

Metabolism of Megacities

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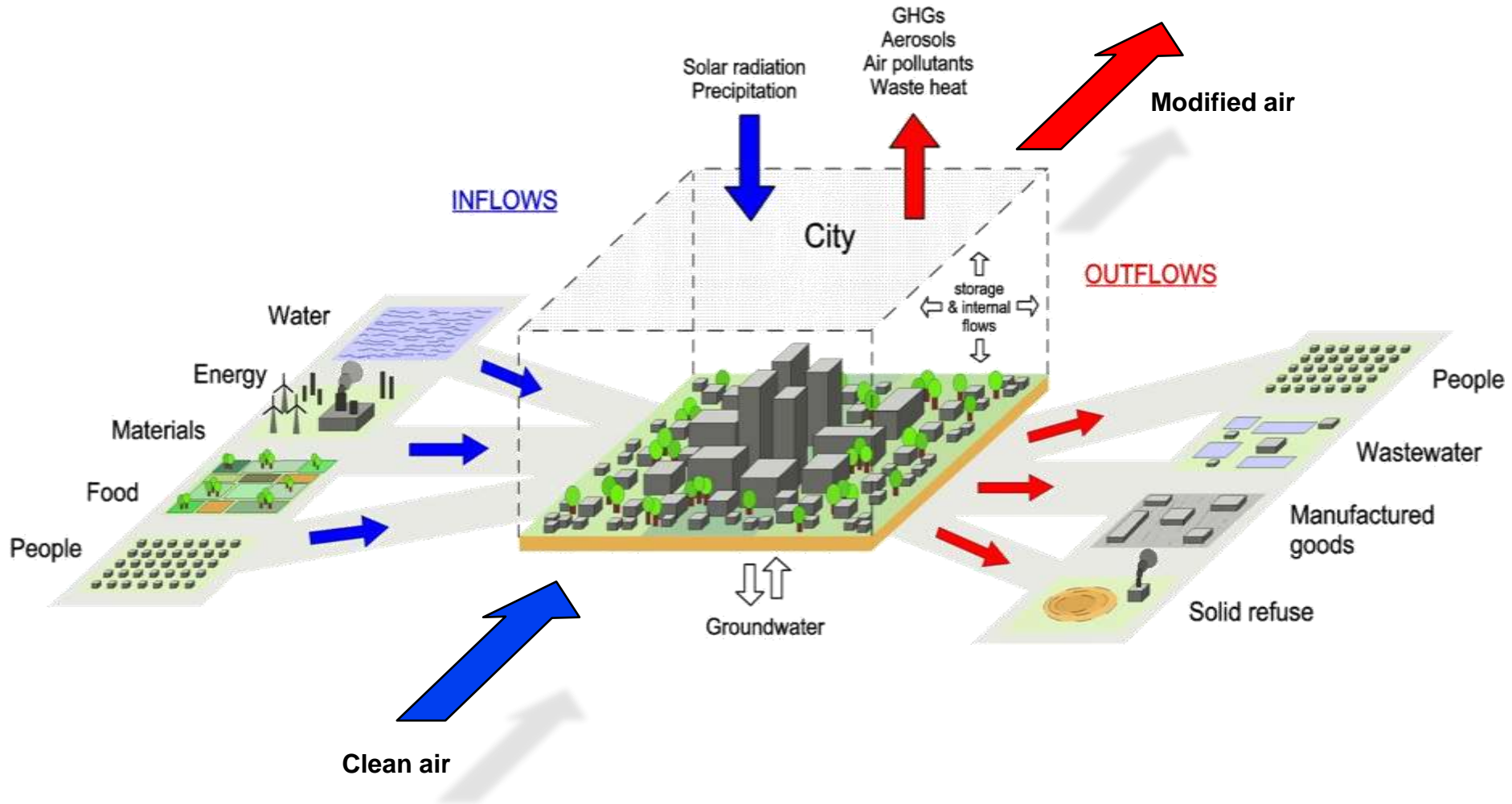
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Global Cities Institute, University of Toronto, February 5, 2016

The urban metabolism framework



Conventional approach

Quantify the energy & material flows through an urban area for a calendar year. Consider electricity use, fuel use, waste disposal, water & food consumption.

Difficult to obtain and compare data at megacity scale

Reporting practices differ among regions



Research aims

Collect and compare data on energy & material flows in the world's 27 megacities

Investigate drivers and rates of change (2001 to 2011)

Relate urban metabolism to basic utility services & quality of life



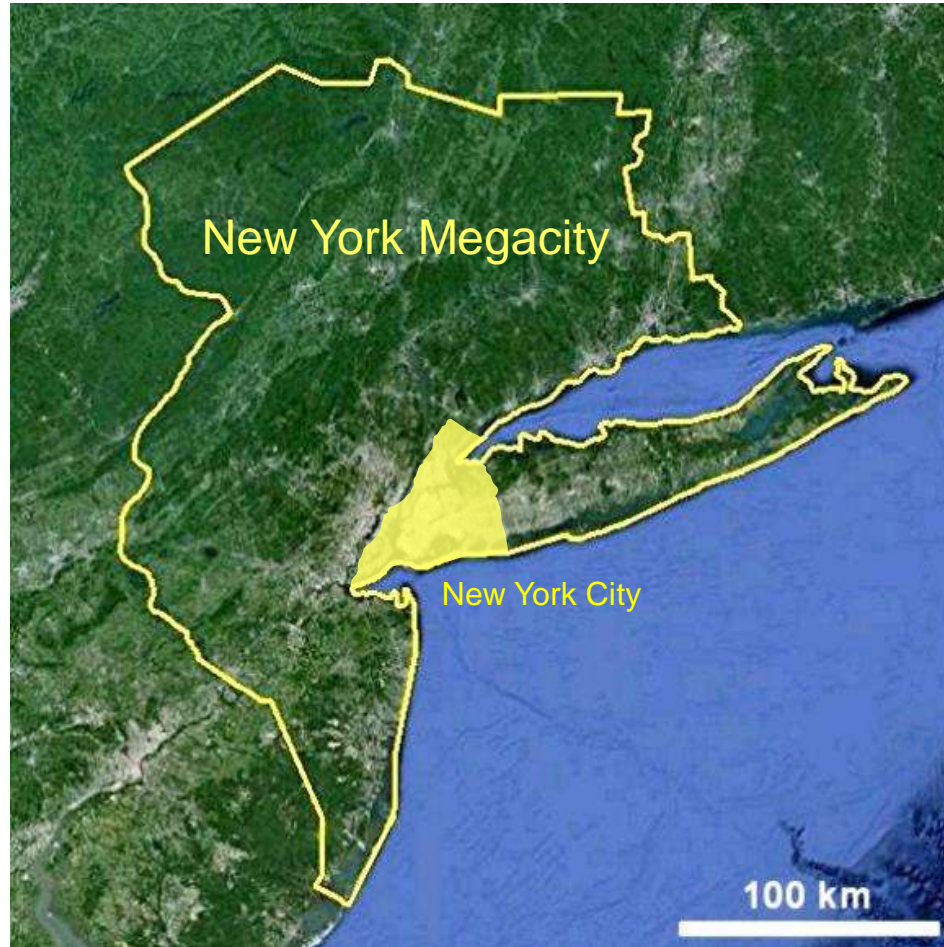
What is a megacity?

+10 million people

common commutershed

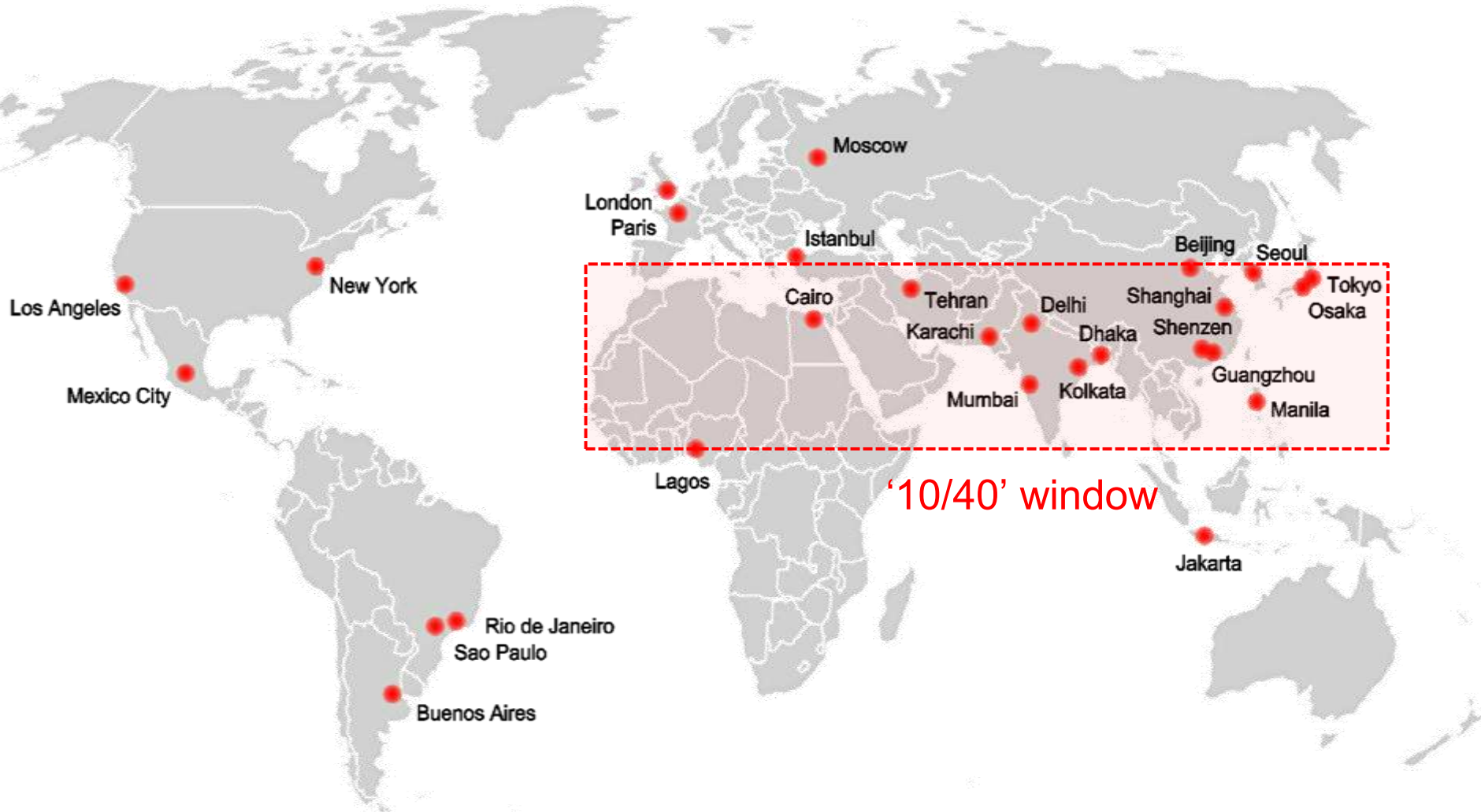
polycentric form

Scale and complexity in megacities

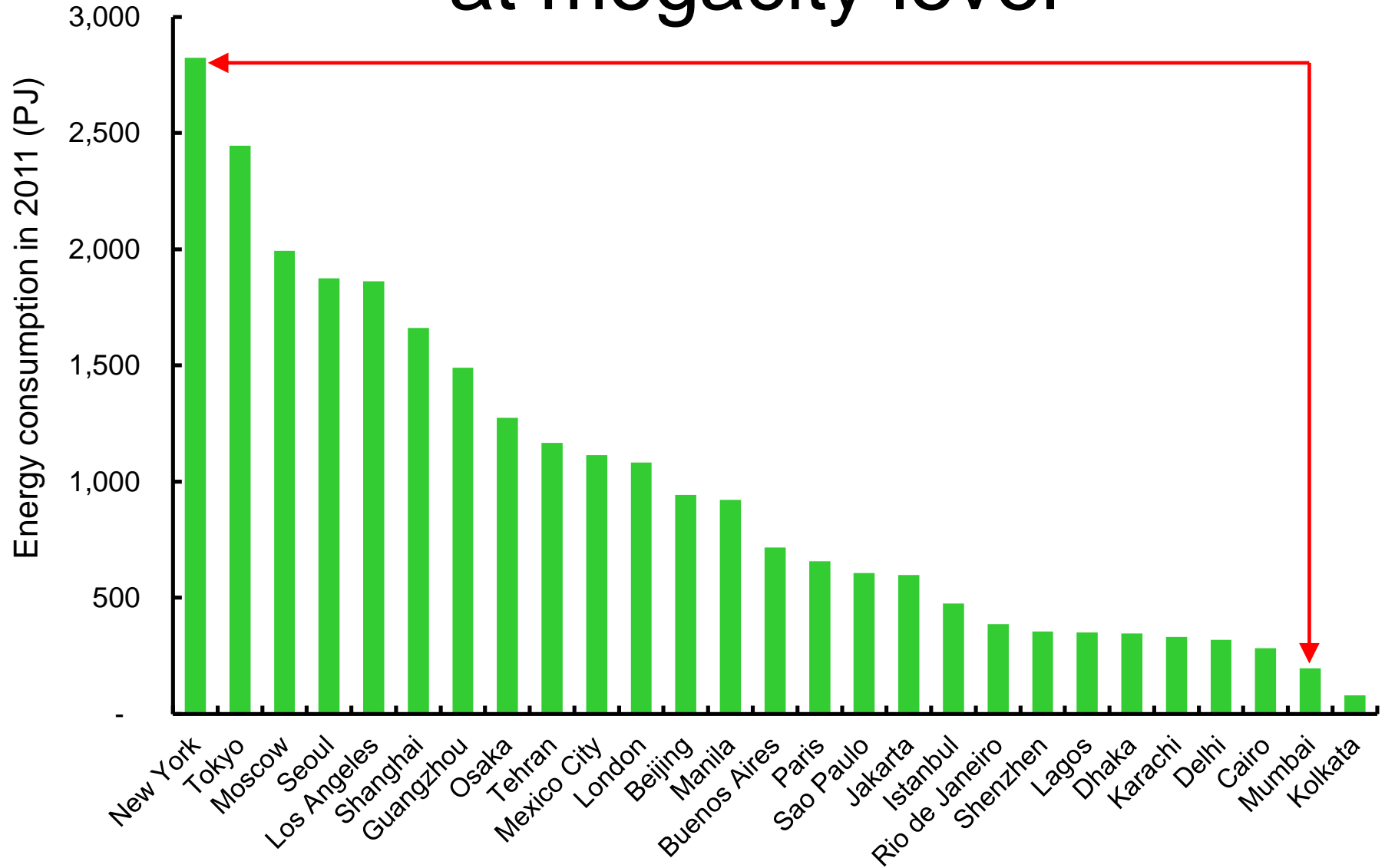


22 million people; 31 counties; 3 states
30,000 km² land area; 10,000 km² urbanized

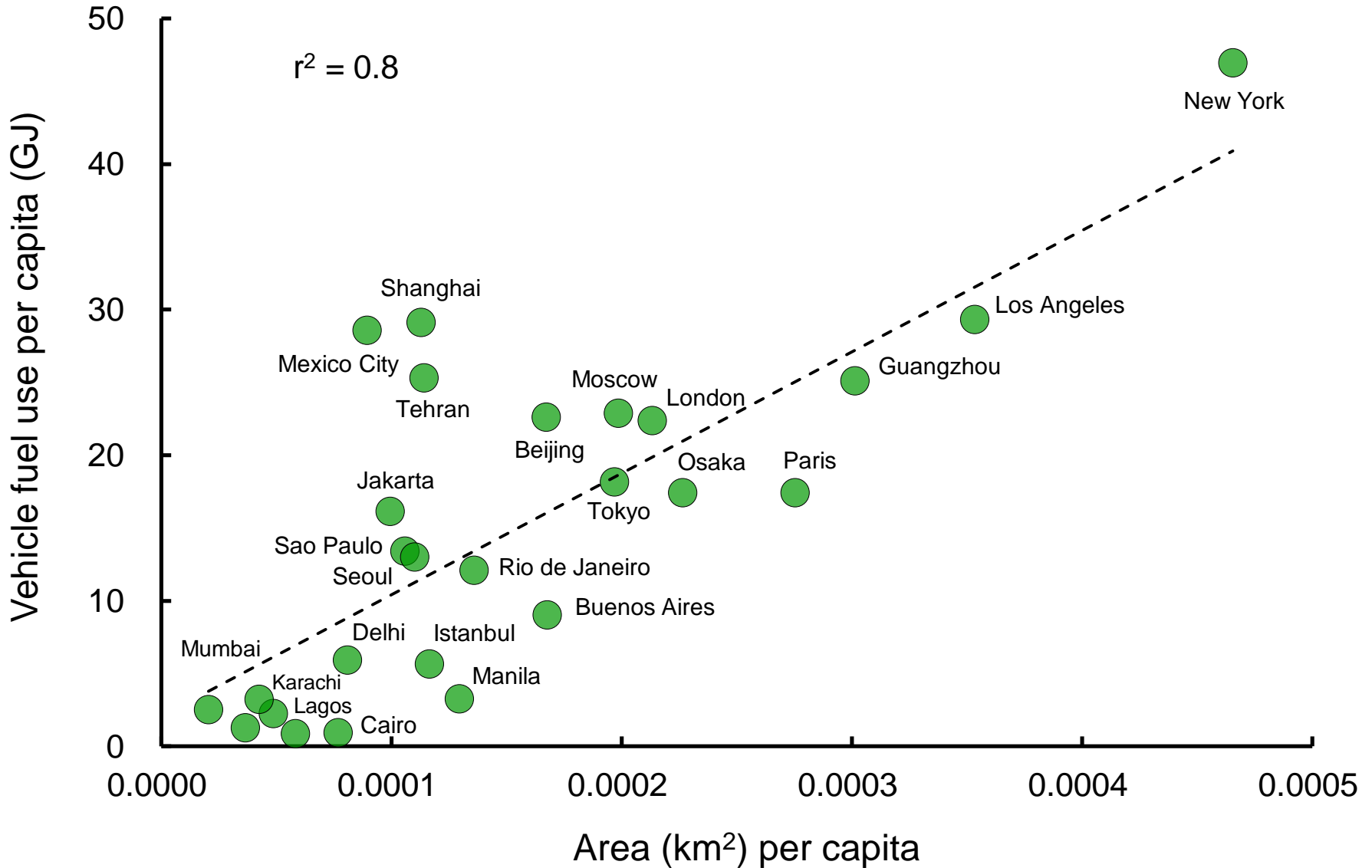
Global distribution of megacities



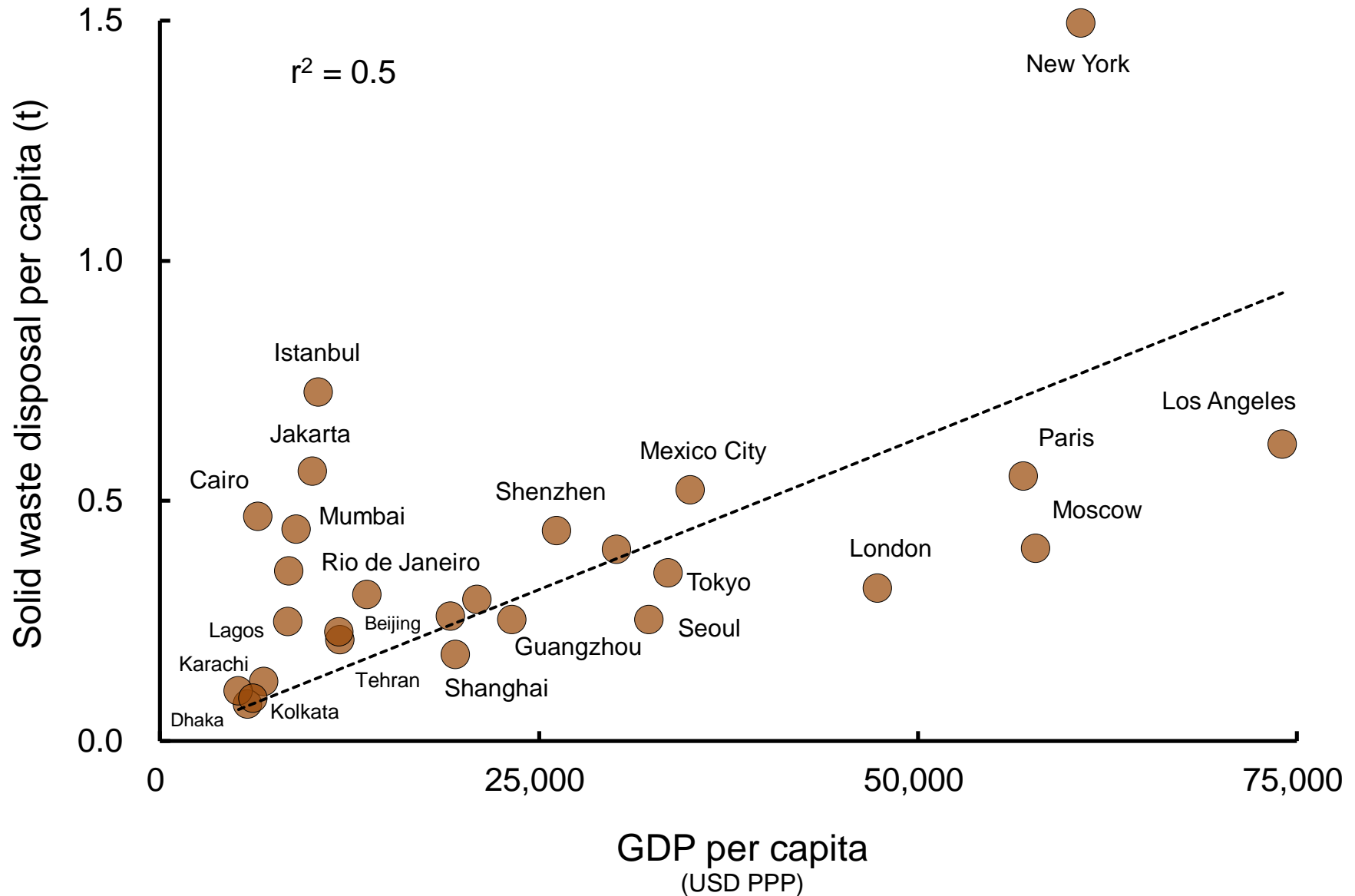
Extreme values in energy use at megacity level



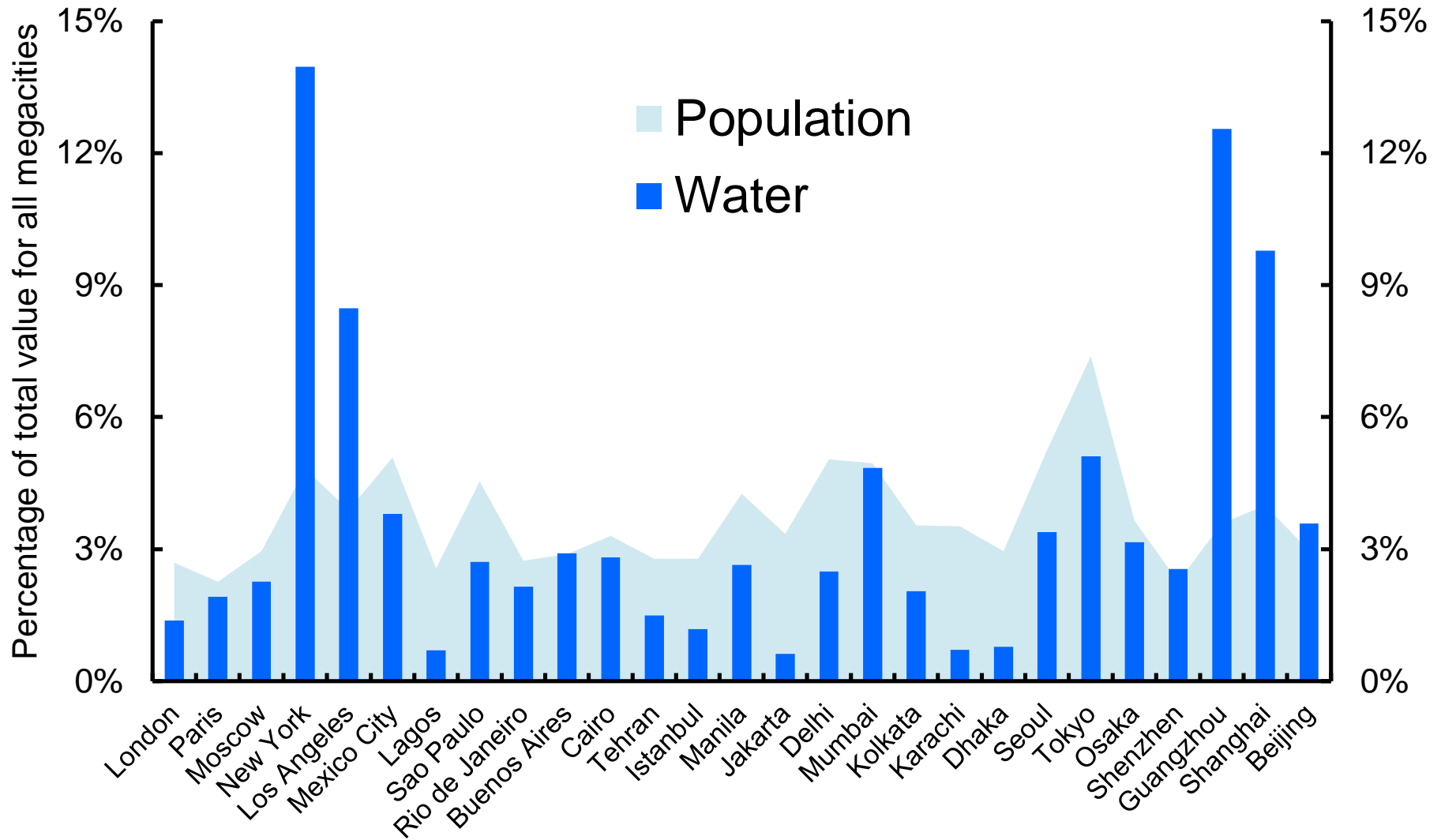
Urban form influences transport fuel use



Urban wealth influences solid waste disposal



Efficient use of water in megacities?



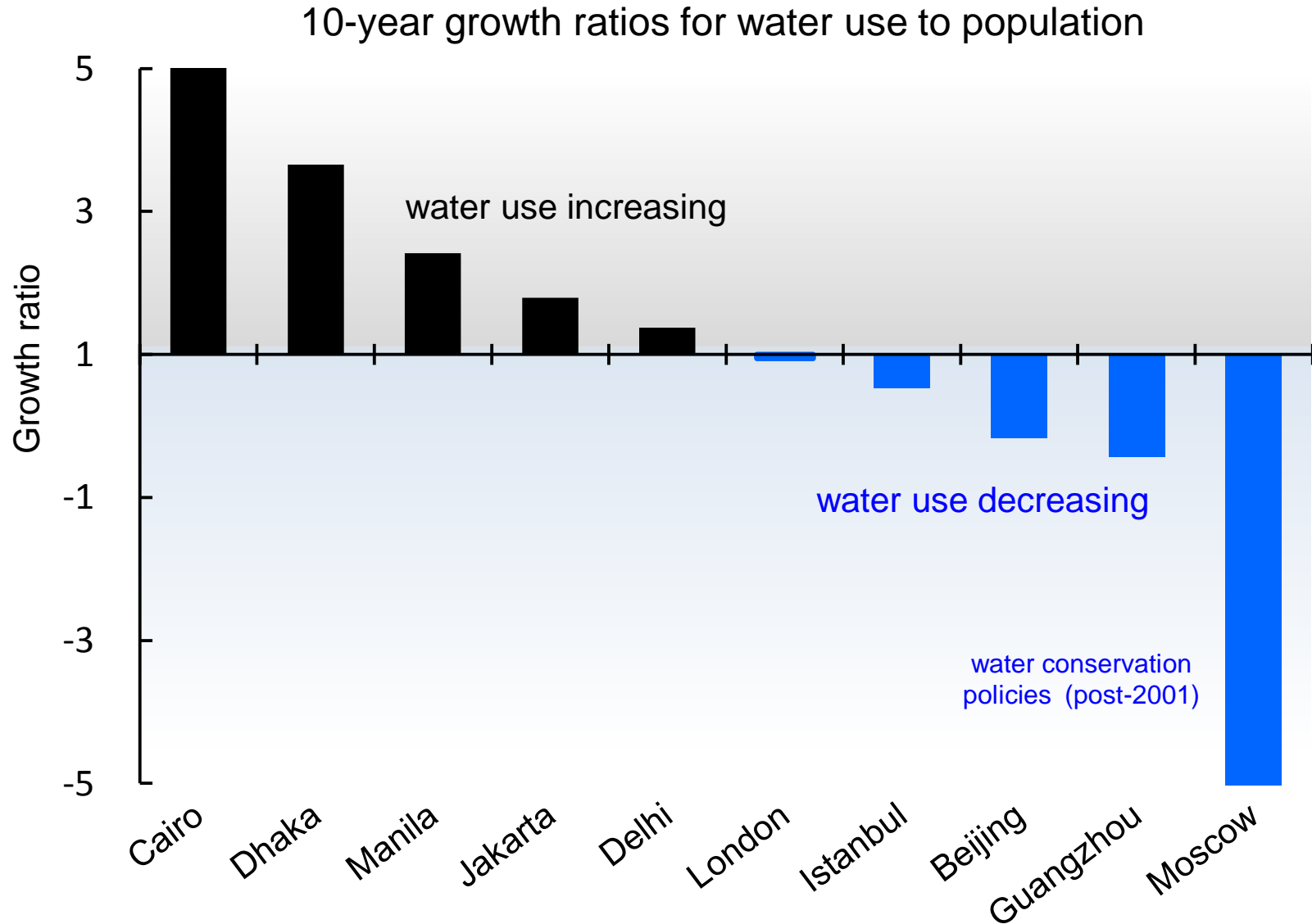
广州为何成为“大花洒”

Why Guangzhou became a giant “showerhead”

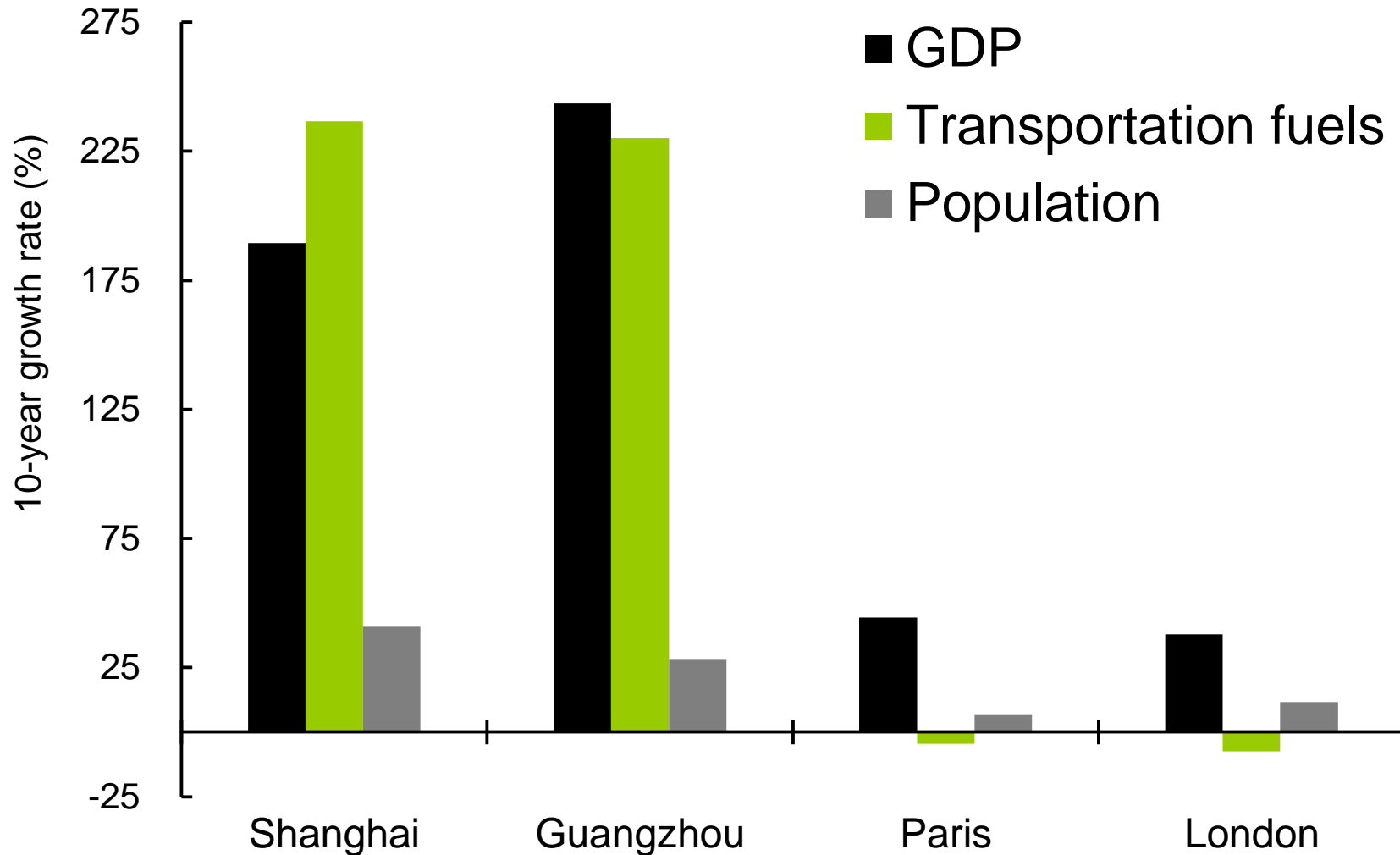
Nanfang Daily, June 2008



Policies matter: Water conservation in Moscow

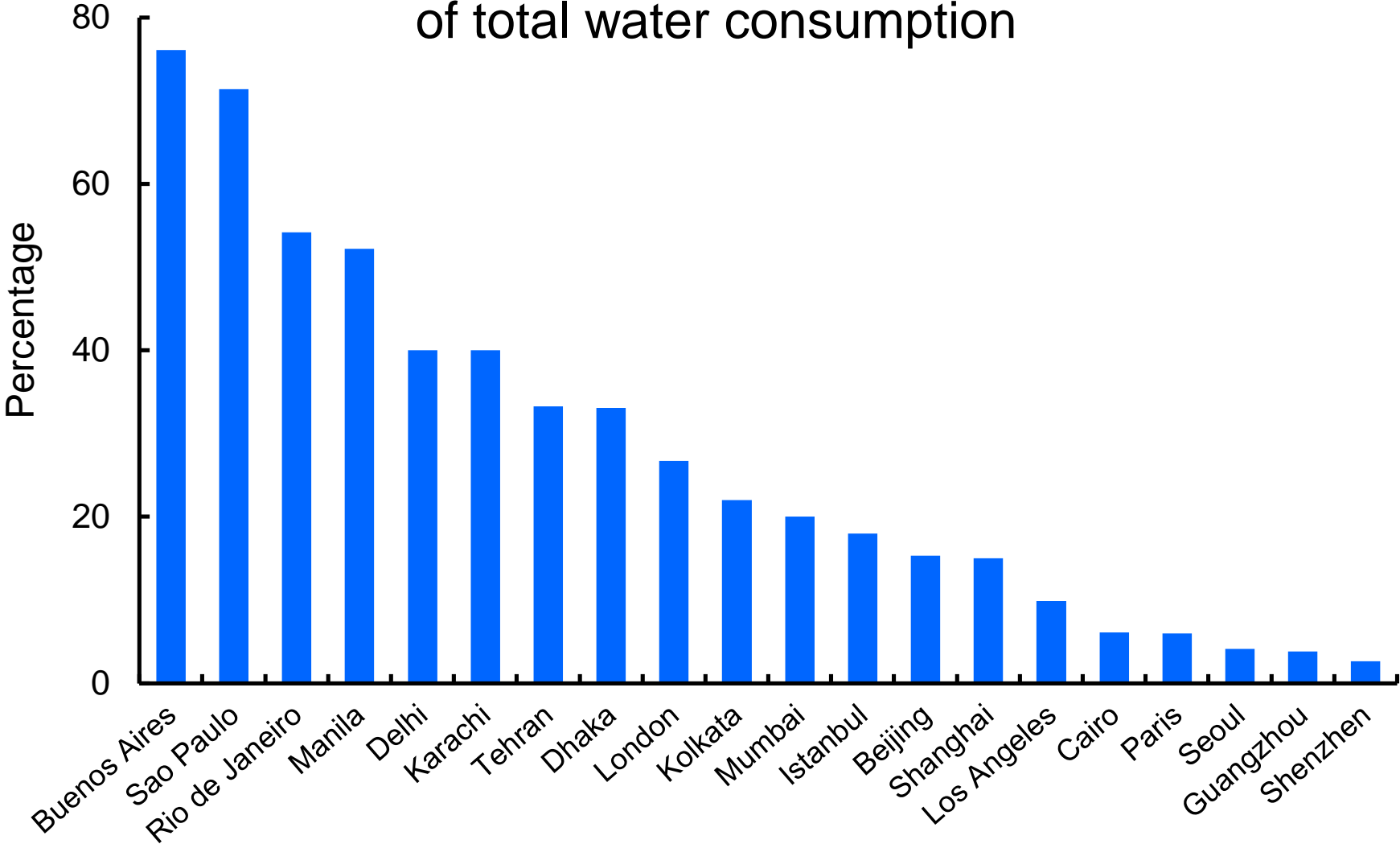


Decoupling urban growth from resource consumption

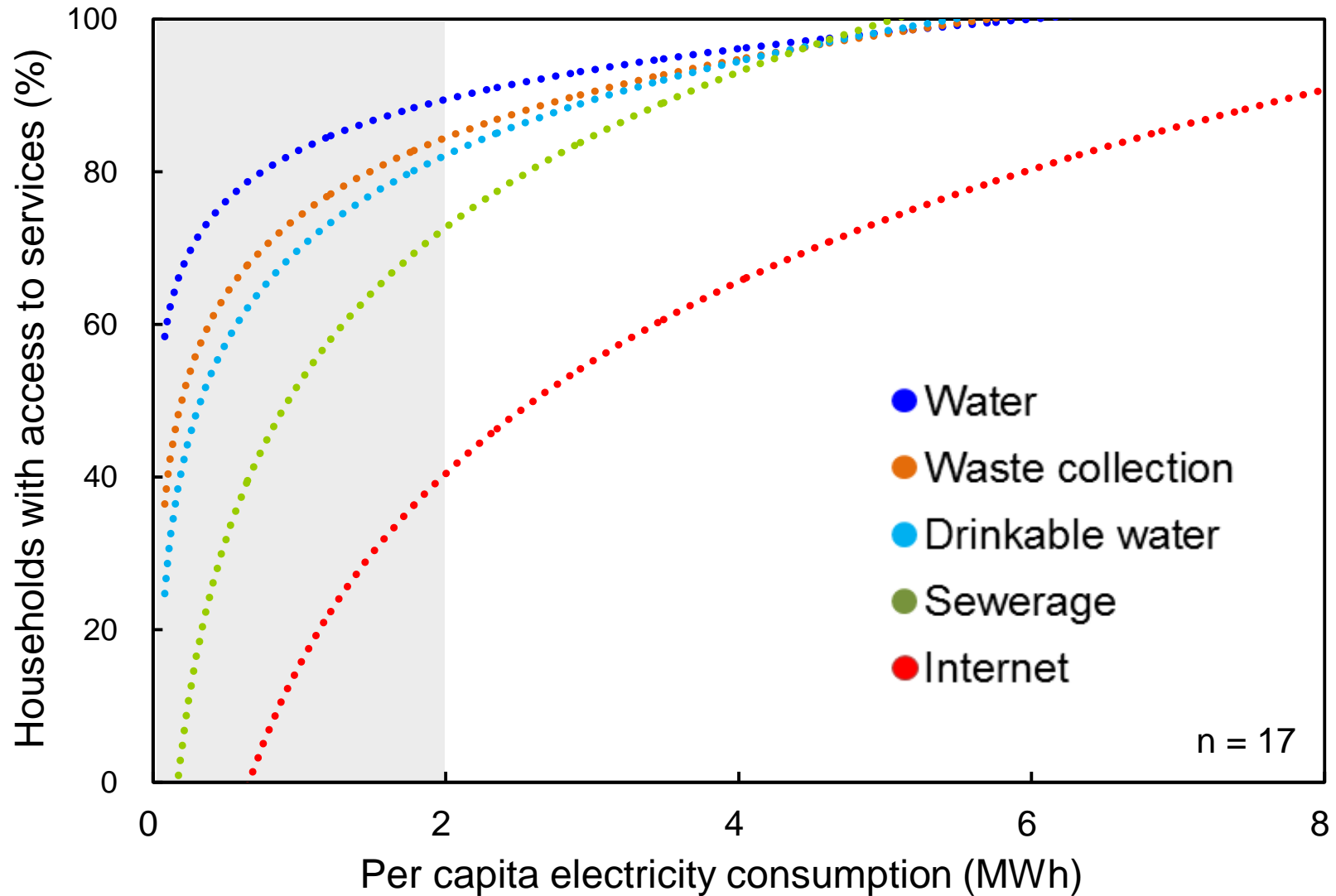


Inefficiencies in urban infrastructure

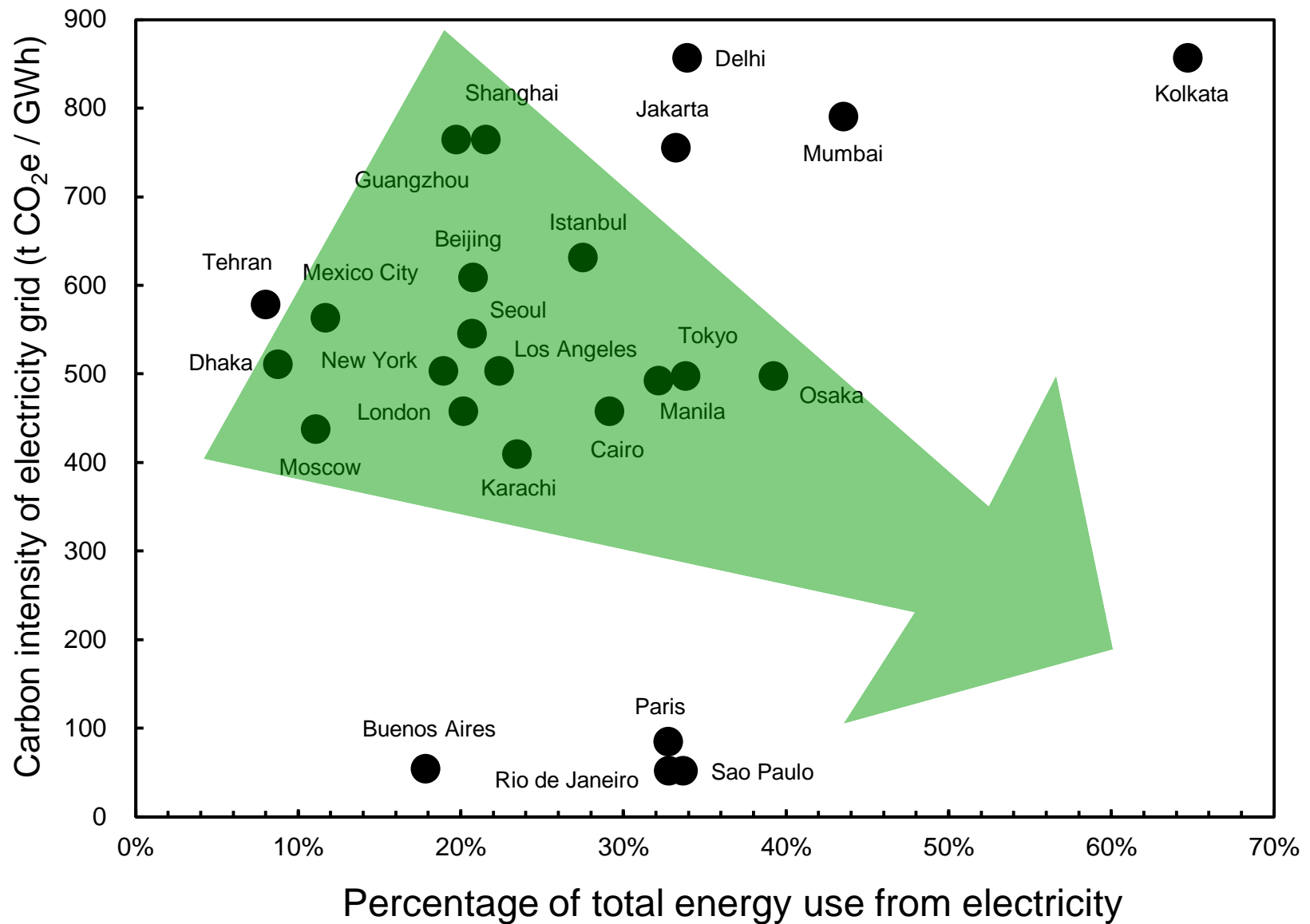
Water line losses as a percentage of total water consumption



Linking quality of life to electricity supply



Transforming to low-carbon electric megacities



Potential for low-carbon electric cities in low/middle income regions?

Air quality
Service delivery
Economic prosperity

Costs & storage
Informal settlements
Energy-density mismatch



Final remark

Urban metabolism data for all megacities are publicly available:

Kennedy, C., Stewart, I., Facchini, A., et al., 2015.
Energy and material flows of megacities. *Proceedings of the National Academy of Sciences of the United States of America*, 112, 5985–90.