


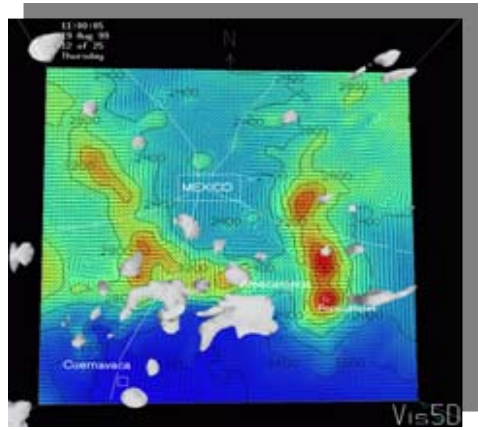

Policy implications of air quality research and co-benefits to climate change

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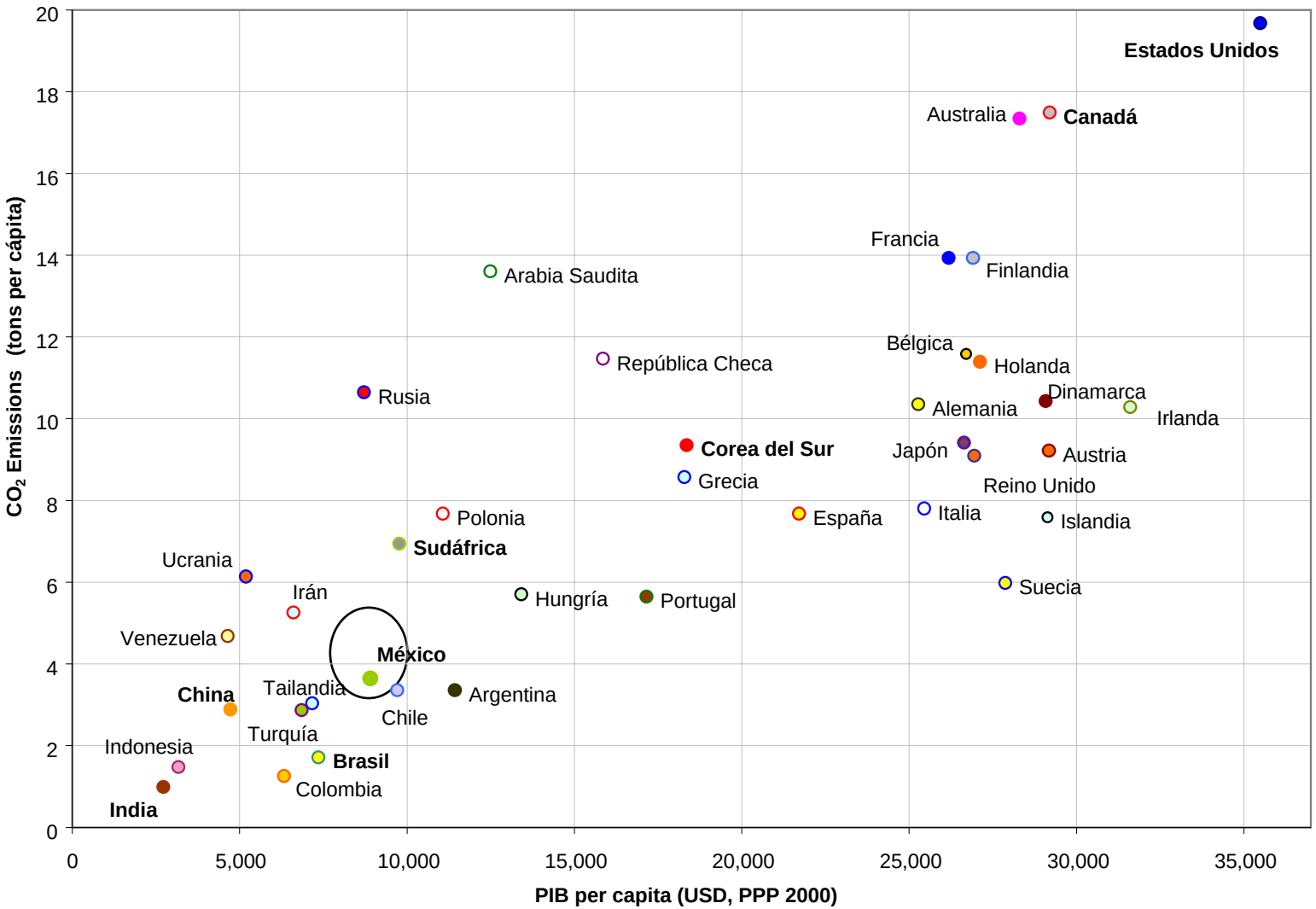
Population growth

People need water, shelter, transport

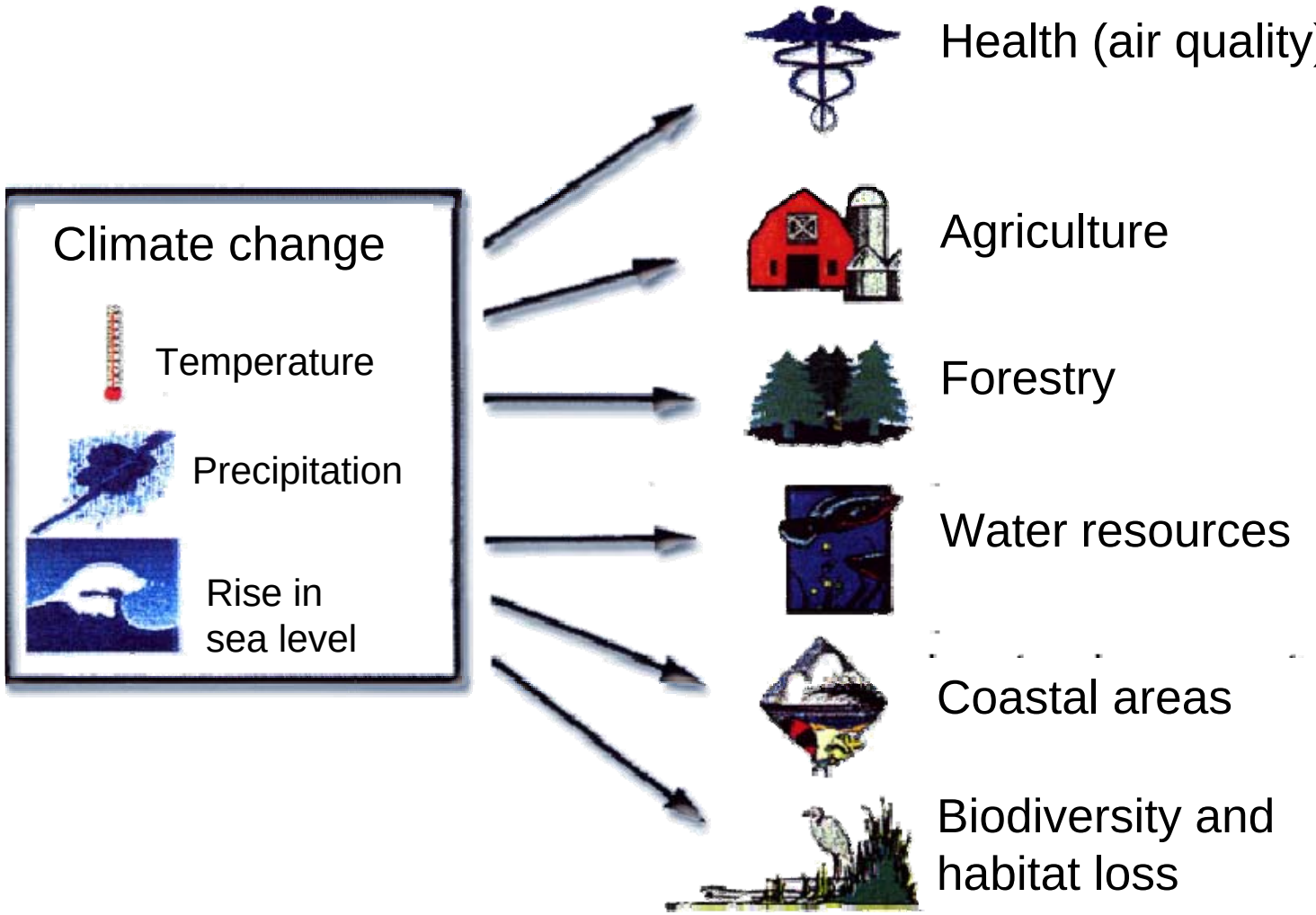
Country	Population 2001 (million)	Annual growth rate (%)	Expected rate change 2001 to 2050 (%)	Projected population (million)		Urban population (%)
				2025	2050	
World	6,137	1.3	47	7,818	9,036	46
Developed countries	1,193	0.1	4	1,248	1,242	75
Developing countries	4,944	1.6	58	6,570	7,794	40
México	99.6	1.9	50	130.9	149.7	74

Source: Population Reference Bureau, 2001

International comparison

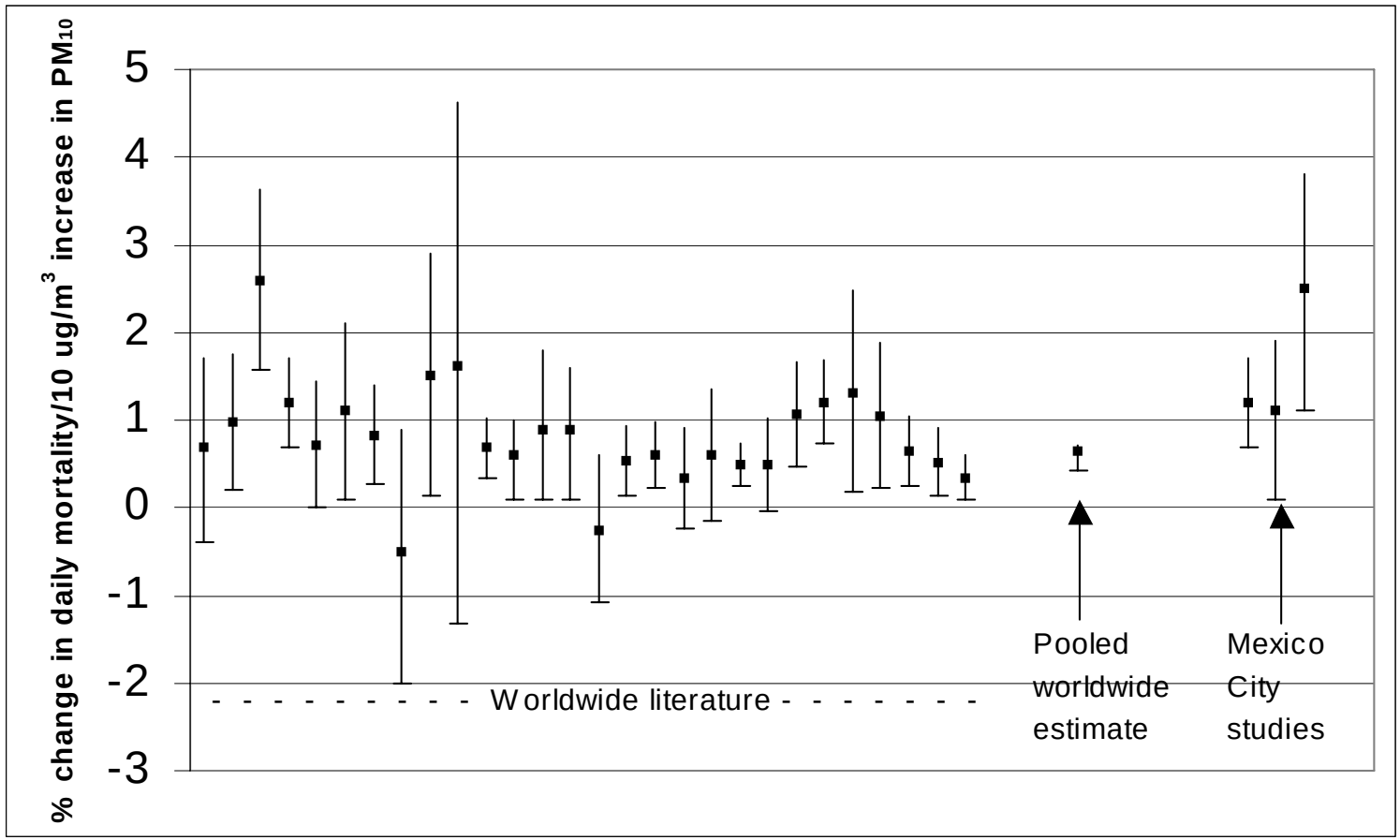


Impacts of climate change



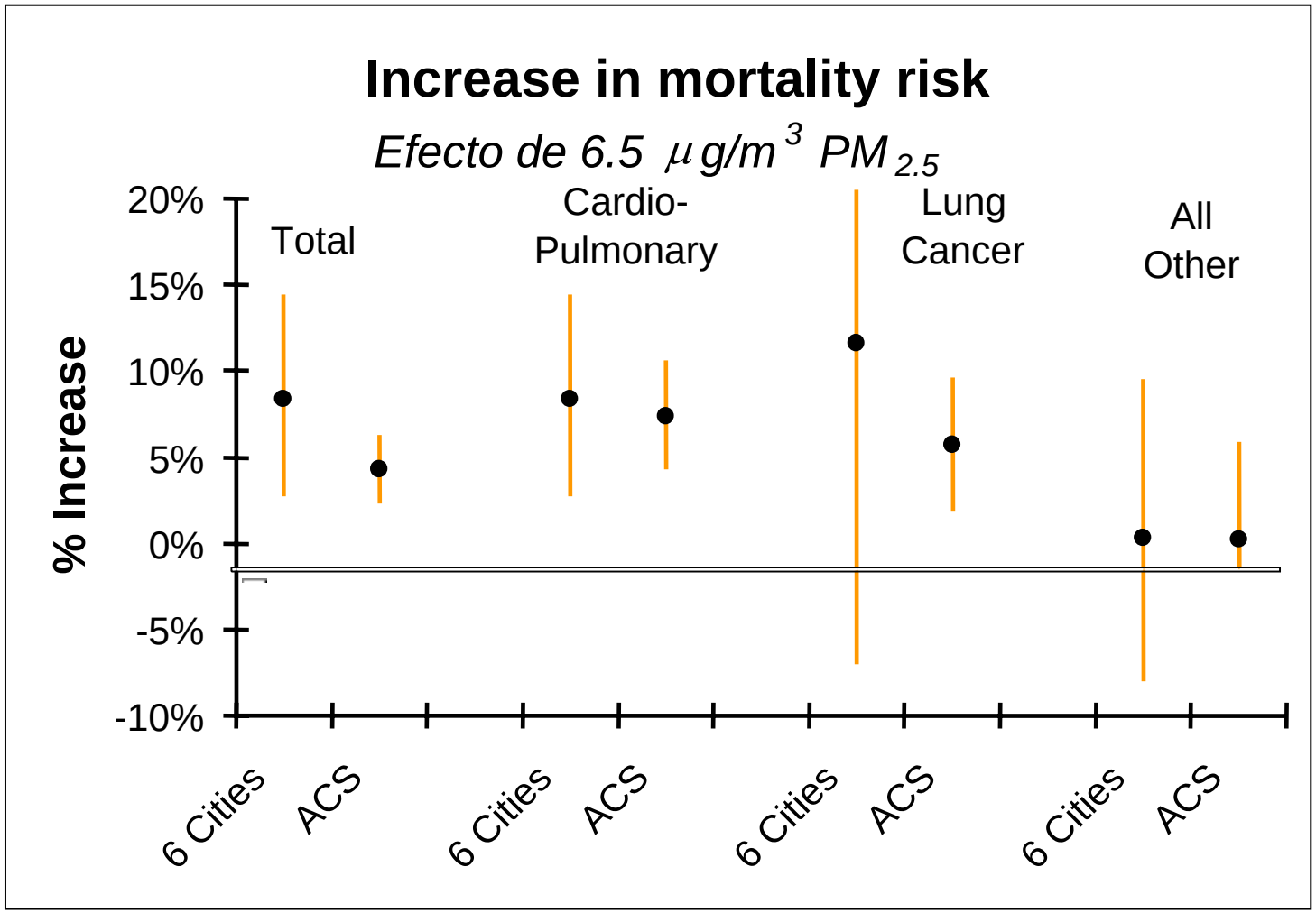
Air pollution and health effects

- PM_{10} and mortality - Time series: international evidence



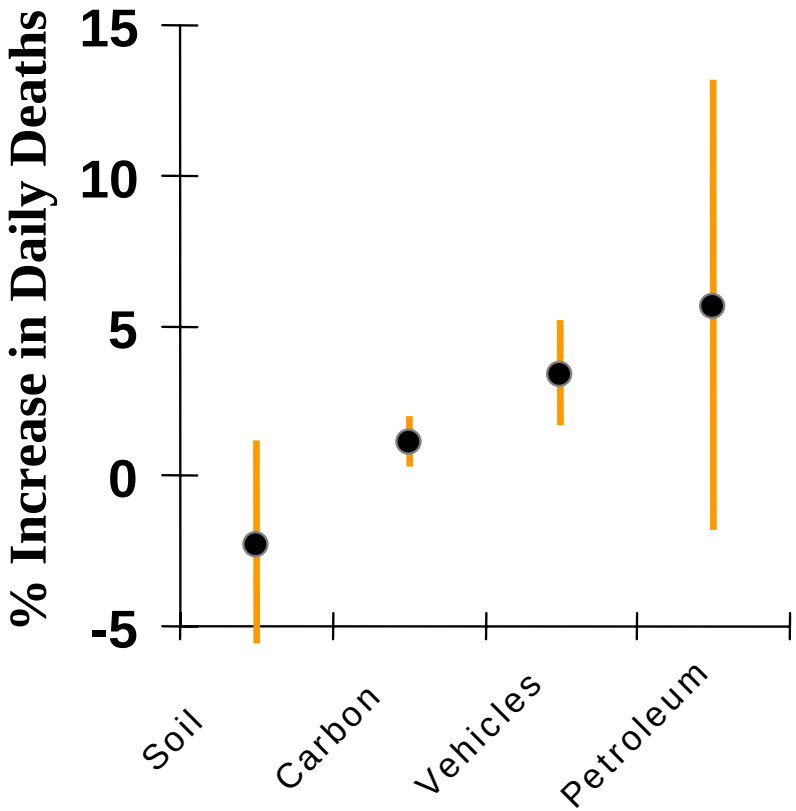
(Evans, 2002)

Air pollution and health effects (2)

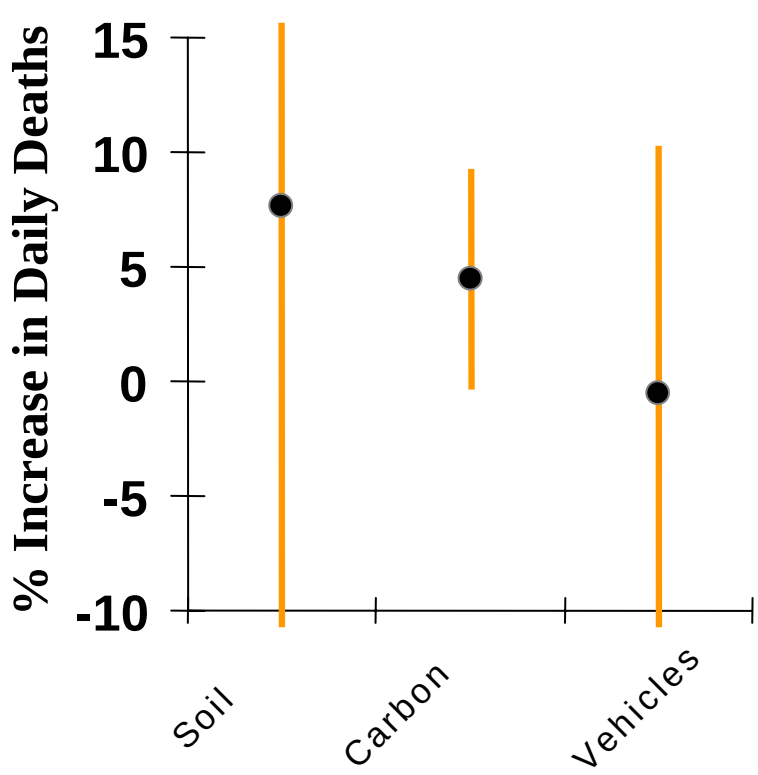


Air pollution and health effects (3)

Cardiovascular Dieseases



COPD and pneumonia

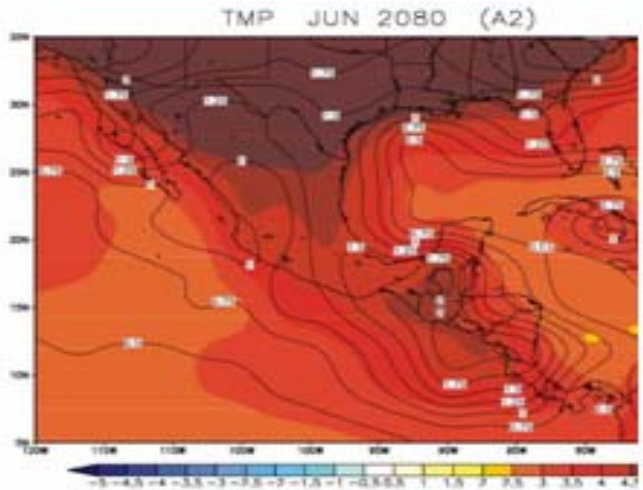


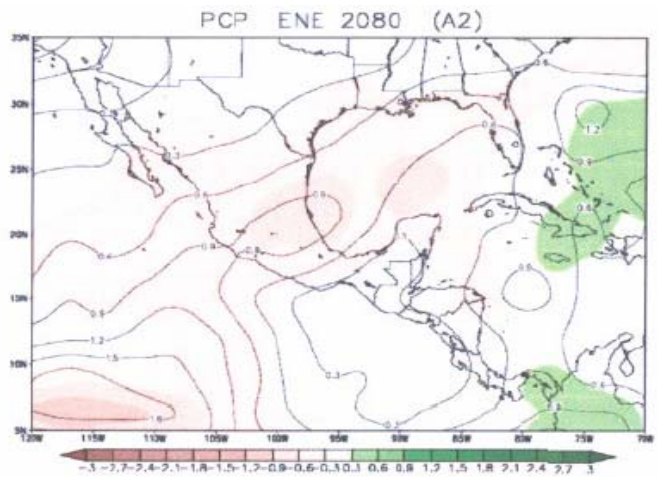
(Six Cities, Laden et al., 2000)

Situation in Mexico

Probable climate change scenarios

- Temperature will increase from 2 to 4°C in the 2050-2080 period, mainly in Northern Mexico.
- Rainfall will decrease nearly 15% in Central Mexico and at least 5% in the Gulf region, within the same period.
- Rainfall season will be delayed and extended into the autumn months in most of the country.



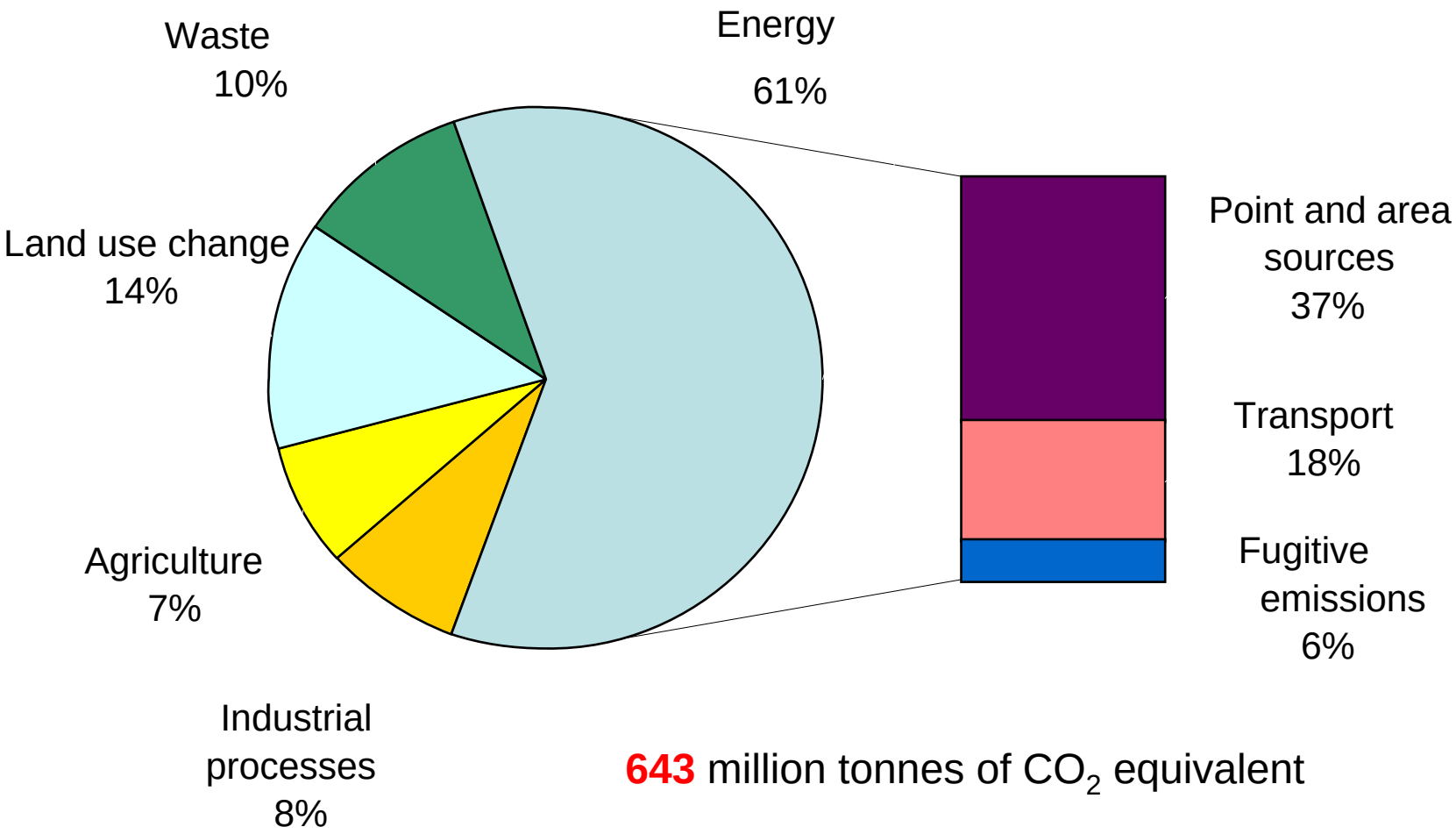


Situation in Mexico (2)

- Nearly 65 million people in Mexico live in urban areas
  - 27 million of urban inhabitants live in cities with poor air quality.
- Analyses of the potential impacts of emission control measures/strategies with local, regional or national impact have been rarely assessed.
- Analytical tools are needed at the national level to support the decision making process.

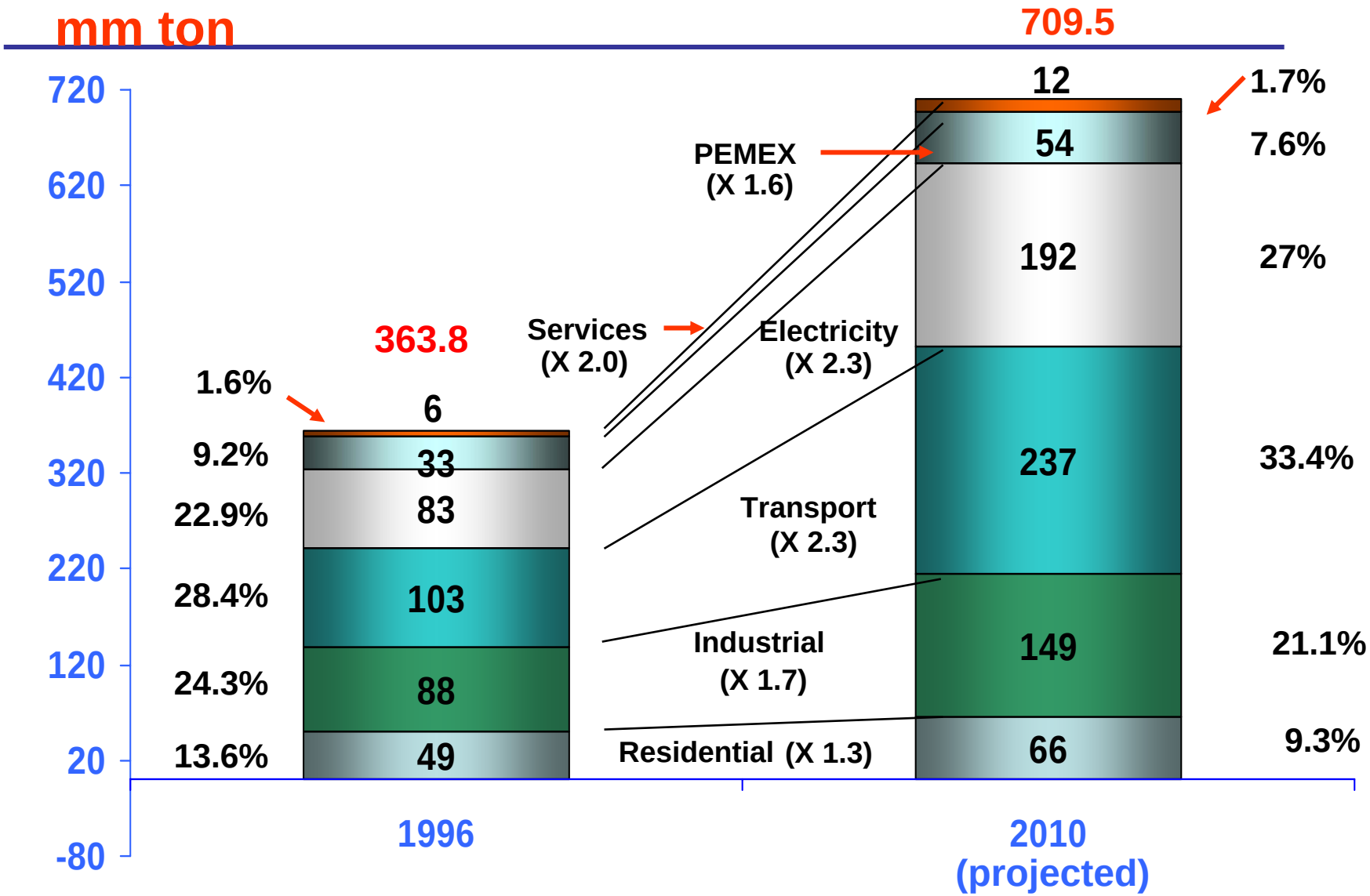
Urban area	**Population (million)**	**# of days above NAAQS**	
		O_3	**PM_{10}**
MCMA	17.9	284	32
Guadalajara	3.7	68	38
Monterrey	3.2	14	64
Toluca	1.2	9	79

National GHG emissions inventory (2002) CO_2 equivalent per sector

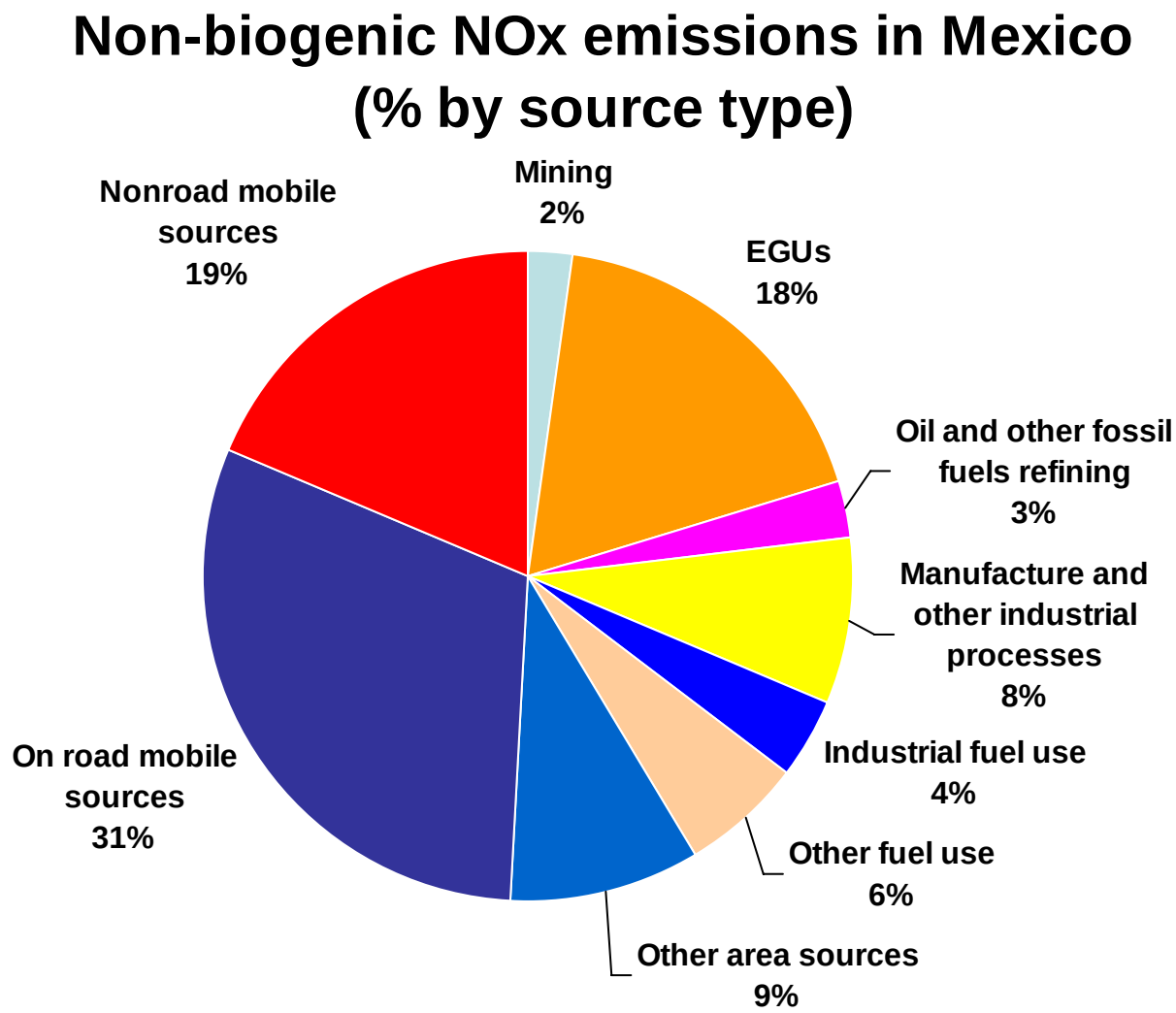


643 million tonnes of CO_2 equivalent

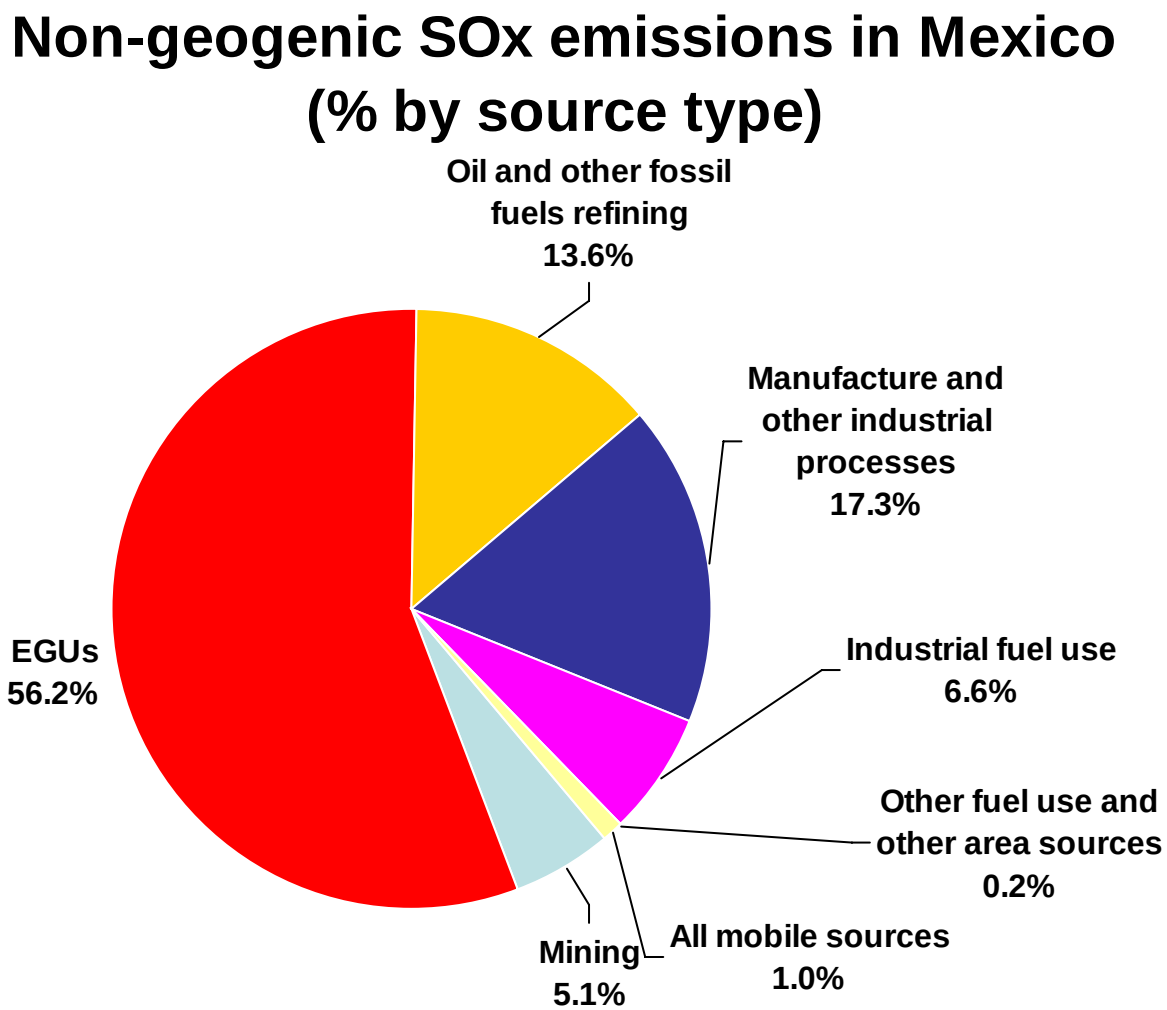
National GHG emissions inventory (2002)
CO_2 emissions by sector in Mexico



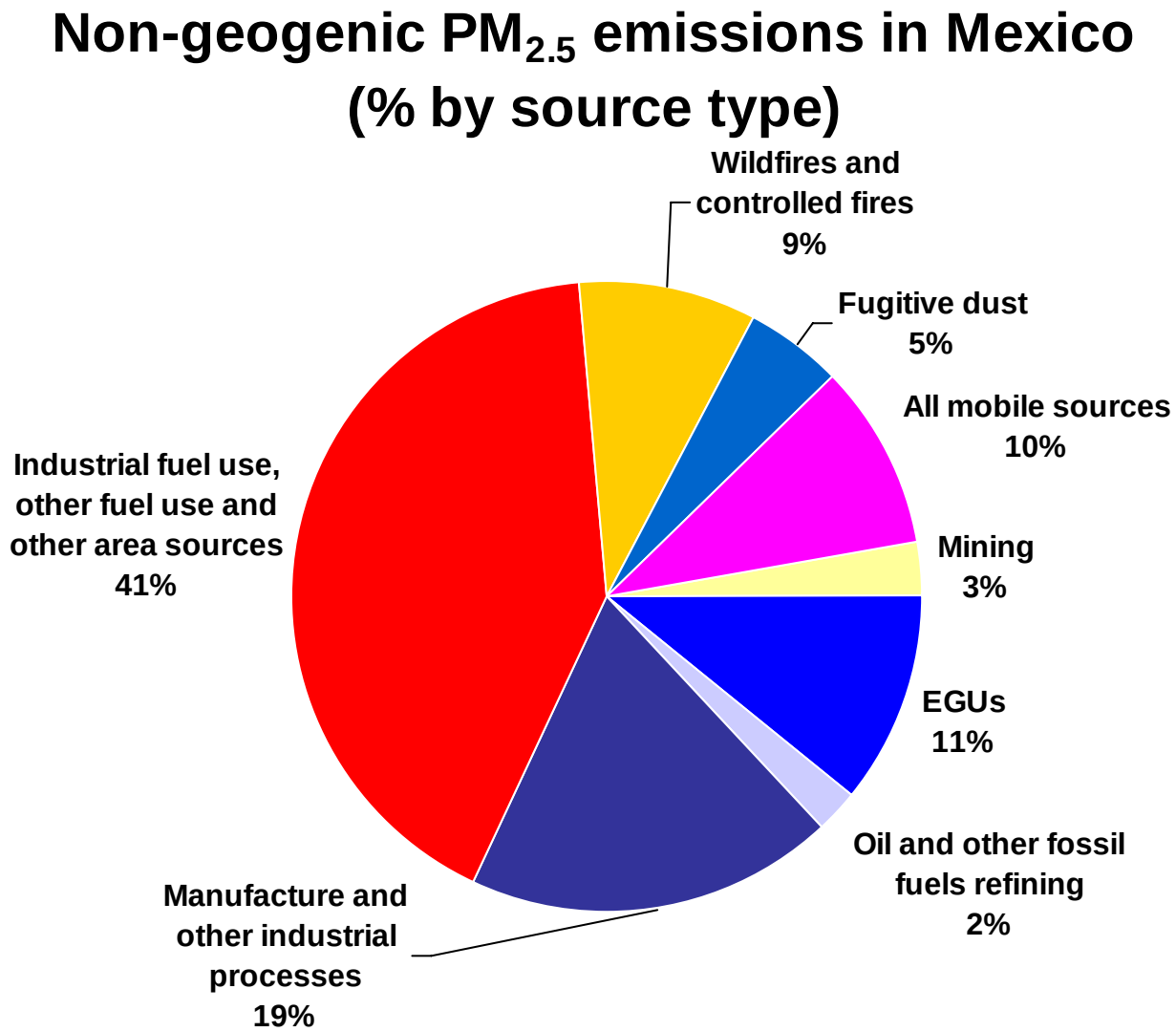
National Emissions Inventory
Criteria pollutants (1999)



National Emissions Inventory (1999)
Criteria pollutants (2)



National Emissions Inventory (1999)
Criteria Pollutants (3)



Local and regional considerations

- Transport sector is large contributor of emissions of GHG and criteria pollutants (NOx, HC, CO).
- Energy consumption for transportation has increased
  - 1,147,016 TJ in 1990 to 1,464,779 TJ in 2002
- CO_2 emissions from transportation have increased **28% in the 1990-2002** period.

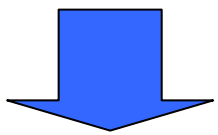
✓**Road transport**	**91%**
✓Air transport	5%
✓National marine transport	2%
✓Rail	2%

Local and regional considerations (2)

- Electricity generation is large contributor of emissions of GHG and criteria pollutants (SOx, NOx).
- Total GHG emissions in 2002 are 30% higher than those for 1990
- Total average GHG emissions growth rate: 2.2% per year

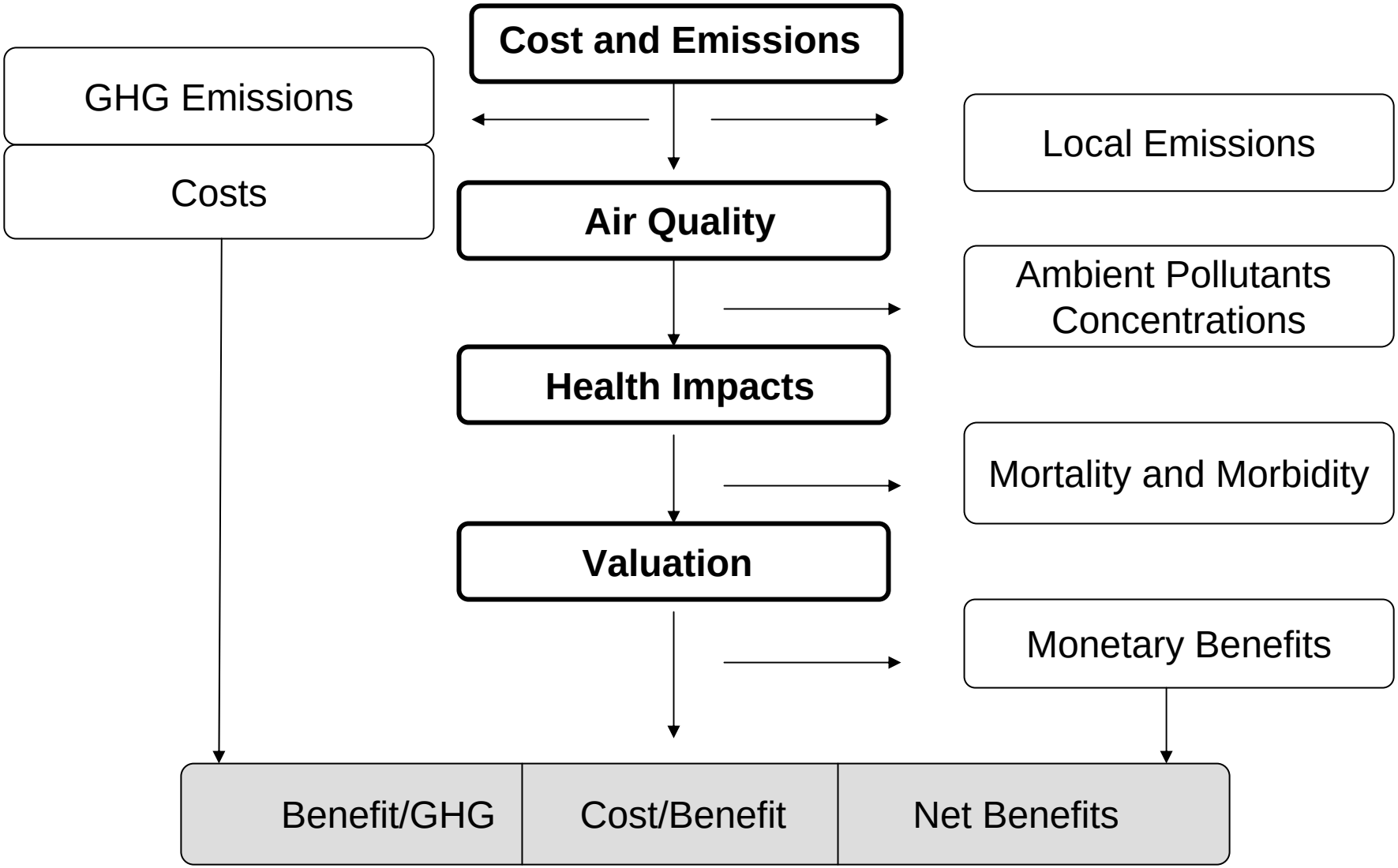
Main options for reducing GHG and conventional pollutant emissions

- Energy efficiency - all sectors
- Quality of fuels and fuel substitution - e.g. lower sulfur contents and use of natural gas, renewables, hydrogen vs. fuel oil
- Cleaner technologies use - transport and EGU's
- Generation efficiency in EGU's
- Carbon sequestration
- Nuclear energy



Co-benefits Analysis

Framework for Co-benefits Analysis



Co-benefits analysis in MCMA (2003)

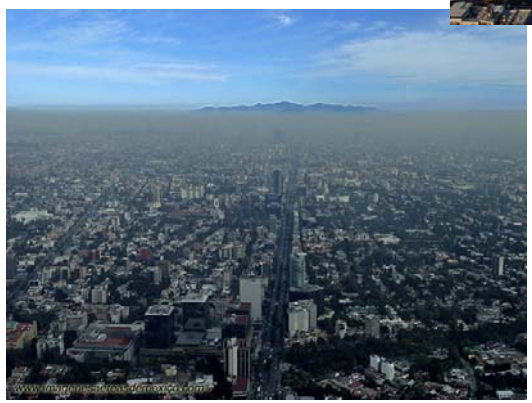
Motivation

- Population: 20 million
- Vehicular fleet: 3.5 million
- Industry: 35,000 plants
- Fuel use: >40 million liters/day

- Ozone NAAQS exceeded in 80% of days (2002).

- Mexico City ranked 13th largest GHG production nation (1998).

- Mexico City emits approximately 13% of the national total.



Co-benefits analysis in MCMA (2003)

Objectives

- Estimate cost savings from health improvements related to air pollution reductions occurring simultaneously with GHG emission reduction
- Compare cost and benefits associated with the specific policy/control measures
- Build capacity in Mexico for integrated, quantitative environmental and economic assessment
- Develop a policy-relevant analysis tool with explicit treatment of uncertainty

Co-benefits analysis in MCMA (2003)

Scope

Evaluation of five control measures 2003-2020:

Transportation

1. Taxi fleet renovation
2. Metro expansion
3. Hybrid buses introduction

Industry

4. Co-generation

Residential

5. Home stoves LPG leaks

Control measures description

Taxi fleet renovation

- Replace 80,000 vehicles by 2010
- Increase efficiency: 6.7 to 9 km/l
- Comply with Tier I standards

Metro expansion

- Construction of 76 km
  - Expansion of Lines 4,5,7,8,9
  - New lines: 12 y 13
- Assumed that microbus users would switch to Metro

Hybrid buses introduction

- Replacement of over 1000 diesel buses for hybrids
- Emission factors imported from NYC study

Co-benefits analysis in Mexico City (2003)
Methodology

- Analysis of Measures
  - Change in emissions and costs for 5 control measures
  - Annualized results for 2003-2020, 5% discount
- Air Quality
  - Reduced-form models derived from field measurements (PM) and photochemical models (Ozone)
- Health Impacts
  - Concentration-response estimates for 19 health indicators
- Economic Valuation
  - Willingness to pay, cost of illness and productivity loss

Co-benefits analysis in Mexico City (2003)
Results

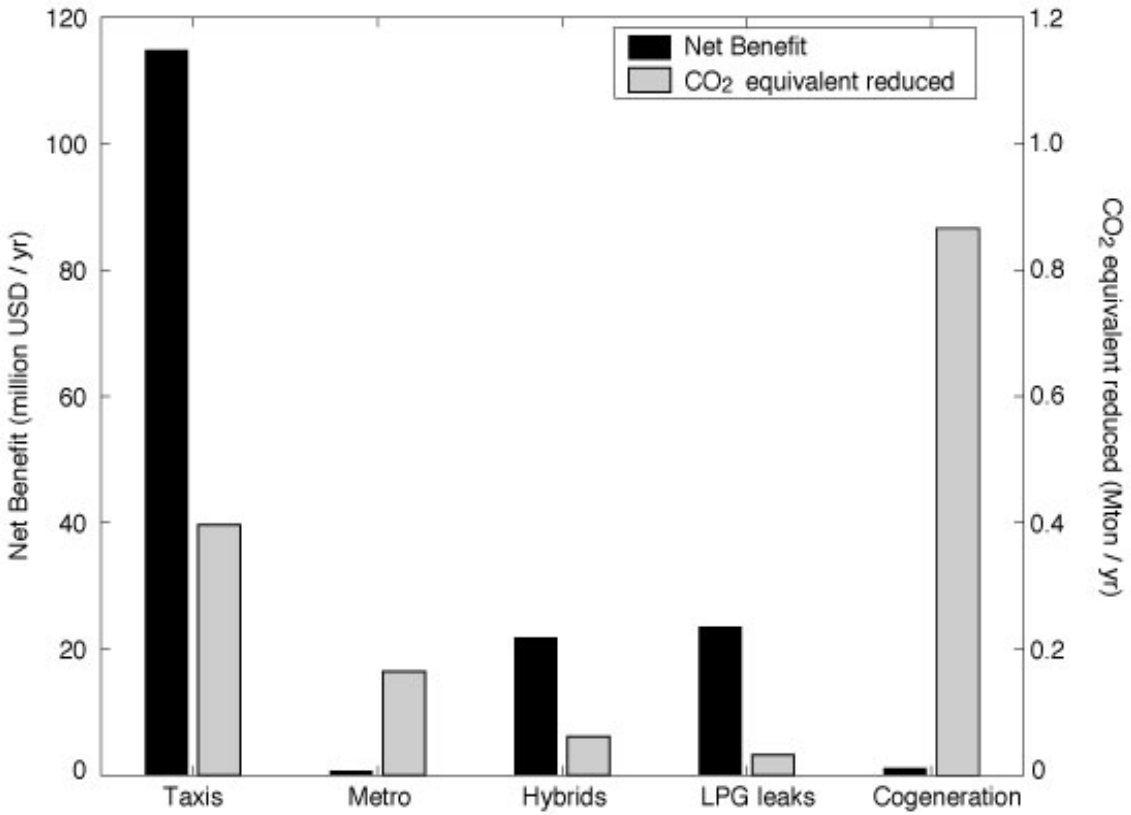
	Emissions reduction (Ton / yr)						Investment cost and Fuel savings (Million USD / yr)	
	PM_{10}	SO_2	CO	NO_x	HC	CO2 equiv.	Capital Investment	Fuel Savings
Taxi Renovation	0	59	145,000	3,100	12,800	397,000	38.6	57.3
Metro Expansion	9	65	28,800	1,270	2,650	164,000	44.1	0.02
Hybrid Buses	82	16	635	-134	307	60,700	30	10.2

Co-benefits analysis in Mexico City (2003)
Results (2)

- The combination of these 5 measures will substantially reduce emissions of local air pollutants, as well as GHGs.
  - 1% reduction of annual exposures to PM_{10}
  - 3% reduction of annual exposures to O_3
  - 2% reduction of GHG emissions (400,000 ton C equivalent) per year
- Monetized benefits: $210 million USD per year
- Total annualized cost: less than 30% of the estimated benefits ($50 million USD)

Co-benefits analysis in Mexico City (2003)
Results (3)

Evaluation of five control measures 2003-2020



Local + Global Benefits / Costs

Taxis: 3.4

Metro: 0.8

Hybrids: 1.3

Public Health Benefits:
$210 million USD/year

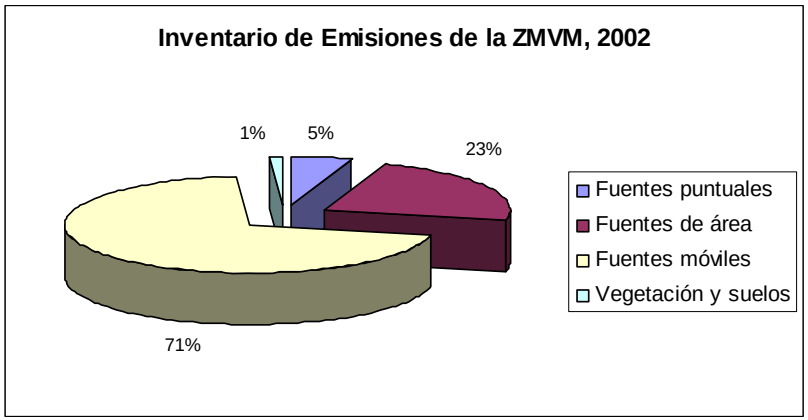
Cost of implementation:
$50 Million USD/year

Net benefits:
$160 Million USD/year

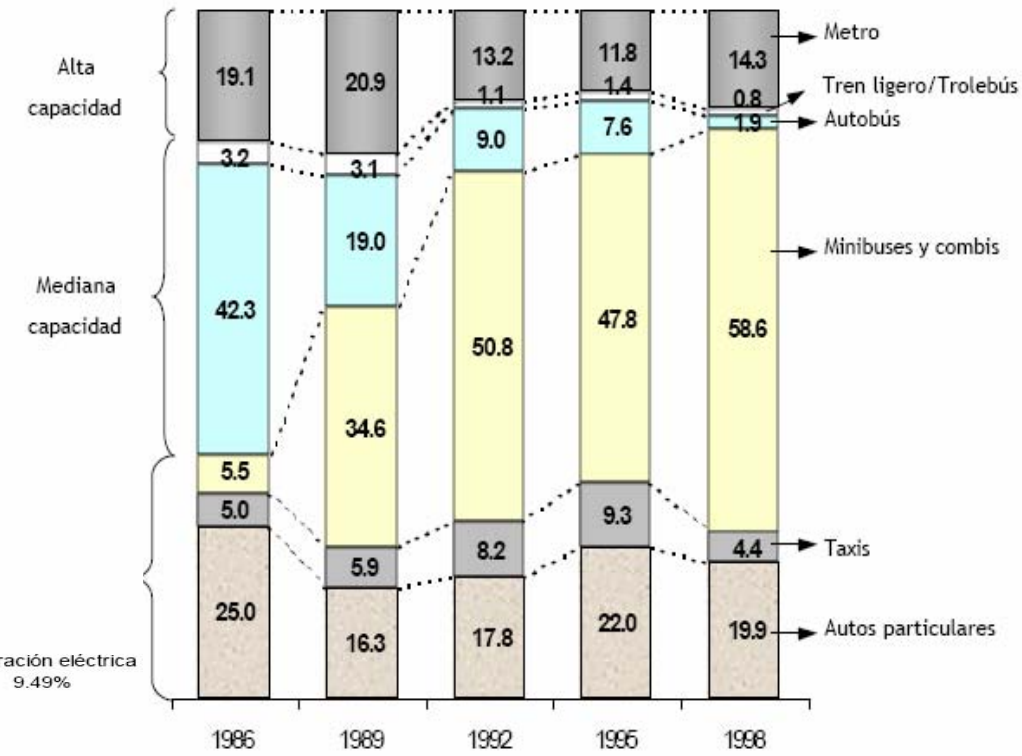
Co-benefits analysis of Mexico City's Bus Rapid Transit (BRT) System

Motivation:

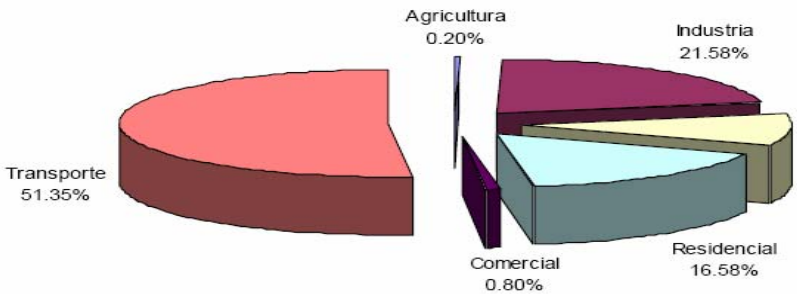
Emissions from mobile sources in MCMA, 2002



Modal distribution of transport in the MCMA



CO2 emission by sector in the MCMA, 2005



Source: SMA-GDF, 2005

Co-benefits analysis of Mexico City's Bus Rapid Transit (BRT) System (2)

Problems with the current public transport system

- Continuous stops – road chaos
- Passengers pay the driver onboard – prolonged stops
- Competition between microbuses
- Low average speed (i.e. 12km/h –Ave. Insurgentes)
- Low efficiency buses
- Poor maintenance of buses
- High pollutants' emissions

BRT System (Metrobús) in Mexico

- A BRT system operates since July, 2005 in a confined lane running 19.4 km with 34 boarding stations
- Passengers pay at boarding stations prior to taking the bus
- Predetermined/fixed stops
- Higher average speed than with traditional buses lanes
- High capacity buses transporting 250,000 passengers per day
- Higher fuel efficiency buses: 80 articulated buses (160 passengers) with environmental certification equivalent to Euro-III standard.

Co-benefits analysis of Mexico City's BRT System

Results

Emission reductions / year

- 144 tons of THC
- 690 tons of NOx
- 2.8 tons of fine Particulate Matter
- 1.3 tons of SO_2

Net Present Benefits
$12.3 Million USD

Avoided health impacts / year:

- 6,100 work loss days
- 660 restricted activity days
- 12 new cases of chronic bronchitis
- 3 premature deaths
- ❖ Health benefits ⇨ $3 million USD / per year

Travel time benefits / year

- Savings of over 2 million hours during peak hour ($1.3 million USD)

Cost of the Metrobús (infrastructure, vehicles, etc.): over 44 million USD

Metrobus corridor: expected to reduce 280,000 tons of CO2 equivalent emissions

Co-benefits analysis of emission control measures at a national level (2006-2008)

Objectives:

- Develop adequate tools to evaluate the potential impacts of emission control measures on Mexican air quality and GHG emissions

- Evaluate the potential co-benefits of different emission control measures at a national level

Work in progress...

Co-benefits analysis of emission control measures at a national level (2006-2008) (2)

- Development of Air Quality Tools (2006-2007)
  - Develop a modeling tool to evaluate the potential impacts of emission control measures on air quality, including primary and secondary pollutants
- Identification of potential Emission Control Measures (2007)
  - Working Group of Policy Makers to select and characterize measures of interest
- Estimate the benefits of emission control measures of both criteria pollutants and GHGs (2008)

Work in progress...

“Es un asunto de valores y también de hechos,
de política y también de ciencia,
el decidir qué tan seguro es seguro
-el decidir cuáles serán los efectos que reduciremos o evitaremos
utilizando los poderes regulatorios y fiscales del estado.”

“It is a matter of values as well as facts,
of policy as well as science,
to decide how safe is safe
-to decide what effects we will use the regulatory or fiscal powers
of the state to minimize or avoid.”

(Landy, Roberts and Thomas, 1990)

Thank you

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