Cooling the Planet by Urban Restructuring

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Abstract

There is a wide scientific consensus about the current and seemingly invariably on-going climate change, the global warming. Moreover, it is becoming evident that even quite novel technological innovations (like CCS utilising biomimicry) and equivalent rapid measures cannot turn the trend until next ten or twenty years. The debate is now more and more turning to the mitigation of its probably serious consequences on the urban development and the whole human culture. The increased number and magnitude of heat waves, storms, flooding, sea level rise etc. are followed by loss of economic values as well as degradation of production power. All this might give reasons to new types of migratory movements, maybe even territorial fights for vital resources (like clean water and air, food and certain materials needed in the industrial processes). If this dystopia is going to happen, it calls for restructuring and reorganisation of the whole urban system. We should assess different roadmaps and scenarios. We need tools capable for assessing the urban eco-efficiency and especially the carbon footprint on local and global levels both linked with the systemic behaviour and dynamics of urban development. This could pave the way to global cooling.

Keywords: urban development, urban design, ecosystems, ecology, sustainability

1. Understanding urbanism and the role of nature

Sustainability of urban development is a popular topic among city planners and other practitioners (architects, engineers, designers, managers). Urban ecology is a rapidly growing field of science helping to understand some of the impacts. However, both in practical fields of different professions and in theoretical fields of different sciences most of the discussion is limited to the scale of a single urban unit like a neighbourhood, town or a city region (see for instance many readers on Urban Ecology: Douglas et al. (ed.) 2011, Gaston (ed.) 2010, Marzluff et al. (ed.) 2008, Mostafavi & Doherty (ed.) 2010, McDonnell et al. (ed.) 2009, Niemelä (ed.) 2011, Wheeler et al. 2004).

Typical question in urban ecology is: What are the impacts of city building on the living conditions of species or how do the different biological organisms survive in or adapt themselves to urban conditions? Most of the research on urban ecology uses concepts and tools of biology, meteorology, geology and other classical natural sciences. Urban

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economics deals with statistical analyses of prices, rents, income distribution, econometric modelling, price mechanism explaining urban change etc. Social and human sciences are interested in human behaviour, geographers are interested in anything which has a place and location, i.e. has geographical coordinates.

Ecologically oriented urban planners are interested in questions like: What is the most ecological urban form – city or countryside, village, small town, large city or metropolis, single city, linear or polynuclear city, or what is the most ecological urban density or optimum shape of blocks, streets, squares and parks, mesh size of networks or are urban sprawl and car dependence ecologically sustainable? *One* part of urban planners, designers and developers seem to support continuing and "classic" urban expansion pattern with the presumed economic advantages, i.e. assuming that growth itself and large scale production (economies of scale) guarantees the required supply, quality and variety of services, allows creating new cultural values, minimizes the resource use per capita, guides to the use of best available environmental technologies etc. The *second* part believes in small scale and local production, distributed small urban units, community approach, self-help etc. New urbanism seeks for a combination of small scale communities within large cities or polynuclear conurbations. The *third* part more or less ignores the question of sustainable urban form and relies on continuing technological (or maybe biotechnological) innovations: in sustainable future we can go on with all possible urban forms because carbon dioxide can be captured and stored in a way or another, possibly imitating biological processes (like those in seashells or corals) or using some other technology which we cannot see today. It is possible that all three approaches have an important role in an eco-efficient urban future.

The question of most sustainable urban form is perhaps not at all relevant in the global context. The problem is that there is hardly nobody to practice the science of "ecosystem of (all) cities" or "the global level of ecological urbanism" or "global urban ecosystem". Without knowledge, there is hardly any base for a credible ideal for eco-efficient urban form.

The global dimension, "the ecosystem of all urban units" is important because the whole (industrial) urbanism is basically global and the ecosystem itself is a global concept. The missing science is surprising because everybody knows that the world (the globe) is one – there is only one atmosphere, all oceans belong to the same sea and all cities are part of the same global economy utilizing the same global material and energy resources.

1.1 The role of nature in the classics of urban analysis

The review of more than 50 urban policy documents (Lahti et al. 2012a, Lahti 2012a) included both the most well-known classics (like Vitruvius, Howard, Wells, Unwin, Sitte, Benevolo, Saarinen, Le Corbusier, Mumford, Jacobs, Alexander, Lynch and Hall) and the very latest 21st century authors (altogether more than 1 000 individuals) of urban development, sustainability and ecology. The results of the review may surprise, because the awareness of the complex relationships between man, urban development and ecological consequences are still based on rather limited knowledge and understanding.

In the conventional understanding (in the classics) nature is regarded as a

1) bottomless reservoir of material and energy resources (even when there is no explicit reference to this fact – it is more or less written between the lines)
2) source of health, mental delight and refreshment (this is most self-evident and almost always quite clearly expressed)

A few examples from the classic literature of architecture and urban planning:

- Roman architect Marcus Vitruvius Pollio gave two thousand years ago detailed instructions how to take into account the sunlight, winds, water systems, local building materials, etc. on the construction site. The durability, healthiness and beauty were also very important to him. (The Ten Books on Architecture)
- More than hundred years ago English writer Ebenezer Howard described his garden cities as places with beauty of nature, bright homes and gardens, pure air and water and without slums and smoke. The areas outside garden cities were agricultural areas, fruit fields, forests, brickfields, water reservoirs and some other special areas – all for the well-being of city dwellers. (Garden Cities of To-Morrow)
- For the Swiss-French architect Le Corbusier in the 1920s the nature represented a place for pleasure and refreshment outside buildings and an aesthetic background for great architectural objects. “A City! It is the grip of man upon nature. It is a human operation directed against nature…” (The Radiant City)
- For the American architect and urban theorist Kevin Lynch in the 1960s and 1970s the nature provided an aesthetical element for the town scape, especially the “edge” between built and natural areas or between sea and land. (Image of the City)
- Peter Hall, the well-known British geographer and writer since 1960s, sees the urban development as a reflection of the social progress. The severe health and social problems (slums, diseases and poverty) in the 19th century industrial cities were reflected in the social utopias, first and foremost in the garden city movement promoted by Ebenezer Howard, Raymond Unwin etc. (Cities in Civilization)

Most of the classics try to figure out the role of built environment in the well-being of mankind, emphasizing beauty and social good, whether it is from nature or man-made origin. So far so good, but it is obvious that this has not been sufficient for a long time.

1.2 Modern understanding

During the last century the environmental awareness has grown so that the complex relationships between man and nature, the elements and functionalities within the “whole system”, the threats and conditions to human survival are subject to more systematic research. The amount of literature dealing with ecology, ecosystems, urban ecology, human impact on natural conditions, climate change etc. is growing fast.

After a short excursion to the newest literature on urban ecology or sustainability of urban development including 40 books with altogether 15 000 pages and written by more than 1 000 authors (Lahti et al. 2012a, Appendix 1) it seems quite clear that:

- The new themes and concepts like “urban ecology”, “green urbanism” and “sustainable urbanism” are getting very popular.

- The majority of the studies deal with highly industrialized countries (where most of the climatic problems have been created) and very few with developing countries (where the future challenges are the greatest); however in both parts the urbanization seems to continue on the “free growth” track
- There seems to be a large consensus that sprawling large cities waste resources, spoil the environment and create socially unfavourable living conditions; many authors seem to promote a kind of return to the compact and walkable city model, the European medieval city form perhaps.

We know that the built environment corresponds to at least half of the global carbon footprint (see for instance Baumert et al. 2005). What is missing is the systematic and hard fact investigation on the links and conflicts between world urbanization and global ecosystem. For the assessment we need a global and usable tool based on evidence and a systemic view built on credible causalities.

Ecosystem (ecological system) is any group of living (biotic) and non-living (abiotic) things interacting with each other. It can be local or global, but local ecosystems can be extremely difficult to separate from their surroundings. Cities and other urban communities are local ecosystems belonging to the global ecosystem.

There are two types of urban ecosystems:

1. Ecosystems in cities (air, water, soil, flora, fauna, ecosystem services, biodiversity, carbon cycles etc. within urban areas) – the narrow explanation
2. Ecosystems of cities (city as a complex cultural ecosystem, cities as one global ecosystem) – the broad explanation

Urban eco-efficiency is the quality of urban life at the cost of resource consumption and environmental harms caused by the urban development. The climate change and carbon cycles are among the key indicators of urban eco-efficiency – the hard core. The awareness and understanding of these key concepts are essential when enabling and promoting eco-efficient urban future.

1.3 Current and expected urban change

The three crucial indicators in the current development of urban ecosystems are global: urban growth, consumption of fossil fuels and (more or less as a consequence of the previous) level of greenhouse gases. The current trends in these crucial factors of urban ecosystems are maybe not surprising but they are clear (Figures 1–3). The correlation between the three is obvious.

The global urban ecosystem is a dynamic system which (temporally and historically) can be divided in three sequential subsystems (Figure 4). The relationships between the dynamics of urban development and dynamics of urban eco-efficiency deserve much more and deeper attention than is currently under way (Figure 5, Hradil et al. 2011). The path from Jay Forrester’s Urban and World Dynamics (1969 and 1971) to The Limits to Growth by the Club of Rome (1972) was interesting but too short, and today already rather overgrown.

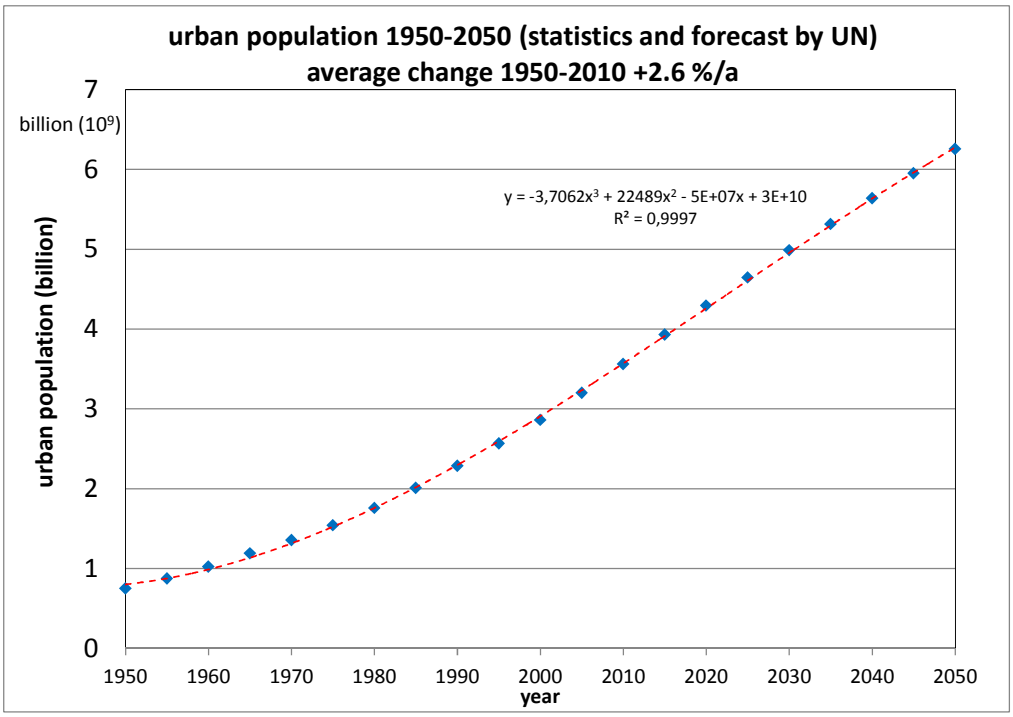


Figure 1: Urban growth during last 60 years and expected growth during next 40 years (blue dots: data from UN 2012) with the corresponding trend curve (red).

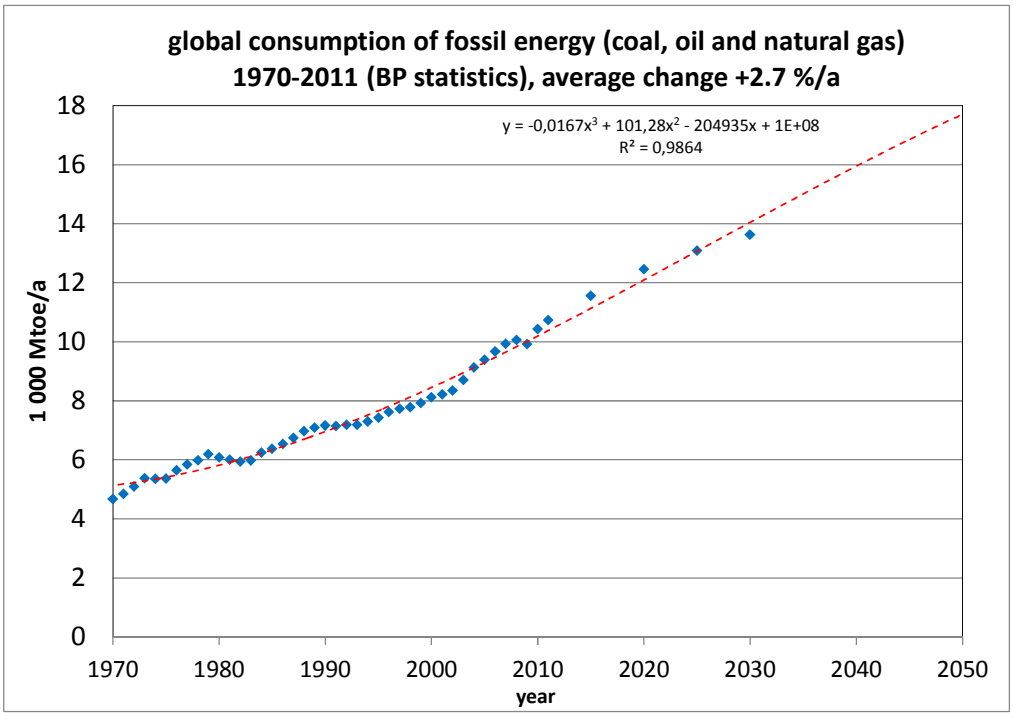


Figure 2: Fossil fuel consumption during last 40 years and expected growth during next 20 years (blue dots: data from BP 2012a and 2012b) with the corresponding and extrapolated trend curve (red) until 2050.

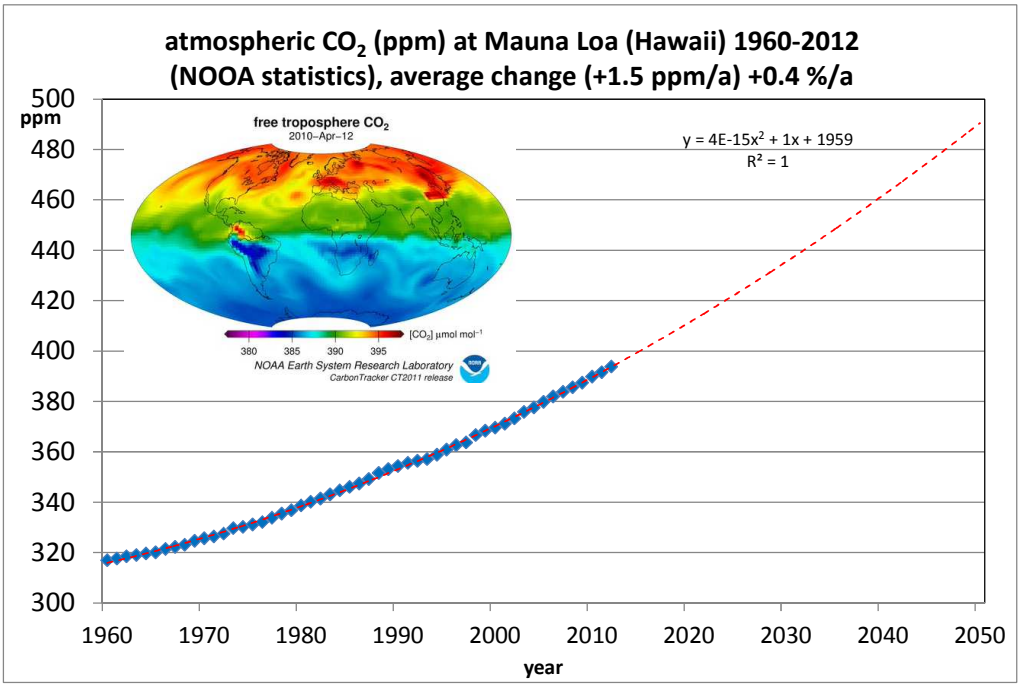


Figure 3: Atmospheric CO_2 at Mauna Loa (Hawaii) during last 53 years (blue dots: data from NOOA 2012) with the corresponding and extrapolated trend curve (red) until 2050. In northern hemisphere (see the image of the globe) the average values are around 2–10 ppms higher than in southern hemisphere (NOOA 2012, CarbonTracker CT2011) due to location of major industrial-urban centres and global air movements.

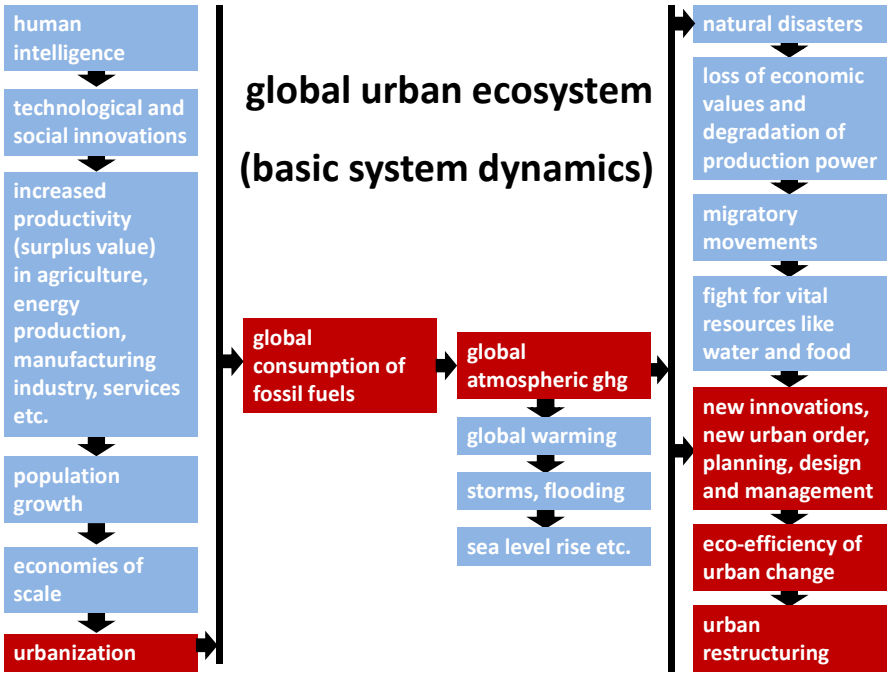


Figure 4: The global urban ecosystem described as three subsystems: 1. preindustrial and industrial phase (the left hand side), 2. counter-ecological phase (in the middle) and 3. preparation for ecological phase (the right hand side). The urban dimension (the chain of red boxes) is probably highly relevant, maybe even crucial part of the big picture, the expected success in the dynamics of the global urban ecosystem.

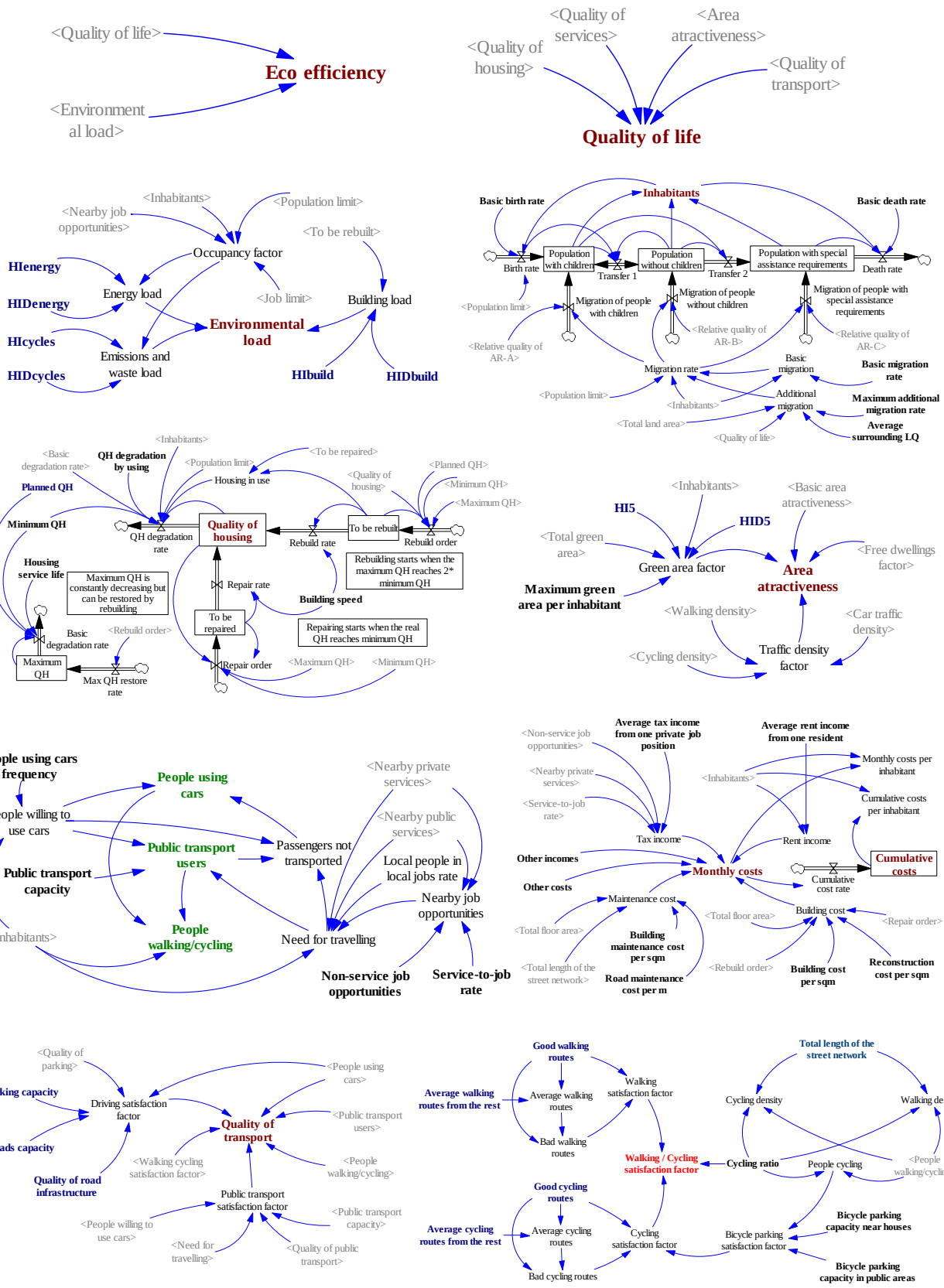


Figure 5: System dynamics of urban development and eco-efficiency, experiment on major sub-systems and impact relationships (Hradil et al. 2011)

The classical socio-economic development behind the urbanization process is normally understood as an extremely positive set of links creating welfare and material wealth – at least in the long run (and after each temporary recession periods). However, the direct consequence of the socio-economic progress has been counter-ecological, disturbing and shaking the balance and continuity of the global urban ecosystem by creating unexpected and harmful natural processes like global warming, storms, sea level rise etc.

The newest and currently emerging phase is a new type of socio-ecological development trying to mitigate and eliminate the negative impacts, return the development on the positive and ecologically sustainable track. The discussions on this kind of global fora (WBC conference) are part of this process. Much of the real and effective development is still hidden and veiled by many superficial processes. The real dynamics needs to be studied and modelled.

1.4 Urban “ecotools”, tools to assess eco-efficiency of urban development

There already exists tools for assessing ”urban eco-efficiency”, “urban sustainability”, ”green development” or alike. They are either in the market already or in the development or research phase. The ecotools cover the spectrum of urban dimensions and eco-efficiency indicators with a variety (see Table 1, the KEKO matrix of 40 different tools, Lahti et al. 2012b, Lahti 2012a) – each tool has its own strengths, weaknesses and market niche.

Methodologically, one of the most difficult tasks is to be able to combine numerous tangible and intangible aspects into one single eco-efficiency result – either a numerical or verbal expression (Figure 6). Difficult or not, this must be done in order to make a reasonable and feasible decision in each individual urban case: which one is the most eco-efficient alternative to promote the urban development towards the success (and finally the survival) of the global urban ecosystem. When using only one indicator, like carbon footprint (Figure 7), the task is much easier.

2. Conclusion

Looking back at the development of written urban policy documents of our civilization, i.e. social and architectural utopias, urban development visions and alike, shows that during the last twenty centuries the role of nature has been more or less the same: to provide human beings the material resources, mental delight and refreshment they need. Only during very last decades the understanding has widened to encompass also more systemic aspects: the interrelationship between man and nature, the environmental and ecological systems, their vulnerability and the global aspects. Both the global and dynamic dimensions of urban development need to be integrated with the (more or less static) assessment methods and tools for ecology and eco-efficiency of urbanism.

Table 1: A summary of the review of 40 different ecotools or "eco-efficiency calculators" (Lahti 2012a)

KEKO STUDY: SUMMARY OF INDICATORS IN 40 URBAN ECOTOOLS (© VTT Technical Research Centre of Finland, Aalto University & SYKE Finnish Environment Institute 30.11.2012)

+ included/ notified + partly ? N/A - excluded/ unnotified		area level					buildings		tech. infrastructure networks/systems					bluegreen infra		social infrastructure (services)						operating the built environment (technical infrastructure)										trans-port	indicators of eco-efficiency								
TOOL (provider)	locational choices, soil conditions	state level	regional level	city, municipality	district level	block level	residential buildings	occupational buildings, others	transport network and system	water supply, waste water and drainage systems	energy supply	information networks	green and other outdoor areas	water areas	commercial services	childrens' day care and school	health and other social services	sports and other recreational services	others (administration etc.)	heating	lighting	other use of electricity	hot water	cold water	waste water	cooling	solid waste management	repair and maintenance	demolition and recycling	utilization of existing structures	commuting, shopping and other trips, goods transport	consumption of materials	energy consumption	renewables	ghg emissions, carbon footprint	other emissions	wastes and recycling	ecosystems, ecosystem services	other assesment criteria (health, security etc.)
Aalto University Hybrid-LCA (Aalto)	-	+	+	+	+	-	+	+	+	+	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	+	-	-	-	-
Beyond Vuores (VTT)	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
BREEAM for Communities (BRE)	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
CASBEE-City (JSBC)	+	-	+	+	-	-	+	+	+	+	+	+	+	+	?	+	+	?	?	+	+	+	+	+	+	+	?	?	?	+	?	+	+	+	+	+	+	+
CASBEE-UD (JSBC)	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	+
CitySim (EPFL, VTT)	+	-	-	-	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+
EcoBalance (VTT)	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+
ECOCITY (EU)	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ecocity Evaluator (EP Ecocity Oy)	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	-	-	-	-	+	+	+	+	-	-	-	-	+	+	+	+	+	+	+	-	+	-	+
EcoProp (VTT)	+	-	+	+	+	+	+	+	-	-	-	-	+	-	-	-	-	-	-	+	+	+	+	+	-	-	+	-	+	-	+	+	+	+	-	+	-	+
ECOREG (SYKE)	+	+	+	+	-	-	+	+	+	-	-	-	+	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	+	+	+	-	+	+	+	+
EkoPassi (VTT)	+	-	-	-	-	+	+	-	-	-	+	+	-	-	+	+	+	+	+	+	+	+	+	+	-	-	+	-	-	-	+	+	+	+	-	+	-	+
Ecocommunity (VTT)	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	-	-	+	+	-	-	+	+	-	+	+	+	+	-	+
ENVIMAT (SYKE)	-	+	+	-	-	-	+	+	+	+	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
EU ecolabel (EU)	-	-	-	-	-	-	+	+	-	-	-	-	+	-	-	-	-	+	-	+	+	-	+	+	+	+	+	+	+	+	-	+	+	+	-	+	-	+
EU GPP (EU)	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
FRES (SYKE)	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	+	+	+	-	+	+	+	+	-	-	+
Green Star Communities (GBCA)	+	?	?	?	+	+	+	+	+	+	+	+	?	?	+	+	+	+	+	+	+	+	+	+	+	+	?	?	+	+	+	+	+	+	+	+	+	+
HEKO (City of Helsinki)	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
KASVENER (SYKE)	-	+	+	+	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	-	-	+	+	-	+	+	+	+	+	-	+
KUHILAS (SYKE)	-	-	-	+	-	-	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	+	-	+
KULE (VTT)	+	-	-	+	+	+	+	+	-	-	+	-	-	-	+	+	+	+	+	+	+	+	+	-	-	-	+	-	-	-	-	+	-	-	-	-	-	+
KulMaKunta (VTT)	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	-	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	+	-	-
Kuntaliitto ecological footprint (Kuntaliitto)	+	-	-	+	-	-	+	+	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	-	+	+	+	-	+
KyläPassi (VTT)	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	-	+	+	-	+	+	+	-	+	+	+
LEED-ND (USGBC)	+	-	-	-	+	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+
LIPASTO (VTT)	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	+	+	-	-	-
MenTouGou (VTT)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Metka (VTT)	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	-	-
NILIM tool (NILIM)	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+	+	+	+	+	+	+	-	+
PIMVAG (Eco-Viikki) (City of Helsinki)	+	-	-	-	-	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+	+	+	-	-	+	+	+	+	-	+	+	+
Nordic Swan label (Nordic countries)	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	-	-	+	+	-	-	-	+	+	+	-	-	+	-	+
PromisE (VTT)	+	-	-	-	-	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	-	+	-	+	-	+	+	+	+	+
Constructor's ecocalculator (HKR)	+	-	-	-	-	-	+	-	+	+	+	-	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	-	+	-	+	+	+	-	-	+	+	-
Region-SD (SYKE)	+	-	+	+	-	-	+	+	+	-	-	-	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	+	+
SYNERGIA (SYKE)	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	+	-	-	-	+
UZ (Urban Zone) (SYKE)	+	+	+	+	+	+	+	+	+	-	-	-	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+	-	-	-	+
WinEtana (VTT)	+	-	-	-	-	+	+	+	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	-	-	-	+	-	-	-	-	+	-	-	-	-	-	+
YKEVAKA (VTT)	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	-	-	-	+	-	-	-	+
YKR (SYKE)	+	+	+	+	+	+	+	+	+	-	-	-	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+	-	-	-	+

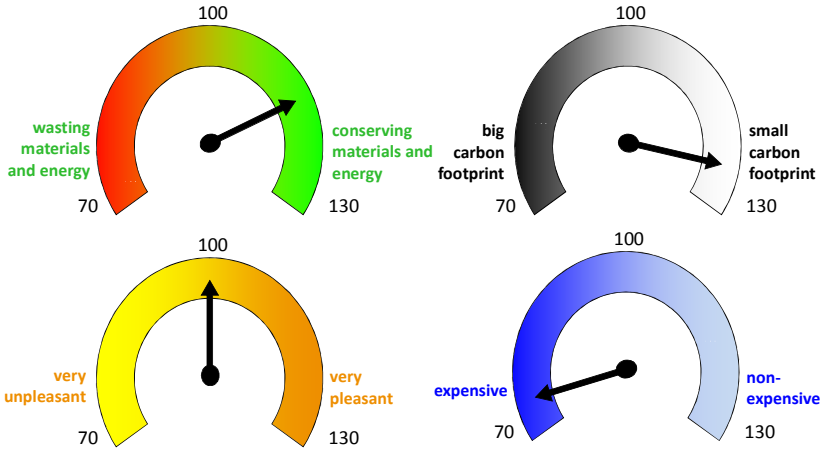
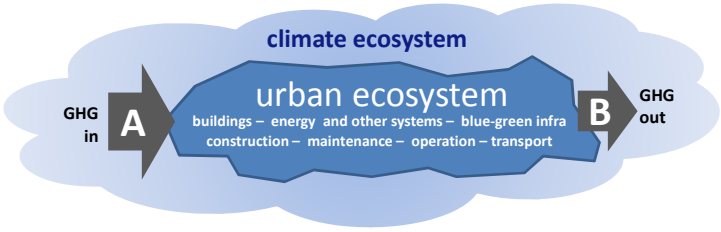


Figure 6: Eco-efficiency as a multidimensional entity, example of possible conflicts between different indicators. Considering any real case: is urban development eco-efficient if it is rather efficient in materials and energy consumption (upper left corner), has a small carbon footprint (upper right corner), is sufficiently (aesthetically, functionally etc.) pleasant (lower left corner) but in the same time extremely expensive (lower right corner) (Lahti 2012a)? How to take into account all dimensions of eco-efficiency simultaneously (including biodiversity, ecosystem services, accessibility and affordability of water, energy and other material resources, vulnerability and resilience of natural and man-made systems etc.)



if A > B, then urban ecosystem consumes more CO_2e gases than it produces, and
the net impact in the atmosphere is either slower increase or decrease of CO_2e level (ppm)

Figure 7: The crucial part of the global urban ecosystem is the linkage between urban ecosystem and atmospheric ecosystem (Lahti 2012a). The global carbon balance seems to be the necessary condition to all other eco-efficiency criteria.

The carbon balance (or net carbon footprint) of urban development can be measured rather objectively and with sufficiently exact numbers compared to many other elements of multidimensional eco-efficiency (Lahti et al. 2012b and Lahti 2012b)[2]:

$$\text{net carbon footprint of urban development} = \frac{\text{ghg captured from the atmosphere } (GtCO_2e) - \text{ghg released to the atmosphere } (GtCO_2e)}{\text{number of inhabitants and jobs (persons) } \textit{or} \text{ total floor area } (m^2)}$$

[2] The equation works globally without the denominator, but the relative figure (for instance per inhabitant) allows one the make comparisons between local urban development alternatives.

The data needed for the calculation include firstly the specific consumption (input) of carbon dioxide and other greenhouse gases (ghg) during the lifecycle of urban metabolism, the ghg captured during the urban processes and embedded in the physical environment. This should include all different materials used during the manufacturing, construction and operation of urban units. Secondly, the equivalent data is needed from the released ghg during the very same processes. To be able to compare urban solutions of different sizes, one needs also data on the volumes of alternatives (measured most often in number of inhabitants or total floor area). In principle we have enough knowledge and understanding for making the assessment, but we seem to lack the ability to construct globally effective feedback links in order to change the direction, to cool the planet (Figure 8).

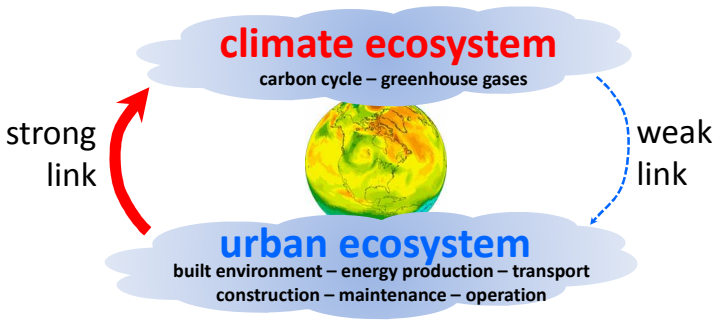


Figure 8: The interaction between the global urban ecosystem and the climate ecosystem where the strong link has so far been the man-made physical processes creating global warming whereas the weak link has been the human (re)action creating the required counter effect, the global cooling (Lahti 2012b). (the globe: NOOA 2012)

Without intentional and effective actions, we cannot say we have really understood the issue, can we? From now on, all potential urban development actions need to be evaluated: are they warming or cooling the planet? The data for constructing the tools that have the power to provide sufficient answers to the question is more or less already available.

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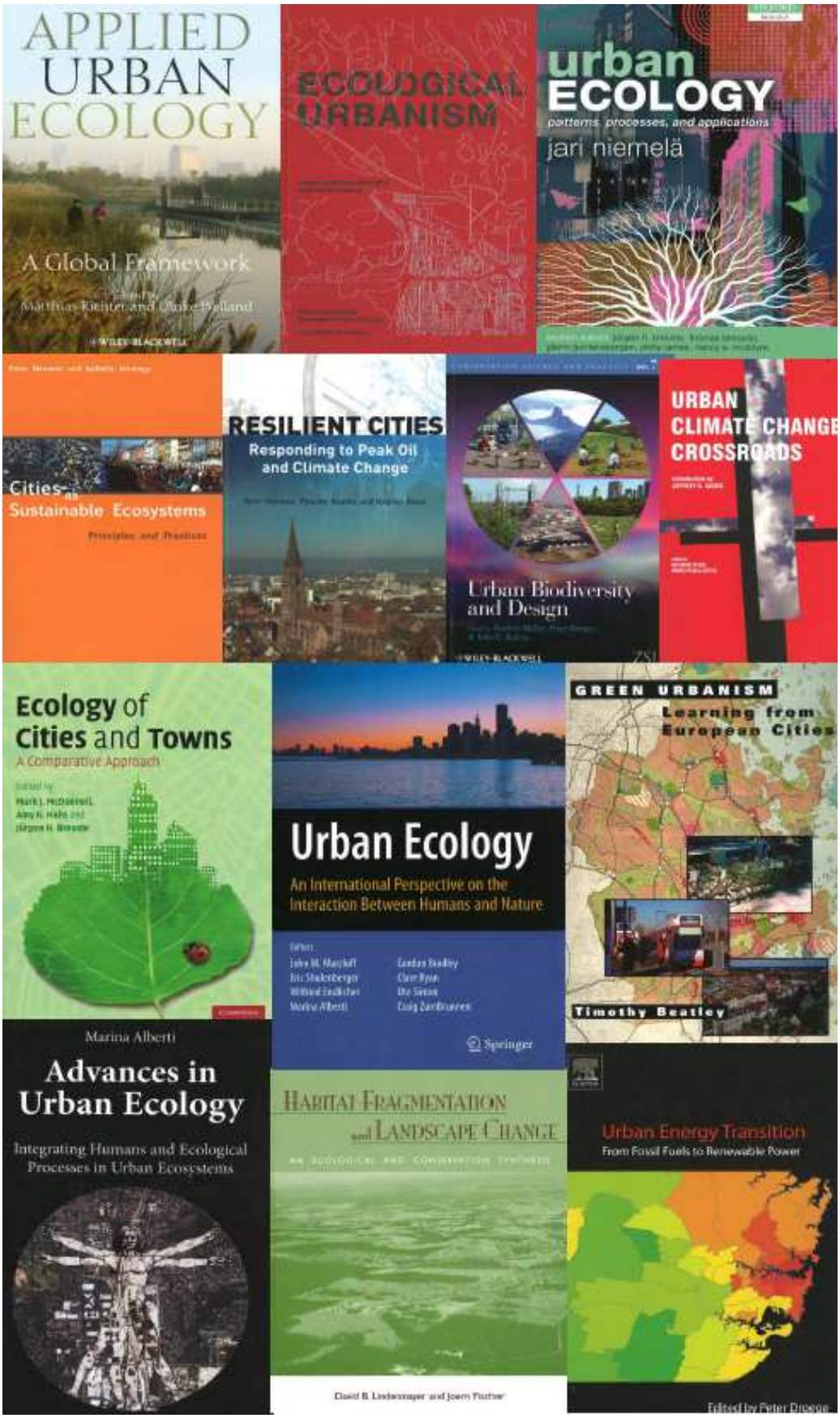
Appendix 1: Some of the reviewed 40 recent books on urbanism and ecology


APPLIED URBAN ECOLOGY
A Global Framework
ECOLOGICAL URBANISM
urban ECOLOGY
patterns, processes, and applications
jari niemelä
RESILIENT CITIES
Responding to Peak Oil and Climate Change
Cities as Sustainable Ecosystems
Principles and Practices
Urban Biodiversity and Design
URBAN CLIMATE CHANGE CROSSROADS
Ecology of Cities and Towns
A Comparative Approach
Urban Ecology
An International Perspective on the Interaction Between Humans and Nature
GREEN URBANISM
Learning from European Cities
Timothy Beatley
Marina Alberti
Advances in Urban Ecology
Integrating Humans and Ecological Processes in Urban Ecosystems
HABITAT FRAGMENTATION and LANDSCAPE CHANGE
Urban Energy Transition
From Fossil Fuels to Renewable Power