Urbanization and the carbon cycle: Contributions from social science

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Definition of urbanization

- Modern urbanization is predicated on complex, increasingly coupled systems (built environment/ socio-institutional/natural) with impacts, drivers and dynamics across multiple temporal and geographic scales

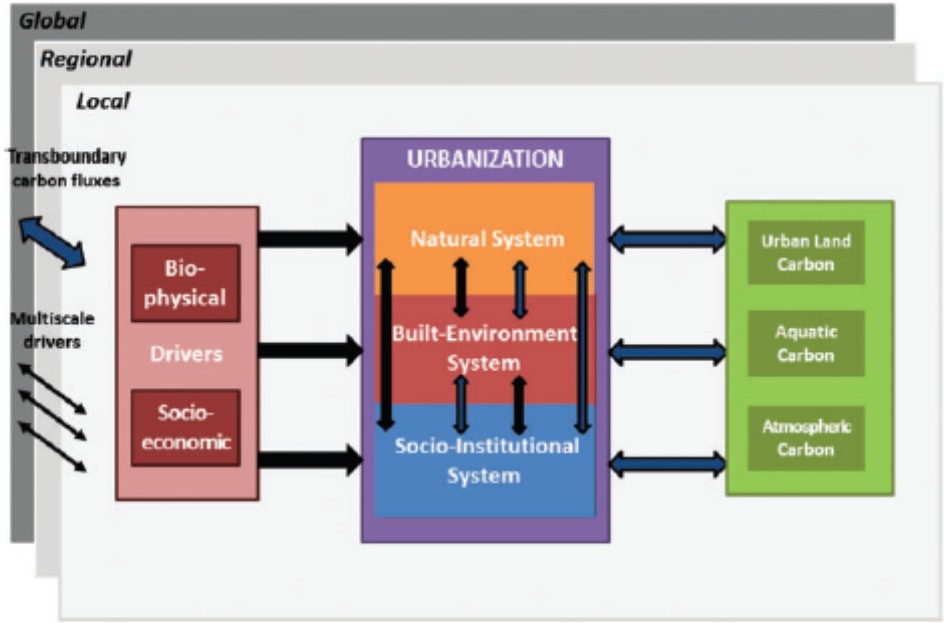
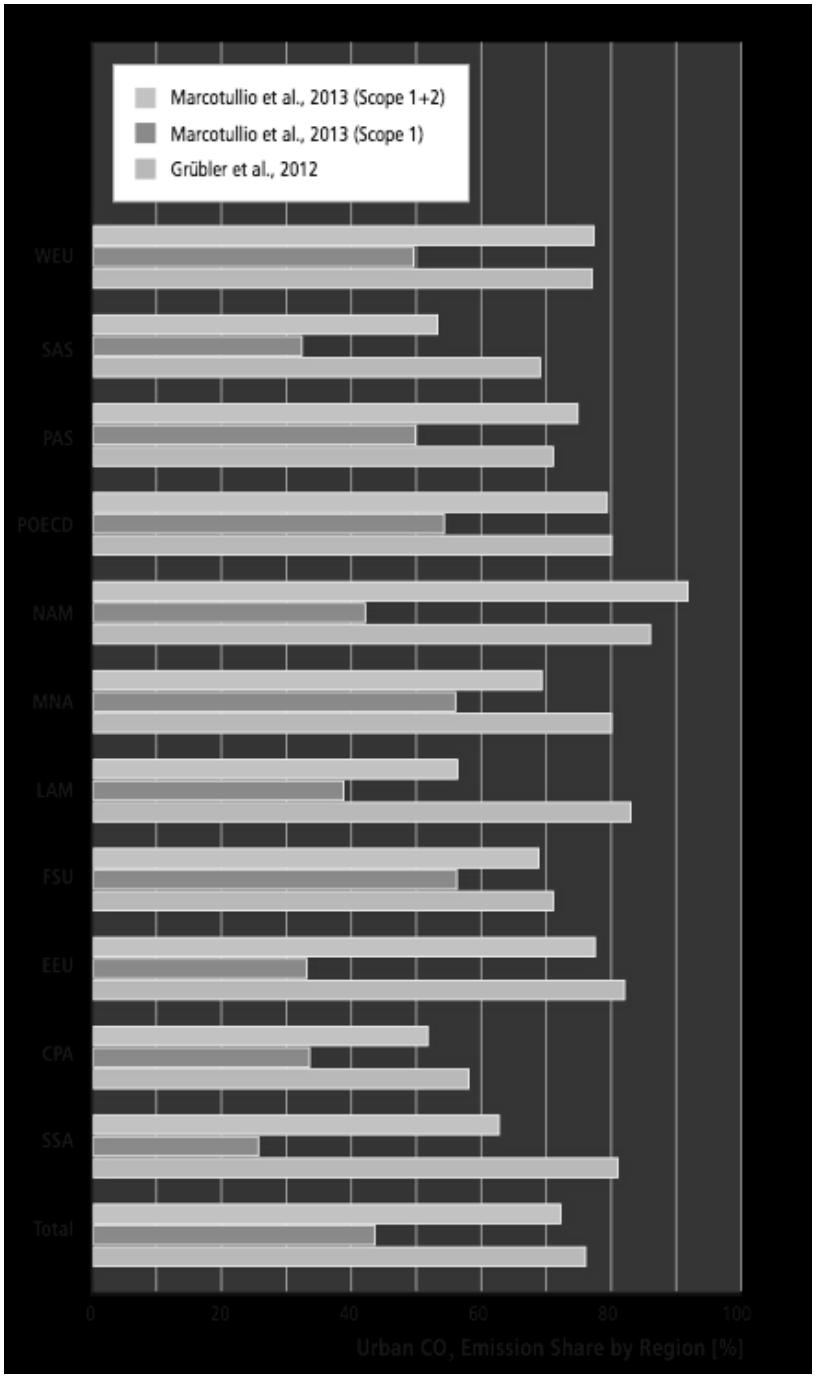


Figure 1. Conceptual framework depicting the key dynamic relationships for an improved understanding of urbanization, urban areas, and the carbon cycle. Note: Blue arrows depict links between systems and components.

Source: Romero-Lankao, et al 2014

Key message

- Until urban energy infrastructures/technologies evolve away from carbon-based fuels, urban socio-institutional system complexity is de-coupled from inequality urban wealth generation is decoupled from consumption/waste (overcoming the rebound effect) and urban natural environments are managed to be, at least, carbon neutral, GHG emissions are tied to the urbanization process.


Marcotullio et al., 2013 (Scope 1+2)
Marcotullio et al., 2013 (Scope 1)
Grübler et al., 2012
WEU
SAS
PAS
POECD
NAM
MNA
LAM
FSU
EEU
CPA
SSA
Total
0
20
40
60
80
100
Urban CO_2 Emission Share by Region [%]

Urbanization processes are not uniform

- These systems co-evolve together over time. Urbanization processes are different in different parts of the world (creating typologies of urban growth and urbanization).

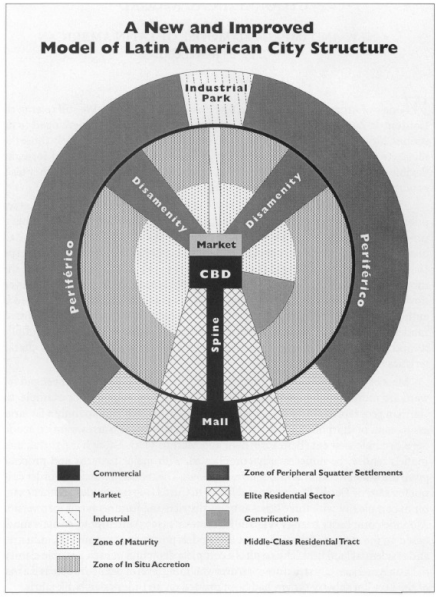
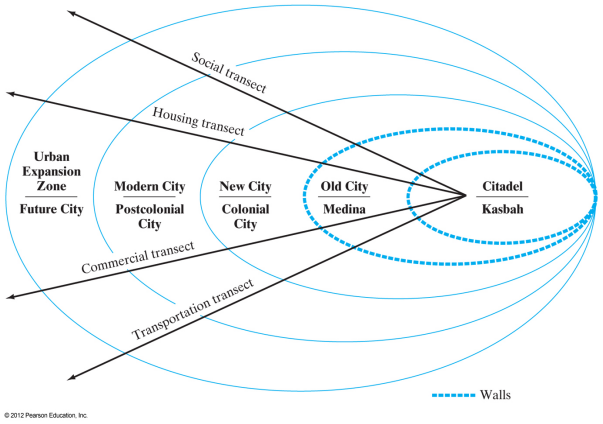


FIG. 1—A new and improved model of Latin American city structure. (Model graphic rendered by Irene Naesse)

Latin American



Middle Eastern

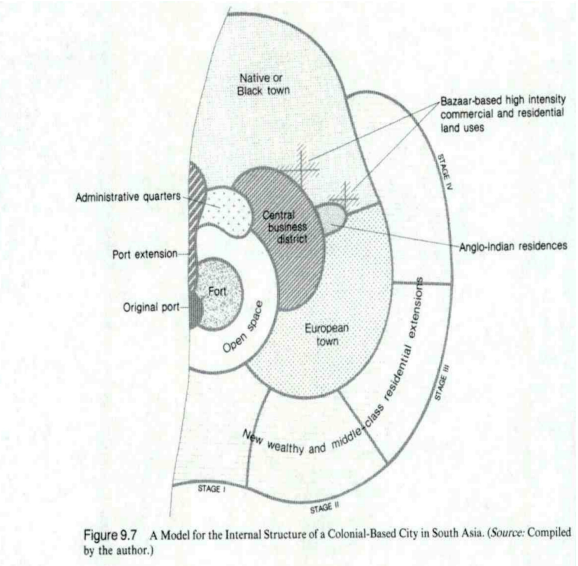


Figure 9.7 A Model for the Internal Structure of a Colonial-Based City in South Asia. (*Source:* Compiled by the author.)

South Asian

What social science literatures address the urban carbon cycle?

- There is a significant body of literature based within different disciplines;
- There is a growing body of literature that attempts to integrate social science methods and variables in order to explore patterns and dynamics of urbanization and the carbon cycle;
- There is an emerging body of literature that attempts to integrate across the life, applied, physical and social sciences to help frame our understanding of elements and dynamics of urban sustainability transitions

Review of findings for select influences

- Demographic change
  - Increasing population size is positively associated with total urban energy use and total urban GHG emissions;
    - Effects are mitigated by population density (among other types of densities), but this relationship is far from straightforward;
  - Increasing population size of cities may, or may not, effect per capita emissions (scaling effects);
  - Age, size of households among other demographic variables, complicate understanding of energy use and GHG emissions

Review of findings for select influences

- Wealth and economics
  - Wealth is positively associated with energy use and GHG emissions, both total and per capita;
    - Carbon footprints vary dramatically, even within similar income categories;
    - Magnitude of the effect varies by development/income status
    - Urban energy and industrial mix, urban economic and urban functional structures also matter
    - Teleconnections (leakage) of emissions complicates the relationship
  - In higher income societies, urban per capita emissions are lower than national averages, while in lower income societies, the reverse is true

Review of findings for select influences

- Behavioral influences
  - Behavioral influences include norms, values, attitudes mindfulness, abilities, opportunities, lifestyles and habits or routines
  - Studies suggest that individuals can be both happy and conserving;
  - Changing behavior can reduce energy consumption
  - Individual actions are constrained by larger forces (technological, economic, demographic, and institutional). Debate continues concerning the magnitude of reductions possible from behavioral change (Naomi Klein, *This Changes Everything*).

Review of findings for select influences

- Institutions and governance
  - There are several politico-institutional factors believed to influence energy use and GHG emissions
    - Social groups, charismatic leaders (Bloomberg), “left” leaning political parties, “growth machines,” etc
  - However, direct empirical evidence associating these to energy and GHG emissions is lacking:
    - What urban governance systems / modes associate with lower energy use and GHG emissions?
    - What types, intensities and durations of public participation directly effect energy use and carbon emissions?
    - How do these factors change with other social variables and what feedbacks might exist?
  - Energy access is a crucial issue in the developing world

Back to the key message

- Urban system sustainability transitions can be defined as a tendency toward decoupling carbon from urban energy use, decoupling increasing wealth from urban consumption/ waste (overcoming the rebound effect), decoupling increasing socio-institutional complexity and hierarchy from urban social inequality, decoupling the built environment change from urban habitat degradation

Research priorities

- Then in order to understand how to move forward with this agenda, we need to work disciplinarily *and* inter-disciplinarily.
  - Solutions will not come from only improved material and energy efficiencies, new technologies, renewables, etc., alone;
- Select social science priority research areas include:
  - Directionality / mechanisms
  - Feedbacks between different influences and system elements
  - Thresholds / transition points / triggers
  - Path dependency / lock–in
  - Rebound effects

Research gaps

- Data (high resolution information) on energy use and GHG emissions associated with different types of cities, different urban forms within cities, different social, economic and political aspects, etc.,:
- Integrated frameworks that can be used to apply different perspectives to diagnostic and prognostic research efforts;
- Integrated research teams (i.e., social, applied, life and physical sciences)

End