Integrated Environmental Strategies

Indo-US Workshop on
Economic and Environmental Modeling

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USAID/India
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What is IES?

- US EPA program begun in 1998.
- Opportunity to look at multiple development benefits in an integrated fashion.
- Currently implemented in Argentina, Brazil, Chile, Mexico, China, Philippines, South Korea, and India.
- Partnership: EPA, NREL, USAID with Indian government and institutions.

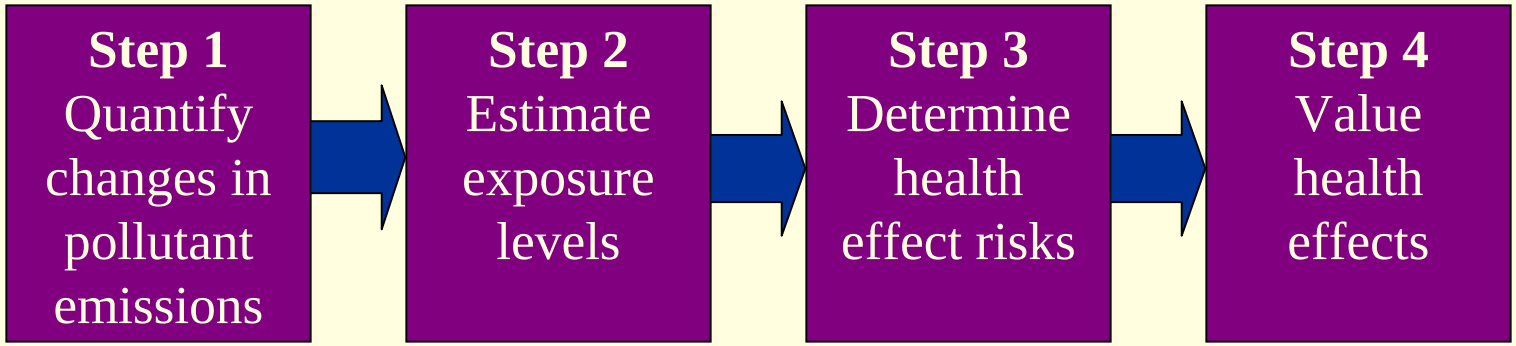
Partners in India

- **EPTRI**
- **Institute for Health Systems**
- **RITES**
- **SRMC/TERI**
- **Confederation of Indian Industries**
- **Winrock International India**
- **APPCB, MCH, MOEF, CPCB**

IES goals

- Identify cost-effective strategies that **improve local air quality** while meeting public health, economic development and **GHG mitigation** objectives.
- Provide stakeholders with **quantitative estimates of local and global co-benefits** of policies and technologies.
- Engage stakeholders to lay groundwork for **implementation** of cost-effective air quality management strategies.
- **Build analytical, institutional, and human capacity** for multidisciplinary analysis of health, environmental, and GHG mitigation impacts of alternative strategies.
- **Transfer** tools and methodologies for co-benefits analysis.

Steps to Quantify Co-Benefits



Estimating Emissions

Countries	Approach	Pollutants Examined	Variables Changed
Argentina	Transportation sector emissions projection	CO, NO, HC, CO2, PM	Proportion of nat. gas vehicles, modal split
	Energy sector emissions projection	CO2, SO2, NOx, PM	Increased hydropower, reduced demand, nat. gas
Chile	Energy, industry, mining and residential/commercial/public sector emissions	CH4, N20, NO, CO, VOCs, SO2, CO2	Electrical interconnection with Arg., new technologies, fuel substitution, renewables
China	MARKAL	CO2, SOx, NOx, PM10	Characteristics of energy system
Korea, Brazil	LEAP	TSP, PM10, CO2	Efficiency improvements in technologies for each sector
Mexico	Emissions projections for MCMA	CO2, NOx, HC, CO, SO2, PM10	PROAIRE measures

Estimating Exposures

Country	Approach	Description	Outputs
Argentina	Software de Impacto Atmosferico (SofIA)	Gaussian dispersion	Average pollutant concentration at any level
Chile	Box Model	PM conc. as function of daily emissions	Projected average daily concentrations through 2020
	Source apportionment method	Changes in ambient PM conc. due to changes in primary pollutant emissions	Future PM levels
China	Shanghai Environmental GIS	Selects dispersion based on emission characteristics	Ground level air concentrations
China, Korea	Urban Branching Atmospheric Trajectory Model	Lagrangian multi-layer trajectory model	Projected mean annual pollutant concentrations
Brazil	CIT Model	Eulerian 3D photochemical model	Pollutant concentrations

Valuation Approaches

Approach	Applied to	Data requirements	Where used
WTP	morbidity & mortality	contingent valuation surveys, wage-risk data	Arg., Chile, China, Korea
Cost of illness	morbidity	medical expenditures	Arg., Chile, China, Korea
Human capital	mortality	demographic, wage data	Argentina, Chile
Value of stat life	mortality	WTP data on mortality risk	Arg., Chile, China, Korea

Summary results: CO2 reductions

(Million Tons)	2010	2020
Shanghai	9-47	14-73
Buenos Aires	0.86-6.5	---
Santiago	5.4	14.3
Seoul	0.6-1.8	1.2-2.3

Summary Results: Avoided Mortality

	2010	2020
Shanghai	647-5,472	1,265-1,1130
Buenos Aires	1,463-3,957	---
Santiago	---	332
Seoul	62-75	93-120

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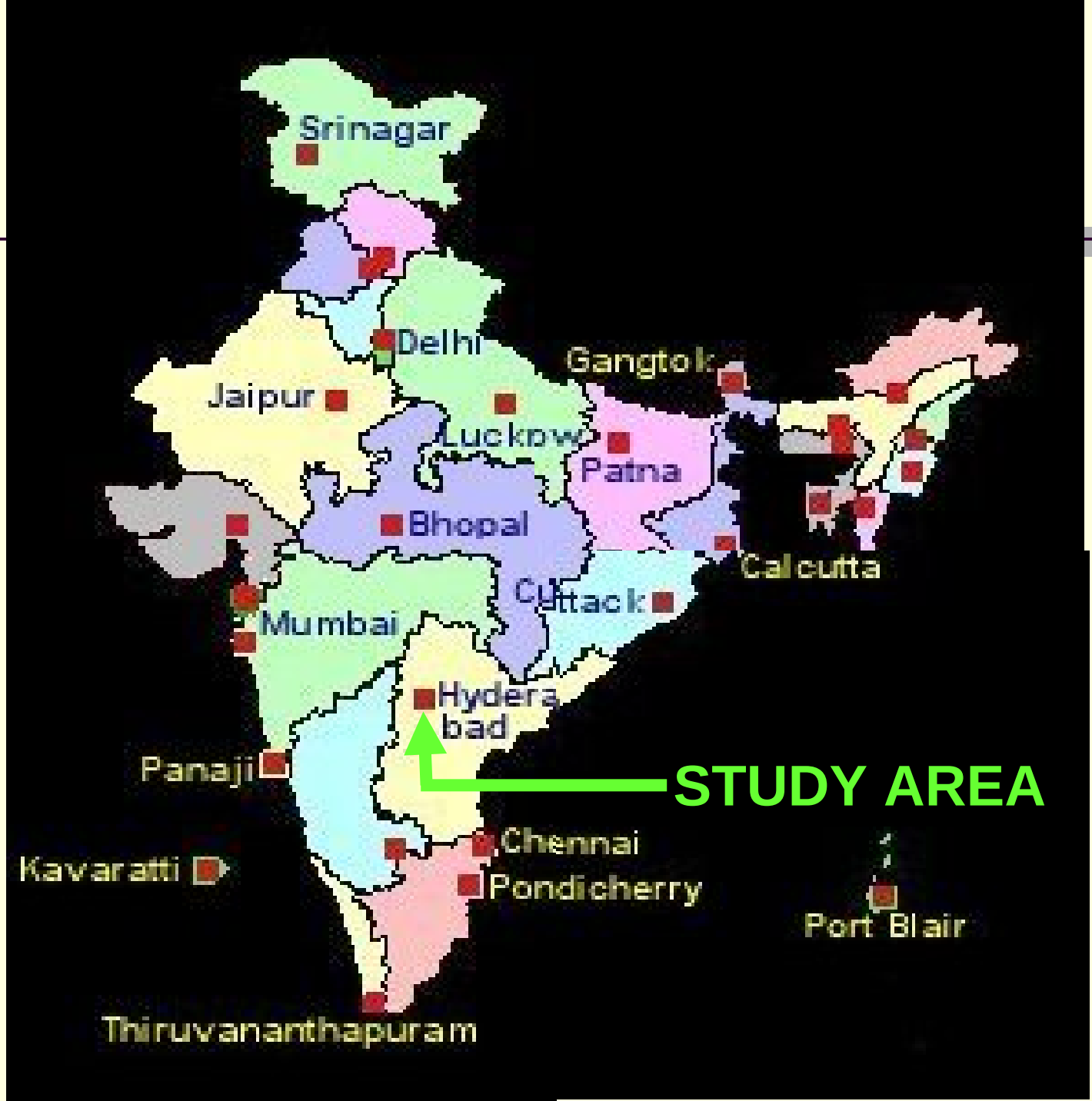
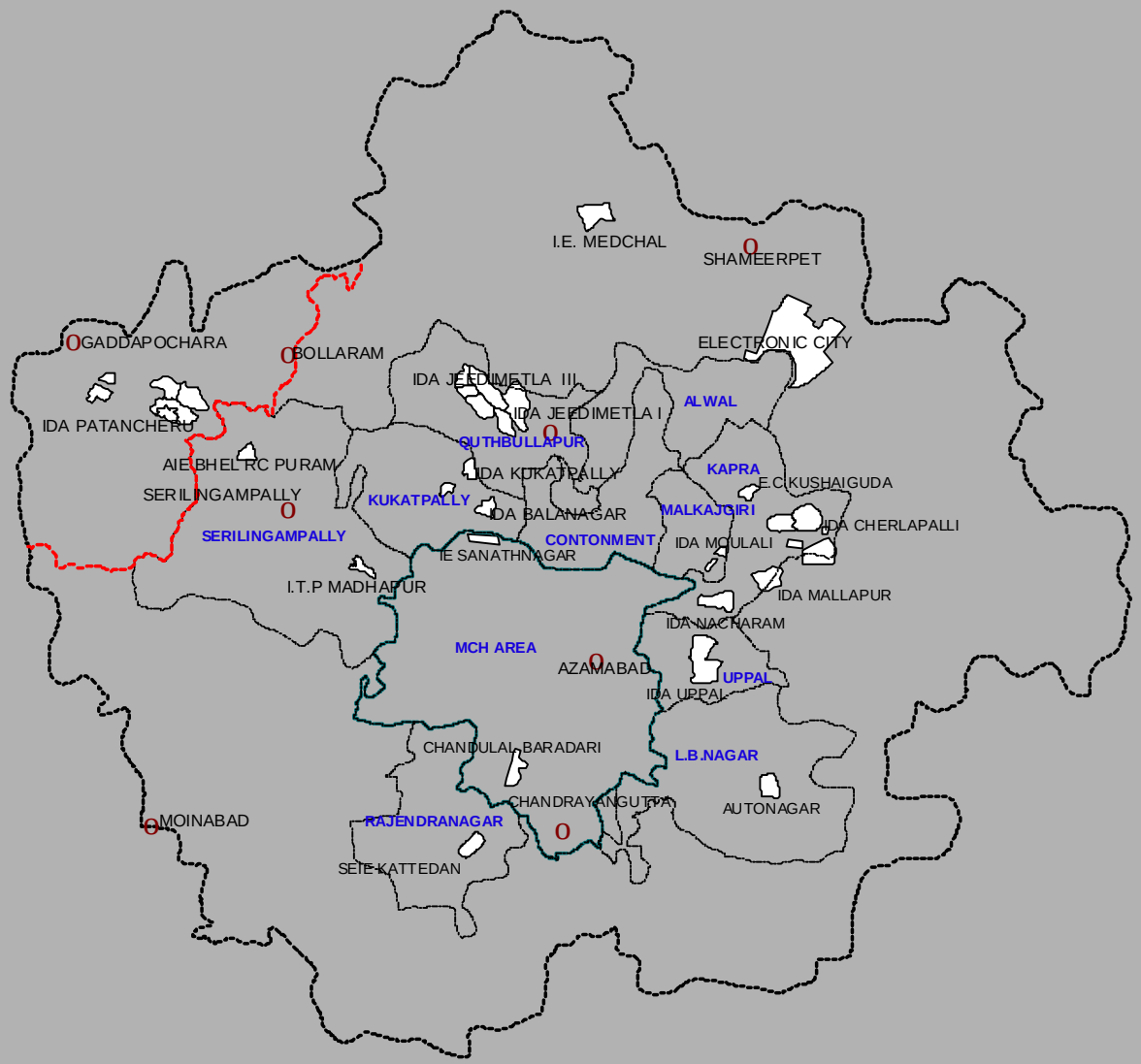

Srinagar
Delhi
Gangtok
Jaipur
Lucknow
Patna
Bhopal
Calcutta
Cuttack
Mumbai
Hyderabad
Panaji
STUDY AREA
Chennai
Kavaratti
Pondicherry
Port Blair
Thiruvananthapuram



STUDY AREA MAP

FOR

INTEGRATED ENVIRONMENTAL STRATEGIES

Legend

- Industrial Areas
- District boundary
- HUDA boundary
- Municipality Boundary
- Hyderabad District / MCH boundary
- Industrial Development Areas

Centre of Excellence,
Spatial Environmental Planning
Environment Protection Training &
Research Institute, Hyderabad.

IES approach

Integrated measures > >

- **Emissions inventories**
- **Develop alternative scenarios**

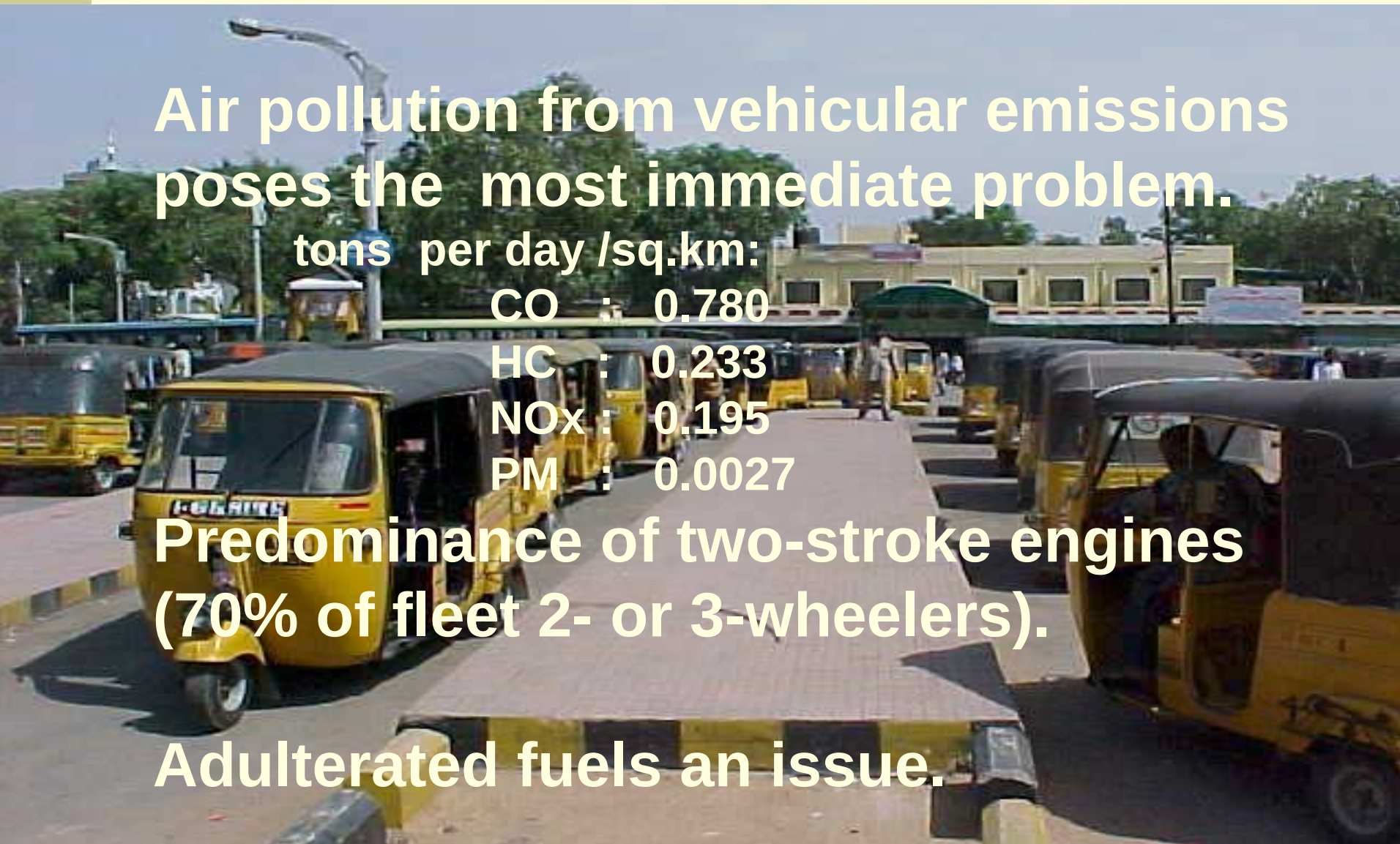
Co-benefits analysis > >

- **Model pollution concentration and exposure**
- **Estimate public-health effects**
- **Compare costs/benefits of alternative mitigation options and business-as-usual**
- **Present results and seek feedback from policymakers/ stakeholders**

Implementation > >

- **Integrate results into planning processes**
- **Implement measures to capture benefits**

Transport emissions



Air pollution from vehicular emissions poses the most immediate problem.

tons per day /sq.km:

CO : 0.780
HC : 0.233
NOx : 0.195
PM : 0.0027

Predominance of two-stroke engines (70% of fleet 2- or 3-wheelers).

Adulterated fuels an issue.

Industrial emissions

- Industry is second largest contributor to air emissions.
- Rapid industrialization and commercialization has increased air pollution.

IES-India targets

- PM_{10} is the primary pollutant of concern for health effects studies.
- Uses available secondary data.
- GHG emissions (CO_2, N_2O, CH_4).
- Air quality modeling studies for BAU and future scenarios.

Unique features of IES-India

- Indoor and ambient air quality for emissions, measures, and health impacts
- Outreach component for general public, private sector, and policymakers.
- Transportation demand-forecasting effort and stated-preference survey.
- Shift from technology to planning in transport sector.
- IES is an ongoing process in India.

Industrial emissions inventory

- **Data collected for 560 industries registered with APPCB.**
- **Type of fuel used, quantity of fuel, stack dimensions, boiler heat rating, stack test data, control equipment, generators.**
- **Base year for inventory is 2001.**

Estimating industry emissions

- **Emission factors and stack test data used to estimate PM_{10} and GHG emissions from fuel usage.**
- **GHG emission factors obtained from International Council of Local Environmental Initiatives (ICLEI).**
- **PM_{10} emission factors obtained from a variety of sources: USEPA, World Bank, and World Health Organization**

IES-India industrial emissions 2001

GHG emissions (metric tons eCO_2)

- **CO_2 : 759,752**
- **N_2O : 4,078**
- **CH_4 : 26,338**

PM_{10} (metric tons)

- **PM_{1O} : 1,251**

Air quality modeling

Industrial Source Complex (ISC–3) model

- Considers point sources, area sources, and line sources
- Considers dry and wet settling of pollutants
- Well established and user friendly model
- Predicts secondary pollutant concentrations

Transportation and industrial alternative measures

- **Quantify bus patronage under different scenarios:**
  Charge different fares, remove tax on buses, shift cost burden of concession fares to state and/or increase state subsidy, change traffic management patterns to favor buses
- **Evaluate traffic flow schemes**
  Analyze impact of practices such as segregation of vehicles, signal synchronization, parking management, bus stop management, remove bottlenecks
- **Evaluate effects of O&M training**
- **Use of additives to improve combustion in fuel oil boilers**
- **Particulate emissions reductions**
- **Increased use of natural gas as primary fuel**

Preliminary Transportation Results

- Developing exclusive busways in Hyderabad, depending on the corridor, would yield great benefits:
  -- Reduce PM_{10} emissions by 30 to 35% in 2011 and by 40 to 55% in 2021.
  -- Reduce CO_2 emissions by about 10% in 2011 and by 20 to 27% in 2021.
- These estimates assume no change in technology; technological change would results in even more significant results.

Conclusions

- Co-benefits analysis can be a **powerful tool** to evaluate options with local and global benefits
- Bottom-up approach- uses a variety of **models and software packages** (e.g., energy, air dispersion, health) to determine costs and benefits
- Results of IES work being incorporated into **local air quality management** plans
- **Multidisciplinary** groups collaborating and building **permanent capacity** in country
- **Multiple stakeholders** engaged in process to ensure support for implementation

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