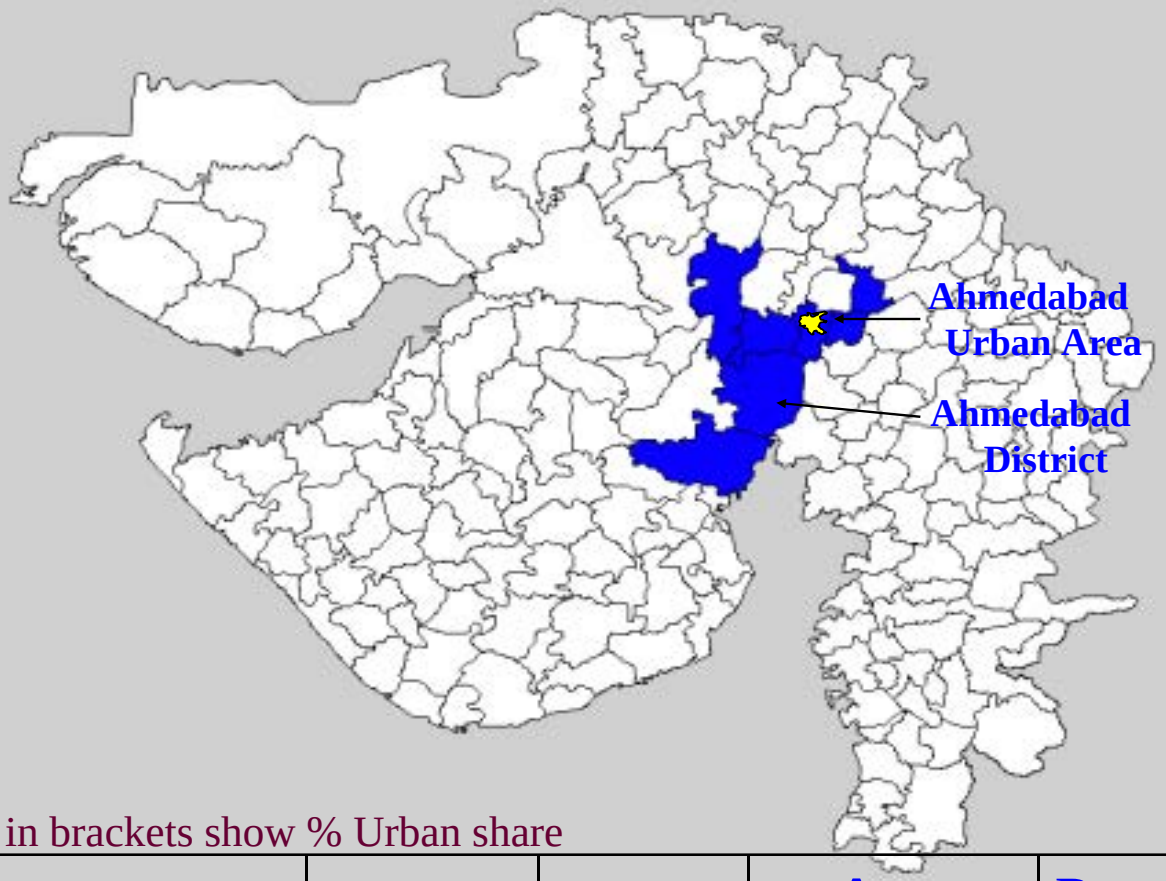
AIM Local Model: Status

- **Model is transferred from NIES**
- **Application Area is selected**
- **Data Collection initiated**

Application Area: Ahmedabad District



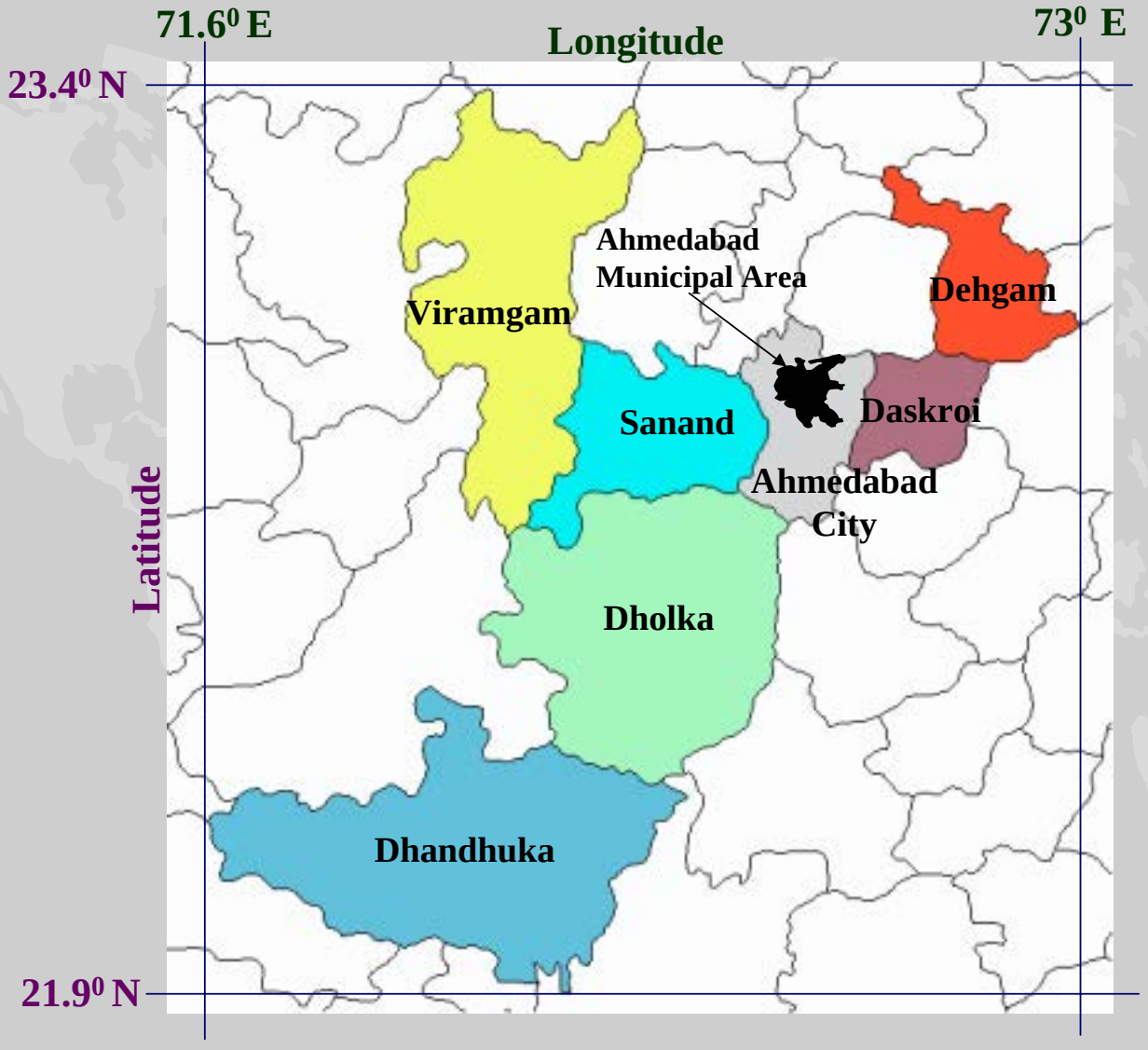
Gujarat State and Ahmedabad District



Figures in brackets show % Urban share

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

Ahmedabad District

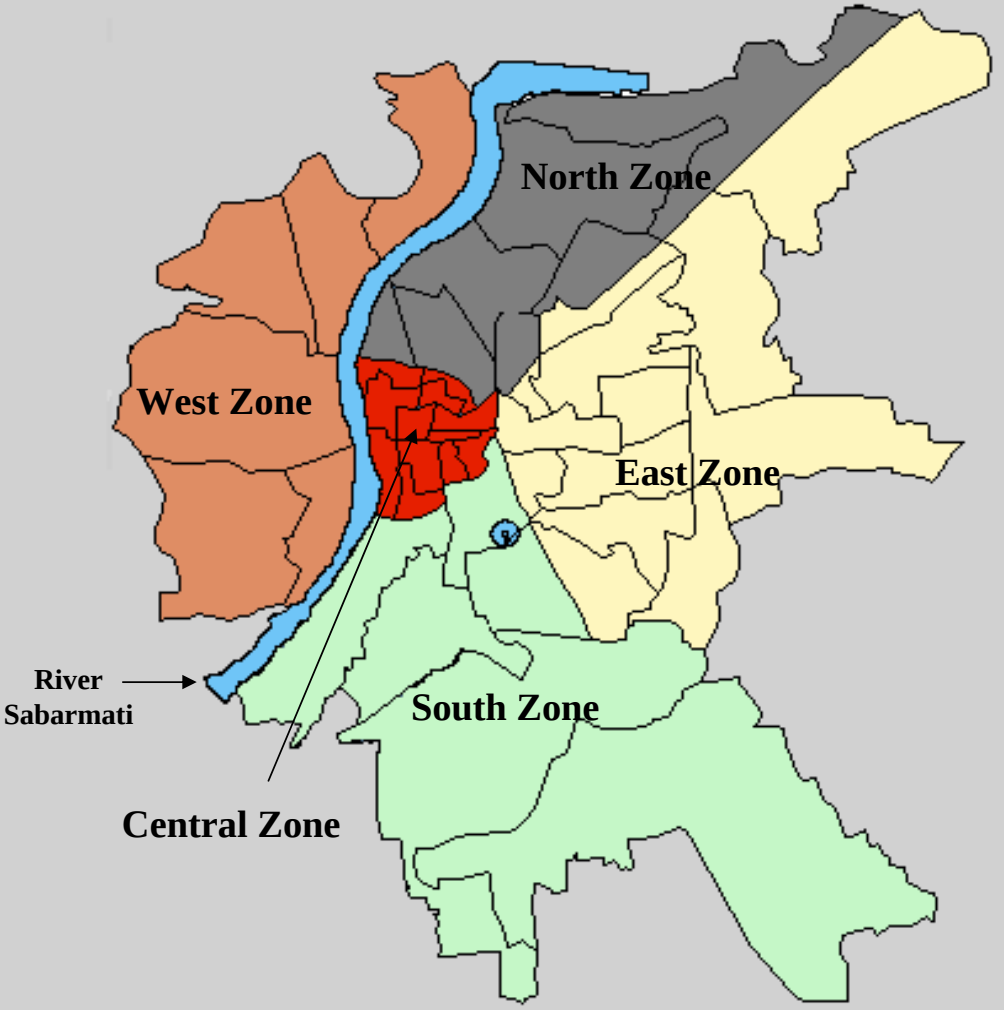


Taluka Data

Figures in brackets show % Urban share

Taluka	Area Sq. Kms.	Population Thousands
Ahmedabad City	292 (83)	3250 (100)
Daskroi	664 (5)	338 (28)
Dholka	1788 (2)	307 (26)
Dhandhuka	2683 (4)	252 (21)
Sanand	791 (5)	162 (16)
Viramgam	1714 (4)	278 (22)
Dehgam	620 (4)	214 (15)

Ahmedabad Municipal Area



Population - Ahmedabad zones

Ahmedabad Municipal Area

Population : 4218 Thousands

Area : 190.84 Sq. Km

Density : 22104 Pop/Sq. Km.

Sr. No.	Zone	Area %	Population %	Density Pop/Sq. Km.
1	Central	9	21	52858
2	West	22	20	19939
3	North	17	22	28406
4	East	14	21	32388
5	South	38	17	9638

Primary Energy Consumption (PJ) - (2000)

Sector	Res.	Comm.	Ind.	Transp.	Power	Total
Coal	0	0	19	0	19	38
Gas	0	0	2	0	5	7
Oil/LPG	7	2	5	11	0	24
Biomass	2	1	2	0	0	5
Total	9	3	28	11	24	74

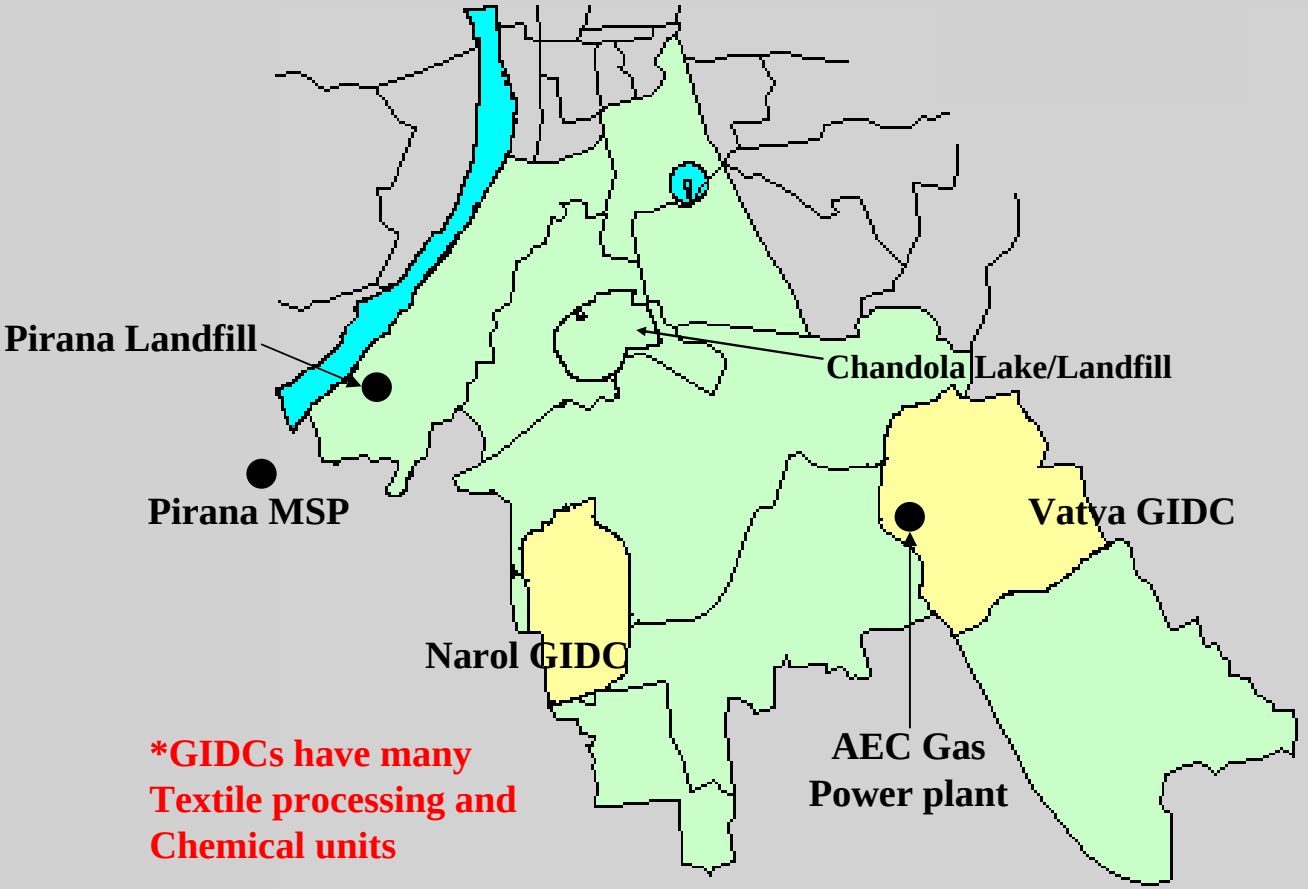
Electricity Consumption (Million kWh) - (2000)

Residential	215
Commercial	205
Industrial	885
Total	1305

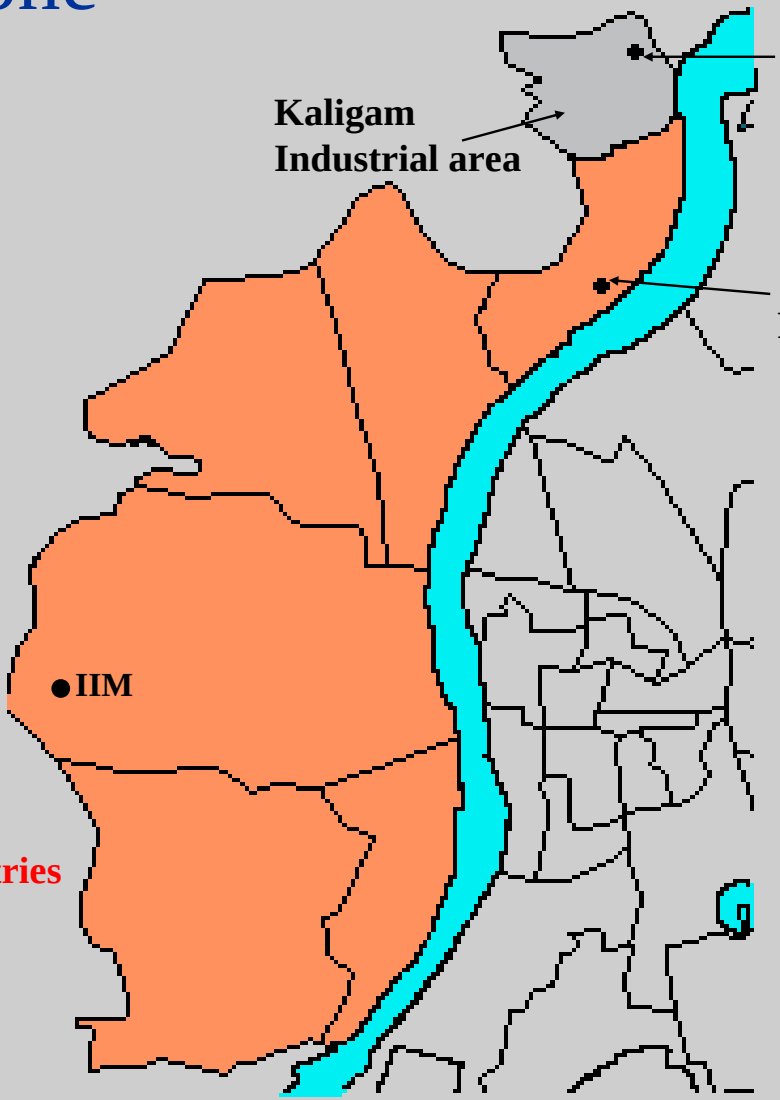
Emissions - (2000)
(Thousand Tons)

Pollutants	Res.	Comm.	Indus.	Transp	Power	Total
Carbon	123	36	625	220	566	1570
SO2	1	0	15	3	10	29
NOx	1	0	3	9	6	19
SPM	2	1	68	2	12	85

South Zone


Pirana Landfill
Chandola Lake/Landfill
Pirana MSP
Vatva GIDC
Narol GIDC
AEC Gas
Power plant
*GIDCs have many
Textile processing and
Chemical units

West Zone



*Barring few industries rest is Residential/ Commercial area

AIM-Local: LPS Database

Power Plants	2
Textiles	18
Chemical	23
Brick Manufacture	43
Metal Smelting	11
Land Fills	2
Other	50
Total	149

LPS: AEC Coal Power Plant

Chimney height (Meters)	90
Coal Consumption (Thousand Tons)	1367
CO_2 (Thousand Tons of Carbon)	656
SO_2 (Thousand Tons)	14
NOx (Thousand Tons)	6

LPS Tables - AIM Local

Regional Classification 1

No.	Code	Name
1	AHU	Ahmedabad District (Urban)

Regional Classification 2

No.	Code	Name	Region 1	Area (Km^2)	Allocation Index		
					Pop. ('000)	GDP	Hshld('000)
1	AHSZU	Ahmedabad City West Zone	Ahmedabad Dist. (Urban)	42	844		169

LPS

No.	LPS Code	LPS Name	Region 2	Op.Rate	Long.	Lat.	Stack Height(Mt.)
1	AHPPT01	Ahmedabad Thermal Power Plant 1	Ahmedabad City West Zone				90

* Energy Data by Year

No.	Energy	Sector 1	Region 1	Price/Gas

*The form in Access database indicates it as Region in place of Sector

IIM Ahmedabad

LPS Tables - AIM Local (Continued….)

Service Demand (LPS)

No.	LPS	Service		Type	Service Demand			
		Name	Unit		Year 1	Value 1	Year 2	Value 2
1	Ahmedabad Thermal Power Plan	Electric Power	('000) kWh	LIN	1995	2194000	2030	

LPS Stock

No.	LPS		Energy Servic	Commination of Air Pollution Contro
	Code	Name		
1	AHPPT01	Ahmedabad Thermal Power Plant	Coal Boiler	

Share (LPS)

No.	Service	Energy Service Technolo	Type	Maximum Share			
				Year 1	Value 1	Year 2	Value 2
1	Electric Powe	Coal Boiler	LIN	1995		2030	

Operating Rate (LPS)

No.	LPS		Energy Service Technolo	Type	Opearatin Rate			
	Code	Name			Year 1	Value 1	Year 2	Value 2
1	AHPPT01	Ahmedabad Thermal Power Plant	Coal Boiler	LIN	1995		2030	

AIM-Local: Area Sources Database

- **Industry**
- **Transport**
- **Residential**
- **Commercial + Municipal**
- **Agriculture**

AIM/CGE Model

AIM/CGE Model: Filling Environment Policy Gap

- Present Policies and Measures in India:
  - **Little Integration (environment or economy)**
  - **Command and Control Measures**
- Felt Need for Integration of environment and Macroeconomic decisions
- Growing acceptance of Market Instruments
- AIM/CGE Model can help integration of environment and macroeconomic policies

AIM/CGE Application for India

- **Integration of air, water and land policies**
  - Assessment of co-benefits
  - Policy integration
  - Quantification
- **Assessment of Environment Industry Dynamics**
  - Identification of Environment Industry
  - Future Growth Pattern
  - Investment
- **Policy Objectives:**
  - Short-term: towards management and control of pollution
  - Medium-/long-term: investments to produce less waste by the way of reuse and recycling

Scenarios

- **BAU scenario under development with 1995 as the base year**
- **Environment constraint scenario:**
  - **Constraint on final disposal of wastes**
- **Policy scenarios:**
  - **Higher investments for air, water and solid waste management**
  - **Integrated policy scenario for global (GHG) and local local pollutants (on air, water, land)**

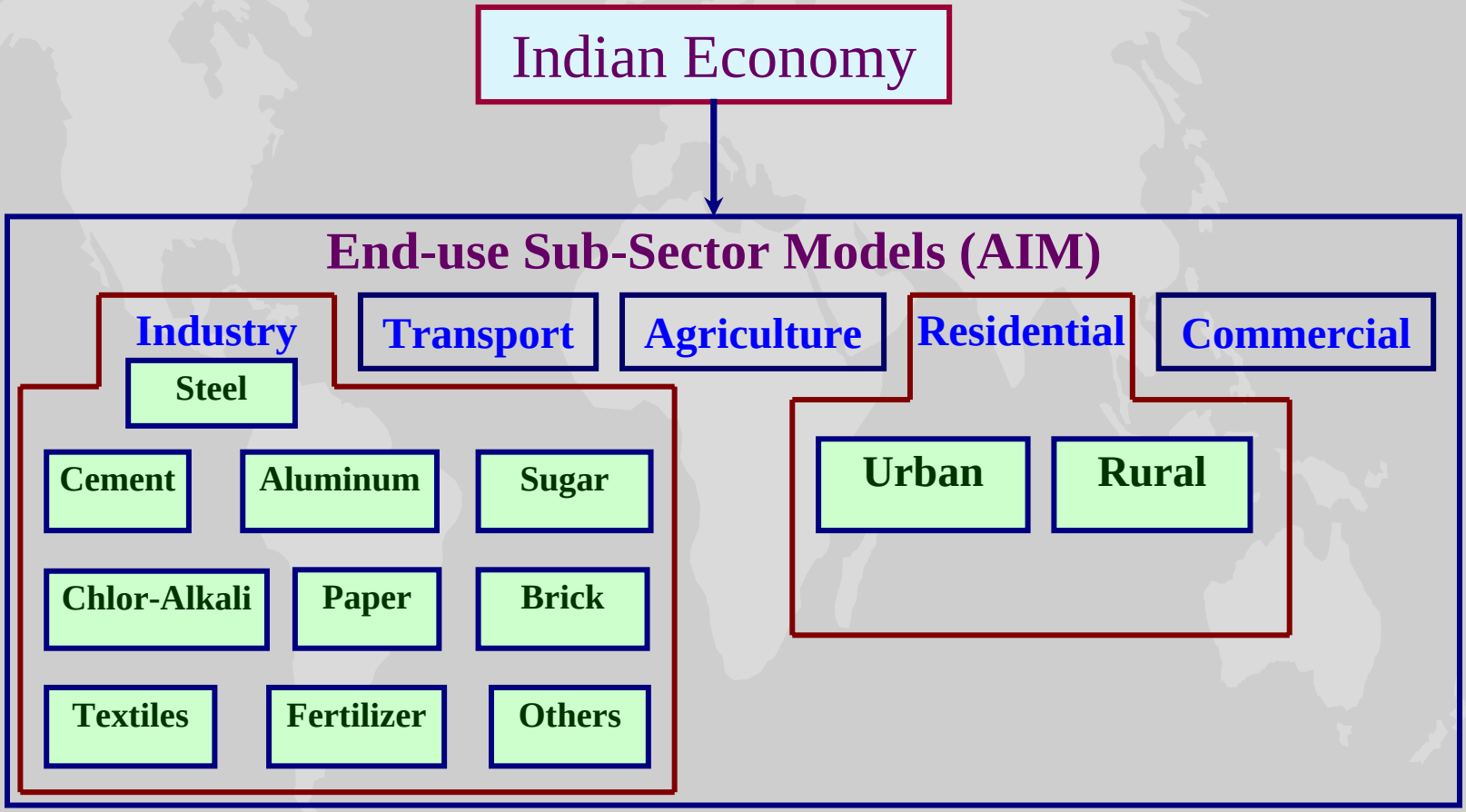
Data Availability and Assessments

- **Available from reliable secondary sources**
  - I-O Transactions Table for 1995, and Use Matrix/Make Matrices
  - Capital Stock, Private/Government fixed capital formation matrix
  - Tax imposed on each sector
  - Total Energy Demand and Carbon Intensity
- **Available but sector/ waste definition is imprecise**
  - Industrial solid waste generation discharged from each sector
  - Transfer from waste to goods
- **For which estimates are made using broad assumptions**
  - Private/Government environmental capital stock in each sector
  - Demand of recycling goods
  - Intermediate demand share in each sector; Labor share in each sector
  - Quantity of Waste Management Way for Industrial/Municipal Waste for each waste

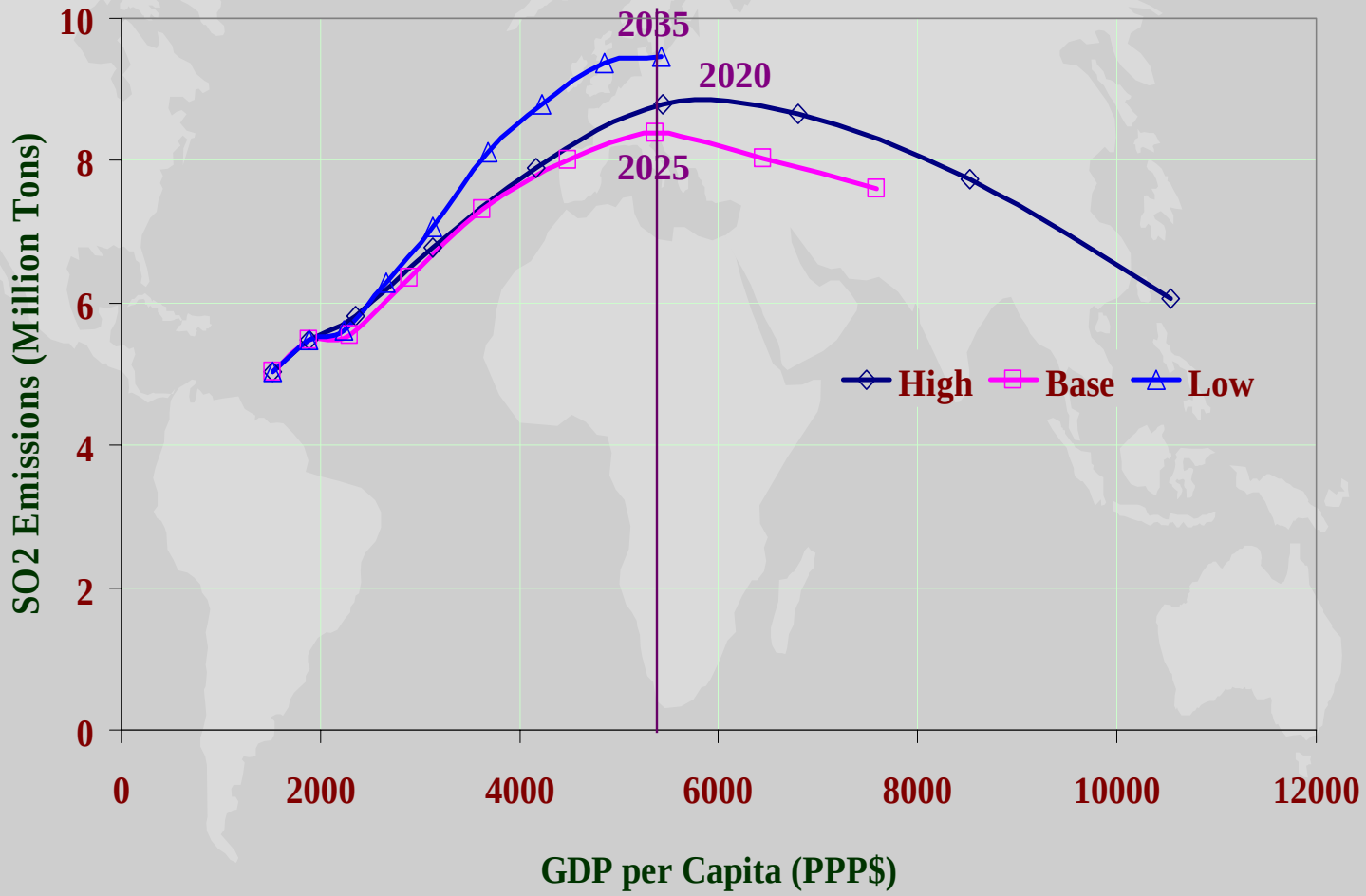
New Analysis with AIM/ENDUSE Model

- **Kuznets Curves**
- **CDM**
- **Technology Database**

Indian AIM/ENDUSE Model



SO2 Kuznets Curve



AIM/ENDUSE: Technology Database

- **Database for 25 Sectors and 250 Technologies**
- **Data adapted to India**
- **Includes Future Technologies/ Performance**

SECTORS	SUB-SECTORS	TECHNOLOGIES
Industry	11	152
Residential	2	46
Agriculture	1	14
Transport	8	25
Services	1	9
Power Sector*	1	22
Oil Refinery*	1	12
Total	25	280

Year 2001 Plan

- **Emissions Inventory and GIS**
- **AIM Local Application**
- **New CGE model**
- **AIM Trend Model**