6-2

How to be green:

Eco-Urban-III

It seems the global ecology is now entangled with the 'global urban ecology', cities being the engines of growth and innovation, but also the concentration of pollution and vulnerability. Some talk about the *urban-ocene*, with cities at the centre of a new global order.[1] But as cities expand and diffuse across larger areas and merge into their hinterlands, a planetary ***peri***-urbanization – a so-called *Peri-cene* – is actually more visible from space, this being more of an *anti-city-region* than any organized system.[2]

For the ecological side, the 'eco-urban', the picture is deeply divided. Most lower-income countries see rapid urban growth and rural depopulation, with primary industries dependent on physical resources, with heavy burdens on local air, water, waste and ground quality. Middle-income countries with expanding industrial cities see growth and restructuring: pressures are rising on water, energy and minerals, but growing prosperity can enable cleaner production and environmental standards. Higher-income cities show complex patterns of growth and change, with counter-urbanization and re-urbanization: as centres of services and consumption most of their physical impacts are displaced to other places and peoples. All these differences are merging and the transitions are accelerating: the shift from pre-industrial to post-industrial took some centuries in Europe, but just a few years in the megacities of Asia, Africa or Latin America.

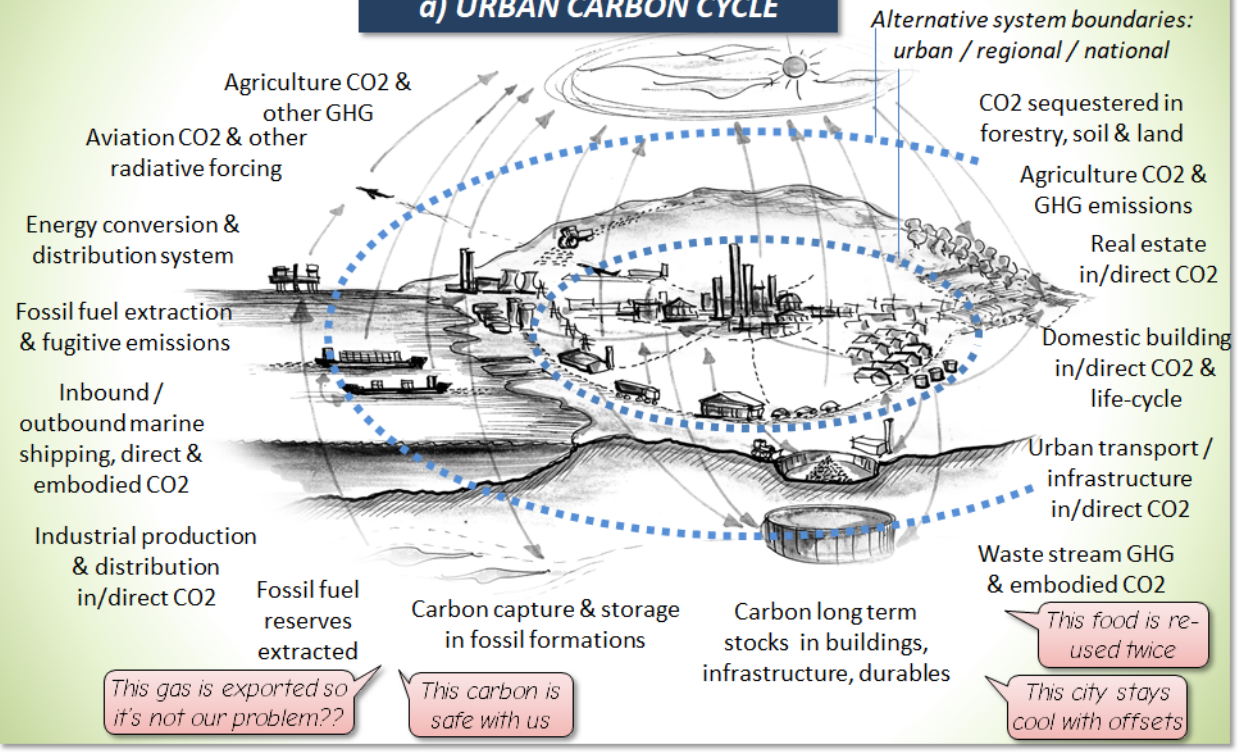
This is the backdrop to the 'urban environmental transition', a mapping of long wave cycles of roughly 50 years, in ***TECHNOLOGIES-MAPPING,*** *(Fig.7-1)*.[3] The timeline begins with mercantile cities awash with sewage; then, early industrial cities in a smog of coal and chemical pollution; and then, mature industrial cities choked by automobiles; and now, post-industrial cities with global impacts and endemic inequalities. The trend lines then point towards a forthcoming wave of post-material cyber-cities, heading for an unknowable future.

Figure 6-2

ECO-URBAN–III

Overview of carbon cycle & socio-ecosystem transformations in cities & regions

a) URBAN CARBON CYCLE



(b) LINEAR ECO-URBAN–I

*Eco-design / industry **FOR** the city:*
'take-make-dump'

Eco-urban services **WITHIN** the city: polluted, degraded

Eco-urban services **AROUND** the city: local food, energy, pollution downriver

Resource flows **THROUGH** the city: depletion of hinterland, pollution & waste

(c) SMART ECO-URBAN–II

*Eco-design / industry **FOR** the city:*
'take-innovate-trade-dump'

Eco-urban-services **WITHIN**: high / low quality by market value

Eco-urban-services **AROUND**: 'brown' industry & 'green' amenity

Resource flows **THROUGH**: global chains & impacts

(d) 'WISER' ECO-URBAN–III

*Eco-design / industry **FOR** the city:*
'borrow-create-share-recirculate'

Eco-urban-services **WITHIN & AROUND**: diverse, fractal, inter-connected

Resource flows **THROUGH**: integrated local-global cycles

ECO-GOVERNANCE - REGULATION

Basic learning & thinking

1) Fixed objectives
2) Clear regulations
3) Measurable performance
4) Clear sanctions

ECO-GOVERNANCE - MARKETS

Evolutionary learning & thinking

1) Moving targets
2) Market signals
3) Asset growth
4) Winners & loser

ECO-GOVERNANCE - SYNERGIES

Co-evolutionary learning & thinking

1) Co- learning for complex issues
2) Co-knowledge of bigger picture
3) Co-innovation for new synergies
4) Co-production of eco-governance

(Box 6a) Overview: the global eco-urban

Eco-urban types around the world each bring a basket of ecological hazard and vulnerability.[4] Cities and megacities on or near the coast, with 20% of the world's population, are the most vulnerable to storm, flood, earthquake, tsunamis or sea-level rise, from Lagos and Manila, to London or Doha. 'Cultivated' zones and 'dryland' zones with a combined urban population of 3 billion, are each vulnerable to climate change and climate-induced migration, as seen in Nairobi, Delhi or Beijing. Inland cities such as Prague or New Orleans, are more prone to fluvial flooding or forest fires. At high altitude Mexico City and similar cities suffer pollution of air and water, along with seismic activity. Overall the outlook for global urbanization and its bio-spheric impacts seems very problematic.[5] While the urban population doubles, the urban land-take is set to triple from 2010–2030, growing by 1.2 million km², with reckless destruction of natural habitats, biomass, biodiversity, flood resilience and carbon storage – all essential to absorb and adapt to a changing climate.[6]

Looking at the drivers of change, the development curve from lower to higher incomes seems clear, but the curve of wealth and inequality is not. It seems economic growth can be good for urban greening, but it also shifts impacts from local to global, and from richer to poorer. And urban development is on a dynamic cycle, as seen in ***CITIES-III*** *(Fig.8-8)***:** following the growth phase there may be 'reverse development' as in former Soviet cities, industrial shrinkage in Detroit or Leipzig, or conflict which destroys whole cities in 'de-urbanization'. Urban ecosystems can then follow the shrinkage and restructuring, as new species re-colonize vacant buildings and derelict land.[7]

As for planned eco-cities, like in the Gulf or in South Korea, as showcases for eco-urban smart technology, the results so far seem to lack vitality.[8] Others see the future in a low-tech, decentralized, communitarian kind of city, as in the Green Belt and urban food movements.[9] And so-called green infrastructure is making a welcome return to urban planning: Greater London is planning a national park, and Paris is turning roads back into riverside green-space. However, it seems that greening often comes alongside gentrification, with displacement of pollution and social impacts even further.[10]

Behind this, a resource metabolism underpins the global urban system. In simple terms, affluent consumers in cities of the Global North import from producers in the Global South, where wages are low and pollution is high. While all cities contain affluence and poverty, there are structural differences, as shown by the economic and carbon footprints.[11] Northern city residents enjoy an average income of $50,000, and a CO_2 footprint (direct/indirect) of over 10 tonnes per year. In the average Southern city there are incomes of $1500 and CO_2 footprints of 1-2 tonnes. The 'Happy Planet Index' is a good measure, combining eco/social/economic measures, i.e. CO_2 and GDP income with human development. While the USA shows the worst combination in the North, the global winner is Costa Rica. This small country has the best ratio of 'happiness per unit of footprint', and in the face of natural hazards, with corruption and instability, has advanced plans for a low-carbon transition.[12]

Overall it seems that cities of the South and North are inextricably linked. The 'poverty of consumption', in the mental alienation and social fragmentation of the North, is the counterpart of the 'poverty of production', of pollution and exploitation in the South. And so, the pathways for one depend on the other, as explored in ***DEVELOPMENTAL-III*** *(Fig.10-2)*. So, we look beyond the idealized sustainable city, where 'eco-affluence' comes from colonial legacy exploitation, and beyond myopic 'urban resilience' projects, which build flood defences for the CBD on the land of the shack dwellers . And thirdly, we look beyond the rhetoric to 'strengthen local governance' or 'empower communities', with technocratic checklists or plain green-washing. The real opportunities for eco-urbanism may be in cities which avoid the rhetoric, which are agile and creative, which 'think, adapt and evolve'.[13] So how would this work?

Eco-urban-services

Cities around the world proclaim their policies for the climate/low-carbon transition, but few have much knowledge of their own carbon cycle with its many stocks and flows. There's a cartoon version in the upper part ***a)*** of ***ECO-URBAN-III*** *(Fig.6-2)*. Carbon cycles show up in three basic formations.[14] The direct cycle ('Scope 1' in technical terms), starts with local burning of fossil fuels, releasing carbon to the atmosphere, with some re-circulation into oceans, soils or vegetation. An indirect cycle burns the fossil fuel outside the city or region to make electricity ('Scope 2') for the urban energy mix. Third come many kinds of local or regional cycles, stocks and flows: land-use and forestry, agriculture and food chains, bio-fuels and bio-mass, imported products which end up in landfill, carbon embedded in buildings and infrastructure, duty-free purchases by passengers in transit and so on. There's an important difference between the first two which are accounted and targeted by production sectors, and the third which is more about consumption. The UK carbon accounts for instance, look good on paper, only because most heavy industry moved to Asia, and its products are then reimported (with ongoing debate about the shipping and aviation accounts).[15]

We could draw a boundary around the built-up city, shown in ***ECO-URBAN-III*** with the inner circle, and try to manage the carbon with local-level policies or markets. But for the most part, local powers are lacking, and the built-up city is only a hub in its region, which in turn is a landing strip for global supply chains. Each level of boundary seems incomplete and problematic, as carbon flows don't often respect political or economic units.

There's a bigger question on 'what is a city?', and how does it fit with concepts of 'ecosystem services'? For example the country park in Manchester stretches from industrial dereliction into open fields, with urban, suburban, peri-urban and rural landscapes, all mixed and inter-connected across an extended city-region.[16] The linkages vary over time: mercantile or industrial cities are strongly linked to local energy, water, minerals, forestry and food. In contrast post-industrial cities tend to shift from local to global supply chains, but new kinds of social-cultural ecosystem services then emerge into the urban pattern. So, we can map out the vital combinations, the *'eco-urban-services'*, in different spatial layers.[17] As seen in ***ECO-URBAN-III,*** lower left ***b),*** here are four:

- Urban-eco-services ***within*** the city: localized resources and habitats, biodiversity and tree-cover, green-space and green infrastructure, flood protection and water quality, air quality and urban micro-climates: all essential for the life of the city.

- Urban-eco-services ***around*** the extended city-region. This links the core urban area to its surrounding hinterland or bioregion, the peri-urban and ex-urban, industrial areas, river catchments and country parks, supplies of water and minerals, and other urban-rural linkages.
- Urban-eco-services as flow ***through*** the city: the physical metabolism of carbon, energy, food, water, minerals and organic materials, along with natural flows of air, water or soil.
- Urban-eco-services as background ***for*** the city, where policy or business uses some kind of ecological knowledge or insights, to name a few: industrial ecology, political ecology, eco-design, eco-innovation, eco-psychology, bio-mimicry or ecological economics.

This mapping of carbon cycles and urban-eco-services starts with a linear, *Mode-I* type of urban-eco-services, with a command-and-control style of resource management and pollution control. It's then a short step towards an evolutionary *Mode-II*, pictured in the lower centre ***c)***. This is more about innovation and competition, with markets and incentives for urban-eco-services, for instance in the 'TEEB' (The Economics of Ecosystems and Biodiversity), and the UK experiments with 'Payments for Ecosystems Services'.[18] A typical *Mode-II* urban structure shifts towards a hollow and diffuse peri-urban sprawl/agglomeration, and within the city, urban-eco-services are polarized into desirable/undesirable locations. ***Around*** the city, the orbital infrastructure places airports and business parks and high value housing on the outside, away from 'human landfill' projects and industrial logistics. The flows ***through*** the city are displaced to global supply chains, waste transfers and climate emissions. Meanwhile some problems such as air quality are still local or regional, generally (but not always) so the urban poor have to breathe the vehicle emissions of the rich.

So far, we have pictures of urban flows and carbon cycles as many-layered and intricate webs which cross many boundaries. But following the synergistic logic, this is more than a question of physical materials, it's about the human learning and thinking process, the *collective eco-urban intelligence*.

With this a *'wiser'*, more synergistic picture takes shape, at the lower right ***d)***. Here the eco-urban system converges directly on its 'global fair share' (equal per person) of 'safe operating space', wherever its boundaries are drawn. It aims for near-zero carbon emissions, from both production and consumption sides, and a factor-four-plus transformation of resource efficiency.[19] Where the cycles are mainly local these can be managed directly: where cycles are mainly in global networks and value-constellations, then other ways are needed of managing such 'collaborative inter-dependency'. And for the *eco-urban-services* ***within*** and ***around*** the city-region, we aim for diversity, multiplicity and fractal complexity, with intricate self-organizing niches and habitats. Local urban street trees and vertical gardening, or larger scale eco-urban parks and bio-reserves, each serve wider goals, of social cohesion and economic resilience and cultural diversity.

Eco-urban pathways

So, here are some likely pathways, arranged here (in contrast to our main method), around the different layers of the *eco-urban-services*. For ***eco-urban 'throughput' pathways*** *(with eco-techno-economic synergies)* , for the metabolism of energy and carbon, water and materials, there's an ideal of local self-sufficiency, the

autonomous off-grid community or city, which produces energy/food/materials from within or very nearby. But such ideal models can overlook complex boundaries, and the advantages of supply chains and value chains in a modern economy. (For instance, oranges grown in Spain and shipped are, on average, lower carbon than oranges grown in the UK). So, the most effective low-carbon actions combine the best of local and global, and include for both direct and indirect effects. Local carbon stocks and flows can (in principle) be measured and directly managed locally by policy, markets, technology or behaviour change. For global cycles, it's more about the *collective eco-urban intelligence,* which can manage the benchmarks, accreditations, producer-consumer responsibilities and the 'collaborative inter-dependency' of extended value chains. The words 'low-carbon pathway' are often used in a limited technical sense, but it's clear that real progress needs pathways which combine social, technical, economic, political and cultural layers.

Within the city, the ***eco-urban community pathways*** *(with eco-social-spatial synergies)* look for an interconnected, 'recirculatory' and 'regenerative' city of human-biodiversity relations. Water, energy, food and materials can be produced in intricate micro-harvesting systems of *bio-mimicry*, with learning and thinking systems of *neuro-mimicry* to realize them.[20] New possibilities emerge in micro-green-space, vertical or roof or box gardening, material-waste cascades or energy harvesting. The *passivhaus* approach works with 'breathing' buildings and micro-climatic design for thermal balance: electric car-shares can store renewable energy by night for use by day. The success of such whole systems then depends on *deeper* layers of thinking, with *wider* communities, with *further* integration upstream/downstream, combining social practice, economic markets and cultural stories.

Around the city, the ***eco-urban 'hinterland' pathways*** cover larger land areas and the interfaces of built with open spaces, and call for the integrated planning of ***CITY-REGION-III*** *(Fig.4-5)*, or the 'sprawl repair' and renewal of the ***ANTI-CITY-REGION-III*** *(Fig.4-6)*. Local-regional infrastructure can be managed around co-dependency, with upstream-downstream coordination of rivers and flood risk, or supply-demand coordination of materials exchange and recirculation. There's an opportunity for '*collective food intelligence'*, as in ***FOOD-III*** *(Fig.6-5)*, which links the growing potential with rural livelihoods and ecosystems, and then with intelligent markets and distribution systems.

Lastly, in ecological systems ***for*** the city, we draw on all the pathways in this chapter. A ***stewardship*** pathway (with political-environment synergies) sets the ground-rules, public investment and creative use of land. The ***eco-business*** pathway (environment-economy synergies) works on the principles of ***FINANCE-III*** *(Fig.5-5)* and ***ENTERPRISE-III*** *(Fig.5-4)*, and the industrial ecology cycles of ***CIRCUL-ONOMICS-III*** *(Fig.5-3)*. And finally there's a ***storyline*** pathway (with social-cultural synergies) for liveability and social cohesion via gardening and greening.

All these show up in the 'eco-policy cycles', shown in the lower part of each picture (***b–d***), which in some ways reflect the recent history of environmental policy. A linear *Mode-I* policy regime of up to the 1970s, puts up command-and-control pollution limits, which often don't work as intended. An evolutionary *Mode-II* policy post 1980s, focuses more on incentives and markets, or negotiated 'best available technology not entailing excessive costs', again with likely side-effects. These all point towards a co-evolutionary *Mode-III* policy cycle, one of collaborative learning and thinking, in the frame of *collective eco-urban intelligence*. In practice all three *Modes* are needed to work side by side.

Overall, this ***ECO-URBAN-III*** sketch aims to build bridges, between the technical potential of low-carbon cities, and the reality of various stages of fragmentation, corruption, inequality or plain confusion. Such pathways have few guarantees, but much potential, in turning a *nexus* of problems towards a *connexus* of opportunities. But all this hangs on the biggest question of all, on the global climate and bio-physical life-support systems…

Notes

<note>[1] West 2017
<note>[2] see http://peri-cene.net; www.periurban.in
<note>[3] McGranahan 2006; Ravetz 2006a
<note>[4] Pesaresi et al 2018
<note>[5] Seto, Güneralp & Hutyra 2012; Güneralp et al 2013
<note>[6] Butler 2015
<note>[7] Haase et al 2014
<note>[8] Cugurullo 2013
<note>[9] Pretty 2002
<note>[10] Ginn & Francis 2014
<note>[11] Hertwich & Peters 2009
<note>[12] NEF 2012
<note>[13] Zenghelis & Stern 2015
<note>[14] Haberl et al 2004
<note>[15] Wiedmann et al 2006
<note>[16] Forster & Escudero 2014
<note>[17] Douglas & Ravetz 2011
<note>[18] TEEB 2010, Defra 2013
<note>[19] von Weizsacker, Lovins & Lovins 1997
<note>[20] Girardet 2014, Lehmann 2015; Alberti 2016; Benyus 2002