

Urbanization and Carbon Cycle

IAI Institute on Urbanization
and Global Environmental
Change in Latin America

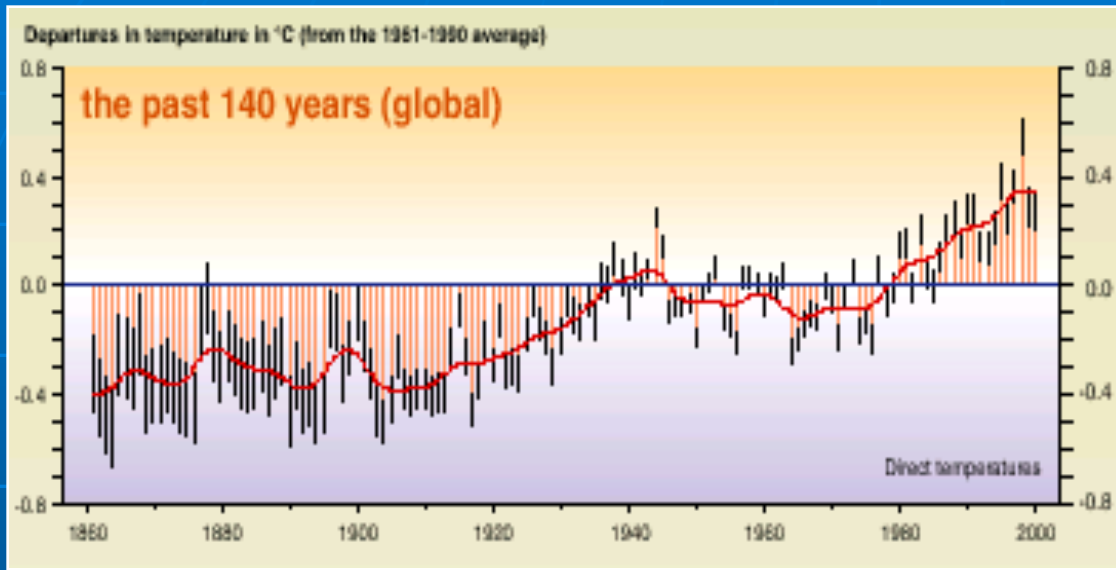
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October 2004

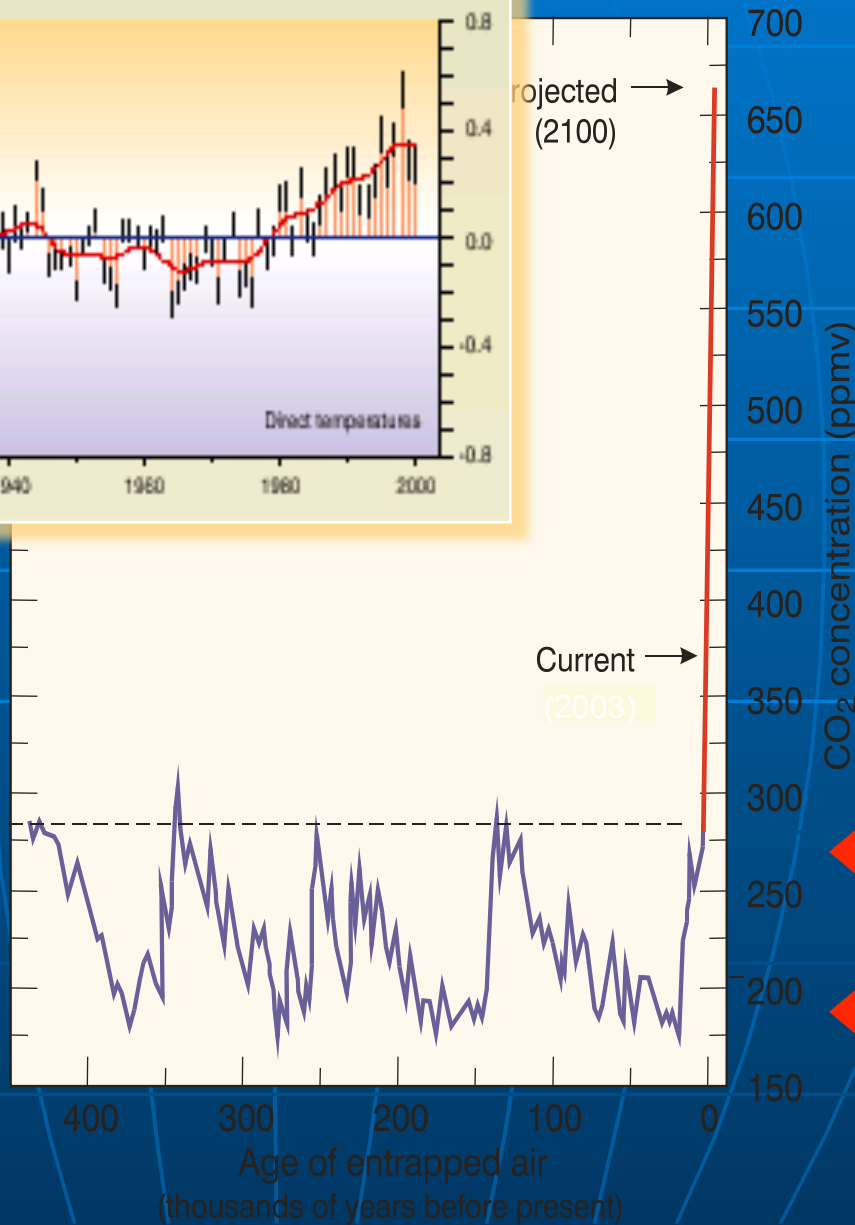
Goals

- General view on carbon and warming
- International context
- Cities and carbon
- Key questions
- Some findings

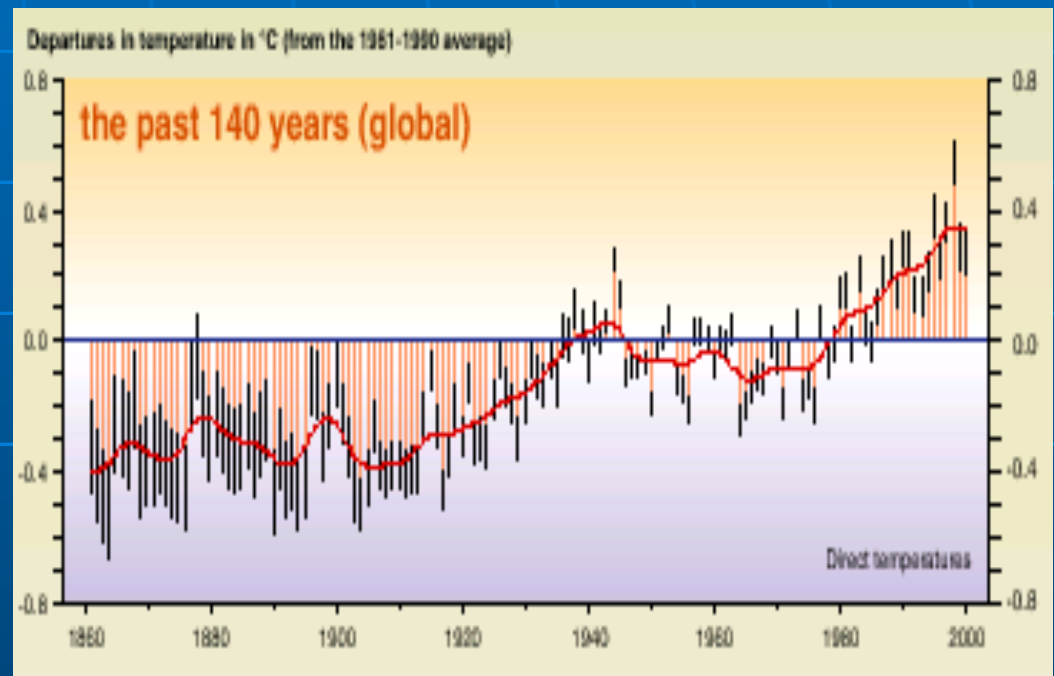
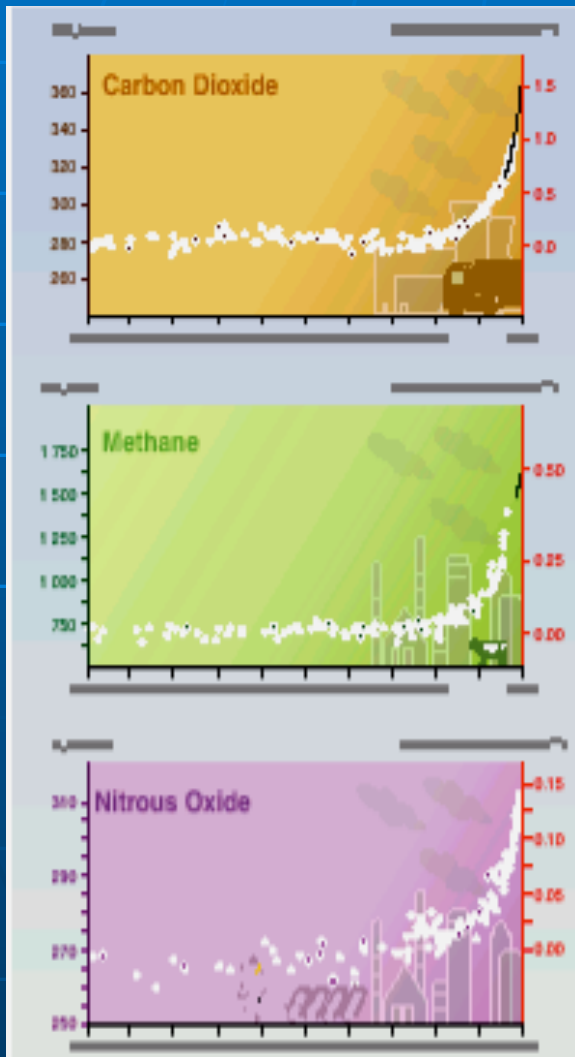
Atmospheric CO₂ and associated warming



- Last 420,000 years: Vostok ice core (blue)
- Last 100 years: Contemporary record (red)
- Next 100 years: IPCC BAU scenario (red)

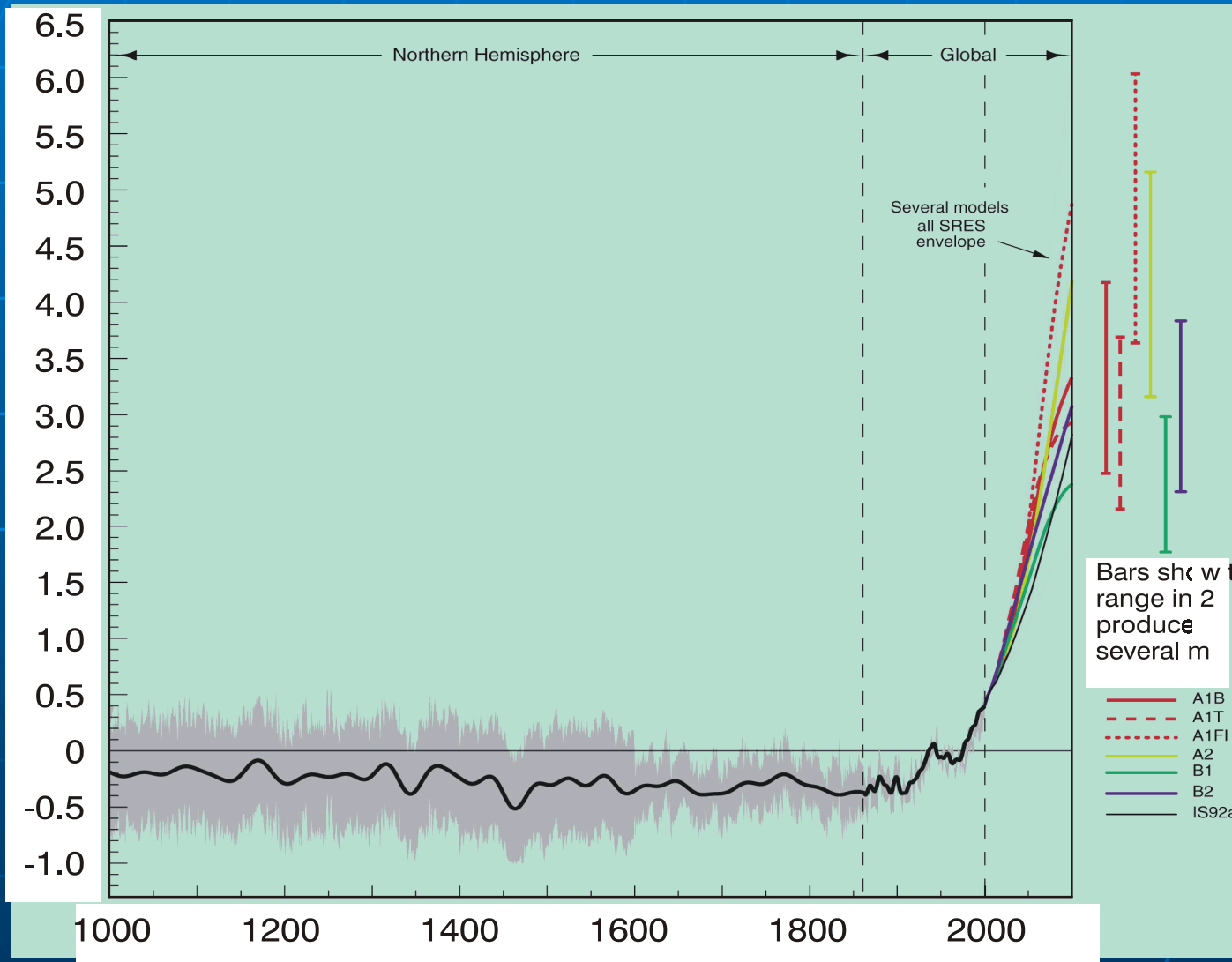


Humans are changing atmospheric composition and climate



Variations of the Earth's Surface Temperature: 1000 to 2100

Departures in temperature (°C) from the 1961-1990 average

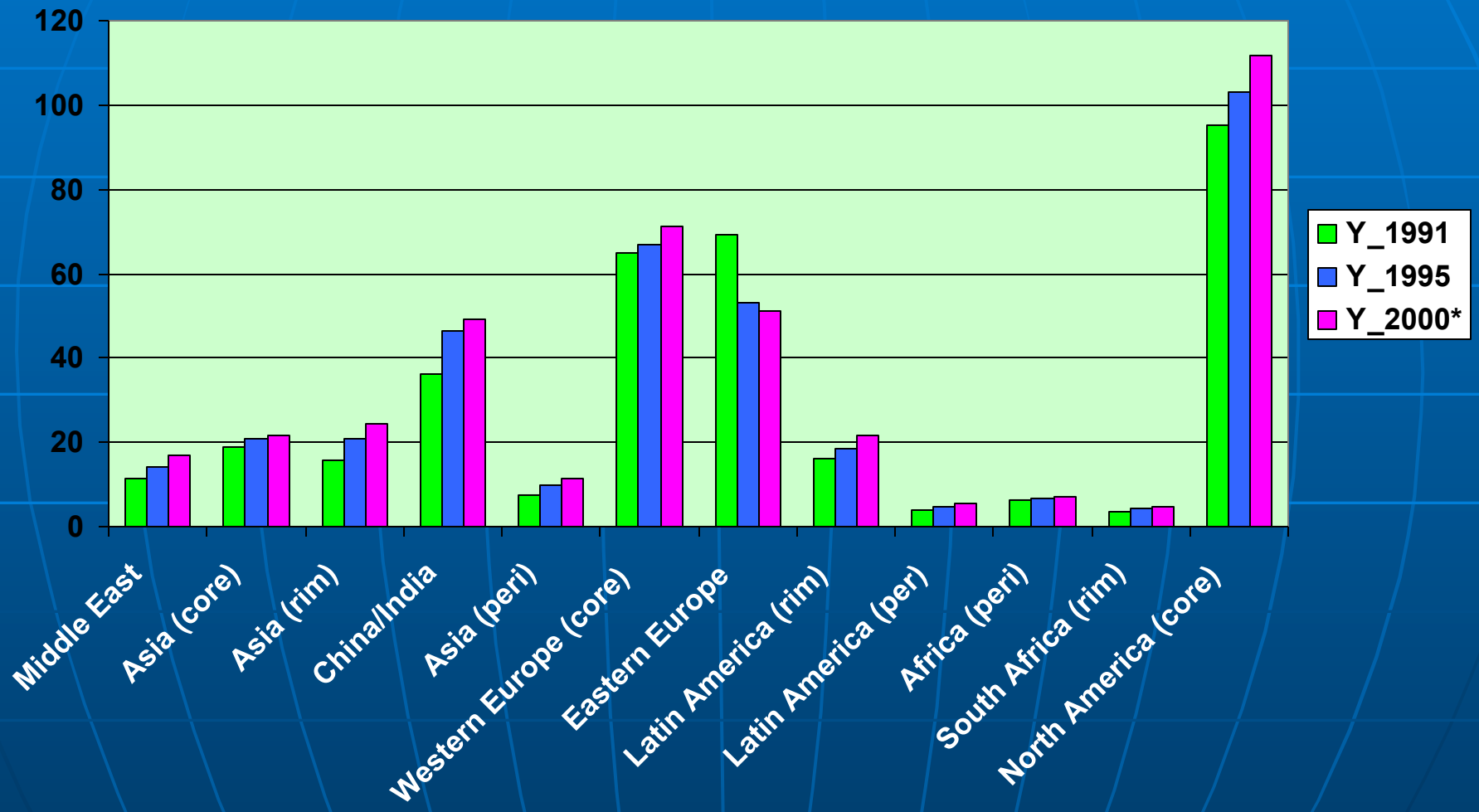


International context

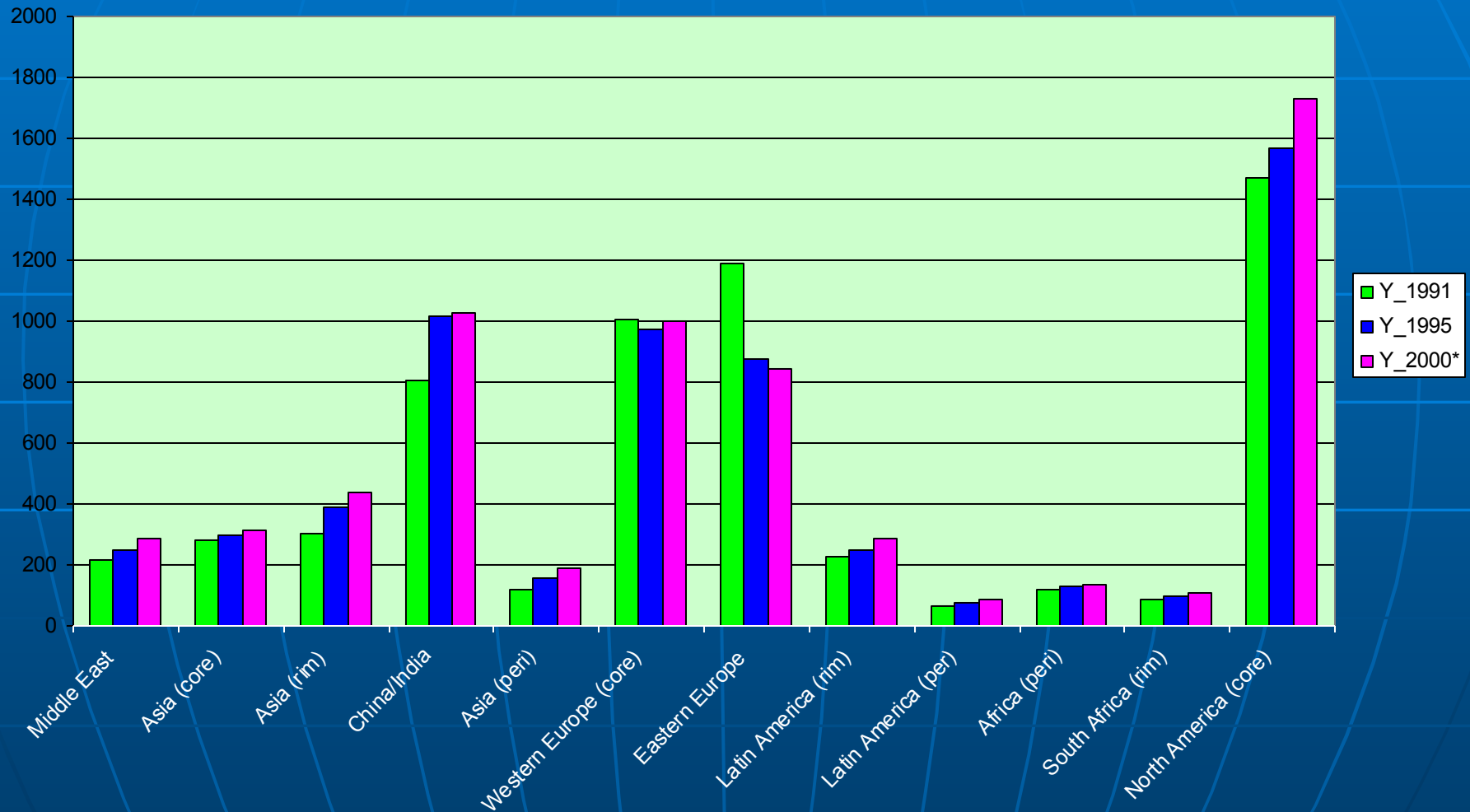
“Humans” are responsible,
but.....

common and differentiated
responsibility

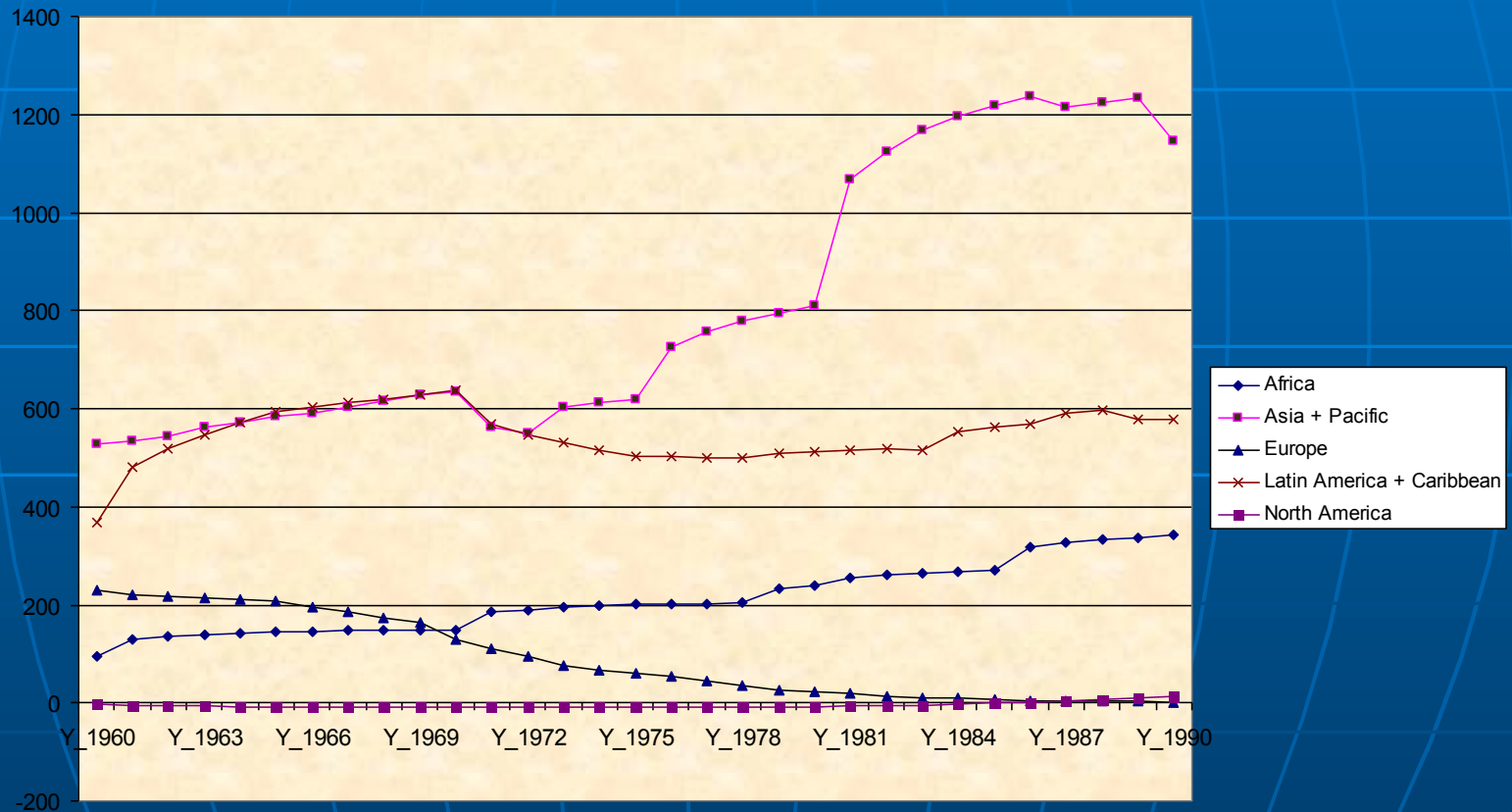
Figure 2. Primary Energy Consumption by Regions
(Quadrillion (10^{15}) Btu)



**Figure 3. Carbon Dioxide Emissions per Regions
(Million Metric Tons Carbon Equivalent)**



Carbon to the Atmosphere from Land-Use Change, Annual Net Flux (Million Tons of Carbon)



**Figure 6. Number of Passenger Cars per Thousand of People
(1995)**

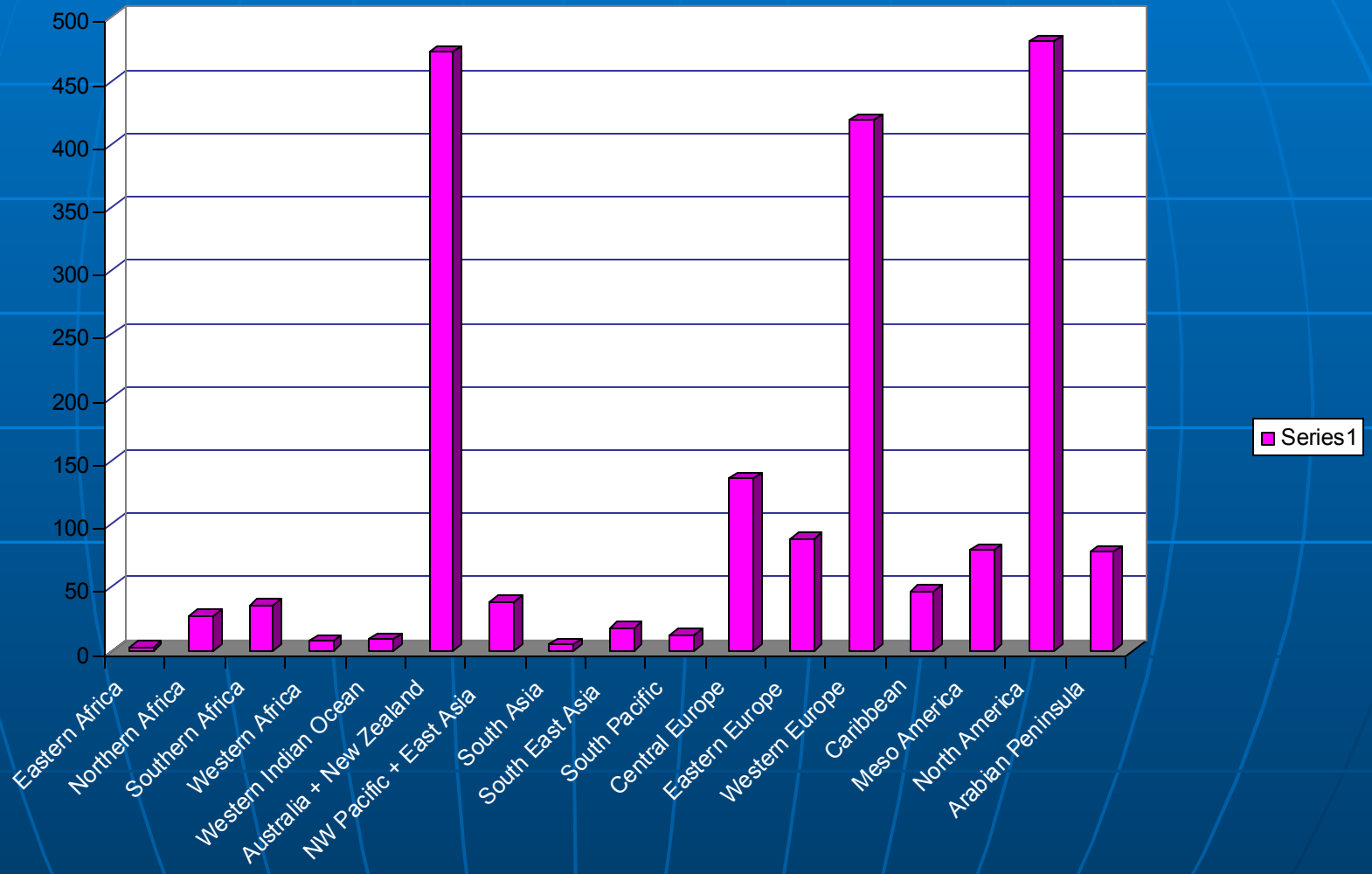
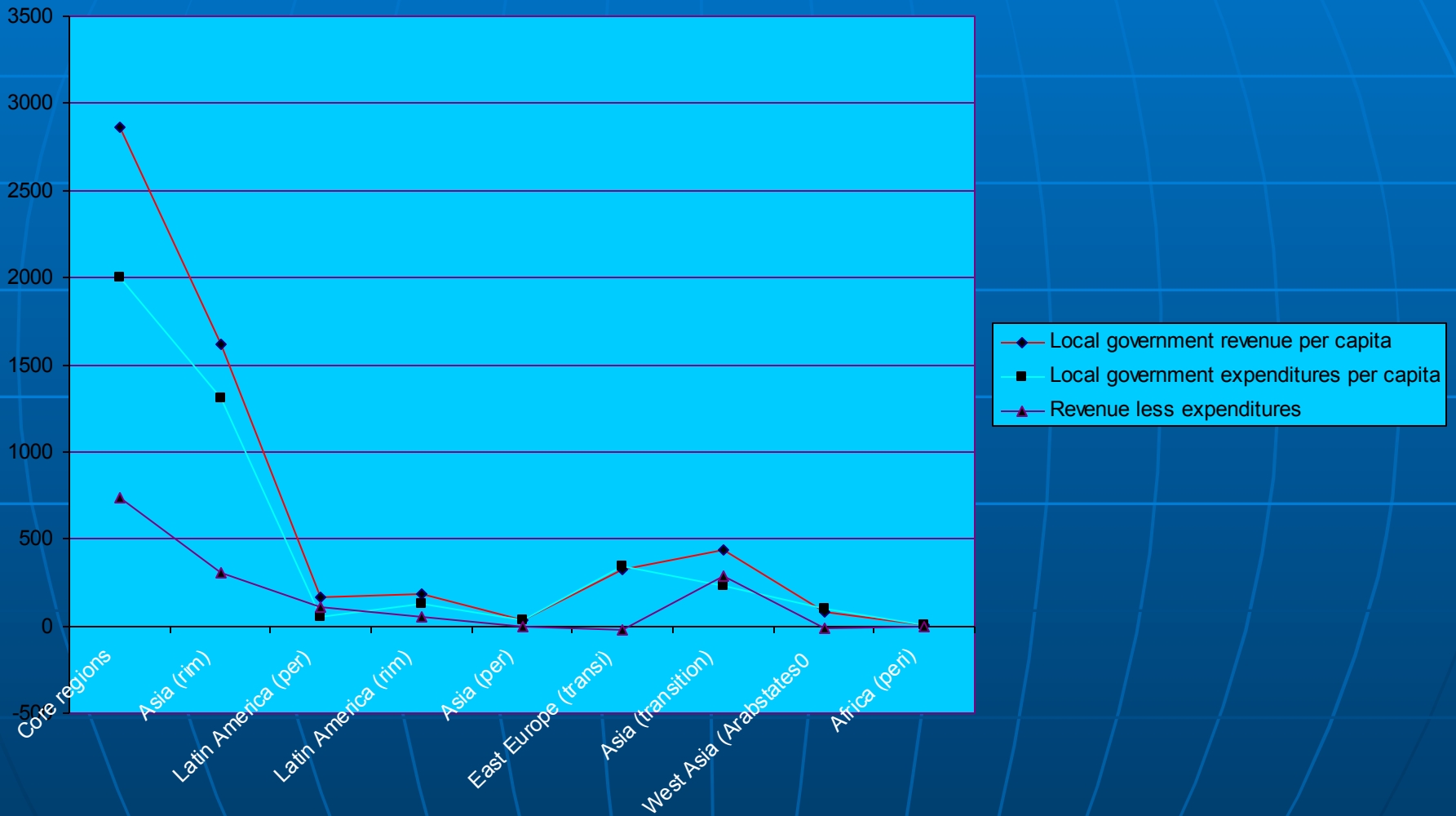


Figure 5. Local Government Revenue and Expenditures
(1998, US dollars)



Why cities, carbon and climate change?

- Increasingly urban nature of consumption, production, population
- Cities drive changes in carbon cycle:
 - Consumption of fossil fuels (direct)
 - Cement and land use changes (indirect)
- Cities key promoters of changes to abate carbon emissions and adapt to CC
- Here hence another argument of call for action on urban sustainability

The argument

- Contrary to current research focusing on top down approaches, we argue that
- Human induced changes in the carbon cycle arise from interactions between different domains of carbon and society, each composed of many systems operating at different scales in space and through time resulting in mismatches in scale between causes and consequences

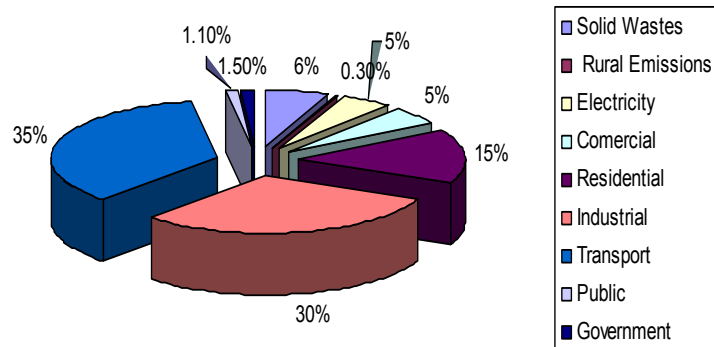
That is why we decided to

- Gather existing estimations of GHG emissions
- Examine emissions patterns to understand their drivers (IPAT identity as a heuristic, and adding institutional settings)
- Assume that most drivers (population growth, technological dynamics) regulated by other social processes, interweaved within an essential structure

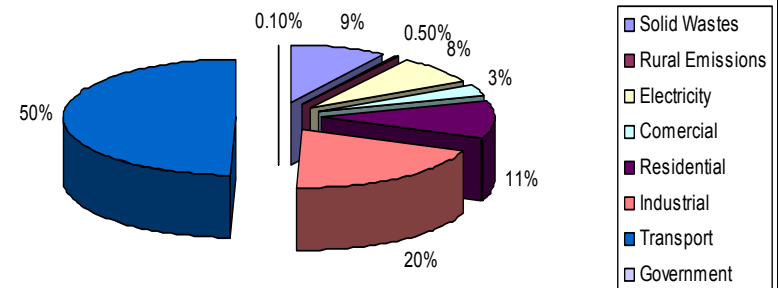
Equivalent CO2 Emissions by Sectors

(Source GDF 2004)

By total energy consumption



By fuel consumption without electricity

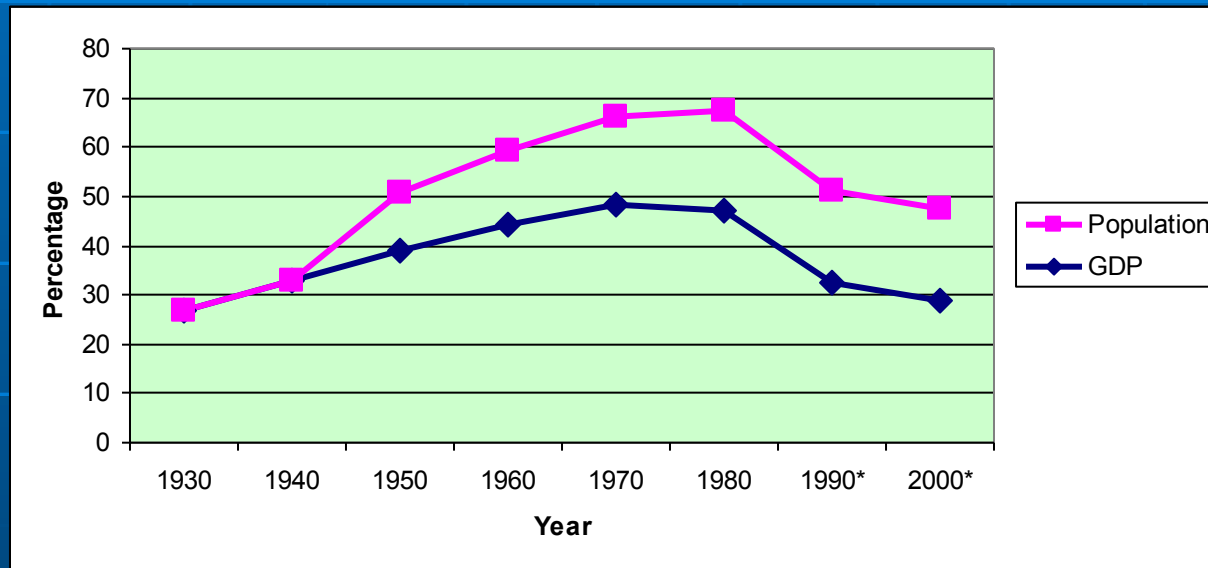


- Transportation
- Industrial
- Residential
- Solid wastes
- Electricity

Four domains operating at different spatial and temporal scales drive carbon emissions

- From a city-based to a polycentric pattern of urban development
- Components of the current era of *globalization*
- (Neoliberal) State reform
- Features of local “regimes”

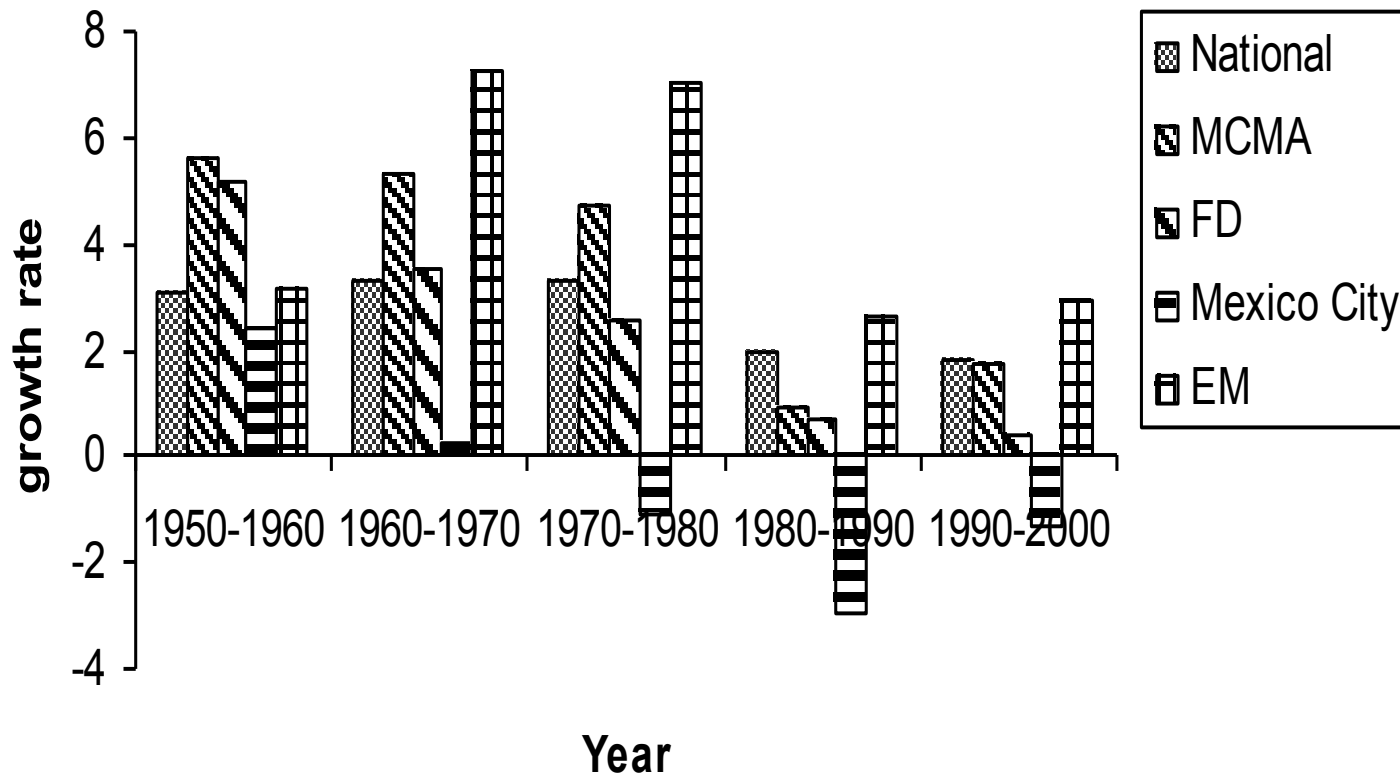
Percentage of National Industrial GDP and Population in Mexico City



Percentage of National GDP Generated by Economic Sectors

State of Mexico/Federal District	1993	1995	1999	1993	1995	1999
Social and personal services	17.29	17.75	14.9	32.28	33.67	30.4
Business, restaurants and Hotels	20.62	19.12	20.23	22.38	20.51	21.38
Financial and insurance services	13.81	15.4	14.5	17.6	19.77	19
Manufacture	31.61	31.29	33.62	17.24	16.86	19.61
Metallic products and machinery	9.25	8.94	11	3.89	3.71	6.3
Chemicals, plastic and rubber	7.01	7.64	7.49	3.94	4.01	3.7

**Figure 4: Rate of Annual Population Growth
(1950-2000)**



Pathways of urban development

City-based:

- Contiguous, “uncontrolled” growth outwards
- Industrial metallic, chemicals, textile in core & to North
- Relatively best endowed with public infrastructure
- High rates of demographic growth

Polycentric:

- Network of centers and sub-centers functionally linked to main city
- Globalized corridors coexist with traditional and informal ones
- Decreased investment in public infrastructure
- Depopulation of core, emigration

Current era of *Globalization*

- Relocalization of enterprises and reorganization of production processes contributed to
- Fragmentation of regional economy:
 - **Corridors** (corporate developments, industrial parks and residential areas);
 - **Hot-spots** in periphery (cheap labor, consolidated services, dormitory towns)
- Motorization (globally present)

State Reform

- Retrenchment of State as investor, developer and “regulator” related to
 - Public investments in infrastructure outpaced by cities demands
 - “Deregulation” of key carbon emitters (transportation, industry, informal activities)
 - Contradictory ethos: more governmental co-ordination-less intervention

Features of *Mexican legal regime*

- Law enforcement and dispute resolution based on administrative mechanisms and negotiations between participants
- Greater power vested in executive governmental bodies (unilateral actions and even acts of corruption)
- Injunction or temporal protection against order of any authority
- Lack of effective mechanisms to induce actors to obey, and warranty the fulfillment of regulations

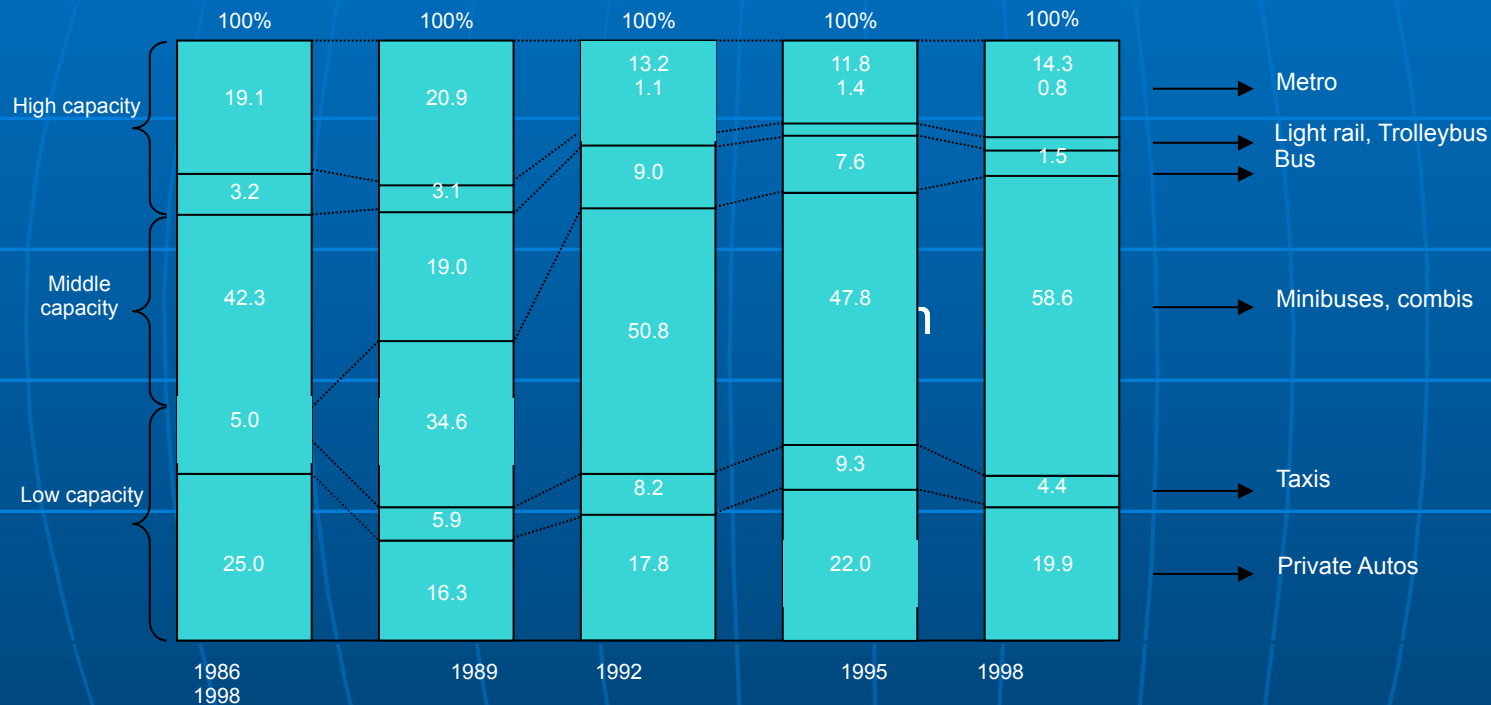
Carbon implications

- “Relatively” more efficient enterprises coexist with less efficient ones
- Longer commuting distances related to more emissions
- Such processes key drivers of both patterns of transference, application of technologies, pathways of use of energy and land

Carbon implications

- Motorization (81% private vehicles 18% of the 29.5 vehicle trip segments)
- Privatization of state firms together with decreased public expenditures, one driver of shift in mode share
- Middle and low capacity more convenient, but higher proportion of emissions per passenger kilometer compared to other public transportation modes
- No big private enterprise as public transportation provider

Tendencies in transportation mode share



Source: SETRAVI 2000

Carbon implications

- Urban planning programs launched, when irregular settlements already in buffer and ecological zones, what
 - makes them violate a number of laws and regulations,
 - puts them in an illegal status,
 - opens the doors to social control and negotiations between participants,
 - gives greater relative power to implementing bureaucracies, and
 - allows for unilateral actions to take place