Cities and Climate Change: Which Option do we have for a safe and sustainable future?

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Peaking of Emission beyond 2020:
> 1x Kyoto/yr

Temperature guardrail: 2 °C - 2100, < 0.2°C/yr
Actual +0.8 °C, at least 0.4 °C in the “pipeline”
0.2 °C we have approx. approached!

“Negative Emissions“
Be aware of simple conclusions.....

CO₂eqv nationwide
Beijing: 205%
Shanghai: 241%
China: 33%  
(Dodman 2009, Weber 2008)

Individual passenger transport energy urban density GHG/cap

after Newman 2006, Dodman 2009

after Gurjar & Lelieveld 2005

The Urban Challenge

2000: 47%  2030: 60%

doubling
urban decline
double after 2015
double before 2015

average annual urban growth rate 1990-2002 (%)  
-2.5 to -2.0
-1.9 to 0.0
0.1 to 2.0
2.1 to 4.0
4.1 to 6.0
6.1 to 8.0

Source: PIK/Various data sources
Are we asking the right questions?

How can we better understand cities, what are driving forces for development, what can explain patterns, social behaviour, etc. with regard to emissions (system analytical approach)?

Are there exist physical determinants for patterns, networks, etc. (e.g. form parameters)?

“Stylised facts” of development pathways and strategic analytical concepts are needed

Complexity calls for a comparative and dynamic pattern approach on an intermediate scale of complexity

Two pathways:
- Case based deterministic cause effect chains
- Systematic structural analyses

Regional Distribution of Functional City Types

North-Rhine Westphalia
18 m residents, 34.000 km², 397 communities, 25% GDP

Neuronal Network Approach, 24 input variables (transport, land use, social determinants, labour market, orography,…) (Source: Kropp et al. 2006/PIK)

#1: Industrial Centres
(mainly Rhine-Ruhr basin)

#2: Recreation Regions

#13: Suburbs and Low Diversified Cities

#24: Rural Communities

Source: Kropp 1998, Kropp et al. 2006/PIK
Health Risks in Urban Agglomerations

Comparative analysis by an indicator-based fuzzy model
- e.g. sealed surface, amount of elderly people, demographic & regional scenarios,...
- not only for densely populated areas a problem

(Source: Kropp, Holsten et al. 2009/PIK)

“Form parameters”: Ratio of open Space
(Huang et al. 2007)

e.g. Brussels: D=1.565
(Keersmaecker et al. 2003)

Structural features have to be combined with (dynamic) pattern approaches and related to consumption styles!

e.g. Leipzig: Land use CA model
Cities in risk prone areas
Coastal Situation in the Gulf of Bengal

Driving force: migration, damage costs

Cause effect chains are useful for the analysis of effects: starting points for action and transformation, e.g. Hyderabad

Source: Sterzel/Kropp 2009/PIK

Source: Reckien et al. 2009/PIK
Concluding Remarks

- Not all the problems have a climate change bias, but what will do climate change with cities and what is the impact on climate?
- What is the (system) border, city metabolism is not really understood!
- What are the major driving forces for urbanisation (self-organised)?
- Derivation of form factors is still in its infancy, benchmarking is really needed!
- Complexity calls for comparative approaches and stylised facts!
- Resource consumption has to do with life styles expressed by intra- and interurban networks and patterns