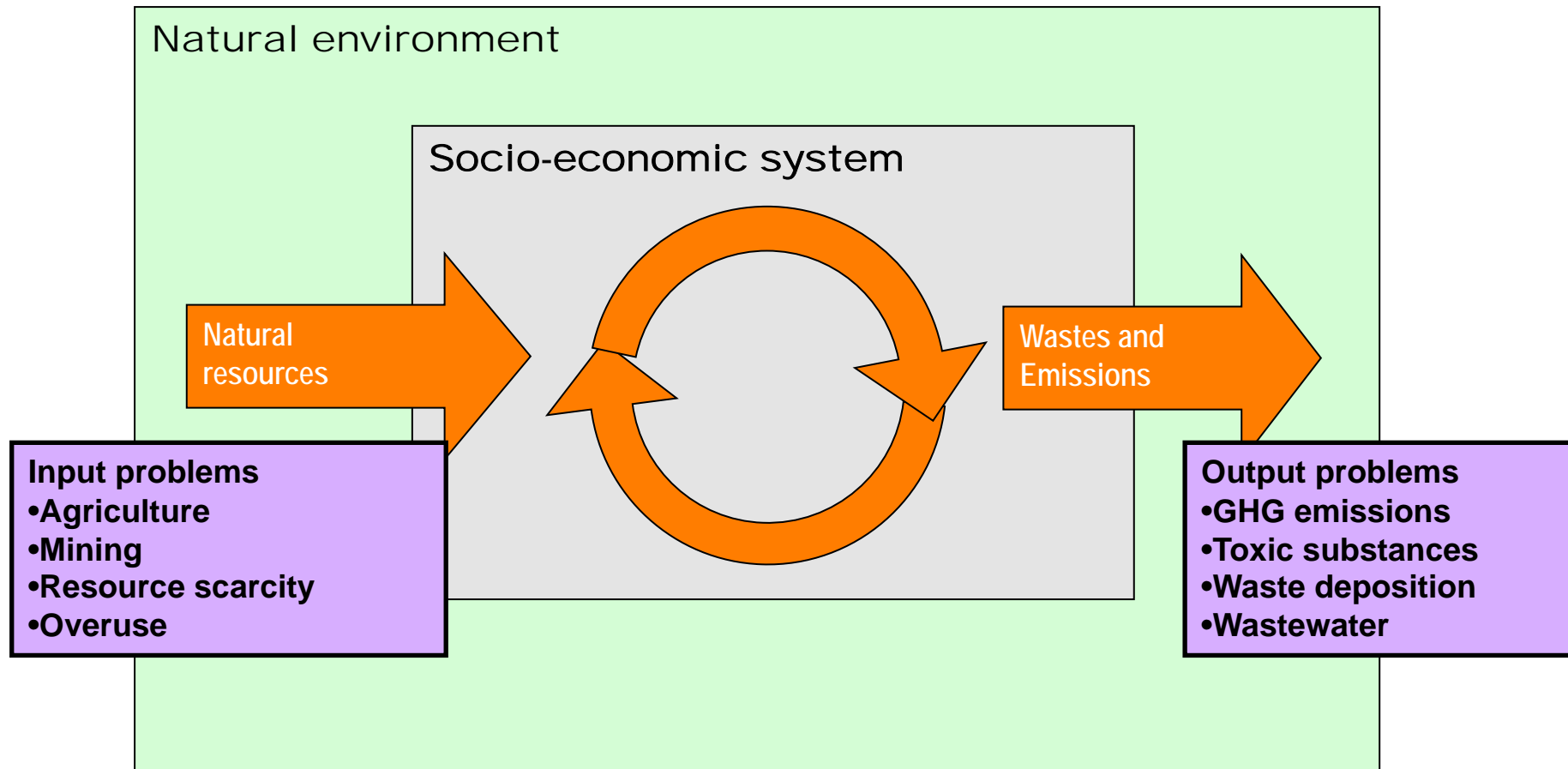


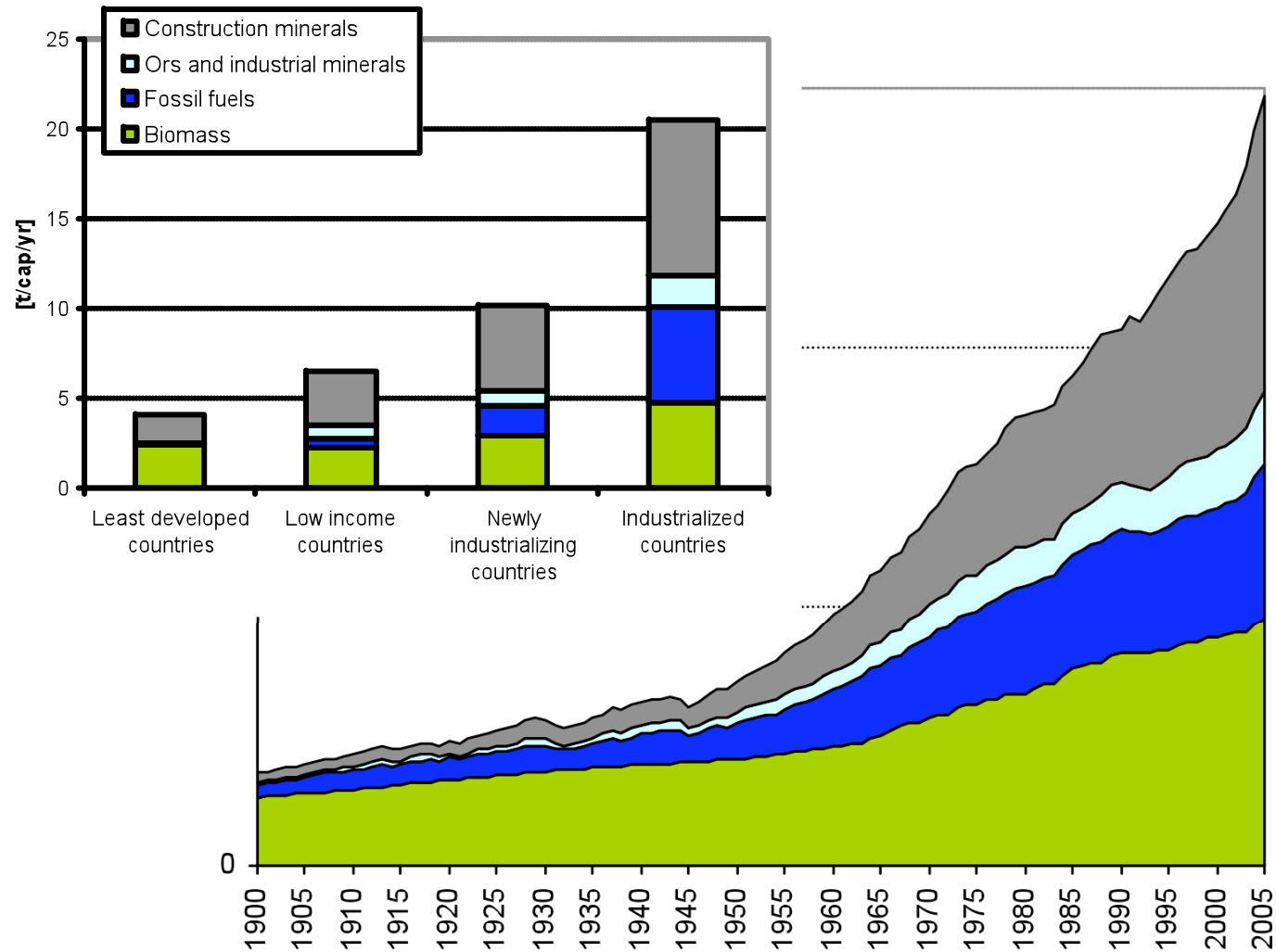
Urban Metabolism and Sustainable Development

Fridolin Krausmann

Social or industrial metabolism: A concept to investigate society-nature interactions



The global metabolic transition: Global material extraction = use 1900 to 2005



Urban Growth: Sustainable metabolic patterns can not be achieved without urban specific considerations

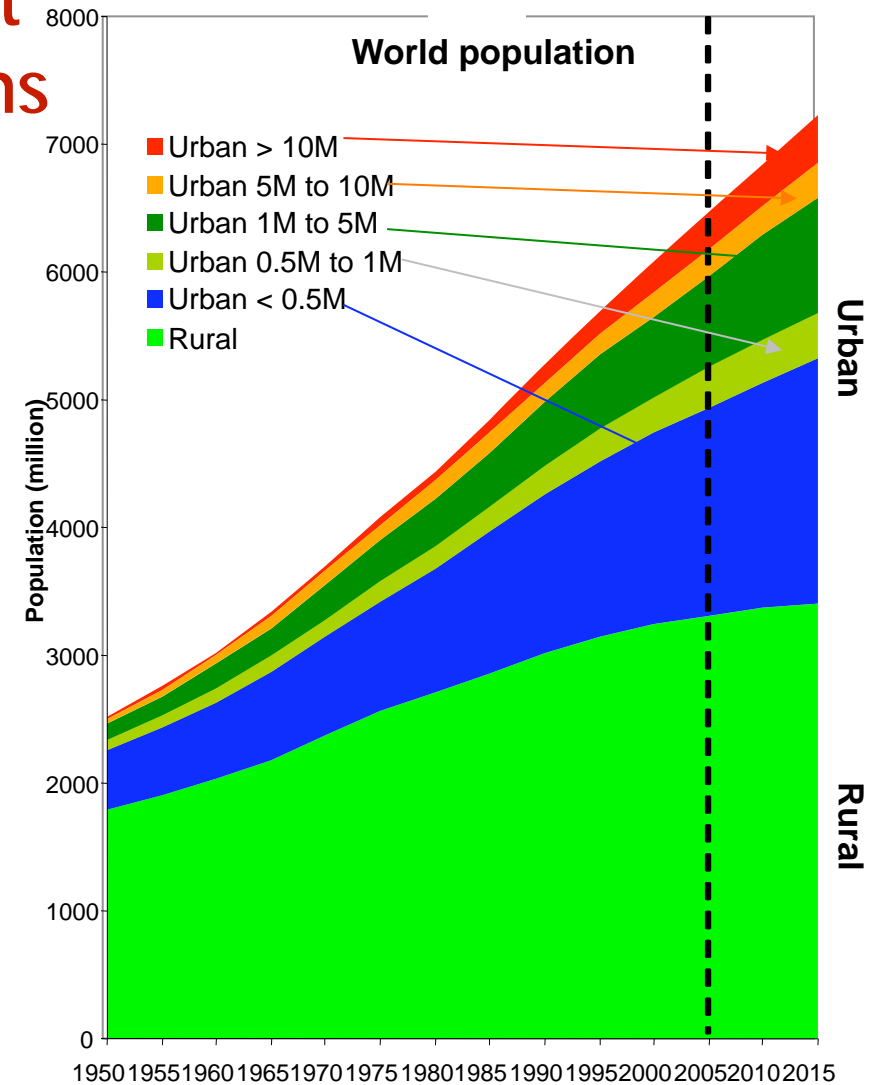
Population growth will occur in urban areas



Drivers of urban metabolism are drivers of overall resource use



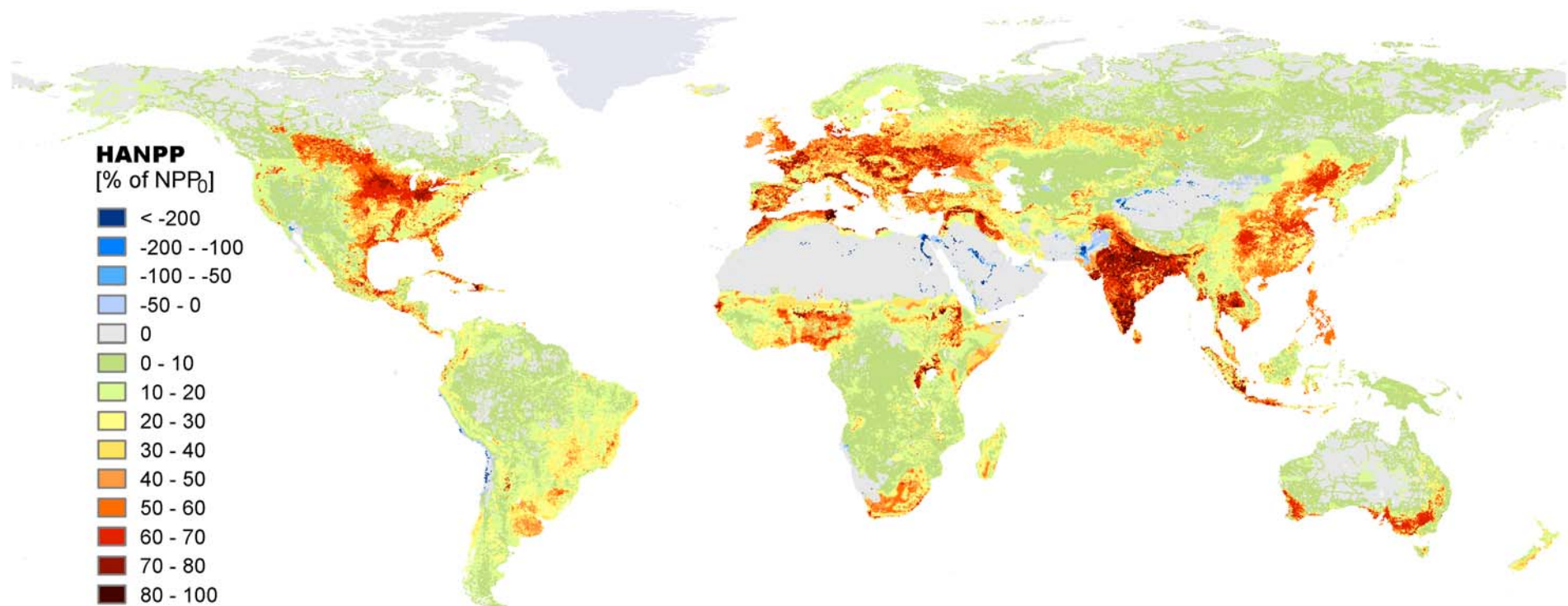
Influencing resource use requires understanding the drivers of urban metabolism



Source: Dhakal 2008 (UNPD Data)

Global HANPP: Human appropriation of net primary production

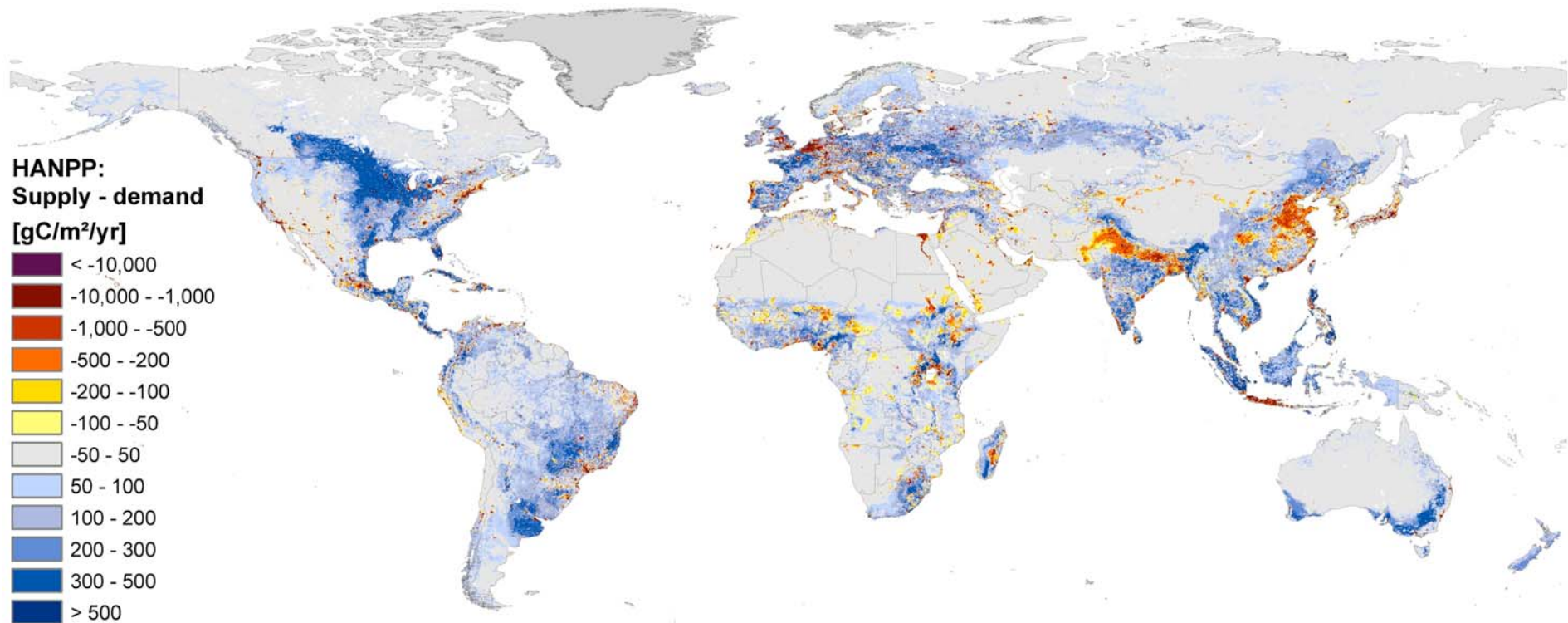
Humans appropriate 25% of the global NPP



Haberl et al. 2007

Transfers of ecosystem services

„Supply“ and „demand“ of embodied HANPP



Erb et al. 2009

Urban Metabolism: Vienna 1991

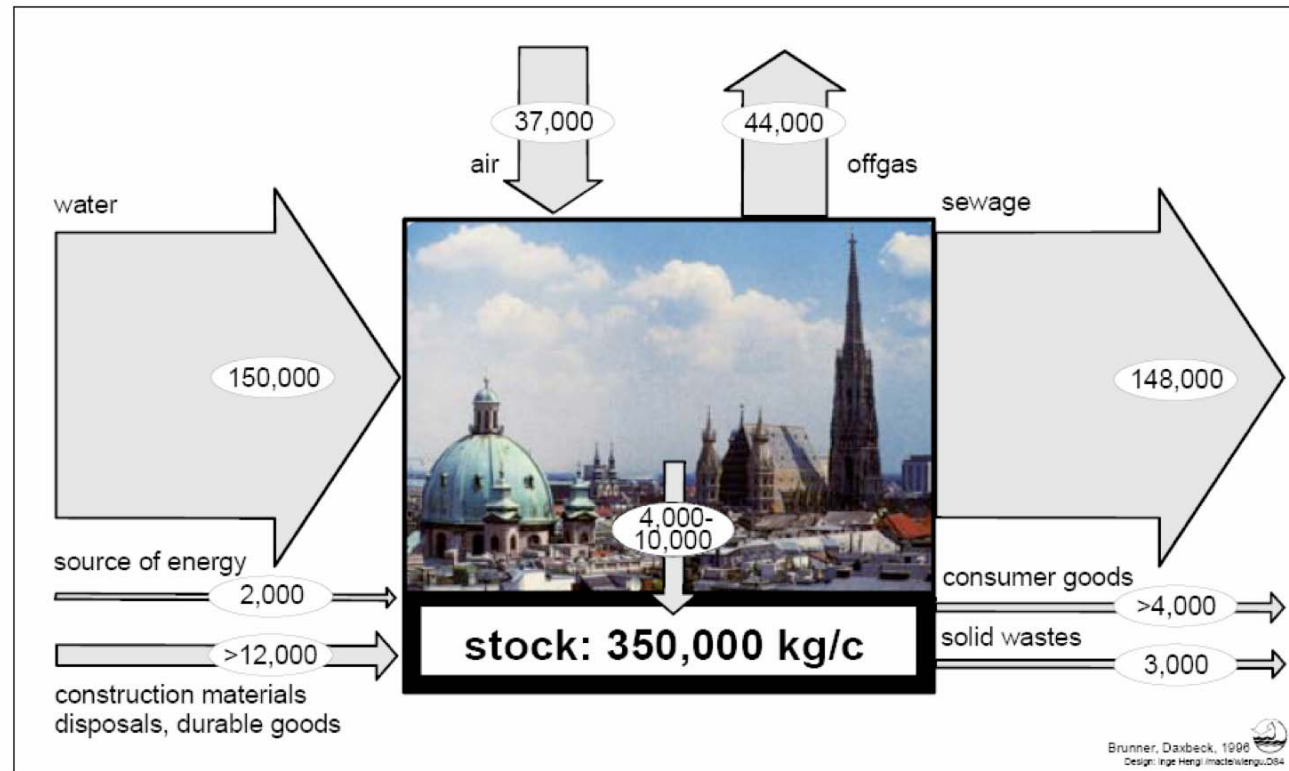


Figure 8-1: Flows and Stocks of Goods in the Anthroposphere of Vienna in 1991 (flows in [kg/c.y]; stock in [kg/c]); Population of Vienna - approx. 1.5 million

Source: Obernosterer et al. 1998 (Urban Metabolism. The city of Vienna)

The city and its hinterland: Nitrogen flows

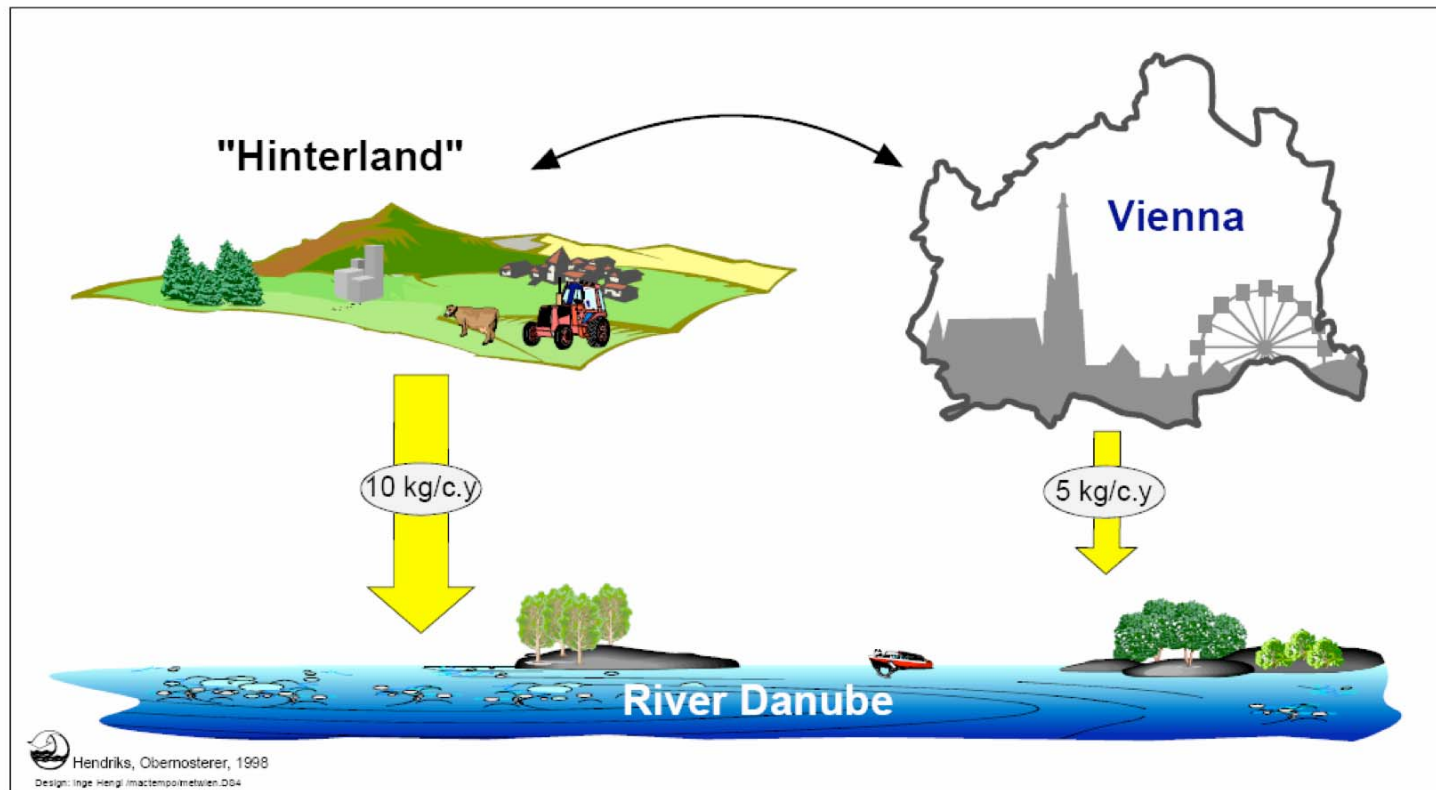
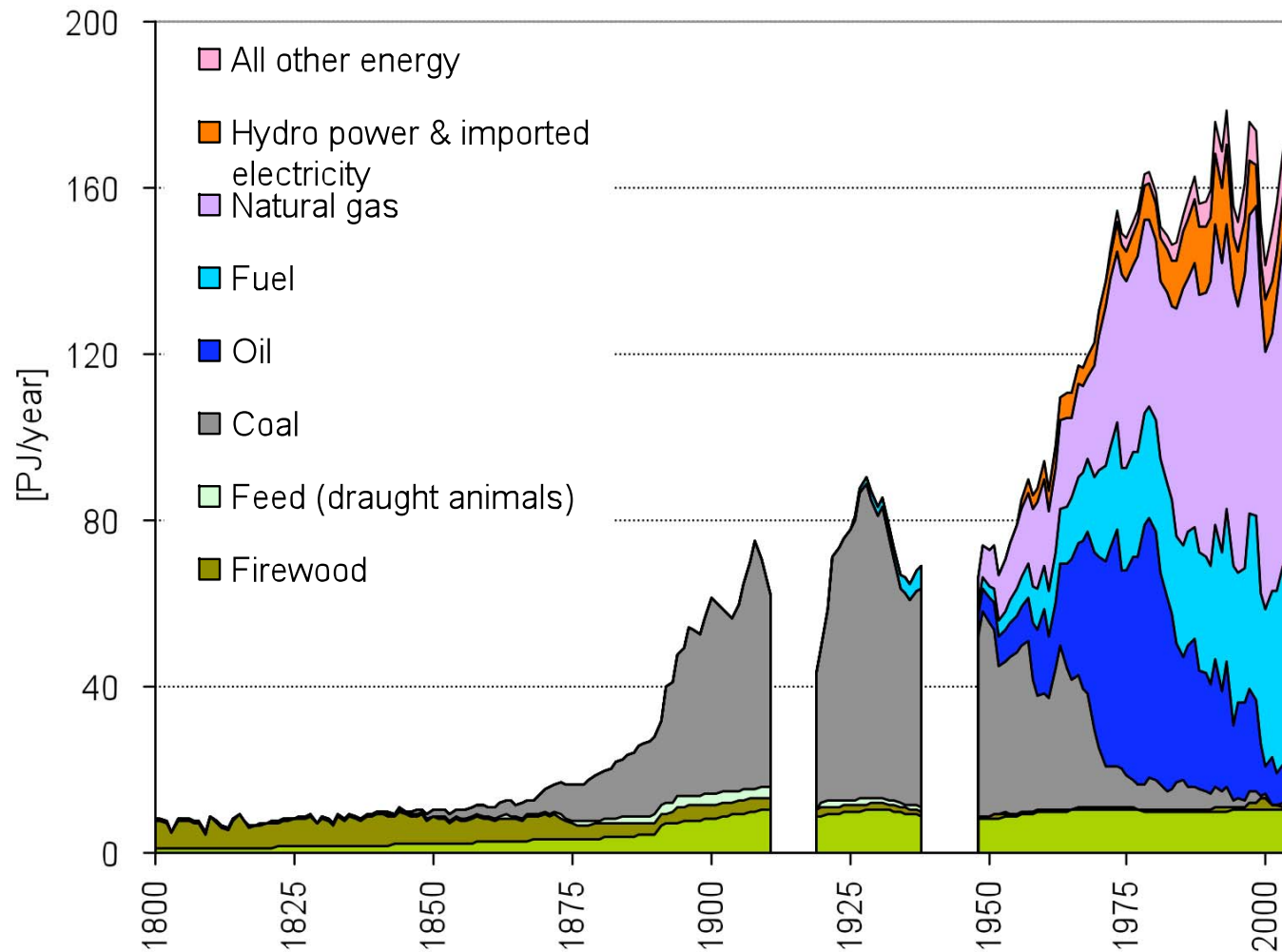


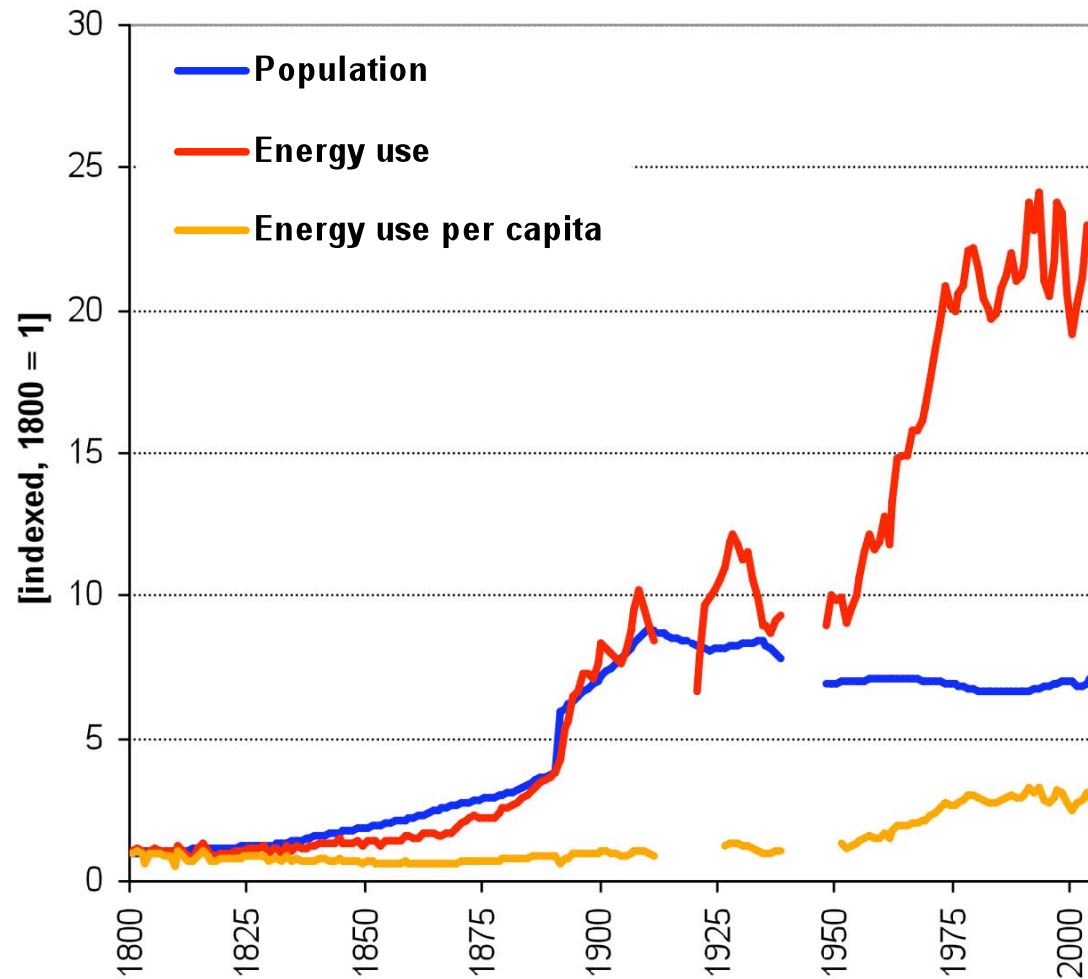
Figure 6-3: Nitrogen flows in kg/c.y induced by the Metabolism of the City of Vienna into the Danube River within the City and the „Hinterland“

Source: Obernosterer et al. 1998 (Urban Metabolism. The city of Vienna)

Urban energy transition: Energy use, Vienna 1800-2006

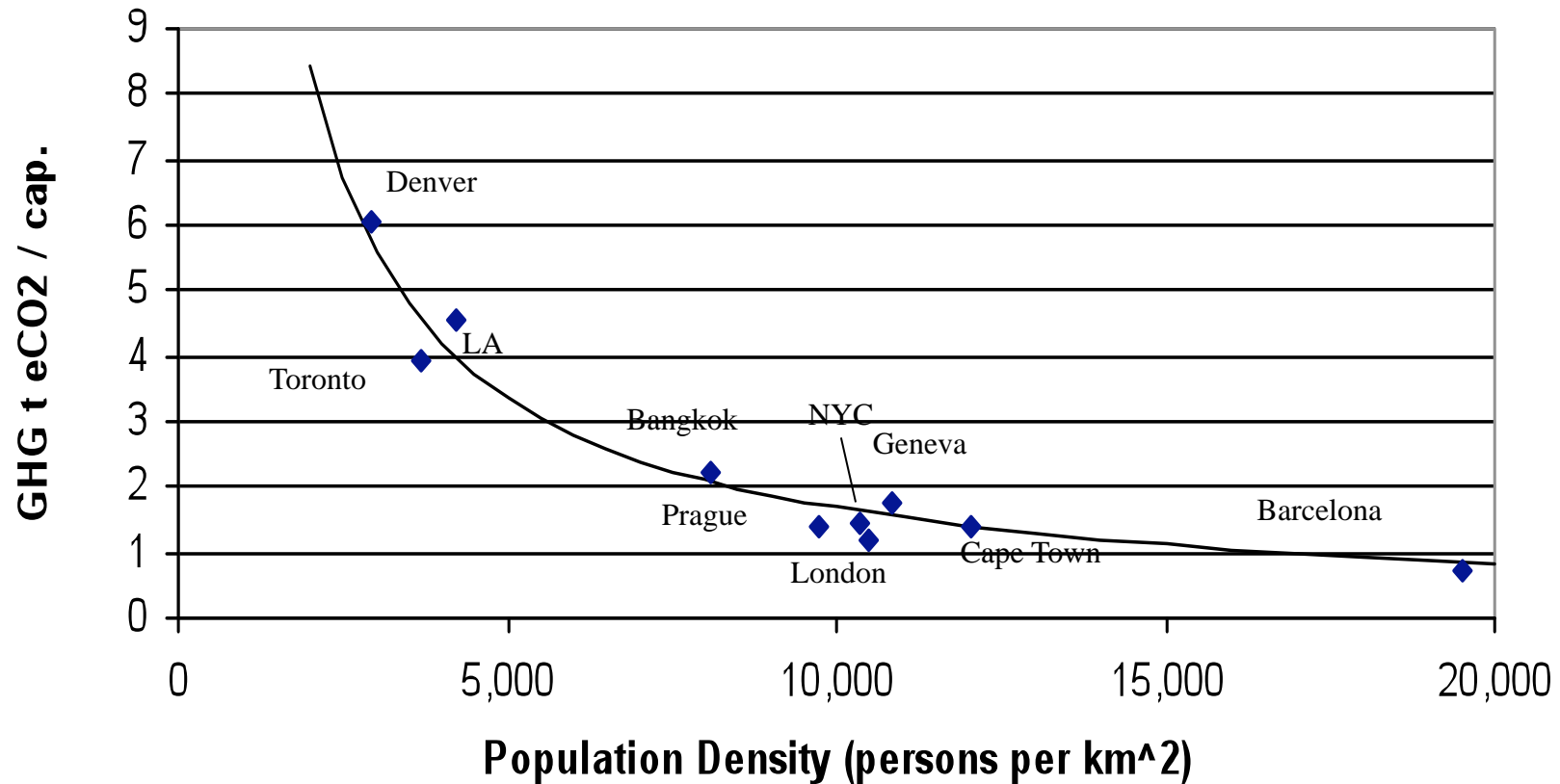


Urban energy transition: Energy use, Vienna 1800-2006



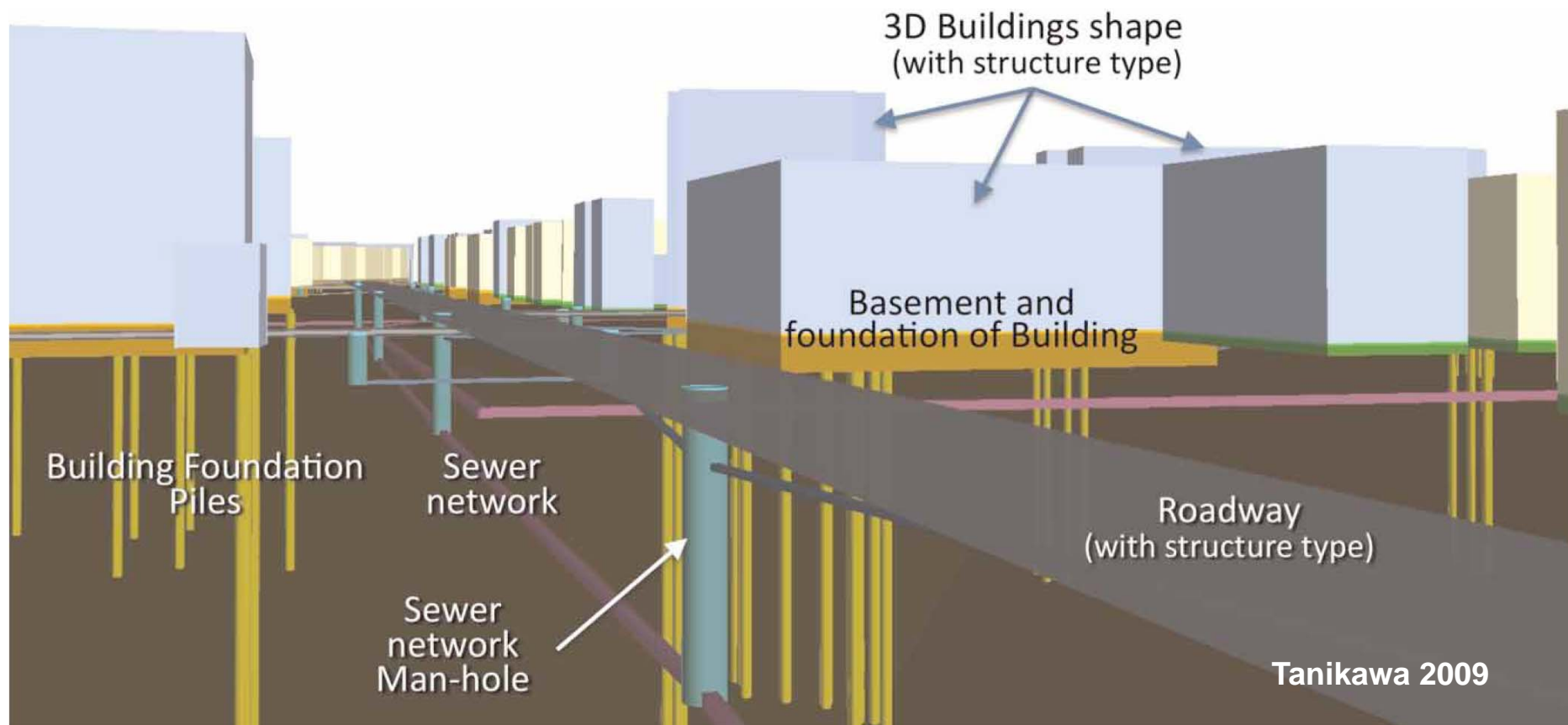
Urban form matters

GHG Emissions from Ground Transportation



Kennedy, Steinberger et al 2009

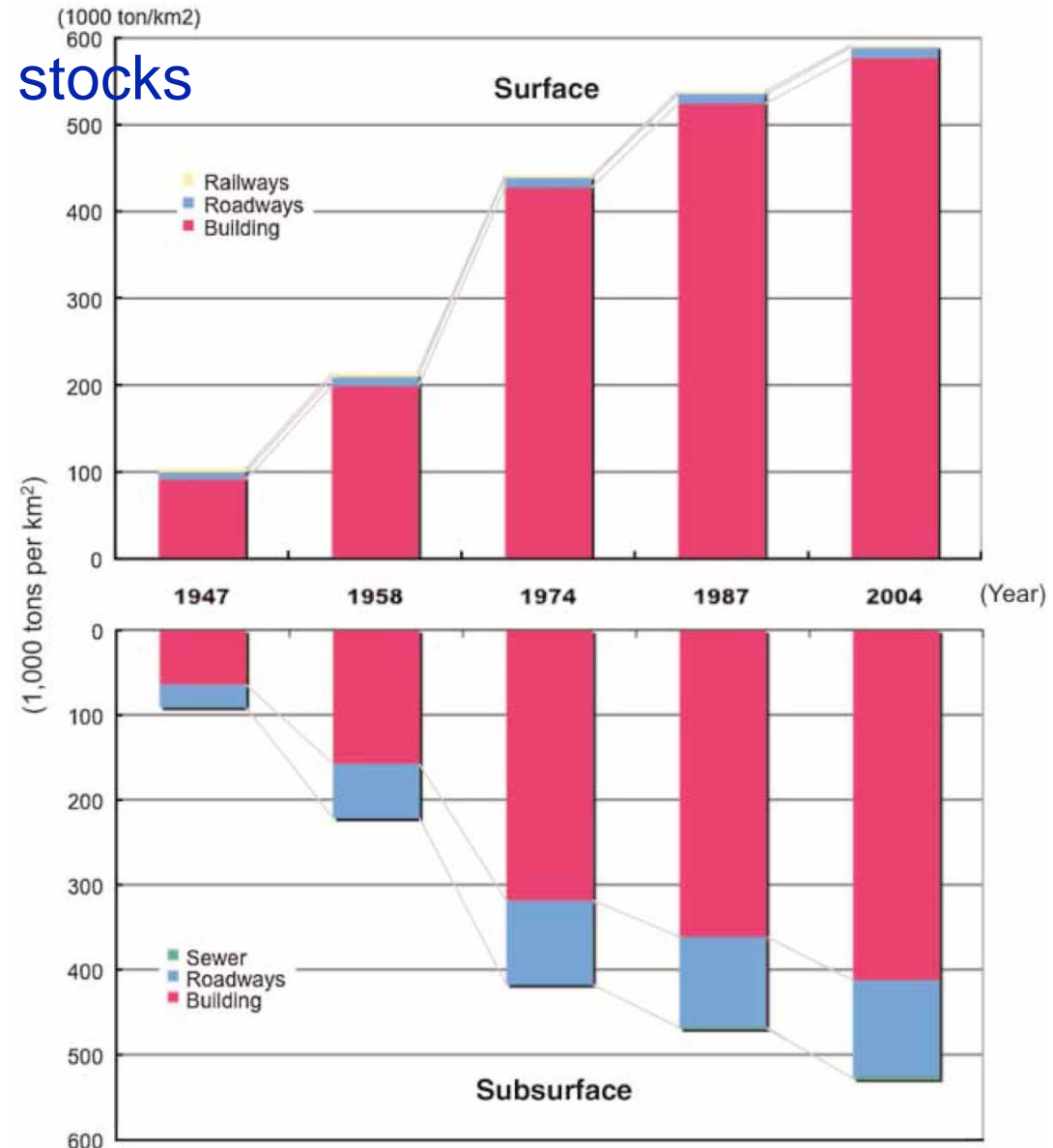
Urban stocks: Legacy and future resource



Material Stocks: Wakayama City 1944-2004

Large and growing urban stocks

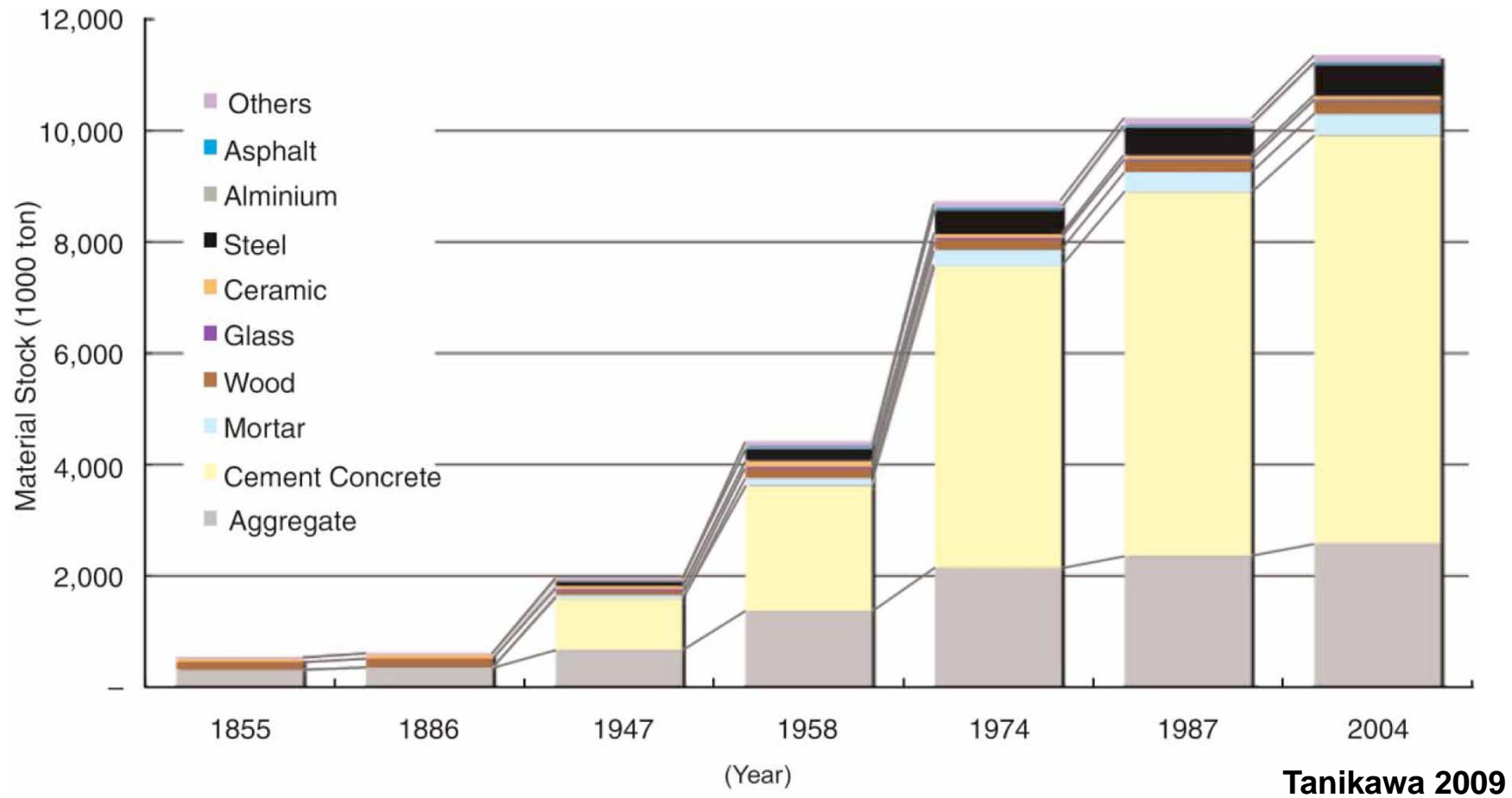
- > 1000 kg/m²
- 200-400 t/cap
- Copper: 240 kg/cap
- Steel: 14t/cap



Tanikawa 2009

Material Stocks: Wakayama City 1855-2004

Waste or resource?



Concluding remarks

- **Urbanisation is not the main driver of resource use** – but urban design has a major impact on future resource demand. Urban planning might be a great opportunity to reduce overall material demand.
- **Urban centres inevitably have a large environmental imprint** - this is not the problem per se, but we need to understand urban hinterland relations and how urban consumption drives environmental change in distant and often very vulnerable regions.
- **Urban metabolism is of major significance** for the ongoing metabolic transition. We need a better understanding of patterns and drivers of urban metabolism to realize the substantial reduction potentials. Tools and methods are available but they need to be advanced and standardized!
- Key issues: **Urban form; urban stocks and urban life-styles.**

Thank you for your attention!