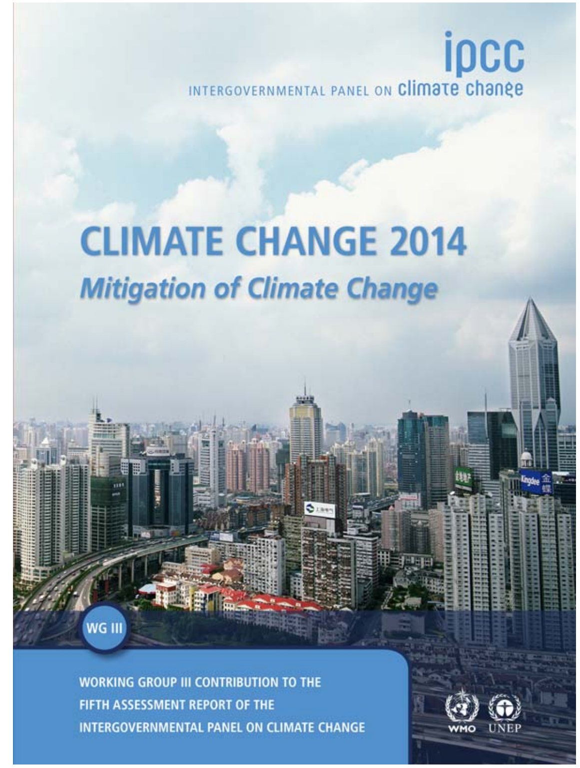
Human Settlements and Climate Change Mitigation:

Key findings from the latest IPCC WG3 report



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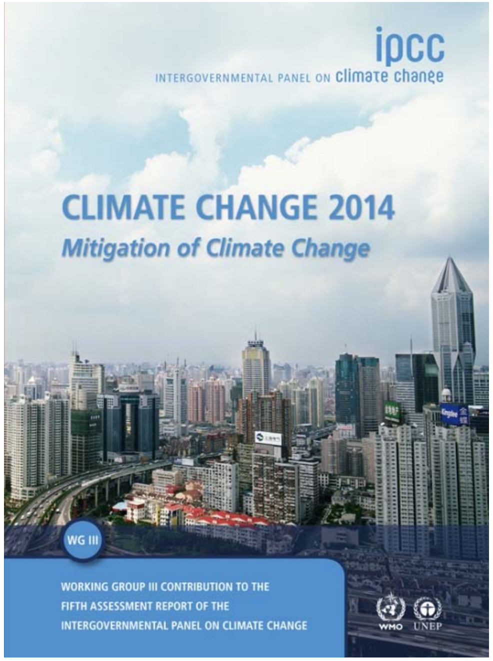
Chapter 12: Human Settlements, Infrastructure, and Spatial Planning

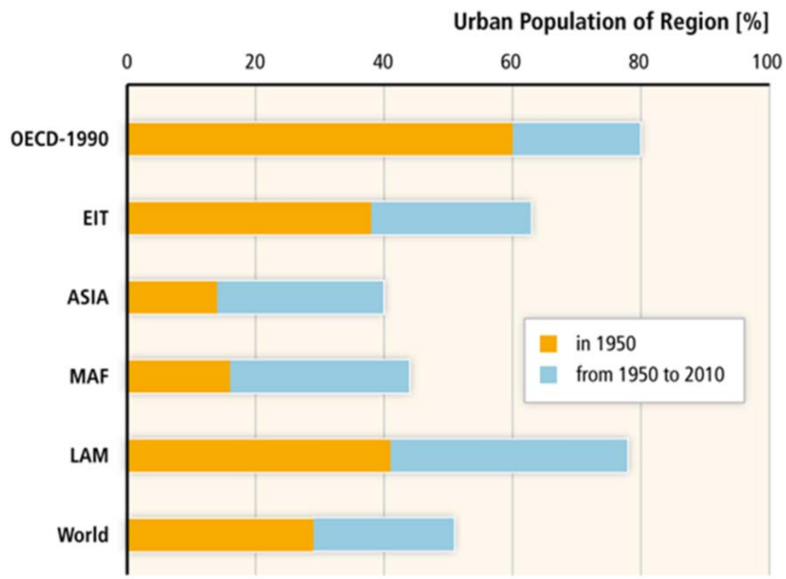
IPCC reports are the result of extensive work from scientists around the world.

2 Coordinating Lead Authors
30 Authors
2 Review Editors
2 Chapter Science Assistants

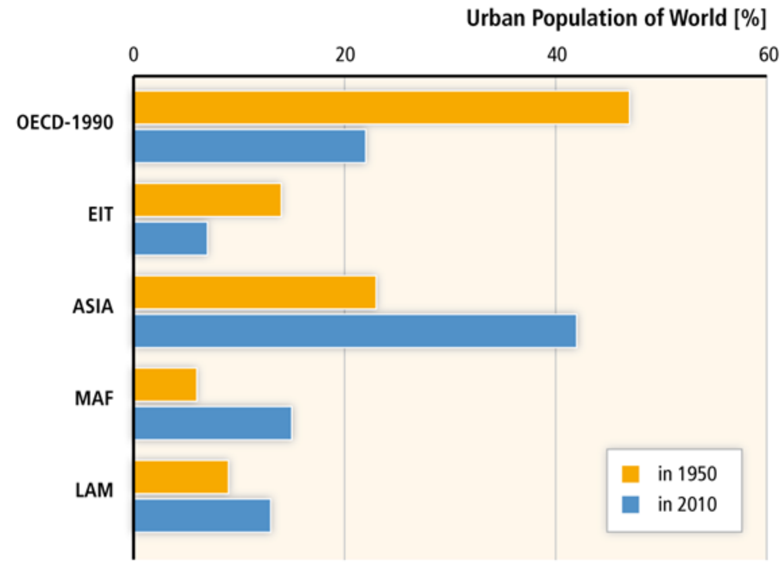
More than **110** pages
Nearly **700** references
More than **3,000** comments



Urbanization is associated with increases in income and higher urban incomes correlated with higher energy and GHG emissions



Urbanization rates in developed regions are higher compared to Asia and Africa, but developing regions are catching up



The overall share developed and developing regions in the global urban population have gone through a structural change in recent decades

- Urban areas account for between 71% and 76% of CO2 emissions from global final energy use and between 67-76% of global energy use
- Cities in non-Annex I countries have generally higher per capita final energy use and CO2 emissions than national averages

No single factor explains variations in per-capita emissions across cities, and there are significant differences within and across countries

- Influenced by a variety of physical, economic and social factors, development levels, and urbanization histories specific to each city
- Key factors include income, population dynamics, urban form, locational factors, economic structure, and market failures
- Key urban form drivers of energy and GHG emissions are density, land use mix, connectivity and accessibility

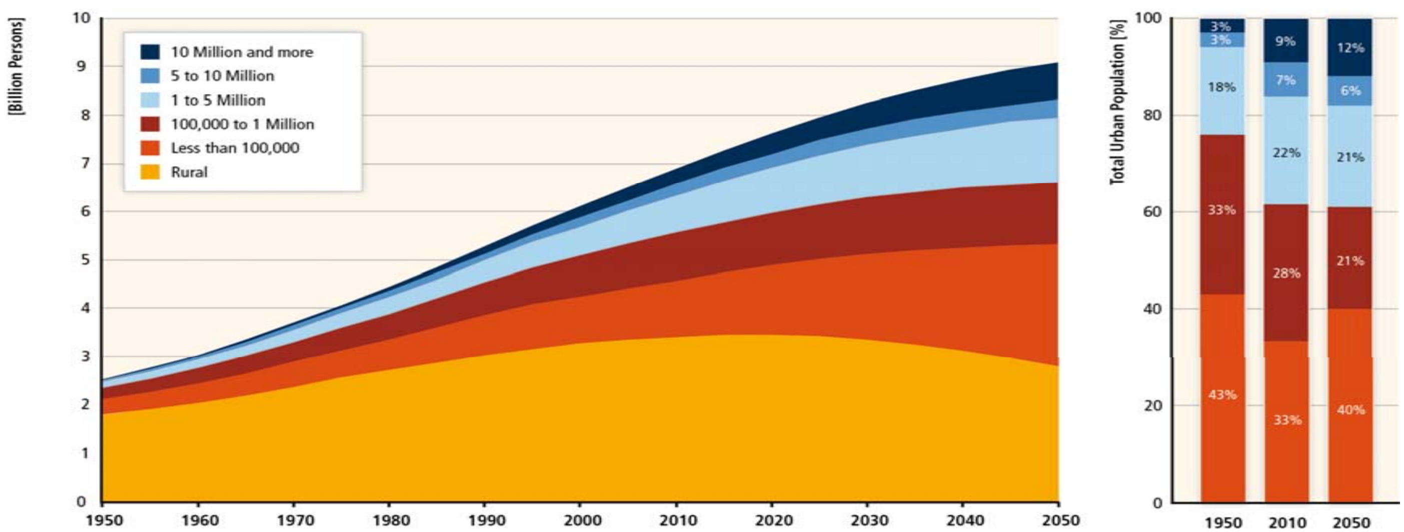
Urban population and urban land is expected to expand further

- Expansion of urban areas is taking place at twice the rate of urban population growth
- Global rural population will decline soon and all population growth will be in urban
- Between 2000 and 2030, urban areas will expand between 0.3 million to 2.3 million km2 (56-310%) - 55% of the total urban land in 2030 is expected to be built in the first three decades of the 21st century
- Nearly half of the global growth in urban land cover is forecasted to occur in Asia; 55% of the regional growth to take place in China and India

Schneider et al., 2009; Angel et al., 2011; Seto et al., 2011, 2012

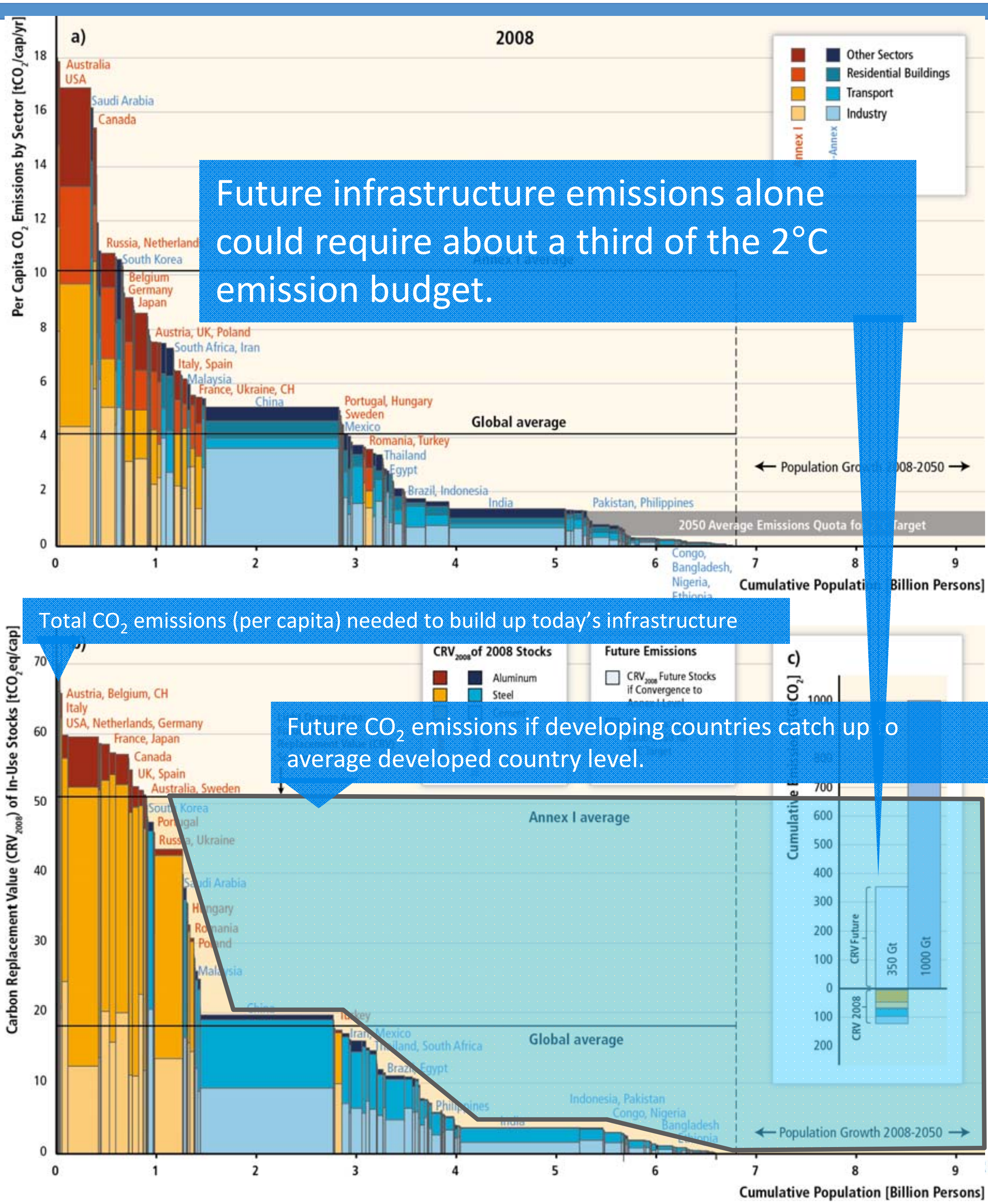
The next two decades present a window of opportunity for mitigation as a large portion urban areas will be developed during this period.

- The kinds of towns, cities, and urban agglomerations that ultimately emerge over the coming decades will have a critical impact on energy use and carbon emissions



- Two sources of emissions: Construction of infrastructure and buildings (stock), usage of infrastructure and buildings (flow)
- Problem “Lock-in”: Long life of infrastructure and built environment determines energy and emissions pathways including lifestyles and consumption patterns

UN DESA, (2010), GEA (2012)

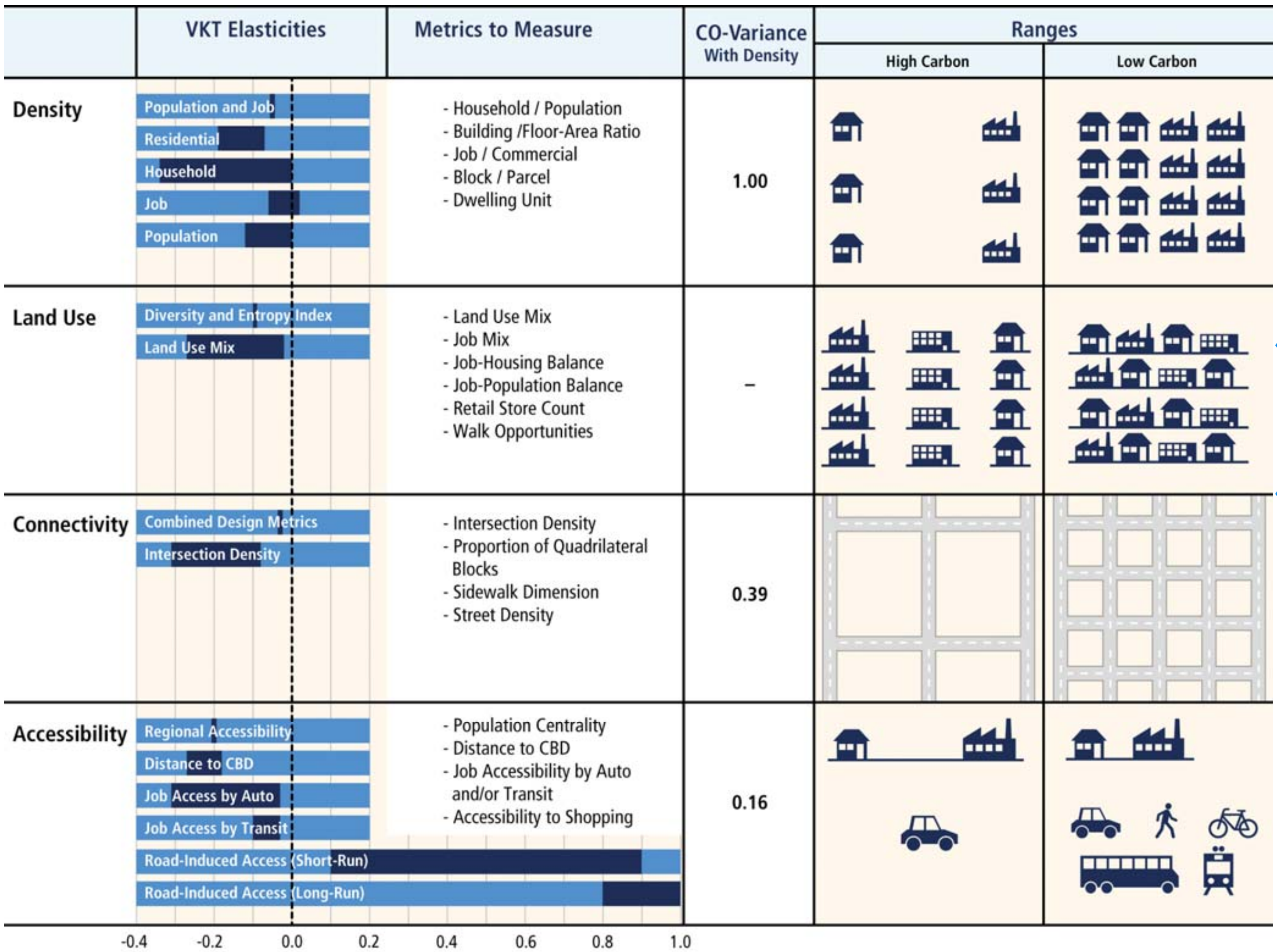


- **The existing infrastructure stock of the average Annex I resident is 3 times that of the world average and about 5 times higher than that of the average non-Annex I resident**
- **The build-up of massive infrastructure in developing countries will result in significant future emissions**

Müller et al., 2013

INTERGOVERNMENTAL PANEL ON climate change

Key drivers for emissions from urban form are density, land use, connectivity and accessibility



Higher density leads to less emissions (i.a. shorter distances travelled).

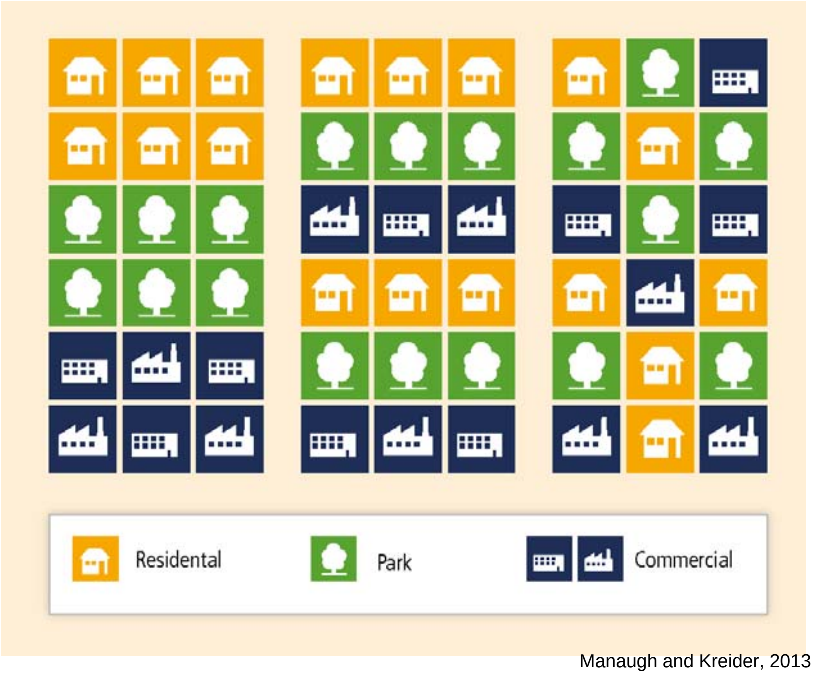
Mix of land-use reduces emissions.

Improved infrastructural density and design (e.g. streets) reduces emissions.

Accessibility to people and places (jobs, housing, services, shopping) reduces emissions.

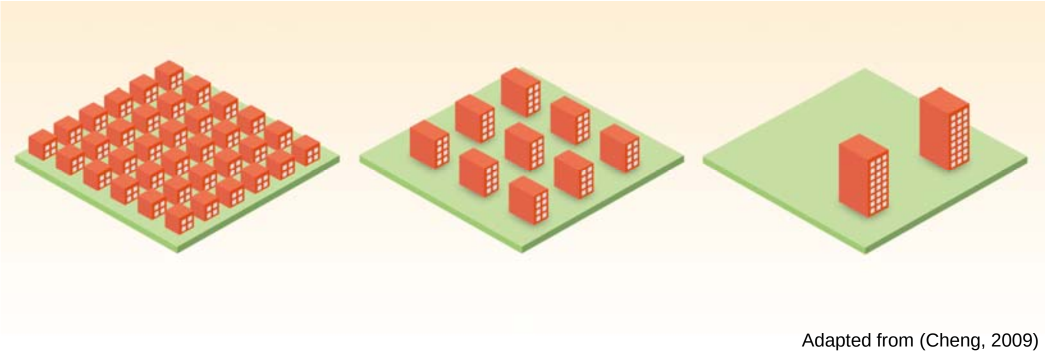
Numbers from Ewing and Cervero (2010), National Research Council (2009a), and Salon et al (2012) are based on the following original sources: Density (Schimek, 1996; Kockelman, 1997; Sun et al., 1998; Pickrell and Schimek, 1999; Ewing and Cervero, 2001; Holtzclaw et al., 2002; Bhatia, 2004; Boarnet et al., 2004; Bento et al., 2005; Zhou and Kockelman, 2008; Fang, 2008; Kuzmyak, 2009a; a; Brownstone and Golob, 2009; Ewing et al., 2009; Greenwald, 2009; Heres-Del-Valle and Niemeier, 2011); Land Use (Kockelman, 1997; Sun et al., 1998; Pushkar et al., 2000; Ewing and Cervero, 2001, 2010; Chapman and Frank, 2004; Frank and Engelke, 2005; Kuzmyak et al., 2006; Vance and Hedel, 2007; Brownstone and Golob, 2009; Kuzmyak, 2009b; Frank et al., 2009); Connectivity (Ewing and Cervero, 2001; Boarnet et al., 2004; Chapman and Frank, 2004; Frank and Engelke, 2005; Ewing et al., 2009; Greenwald, 2009; Frank et al., 2009); Accessibility (Goodwin, 1996; Ewing et al., 1996, 2009; Kockelman, 1997; Cervero and

Low carbon cities need to consider urban land use mix



Manaugh and Kreider, 2013

Density is necessary but not sufficient condition for lowering urban emissions



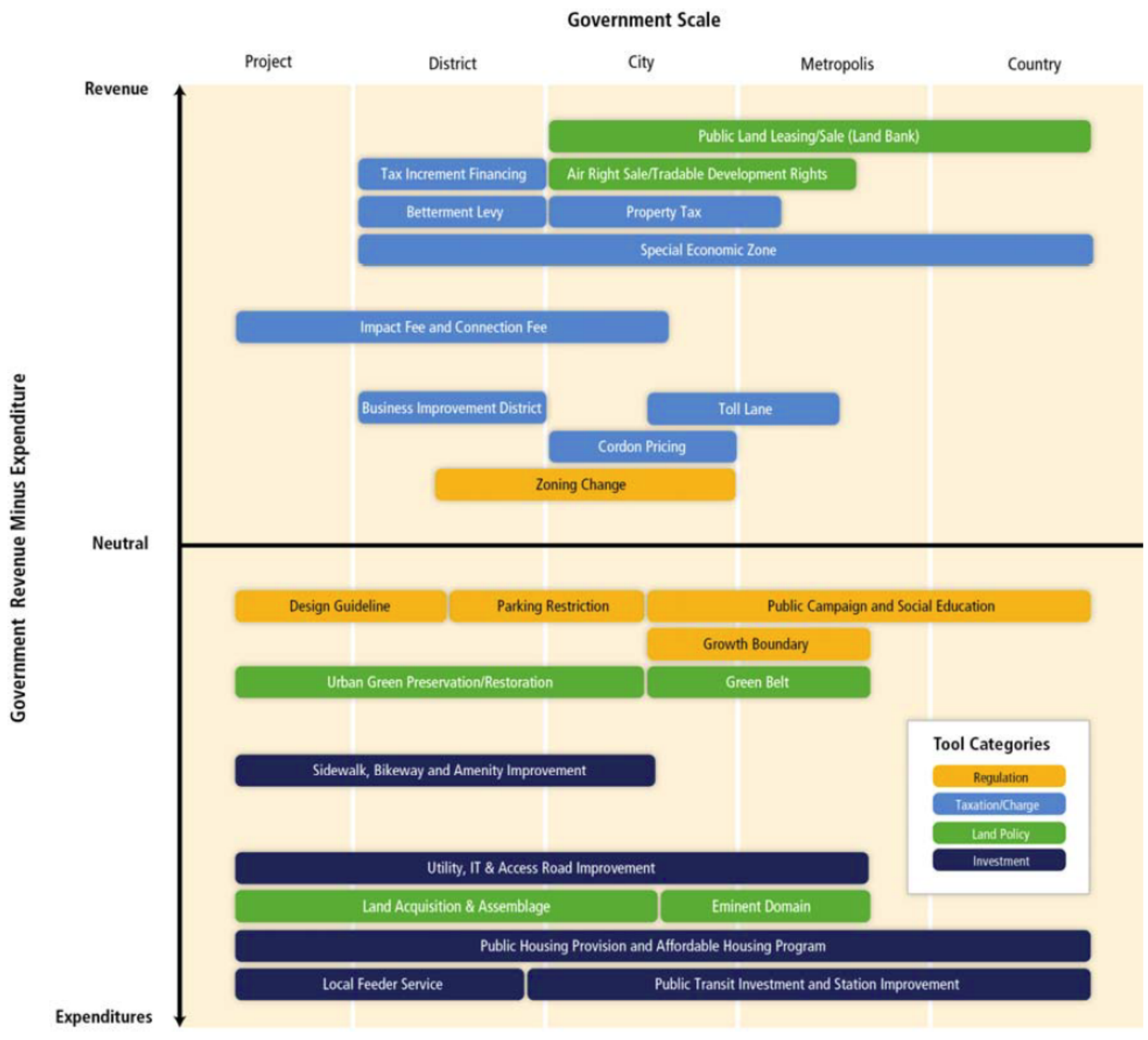
Adapted from (Cheng, 2009)

Mitigation options vary by urbanization trajectories and are expected to be most effective when policy instruments are bundled

The largest mitigation opportunities with respect to human settlements are in rapidly urbanizing areas with

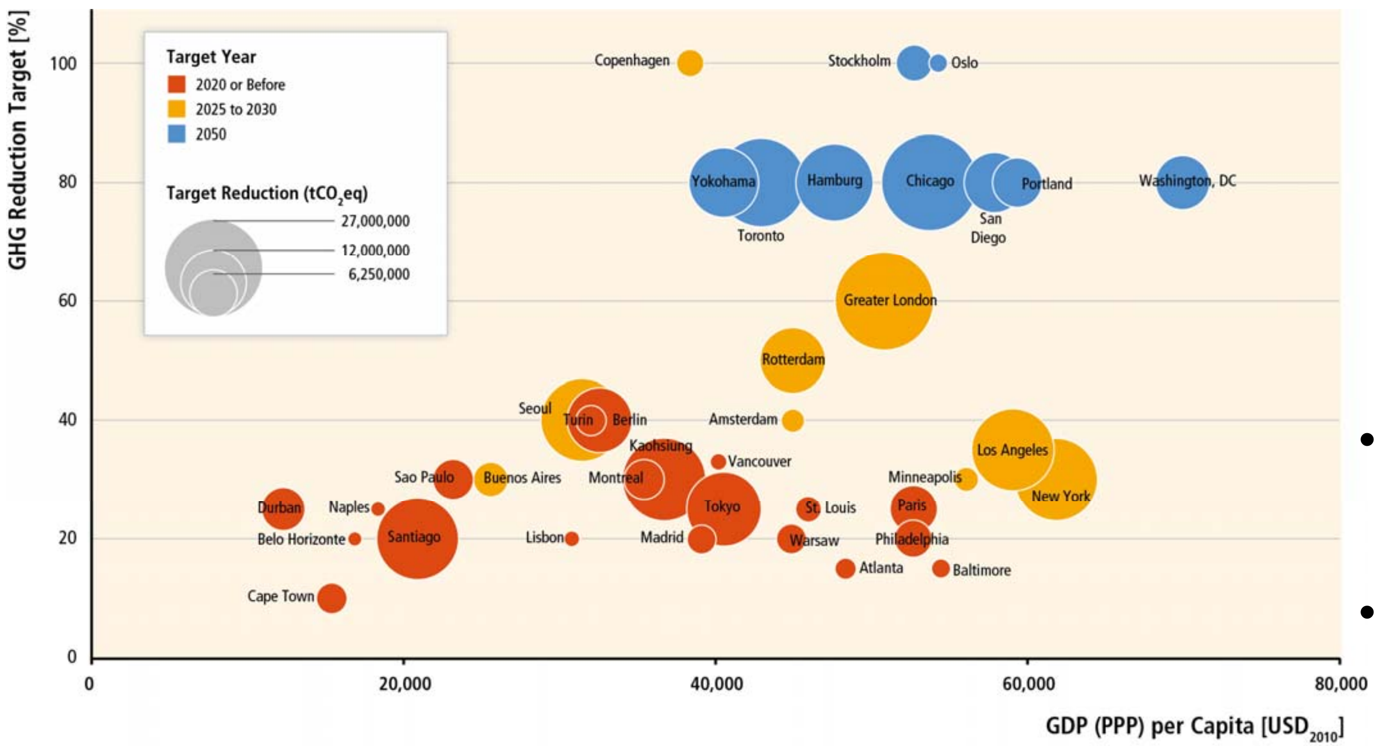
- **Small and mid-size cities**
- **Developing regions of the world**
- **Economical growing regions**
- **Infrastructure is being built and yet not locked-in**

The feasibility of spatial planning instruments for climate change mitigation is highly dependent on a city’s financial and governance capability



Sources: Bahl and Linn (1998); Bhatt (2011); Cervero (2004); Deng (2005); Fekade (2000); Rogers (1999); Hong and Needham (2007); Peterson (2009); Peyroux (2012); Sandroni (2010); Suzuki et al. (2013); Urban LandMark (2012); U.S. EPA (2013); Weitz (2003).

Thousands of cities are undertaking Climate Action Plans and mitigation commitments



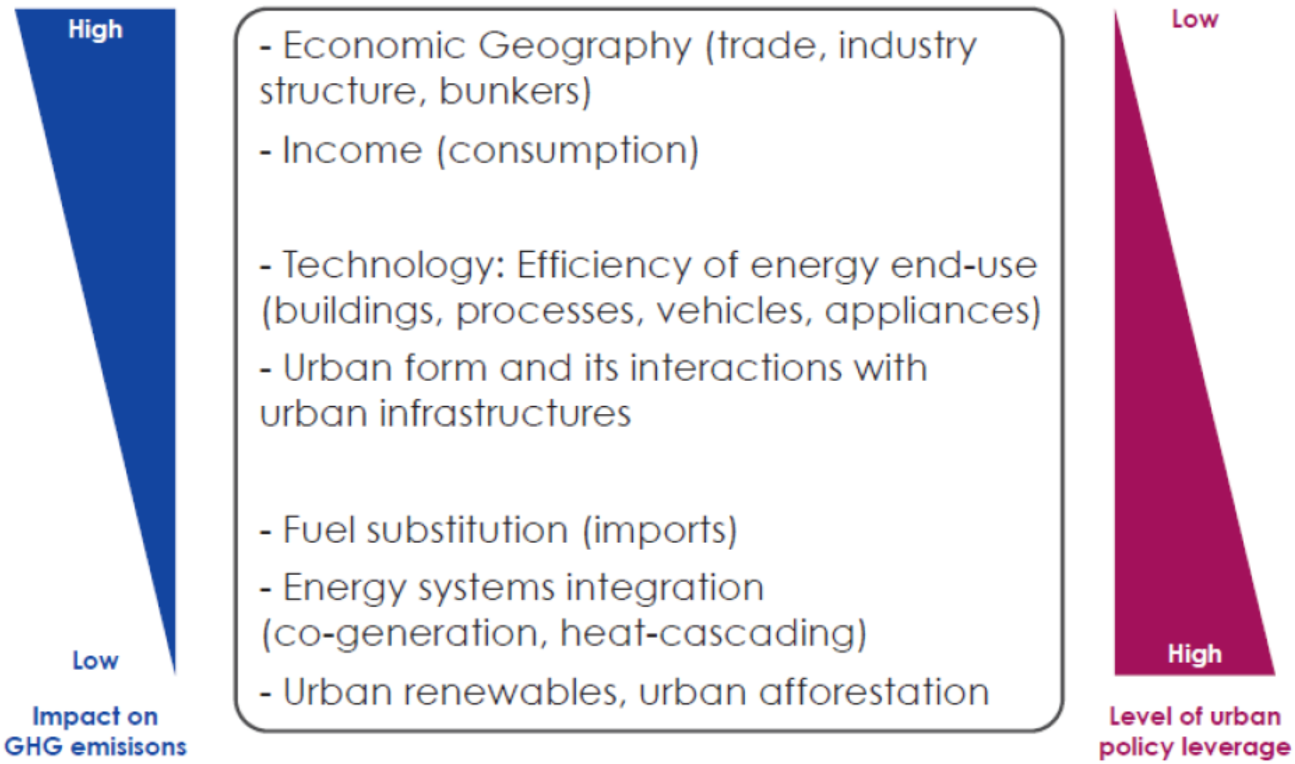
Sources: Baseline emissions, reduction targets, and population from self-reported data submitted to Carbon Disclosure Project (2013). GDP data from Istrate & Nadeau (2012). Note that the figure is illustrative only; data are not representative, and physical boundaries, emissions accounting methods and baseline years vary between cities. Many cities have targets for intermediate years (not shown).

- Little systematic assessment on their implementation & the extent to which reduction targets are being achieved or emissions reduced
- Focus largely on energy efficiency
- Limited consideration to land-use planning strategies and other cross-sectoral measures

Yet, their aggregate impact on urban emissions is uncertain

In decisions making, the policy leverages do not often match with the largest mitigation opportunities

Stylized Hierarchy of Urban Energy/GHG Drivers and Policy Leverages



Systemic changes have more mitigation opportunities but hindered by policy fragmentation

Successful implementation of urban-scale climate change mitigation strategies can provide health, economic and air quality co-benefits

- Urban areas continue to struggle with challenges, including ensuring access to energy, limiting air and water pollution, and maintaining employment opportunities and competitiveness

- **Action on urban-scale mitigation often depends on the ability to relate climate change mitigation efforts to local co-benefits**

Mitigation measures	Effect on additional objectives/concerns		
	Economic	Social (including health)	Environmental
Compact development and infrastructure	↑ Innovation and productivity[1] ↑↑ Higher rents & residential property values[2] ↑ Efficient resource use and delivery[5]	↑ Health from physical activity[3]	↑ Preservation of open space[4]
Increased accessibility	↑ Commute savings[6]	↑ Health from increased physical activity[3] ↑ Social interaction & mental health[7]	↑ Air quality and reduced ecosystem/health impacts[8]
Mixed land use	↑ Commute savings[6] ↑↑ Higher rents & residential property values[2]	↑ Health from increased physical activity[3] ↑ Social interaction and mental health[7]	↑ Air quality and reduced ecosystem/health impacts[8]

‘Governance paradox’ and need for a comprehensive approach

- ‘Systemic changes’ in urban areas have large mitigation opportunities but hindered by current patterns of urban governance, policy leverages and persisting policy fragmentation
- Governance and institutional capacity are scale and income dependent, i.e., tend to be weaker in smaller scale cities and in low income/revenue settings
  - However, the bulk of urban growth momentum is expected to unfold in small- to medium-size cities in non-Annex-I countries
  - The largest opportunities for GHG emission reduction might be precisely in urban areas where governance and institutional capacities to address them are weakest
- The feasibility of spatial planning instruments for climate change mitigation is highly dependent on a city’s financial and governance capability
- For designing and implementing climate policies effectively, institutional arrangements, governance mechanisms, and financial resources all should be aligned with the goals of reducing urban GHG emissions

Knowledge gaps

1. Lack of consistent and comparable emissions data at local scales
2. Little scientific understanding of the magnitude of the emissions reduction from altering urban form, and the emissions savings from integrated infrastructure and land use planning.
3. Lack of consistency and thus comparability on local emissions accounting methods
4. Few evaluations of urban climate action plans and their effectiveness.
5. Lack of scientific understanding of how cities can prioritize climate change mitigation strategies, local actions, investments, and policy responses that are locally relevant
6. Large uncertainties as to how urban areas will develop in the future

For further information

www.mitigation2014.org