The Need for a Systems Perspective on Urban Sustainability

Karen C. Seto

Associate Dean of Research

Professor of Geography and Urbanization

IPCC WGIII Coordinating Lead Author

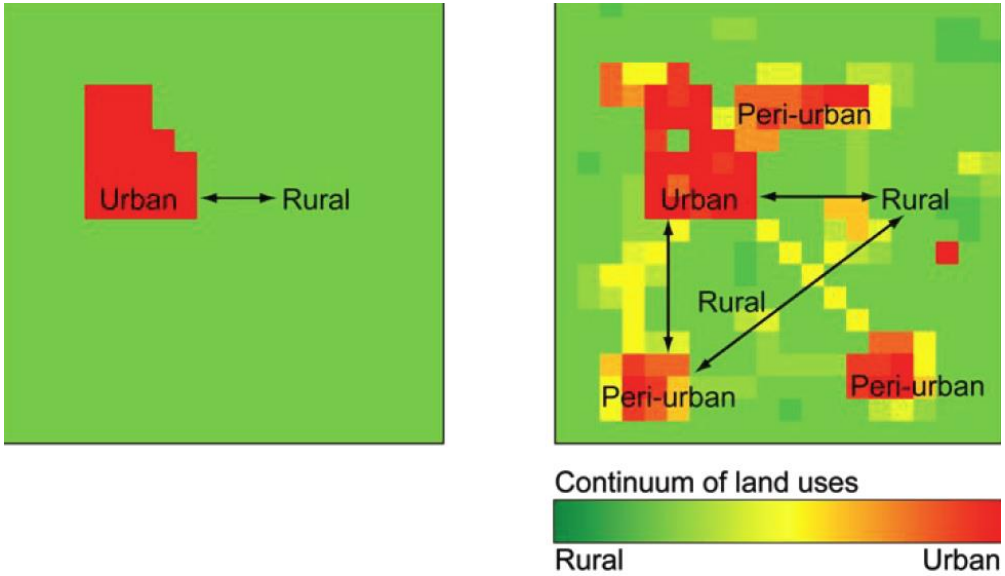
karen.seto@yale.edu

What are urban system boundaries?

3. Classical Athens seen from the northwest. (Watercolor by Peter Connolly)

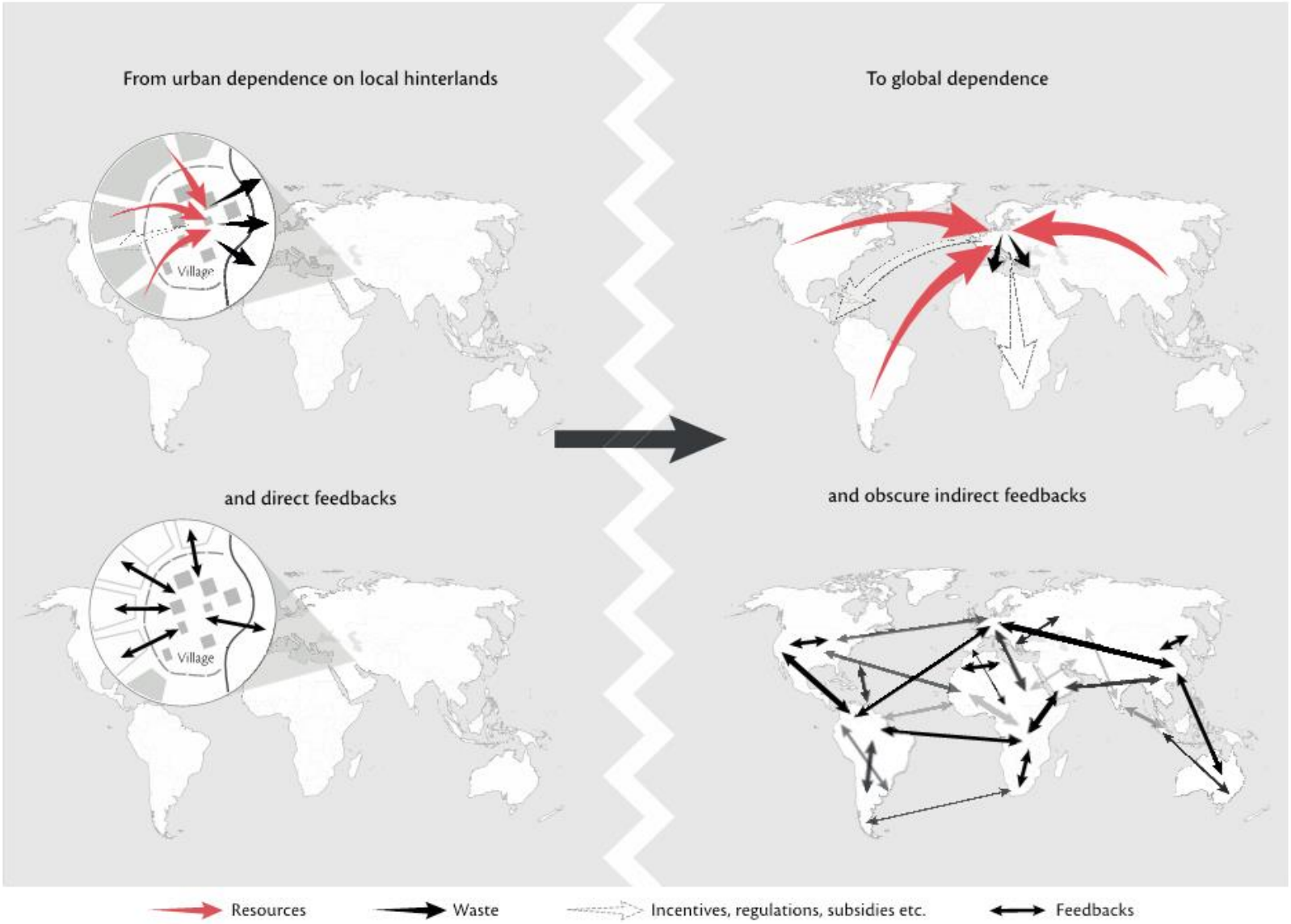
http://www.yale.edu/yup/pdf/081979_front_1.pdf

Classic Urban-Rural Linkages



(Seto et al., 2012)

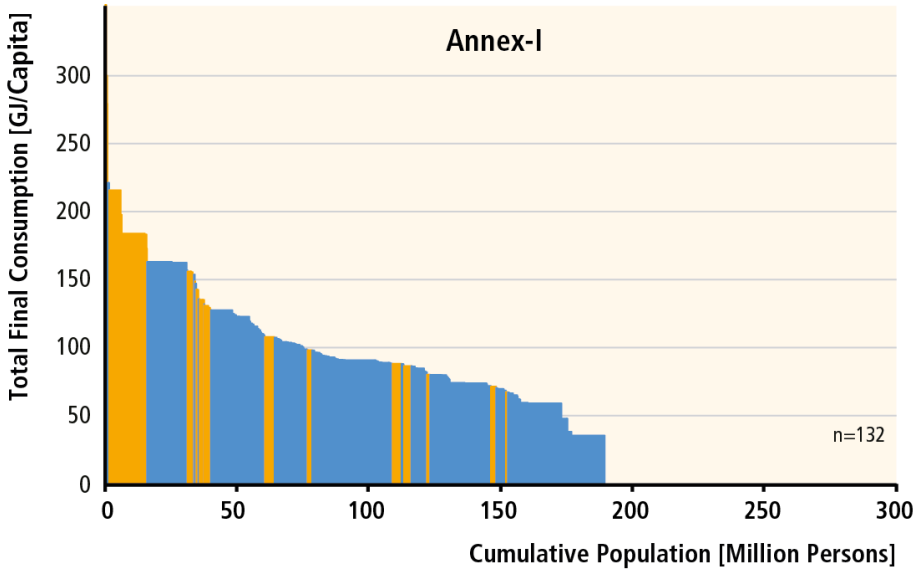
Planetary urbanization requires rethinking urban impacts and sustainability

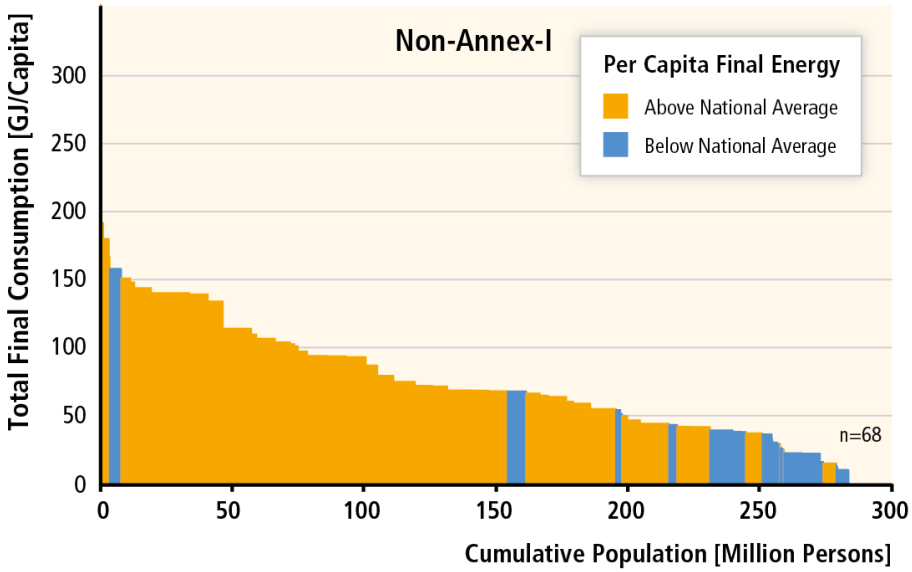


(Elmqvist et al. 2013)

Urban areas are focal points of energy use and CO_2 emissions

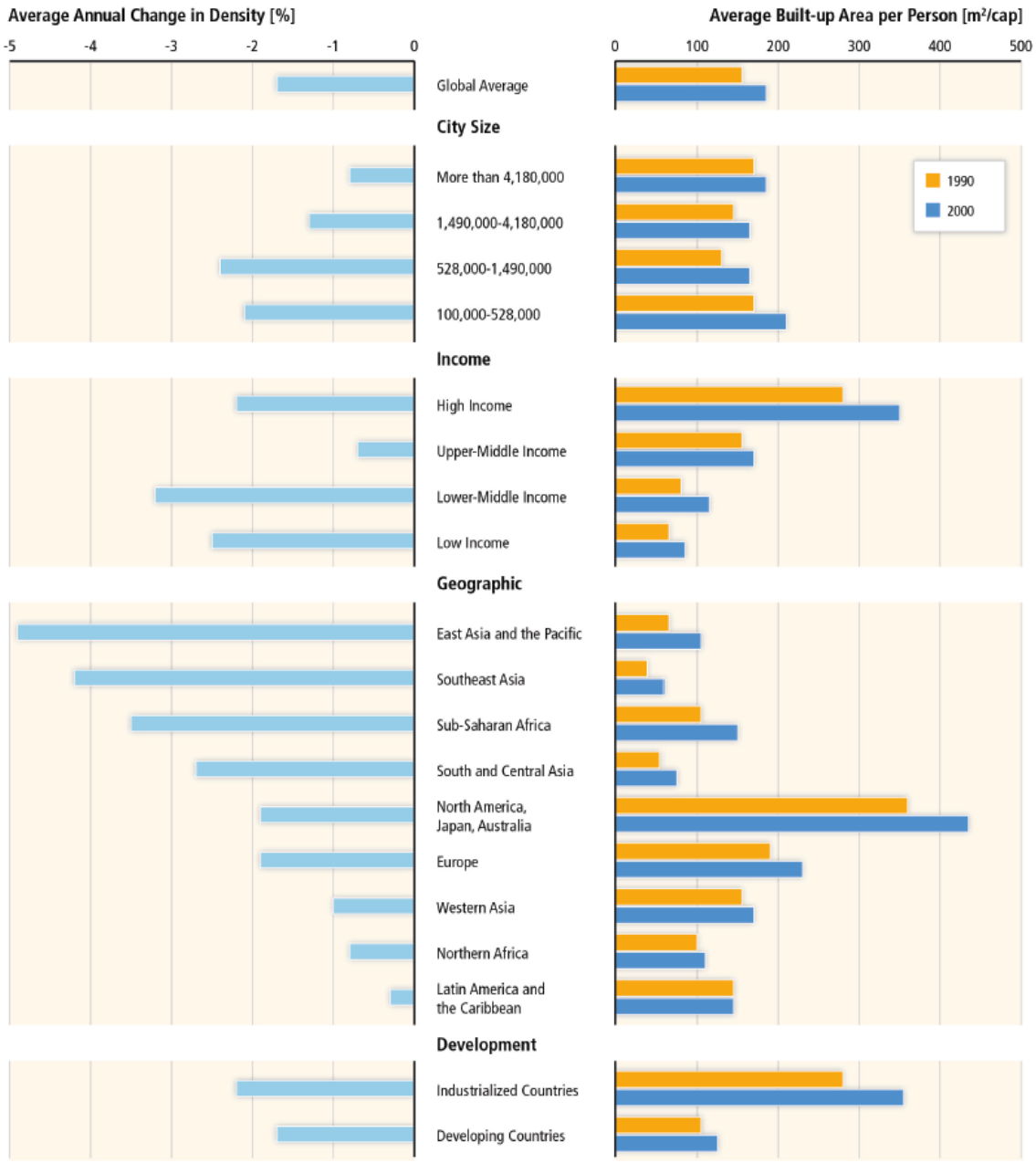
Urban energy use: 67–76%
Urban CO_2 emissions: 71–76%
} of global total





Worldwide, urban areas are growing faster than urban population.

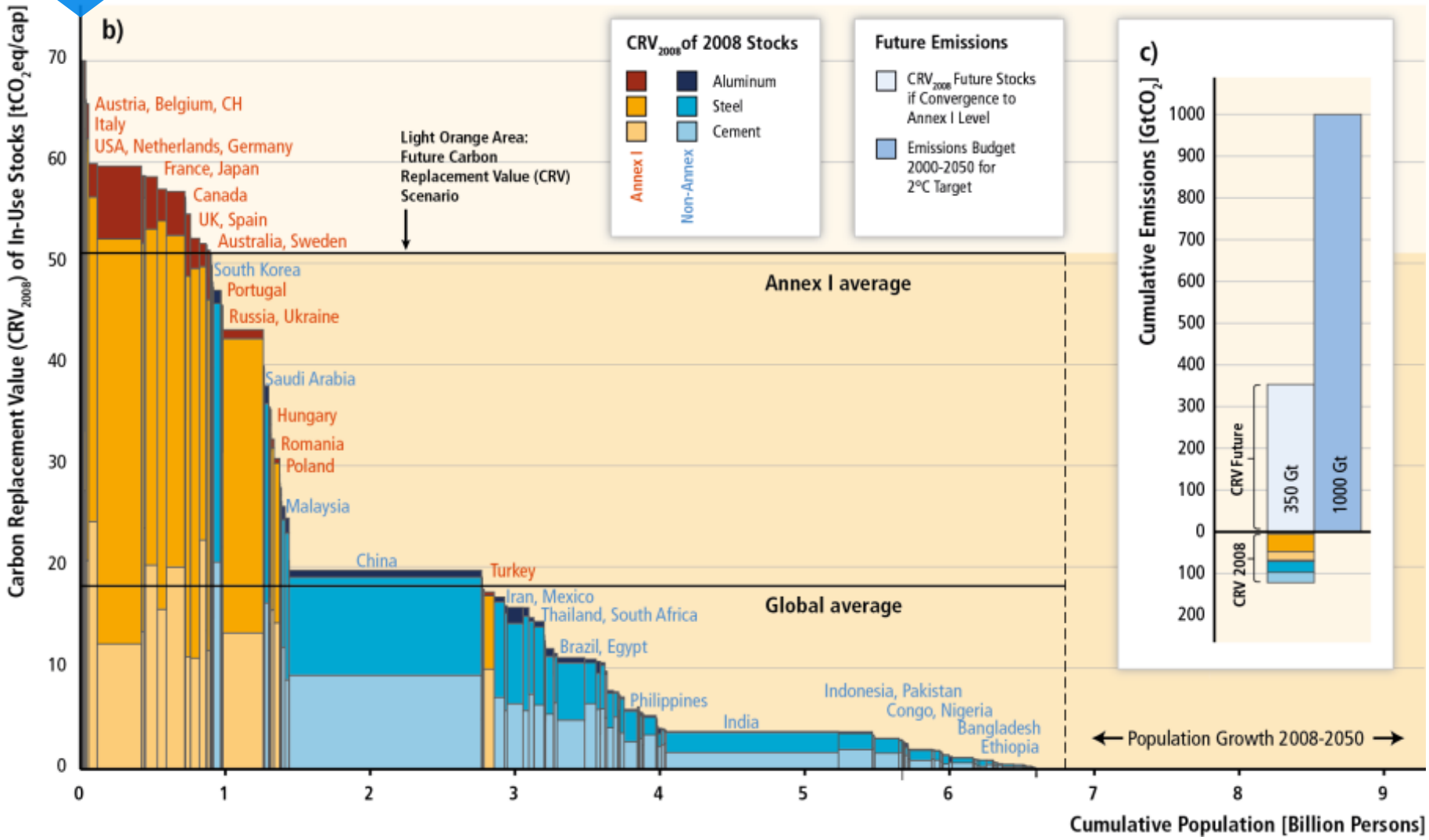
Important implications for resource and energy demand to construct and operate urban areas and their built environments.



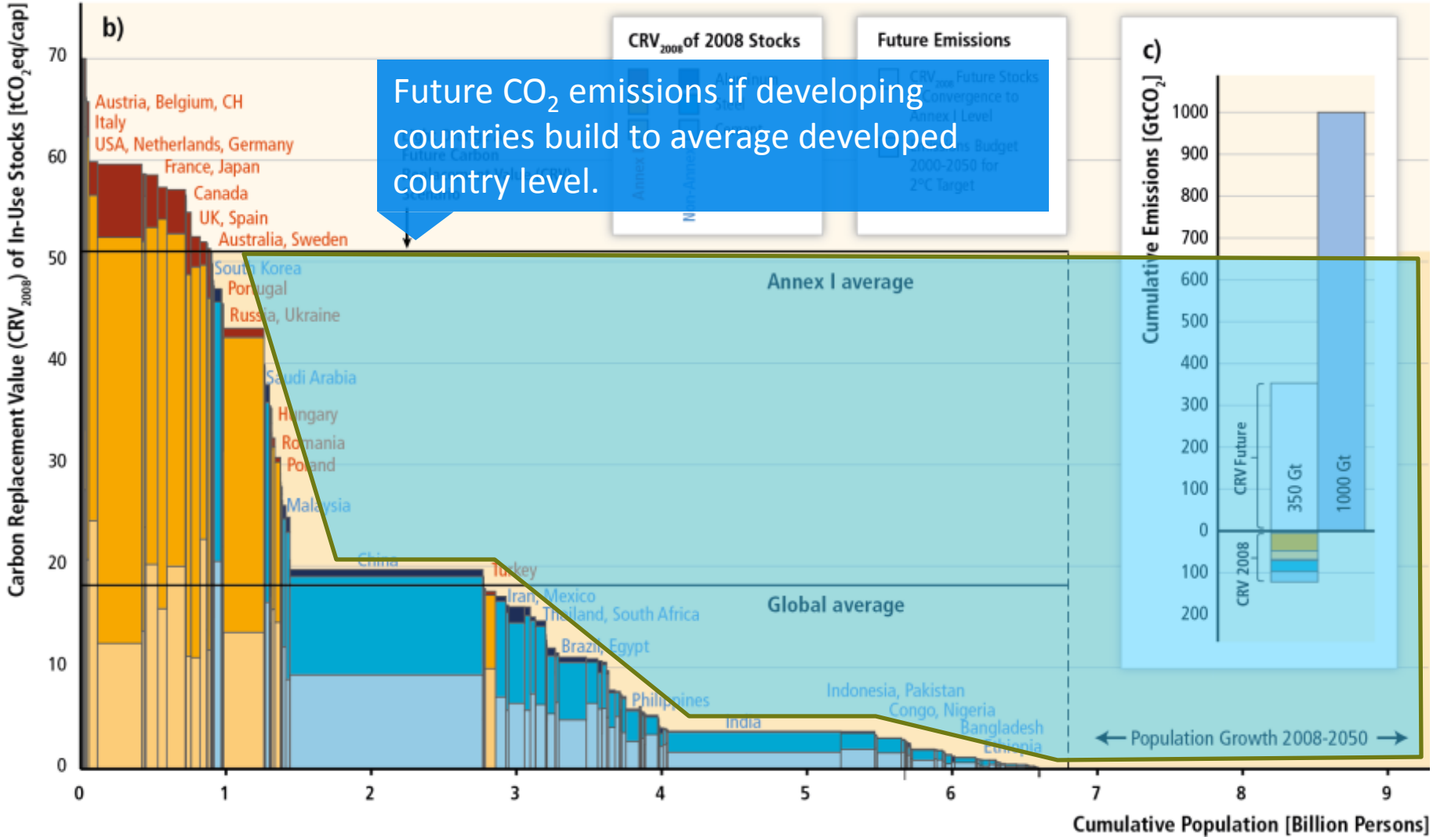
(IPCC WGIII, 2014)

Infrastructure build-up over the next few decades will result in significant emissions

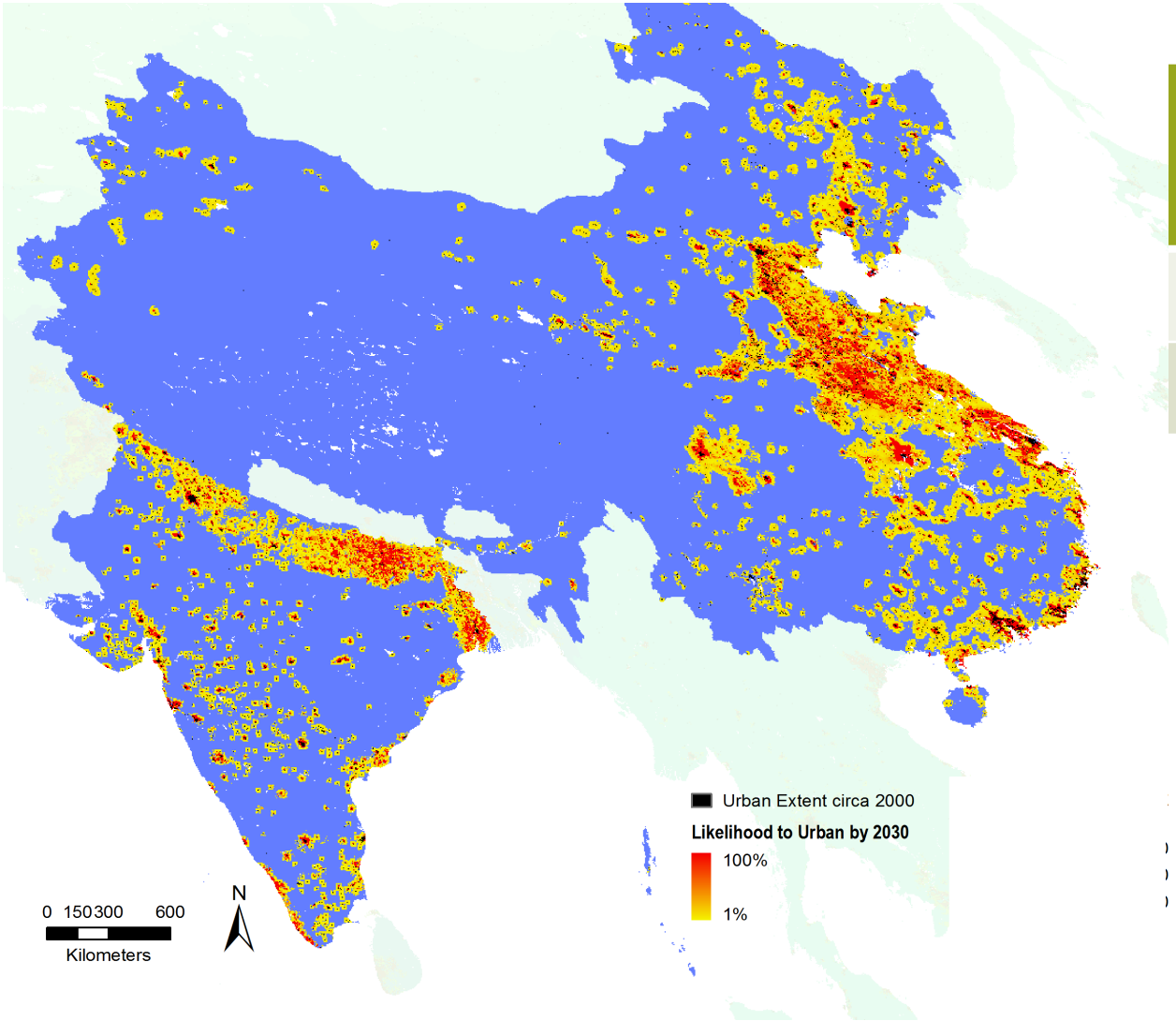
Total CO_2 emissions (per capita) needed to build up today's infrastructure



Future emissions of infrastructure development will be enormous if LDCs follow Annex-I urban development paths



More urban areas will be constructed during first 3 decades of 21st Century than all of history



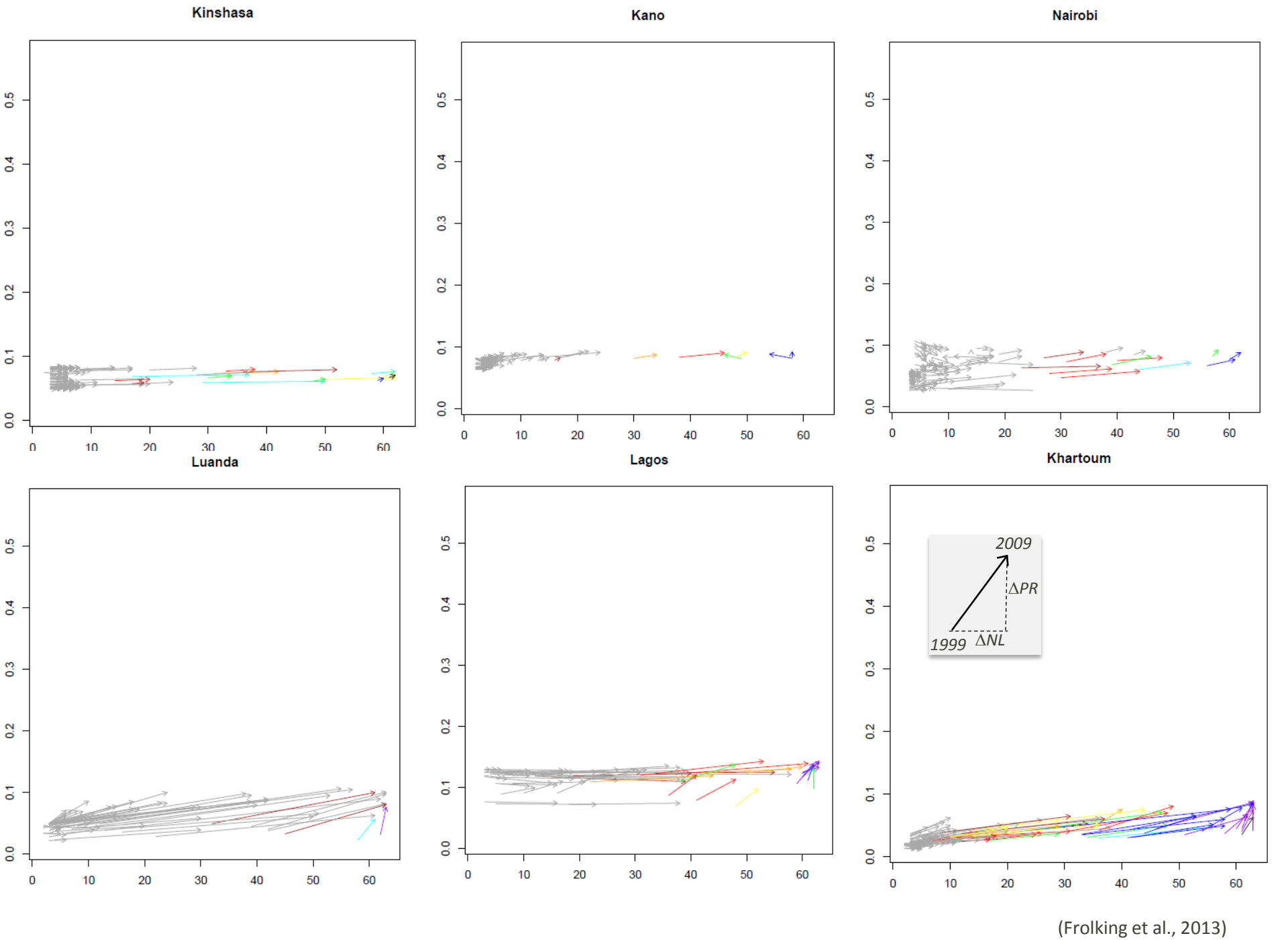
Year	Urban Land (km^2)	
	China	India
2000	80,500	30,400
2030	486,000	174,000

(Seto et al., 2012)

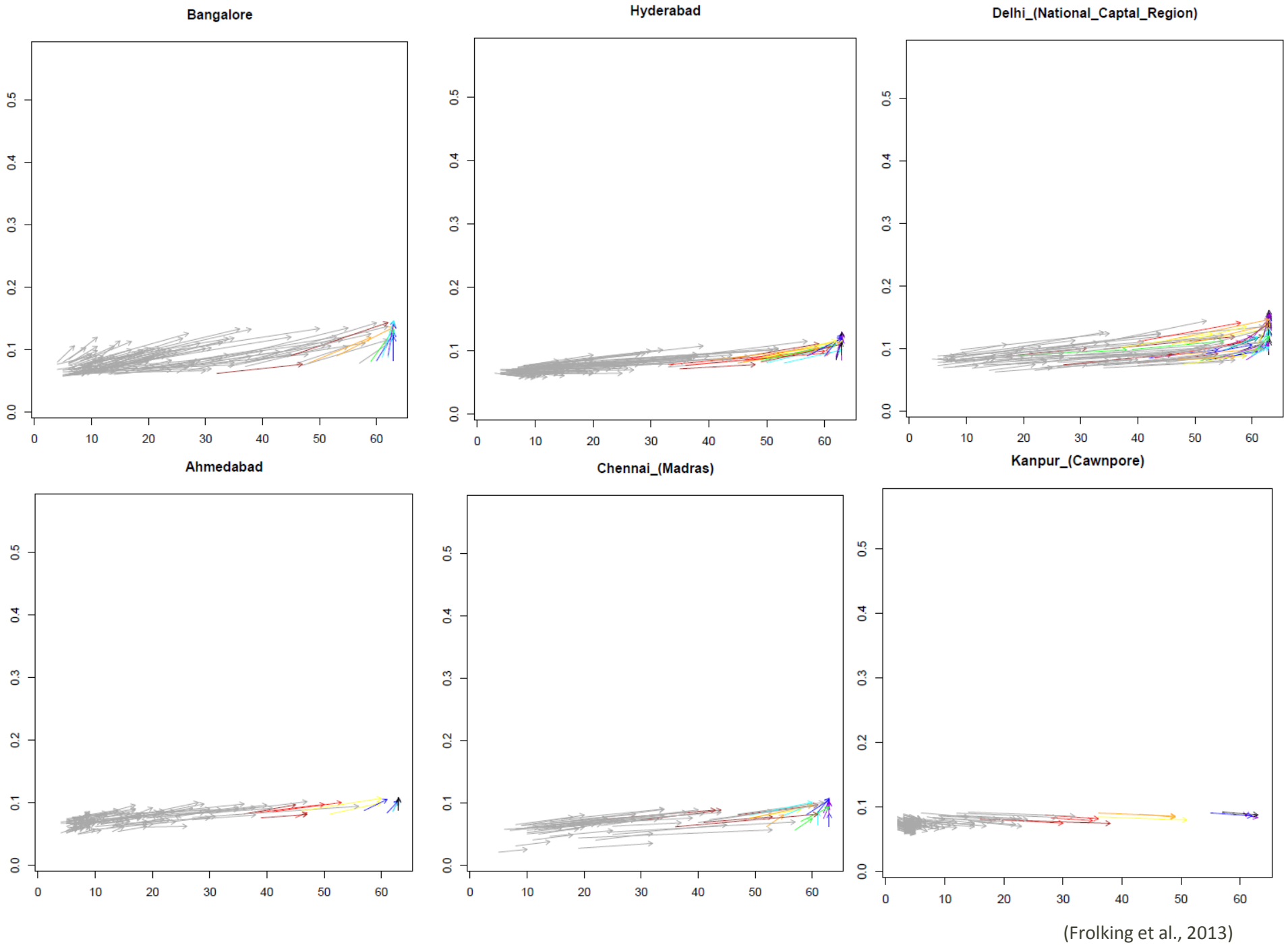
Drivers of urban land expansion differ within and between countries

Location	*Average annual urban expansion growth rate*	*Approximate percent of urban land expansion attributed to*	
		Population growth rate	*GDP per capita growth rate*
China	7.48	18	53
India	4.84	30	23
Africa	4.32	43	Not significant
North America	3.31	28	72
Europe	2.50	4	86

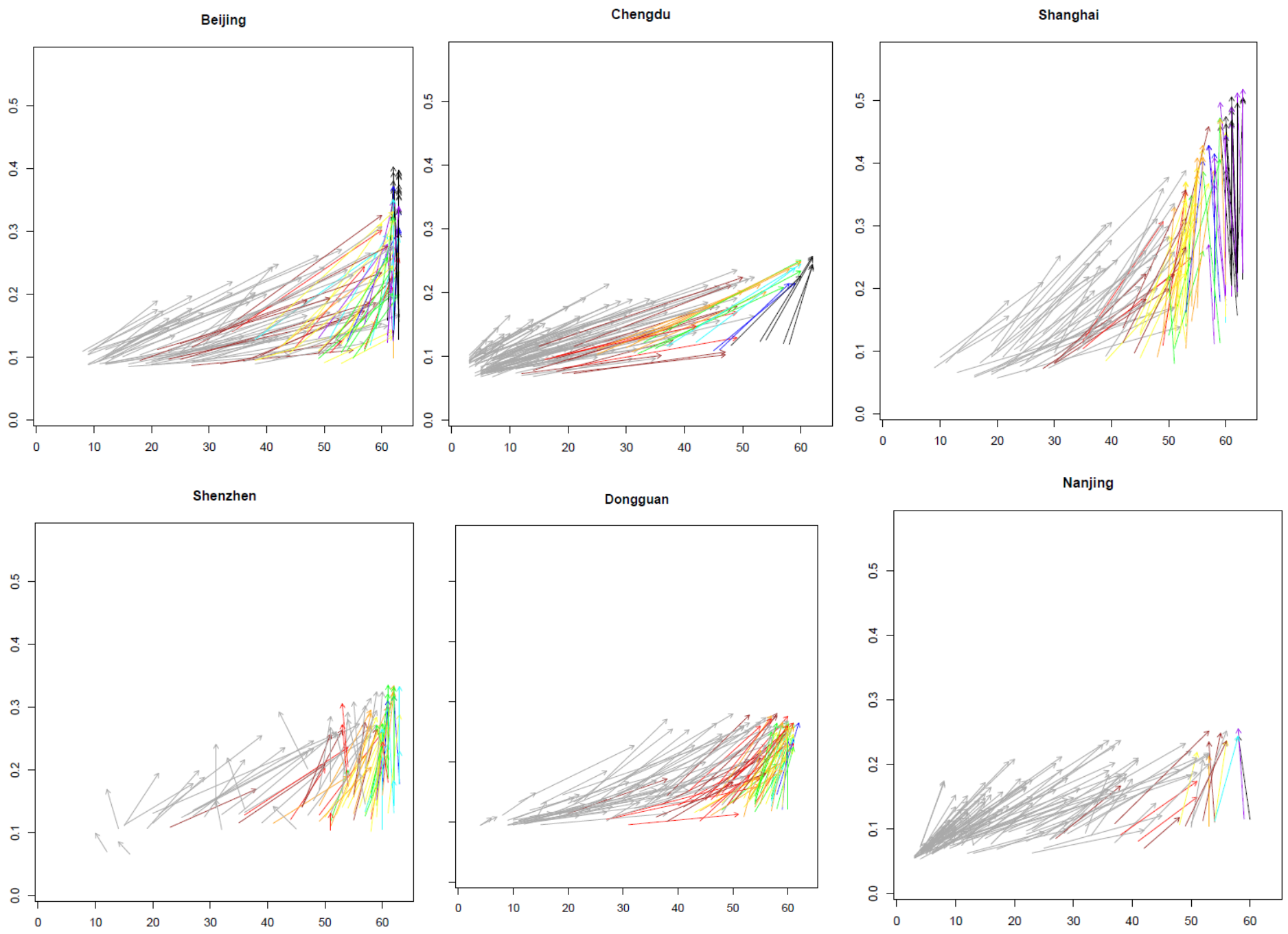
(Seto et al. 2011)



(Frolking et al., 2013)

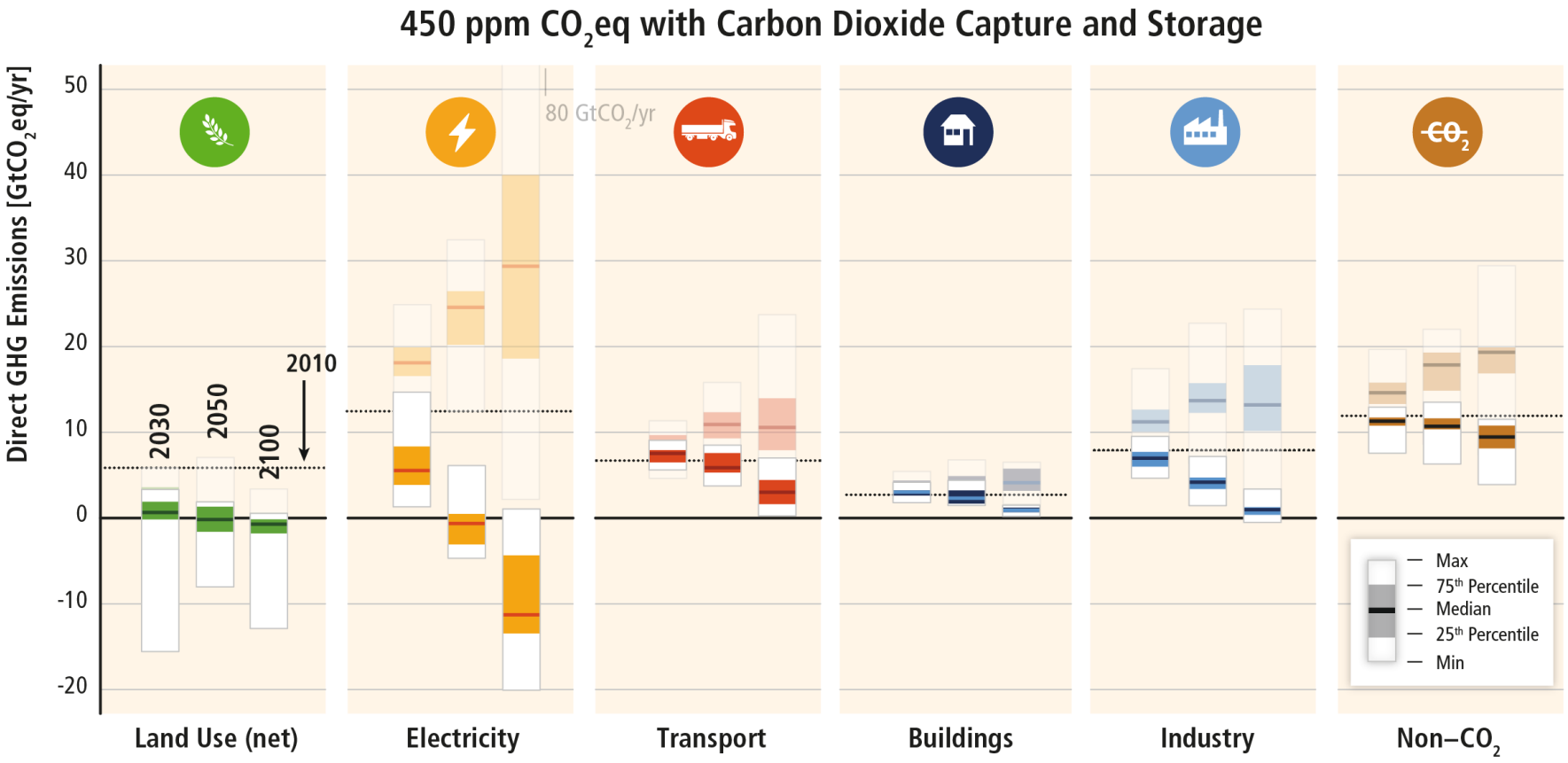


(Frolking et al., 2013)



(Frolking et al., 2013)

Mitigation requires changes throughout the economy. Systemic and cross-sectoral approaches are expected to be most effective. Mitigation efforts in one sector determine efforts in others



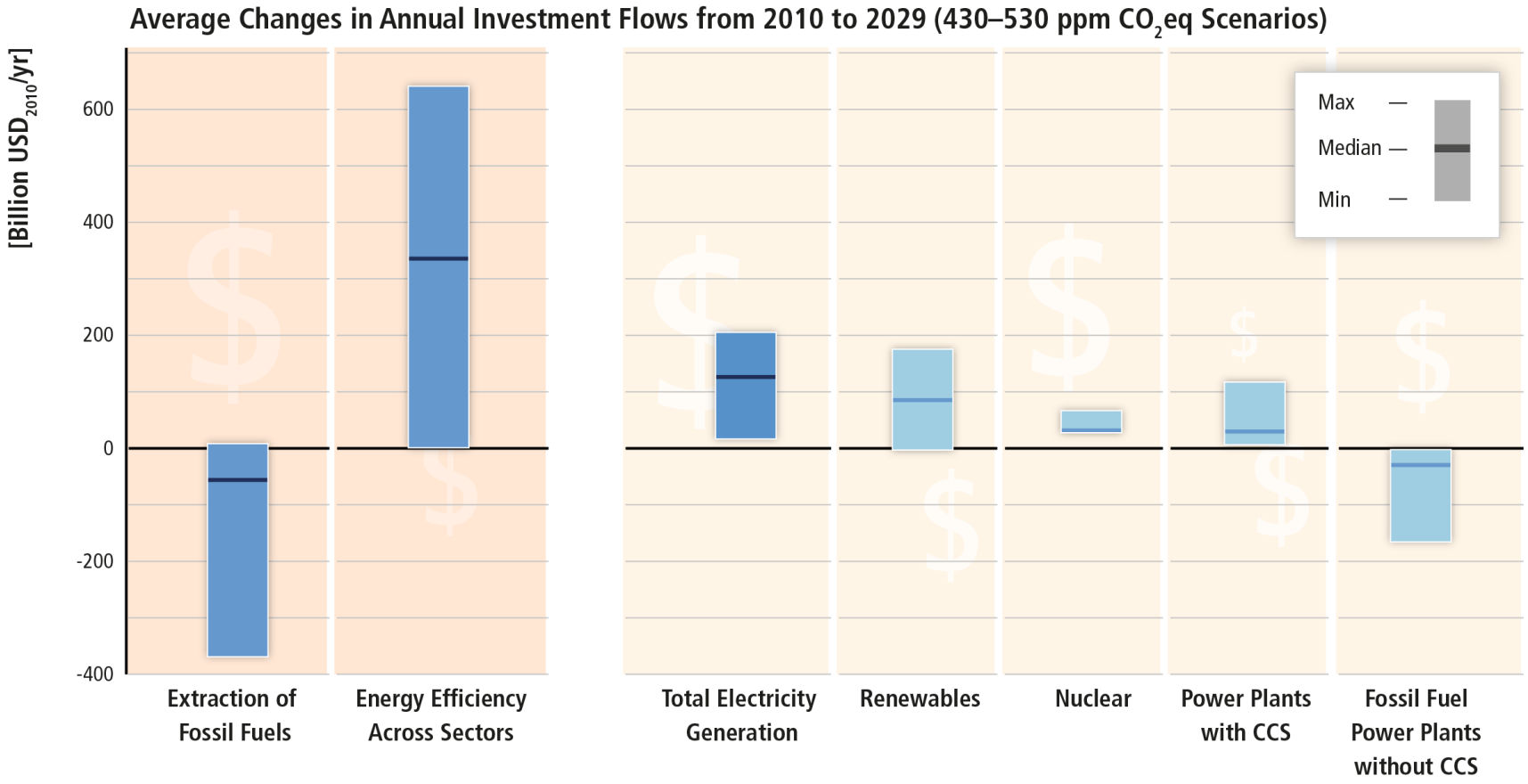
Based on Figure TS.17

Gains in energy efficiency overshadowed by scale of urban expansion

A 25% decrease in energy required per tonne of concrete in China.

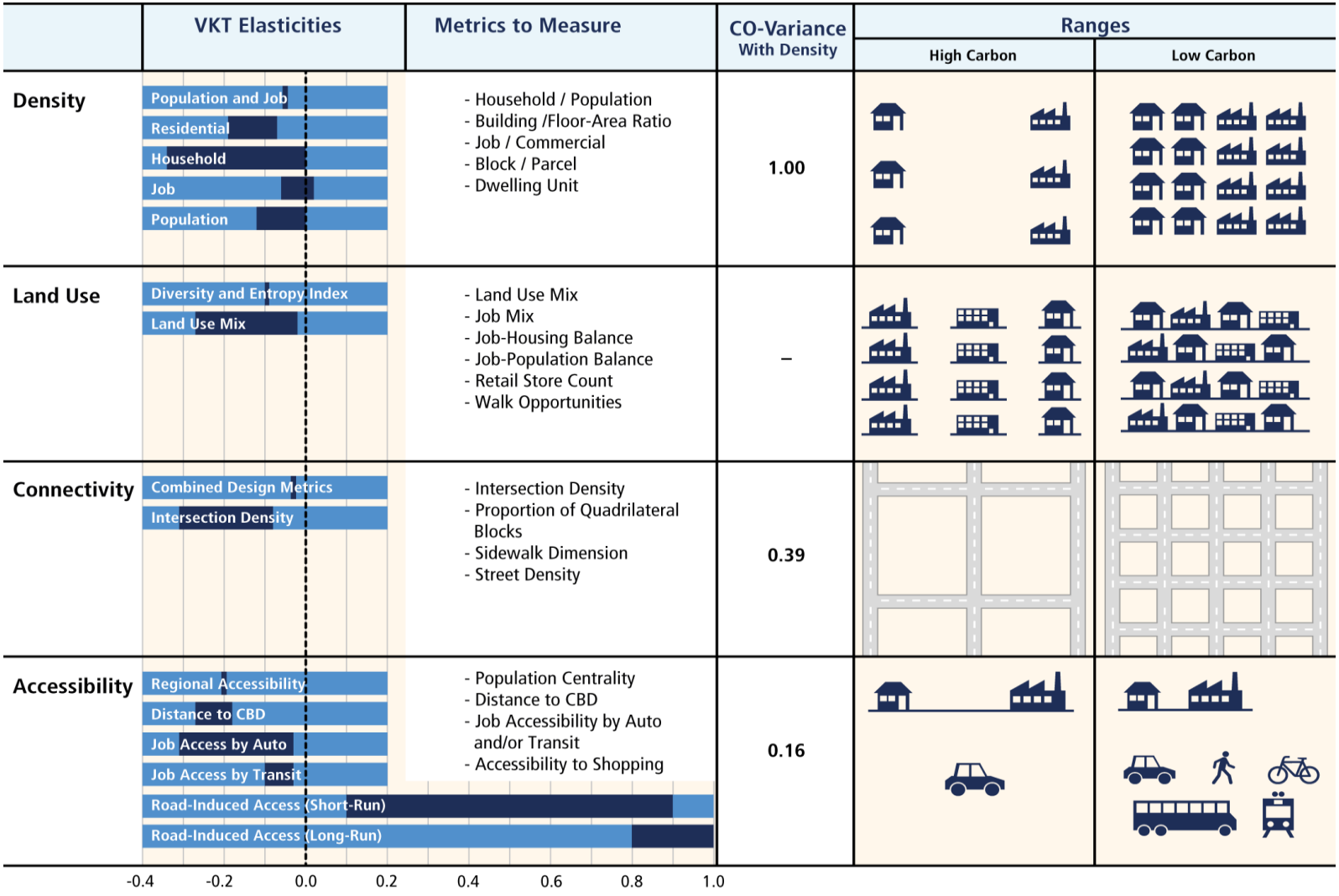
A 300% increase in annual CO_2 emissions due to concrete used in building construction.

Substantial reductions in emissions would require large changes in investment patterns and appropriate policies

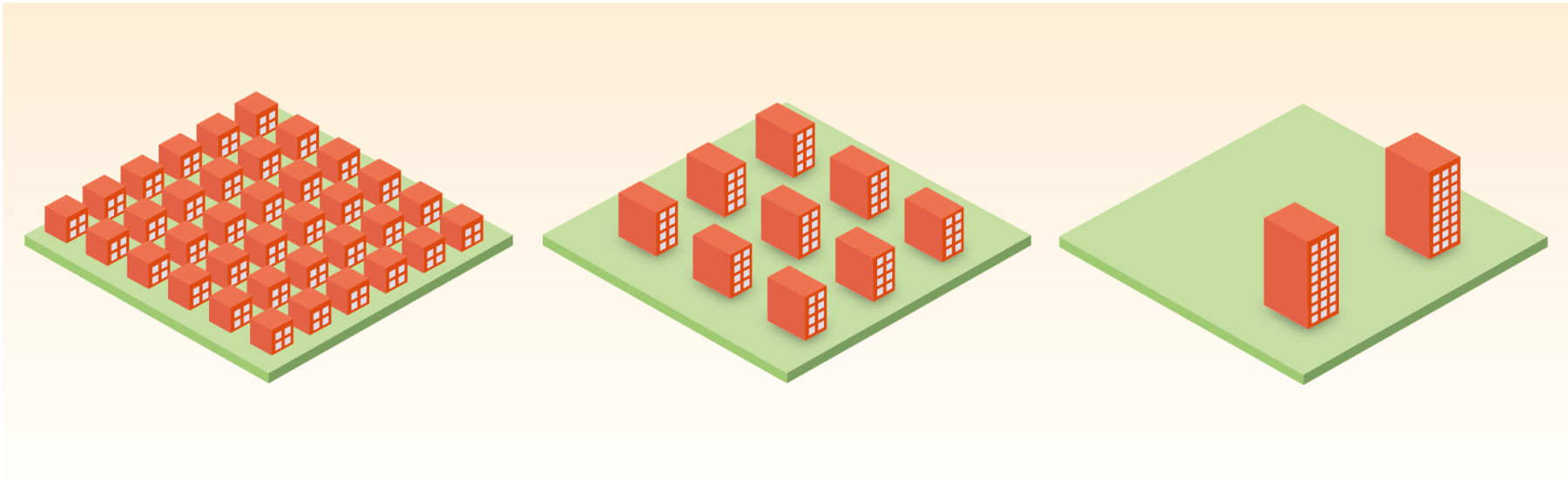


Based on Figure 16.3

Accessibility is key factor to lower urban emissions



Increasing urban density is a necessary but not sufficient condition for lowering urban emissions



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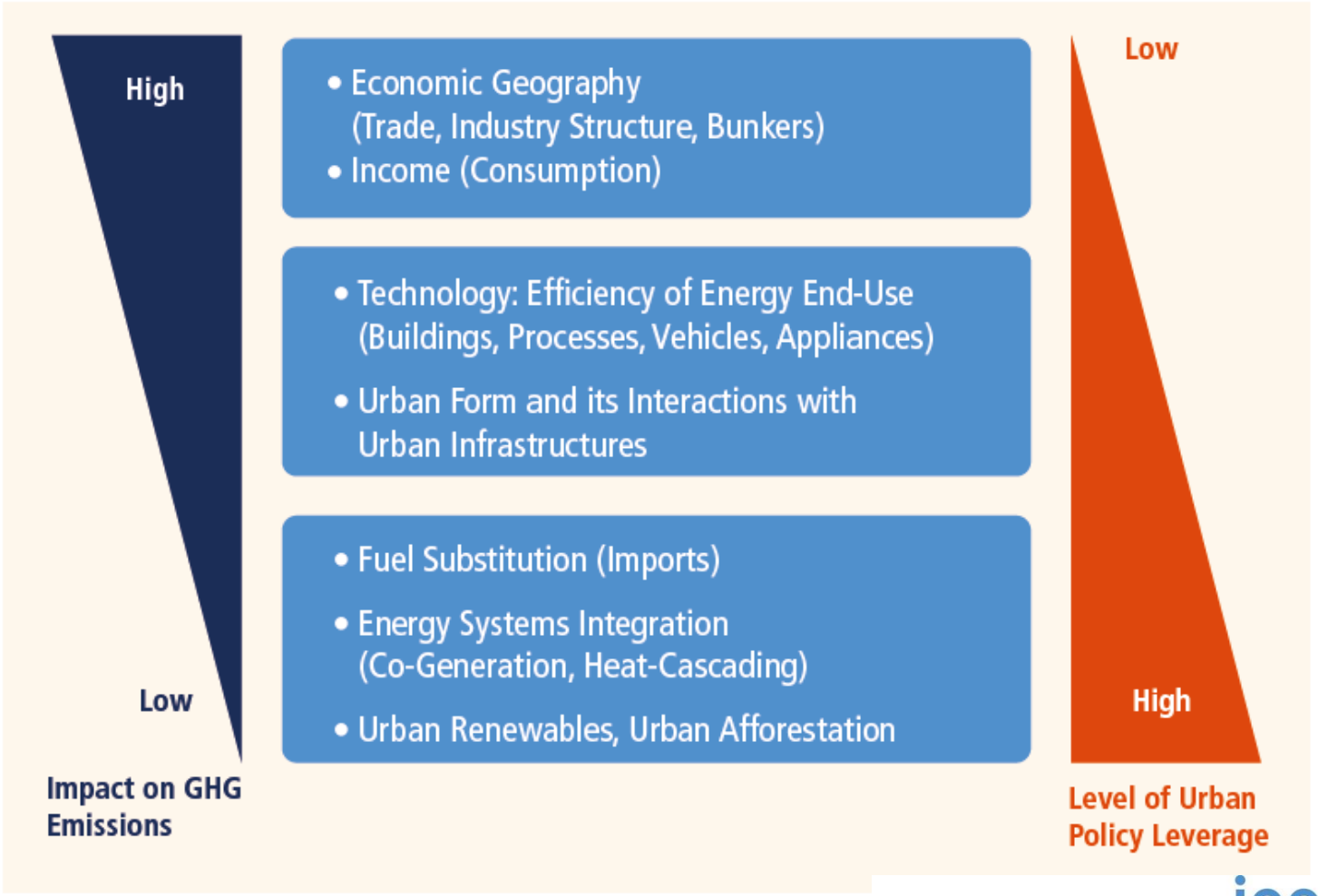
Governance Paradox: Largest opportunities to GHG reduction may be in places where institutional and governance capacities are weakest



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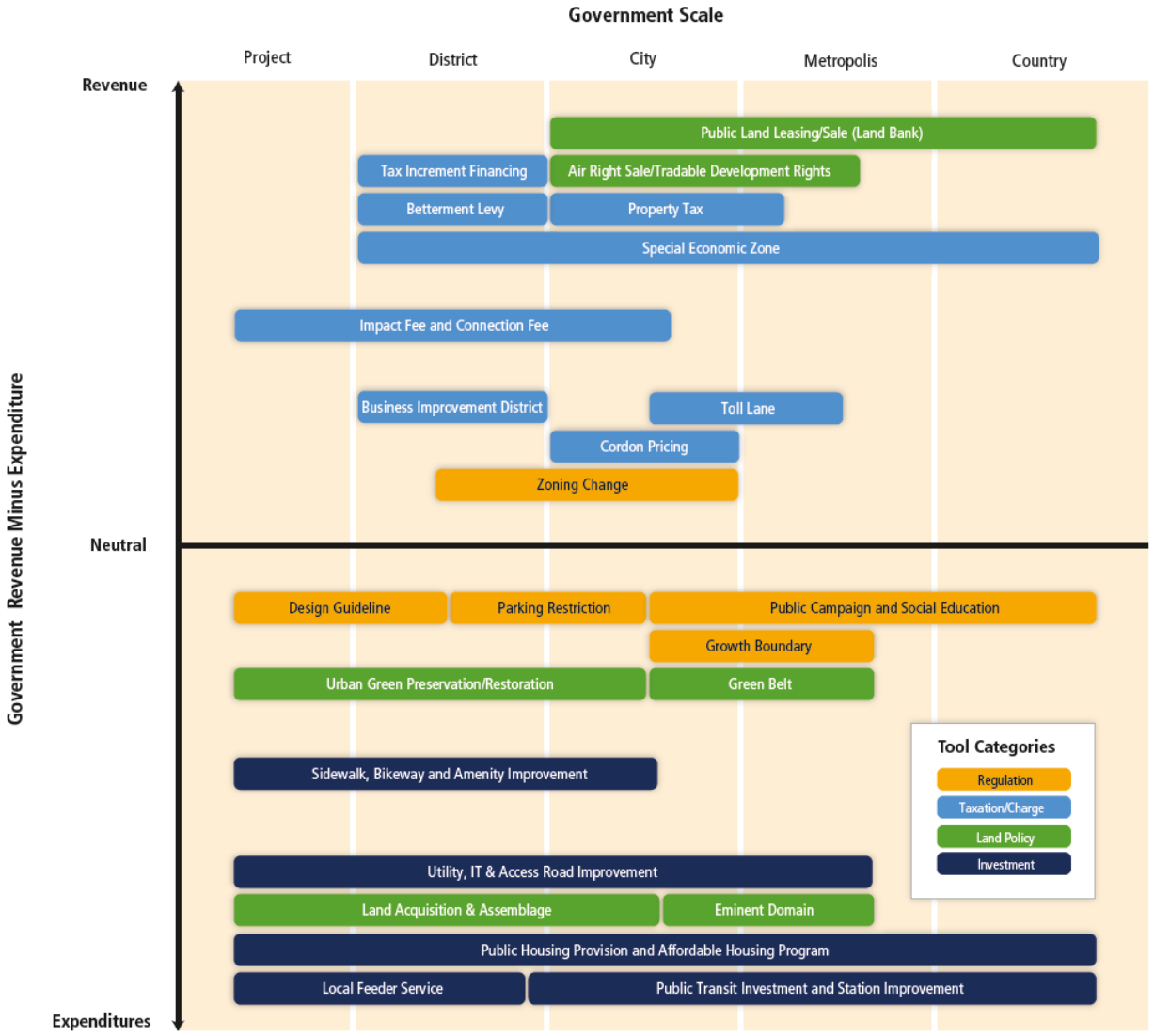
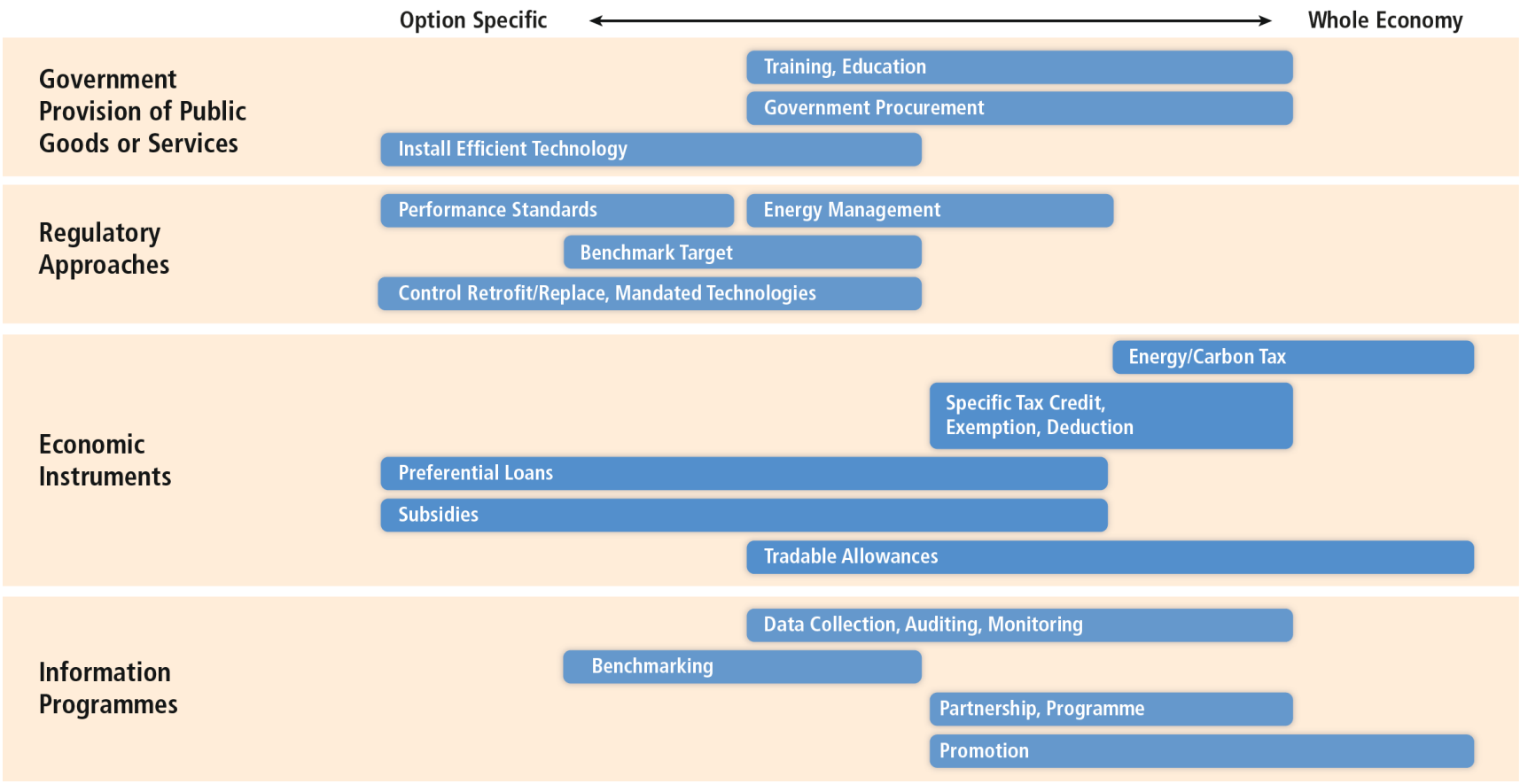
Different spatial planning tools have different ability to raise revenue or require expenditures

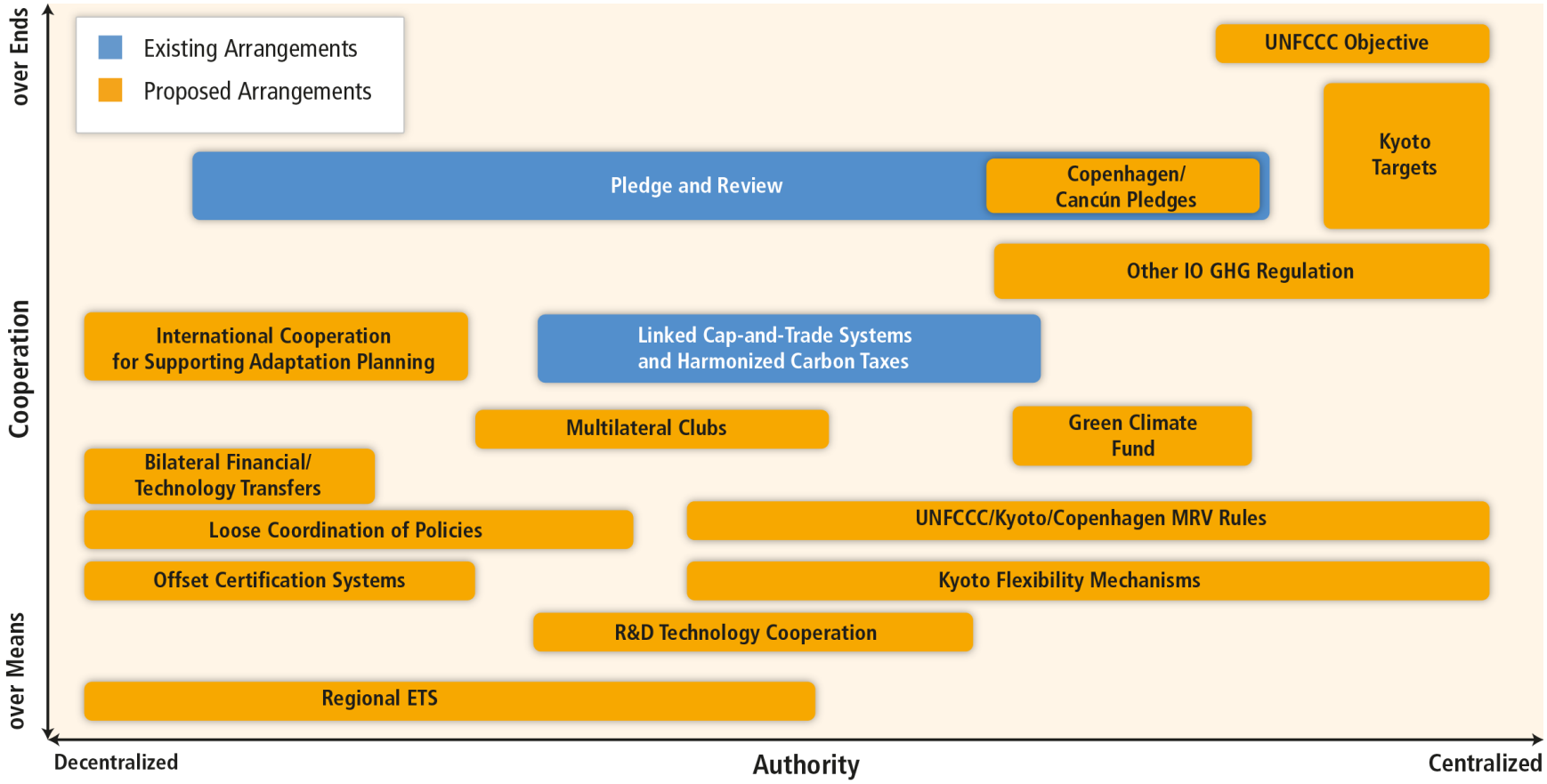


Sector-specific policies have been more widely used than economy-wide policies



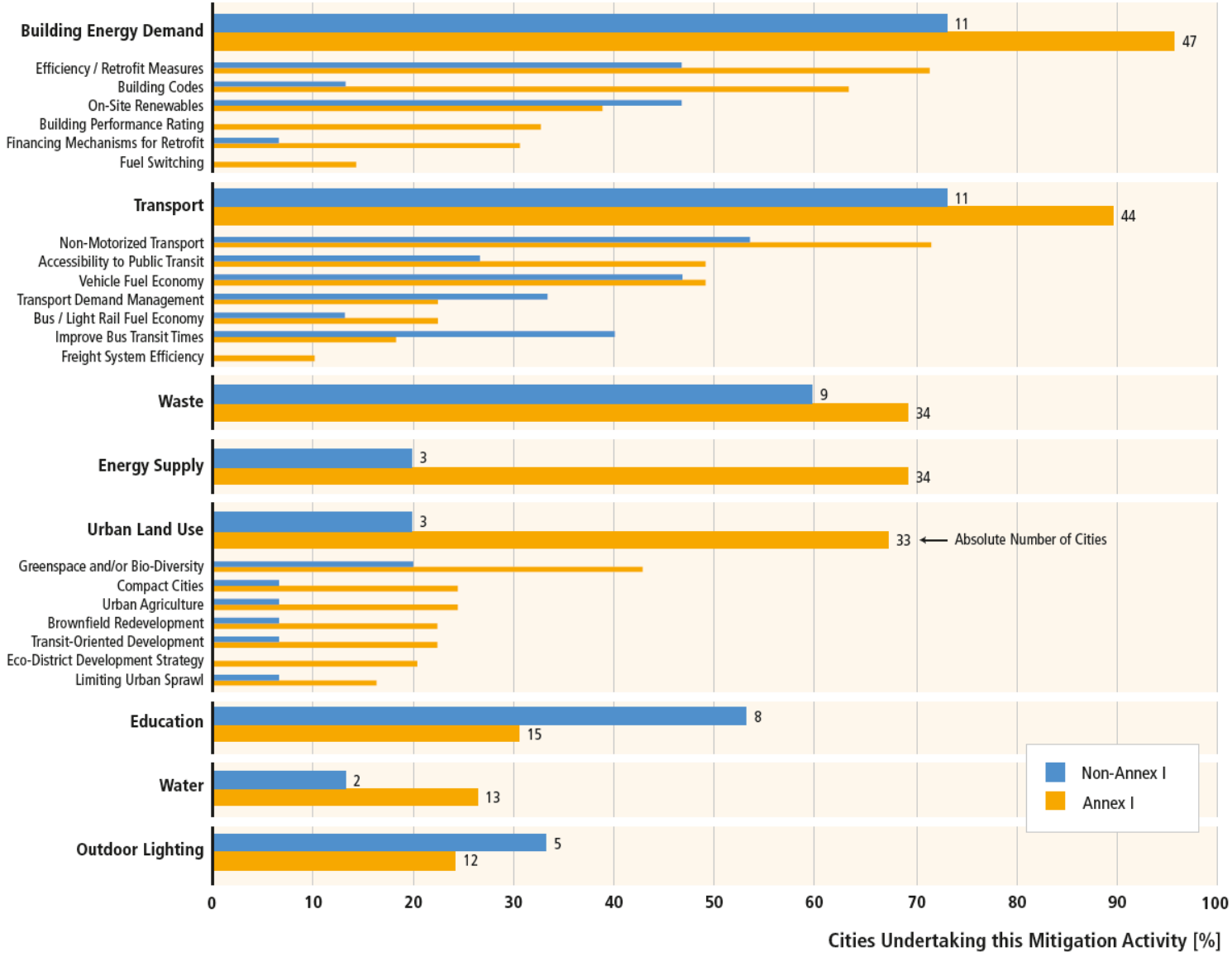
Based on Figure 10.15

Effective mitigation will not be achieved if individual agents advance their own interests independently



Based on Figure 13.2

Thousands of cities are undertaking climate action plans, but impacts on emissions are unclear, few take systems approach



The importance of co-benefits as entry points to discuss mitigation or sustainability

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]

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