From urban systems to eco-urban-systems

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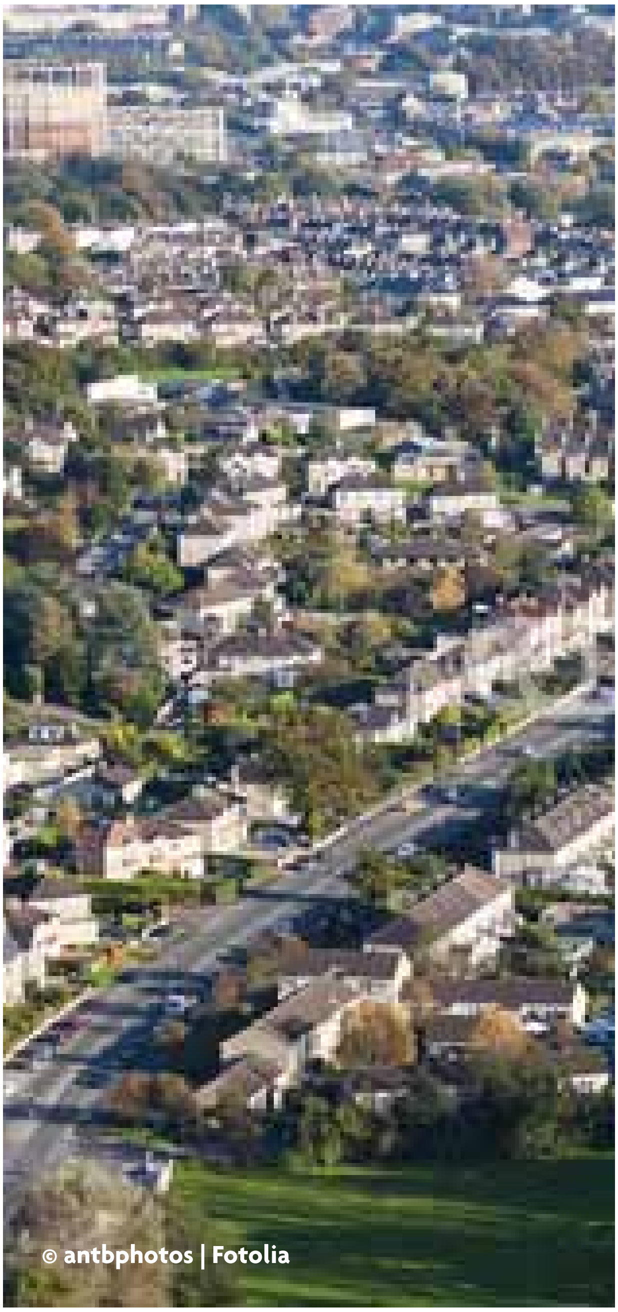
Joe Ravetz explores different futures for UK urban ecosystems services.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I regularly find myself in the middle of heated debates on ecosystems services. Many are strongly for, arguing it's the only way to get natural assets balanced with human demands. Others are strongly against, on the basis that it dumbs down both sides, into some kind of fictional shopping list, where in theory the entire planet is worth only $33 trillion per year[1].

It seems that servicization might be useful if used with care. If we follow the holistic Ecosystems Approach, then it would be ok to take simple cross-sections of a more complex reality. My concern is that urban systems (at least in the UK) are apparently at least as complex, and as powerful as eco-systems. So to make real progress we need ways to understand 'urban-eco-systems services'.

This paper draws on the *Future of Urban Ecosystems Services and Environment in the UK* report, prepared for the Foresight Future of Cities programme[2]. This Foresight programme looks ahead 2 and 50 years, and is linked to a network of 22 cities with various kinds of futures activities. Here, *Greater Manchester 2040* is a demonstration of the aspirational approach to foresight. This paper tests the notion of urban ecosystems services by looking ahead, in particular to where the future might not be a continuation of the present. Ultimately we raise a question: if ecosystems services are best seen as complex, collaborative and co-evolutionary, how can we best work with them?

The first question is: what is urban? The simple understanding of urban as the physical built up area covers only part of a wider 'gravity field' of economic and social activity associated with towns and cities. The UK overall has 80 per cent of its population on 9 per cent of its land area[3]: but much of the rural hinterland is predominantly urban in social and economic structure (even in rural areas only 3 per cent of the population work in farming). The study of urban-related ecosystems services confirms the inter-dependency of built areas with their fringes, catchments, peri-urban and rural hinterlands. But such categories may be changing rapidly. For instance the European project PLUREL defined the peri-urban (areas surrounding or near to urban areas) as areas with a density threshold of over 35 people per hectare, on which basis most of England and large parts of western and central Europe, are effectively peri-urban areas of low- to medium-density urbanisation[4,5]. The implication is that to understand urban ecosystems services we need to look beyond the built-up boundary to a wider view of urban activity systems and their hinterlands.

The second question is: what is an urban ecosystem, and what are its services?[6] According to Defra, "Ecosystem services can be defined as services provided by the natural environment that benefit people"[7]. We can look at the interface of ecosystems with other domains and policy agendas, as in **Figure 1**: extending from typical foresight studies, this shows a multi-layered landscape, with social, technical, economic, environmental, policy, cultural and urban components ('STEEPCU'). Each of the circles overlaps or interconnects, with possible tensions or conflicts, but also with potential for synergy and added value.

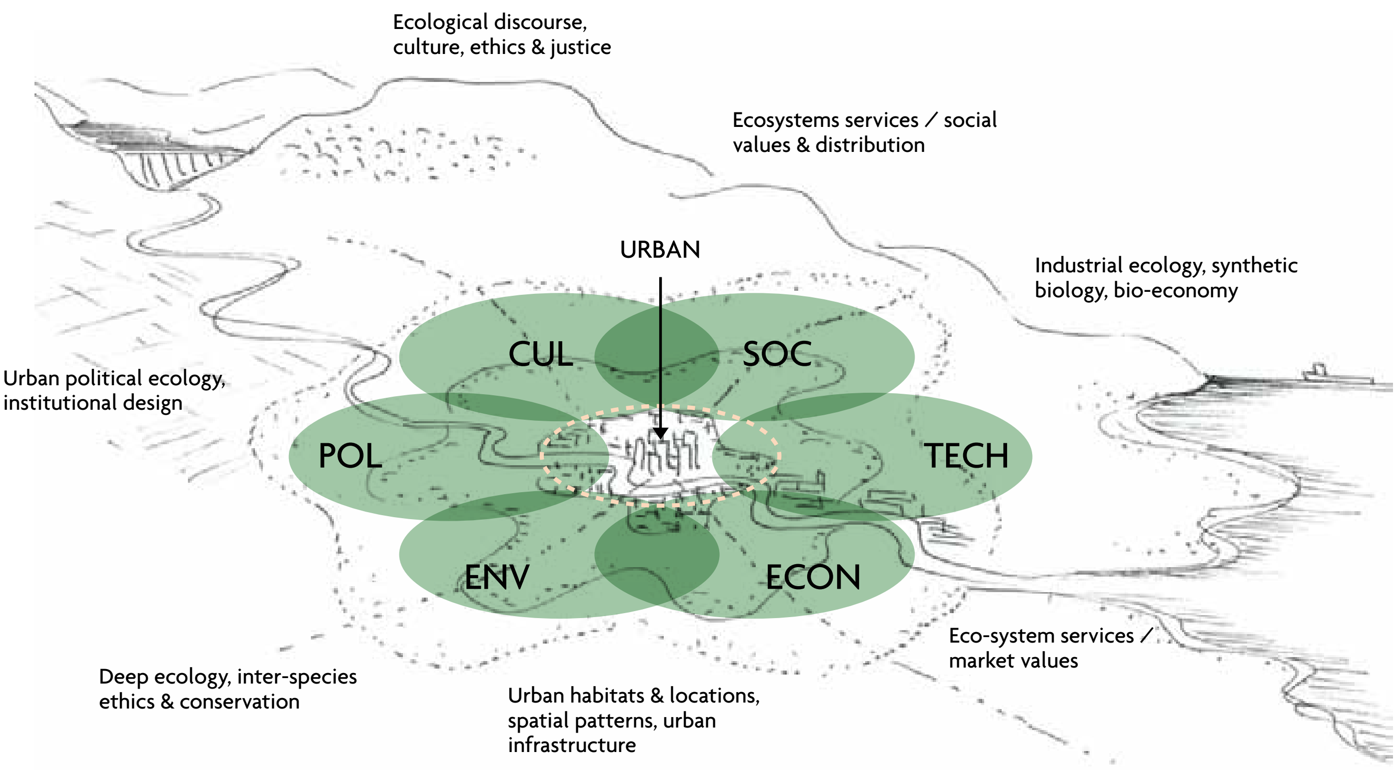
Putting these together we can see urban ecosystems services interactions in four broad domains (see **Figure 2**):

- Ecosystems services **within** the city;
- Spatial ecosystems services patterns **around** the wider city–region;
- Ecosystems services and physical flows **through** the city, such as food, water, energy and materials; and
- Ecology-related human systems **for** the city: including wider applications in industrial ecology, political ecology, eco-design and others.

STATE OF THE ART: A LANDSCAPE MAPPING

This is a very brief summary of a wide range of studies, headed up by the urban chapter of the UK National Ecosystems Assessment[3].

Most ecosystems **within** the typical UK city have improved over the last 50 years – including habitats and micro-climates, greenspace and green infrastructure, air quality, water quality and land contamination. However there are continuing risks generated by urban development and infrastructure, increased urban densities, exotic and invasive species, soil degradation, and climate-related flood, storm, heat and drought. Air pollution and waste generation each continue at levels



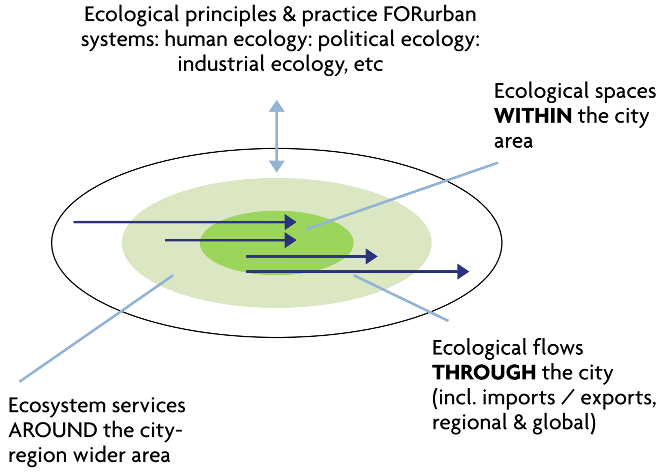
▲ **Figure 1. Urban ecosystems domains, or human perspectives, shown as overlapping fields. (Author's artwork; © Joe Ravetz)** that are deemed unacceptable. There are economic risks in the lack of public funding for investment and maintenance, and political risks in reduced public access to privatised space.

Around the city, i.e. in the various spatial layers between city centres and the rural areas around them, there are recent improvements with access to rights of way, country parks etc. There are also increasing risks from climate change-related flood, heat, storm, drought and sea-level rise. Green belts are seen as the primary defence against urban development and speculation on land values, but are under pressure from housing and commercial development. Intensive agriculture in some areas also undermines the 'green' qualities of the belt. Meanwhile large areas of hinterland are now effectively urbanising in social and economic functions, and it's arguable how far these should be included in the picture.

For ecological flows **through** the city, i.e. energy and material resources, the picture is mixed. Improvements in the efficiency of buildings, transport and industry are often outweighed by growing demand for energy, water, construction materials, and the general flow of globalised consumer goods. While most of these provisioning services are external to urban areas, responses such as local recycling, food cultivation or energy efficiency can be very localised. In practice many cities have low-carbon or climate-proof strategies, but lack the resources, know-how and political powers to achieve them. For many organisations and citizens, their low-carbon aspirations seem to conflict with high-carbon activities such as travel and shopping.

Regarding **ecosystems for the city**, the UK is on a learning curve. Integrated systems for industrial ecology are making progress with schemes such as the National Industrial Symbiosis Programme, but these are still in the minority. Eco-design and eco-investment are slowly gaining ground. Political ecology and social ecology principles are often not well formed, but show up in *ad-hoc* protest movements such as the opposition to hydraulic rock fracturing.

The context here is the national level '**system of cities**', in both the spatial arrangement of settlements and the underlying socio-economic interactions. The first issue is the dominance of London and the greater southeast: continuing such trends would then have major effects on urban ecosystems. Urban growth areas would see intensification (building on all available land), densification (increasing residential or activity densities), gentrification and over-development, likely to result in further habitat loss and more extended supply chains for energy, water, waste, biomass and minerals. In contrast, areas of urban decline could see increases in derelict and vacant land, which raises social and economic problems but also provides opportunities for ecosystems and biodiversity.



▲ **Figure 2. The links between urban systems and ecosystems. This diagram shows a simplified 'urban systems', with four different kinds of interaction with ecosystems. (Source: Joe Ravetz)**

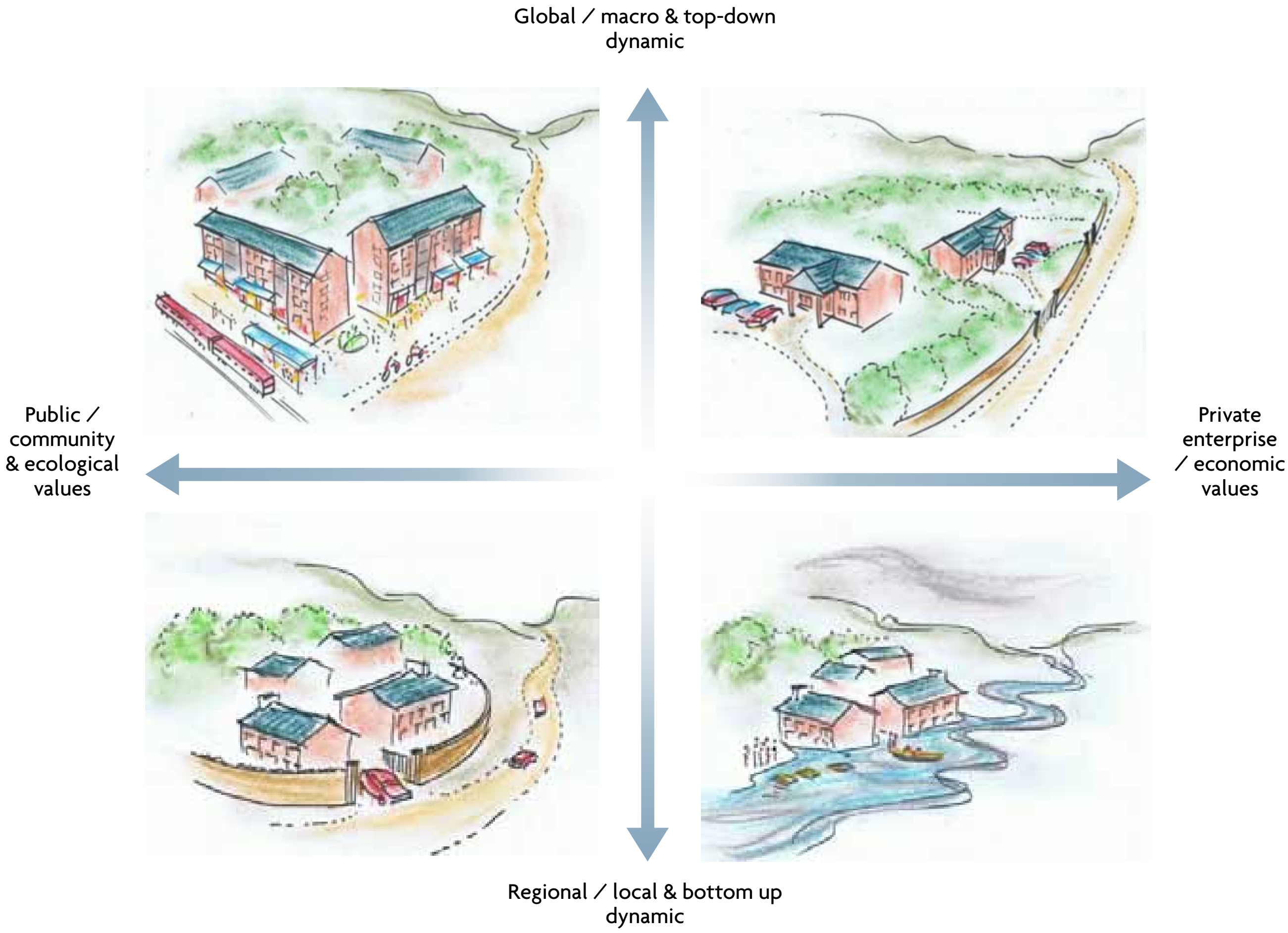
FUTURE SCENARIOS: CHANGE MAPPING

There are many alternative possibilities, for both 25- and 50-year horizons: here summed up in a set of urban ecosystems scenarios (adapted from the IPCC global 'SRES' scenarios[8]). Note there is no central forecast or business as usual (BAU) scenario: the four alternatives shown here are simple caricatures, and reality would of course be more complex. Each scenario can be illustrated with a different urban model from around the world (see **Figure 3**):

- **Technology urbanist scenario – Singapore model:** smart, climate-controlled, sealed buildings are the norm, as environmental hazards and social divisions increase. Food, water and energy come through hi-tech centralised systems. Urban greenspace that is not developed is generally privatised and intensively managed.

- **Technology hinterland scenario – Los Angeles model:** car-based urban sprawl; many local ecosystems are destroyed or degraded, or turned into private leisure, golf courses and high-value tourism. Food, energy and water are imported over large distances by privatised utilities according to the global market logic.

- **Ecological urbanist scenario – Freiburg model:** this can be low-tech or hi-tech/smart, and is the classic sustainable urban model with dense, mixed-use urban neighbourhoods. Greenspace is used and managed intensively to increase resilience to climate and other environmental hazards. Urban ecosystems are designed around quality-of-life factors.



▲ **Figure 3. Alternative futures for urban-eco-system. Four different directions for urban and ecological development are shown: the scenario axes are based on the 'SRES' scenarios of IPCC, 2000[8]. (Author's artwork; © Joe Ravetz)**

- **Ecological hinterland scenario – Greater Stockholm model:** many households relocate to peri-urban and rural areas to be in closer contact with nature and to produce local food, energy and natural materials. Local economies are revitalised and better connected with local ecosystems, with alternative forms of ownership and management.

CHALLENGES AND TRANSITIONS: SYNERGY MAPPING

This stage is more exploratory of critical perspectives and bigger pictures. First we look for ecosystems-services-related socio-economic challenges, such as demographic change, the changing nature of work and new patterns of physical and mental health. There are political and cultural challenges, such as the privatisation of space, distrust in governance, and conflicts on environmental justice. This leads to a wider view on transitions and discourses, which can be transformational in the sense of combining various opportunities: and also problematic in the sense of generating new tensions. Here are some of the most topical discourses:

- Resilient city: urban-ecosystems services will aim at capacity to withstand or adapt to physical pressures;
- Liveable city: urban-ecosystems services will aim towards social and cultural benefits;
- Eco-smart city: urban-ecosystems services can be enabled by digital technology;
- Transition towns: urban-ecosystems services can enable movement towards low- or zero-carbon performance;
- Circular economy: urban-ecosystems services will be geared to material recirculation and zero waste; and
- Sustainable community or neighbourhood: urban-ecosystems services will aim to meet the needs of both the present and the future, locally 'as far as possible'. How far in practice, is a matter for great debate.

Each of these discourses can then be tested, not only against current environmental policies, but against wider trends and problems. At the top of this list could be the widening gap between rich and poor, and the projected increase in child poverty[9]. As projected by 2020, nearly 1 in 4 of children will be in both relative and absolute poverty, and so their participation in the above discourses or as users of urban-eco-system services, is likely to be much impaired. The wider effect fragmentation of social structures can only be guessed, but there are implications for the pathways below.

RESPONSES: PATHWAY MAPPING

From these challenges, transitions and opportunities above, we developed some future-proofed pathways (also called success scenarios)[8]. Again these can be tracked to each of the four ecosystems services domains.

For ecosystems services **within** the city, there are opportunities in community greenspace, food cultivation, and benefits in health, education and local enterprise. Creative adaptation to climate change is a whole new agenda for the interactions of humans and ecosystems. The principal threat may be the privatisation and enclosure of public and ecosystems services space. The response might be in new social models for access, stewardship and crowd-sourced investment for such spaces.

For ecosystems services **around** the city, there are opportunities in wider patterns of green infrastructure, local food supply chains, and climate change adaptation to flood, heat and drought. New settlement forms may see new kinds of interaction between people and ecosystems, as in eco-belts, forest gardens, water parks, outdoor schools, community orchards, co-eco-housing and 'incredible edible' type food schemes. The main threats to ecosystems services may be direct pressure for development, or related problems caused by policy restrictions.

For ecosystems services **through** the city, there are growing policy pressures to move towards the low-carbon, zero-waste type of city system. Achieving these physical goals is technically feasible for the most part, but is likely to involve similar changes in economic, social and political systems. The current direction is towards smart, digitally enabled cities, though this may bring its own risks and unintended consequences. In ecosystems services **for** the city, there are many

▲ **Figure 4. Allotments in Edinburgh. Ecosystem services may be under threat by the privatisation or development of such spaces. (© JoannaTkaczuk | Fotolia)** opportunities in industrial, social and political ecological thinking. Industrial ecology aims towards a circular economy or bio-economy: for instance integrated systems of algal biomass, materials recycling, ecological habitat and microclimate management. There are opportunities in social ecology: urban food growing, for instance can promote education and health, community cohesion, social enterprise and resilience. For urban political ecology, ecosystems services can enhance social empowerment, inclusion and public participation.

For the UK **system of cities**, if London and other larger cities continue to increas e their densities, new and exciting forms of urban ecosystems will continue to emerge. Some possibilities include green roofs and living walls, elevated walkways and cycleways, vertical gardening and aquaponics, semi-enclosed microclimates in public spaces and atriums, biomimicry on urban rivers and waterfronts and creative landscapes for climate adaptation[10]. In many urban forms there is potential for ordinary dwellings to host diverse ecological habitats, with integrated breathing walls, passivhaus-type dwellings with solar conservatories, flow-form sculptural type waterfalls, rare species nests, with eco-design embedded in the low-carbon re-engineering of the building stock.

If we take on the above challenge of child poverty, we could look for opportunities from quite simple measures. Schools should be designed around greenspace and ecological habitats, and subject curricula should enable outdoor activity in school gardens, walking tours and so on. Leisure activities and meeting points for children and youth can be in outdoor or semi-outdoor spaces, with facilities for cycling, woodland activities, self-help shelters or creative arts. The 'incredible edible'[11] principles of urban cultivation as a community development involving all social groups, is a powerful statement of the potential[12].

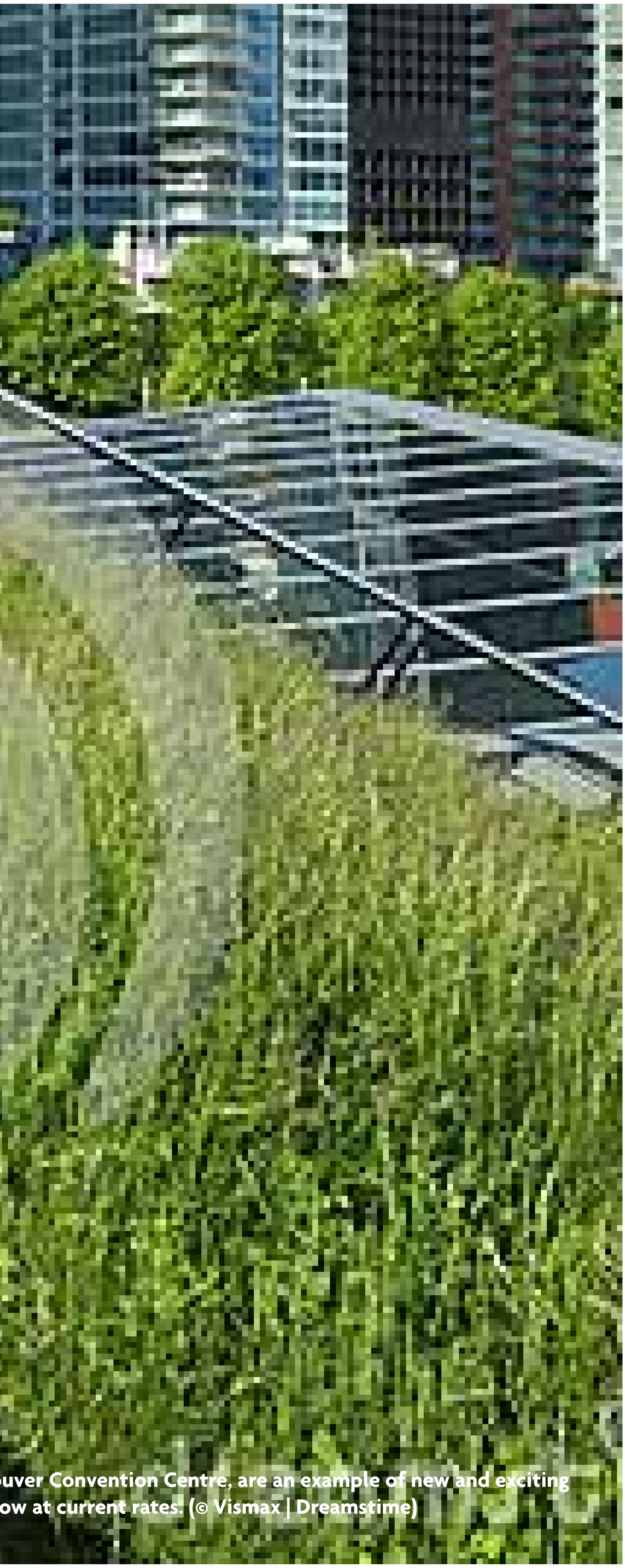
CONCLUSIONS AND THE NEXT CHALLENGE

This article highlights some topical issues for the future of urban-eco-systems services in the UK. In terms of global urbanization, with 300,000 new city dwellers per day, the UK is relatively slow changing, although with many local pressures of growth or decline. So we could anticipate more change on the human side, than on the physical urban environment: current social, economic, technology and political trends all raise problems and opportunities.

This comes back to the question raised at the start: is it possible to understand and assess the complexity of urban-ecosystems services, so that scarce resources can be used more wisely? My paper later in this issue explores this question and proposes a method and toolkit. **ES**

"if London and other larger cities continue to increase their densities, new and exciting forms of urban ecosystems will continue to emerge."

▲ **Figure 5. Green rooves, such as this example at the Vanco urban ecosystems which could emerge if cities continue to gr**



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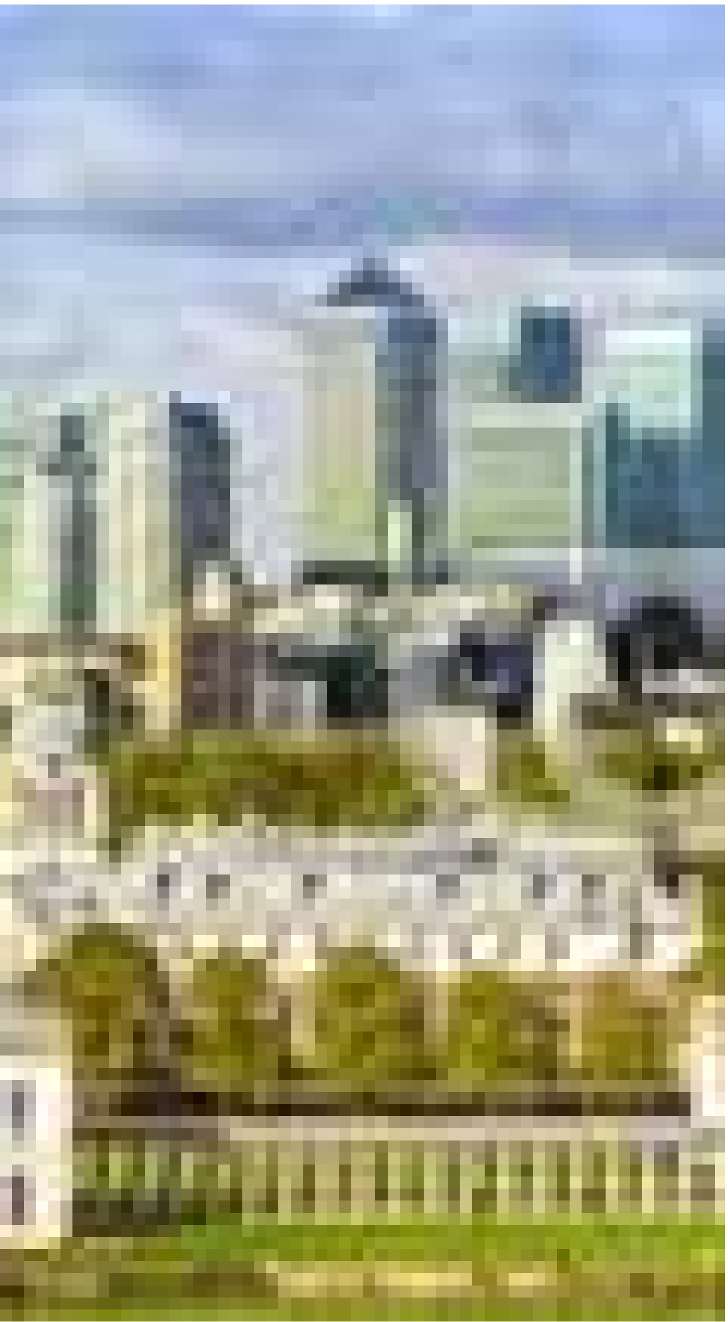
The complexity of urban ecosystems services

Joe Ravetz outlines a synergistic way of working with complex systems.

The previous paper in this issue looked ahead at the future of urban ecosystem services, drawing on the Government Office of Science Foresight study[1]. The backdrop is the Ecosystems Approach, a general way of looking at the inter-connected whole rather than the sum of parts[2]. The paper ended with a question: if the reality of urban systems and ecosystems is complex and inter-connected, how can we understand and work with them?

So here we set out a new method, known as the synergistic approach. This works with urban ecosystems services and similar problems: these are often the kinds of systems which are complex, cognitive and co-evolutionary ('3C'), shaped not only by biological forces, but human factors such as collaboration and social learning. Where used for assessment, valuation or evaluation, the synergistic approach doesn't replace existing methods, but it can help with their gaps and shortcomings[3,4].



QUESTION: IF URBAN SYSTEMS AND ECOSYSTEMS ARE COMPLEX AND INTER-CONNECTED...

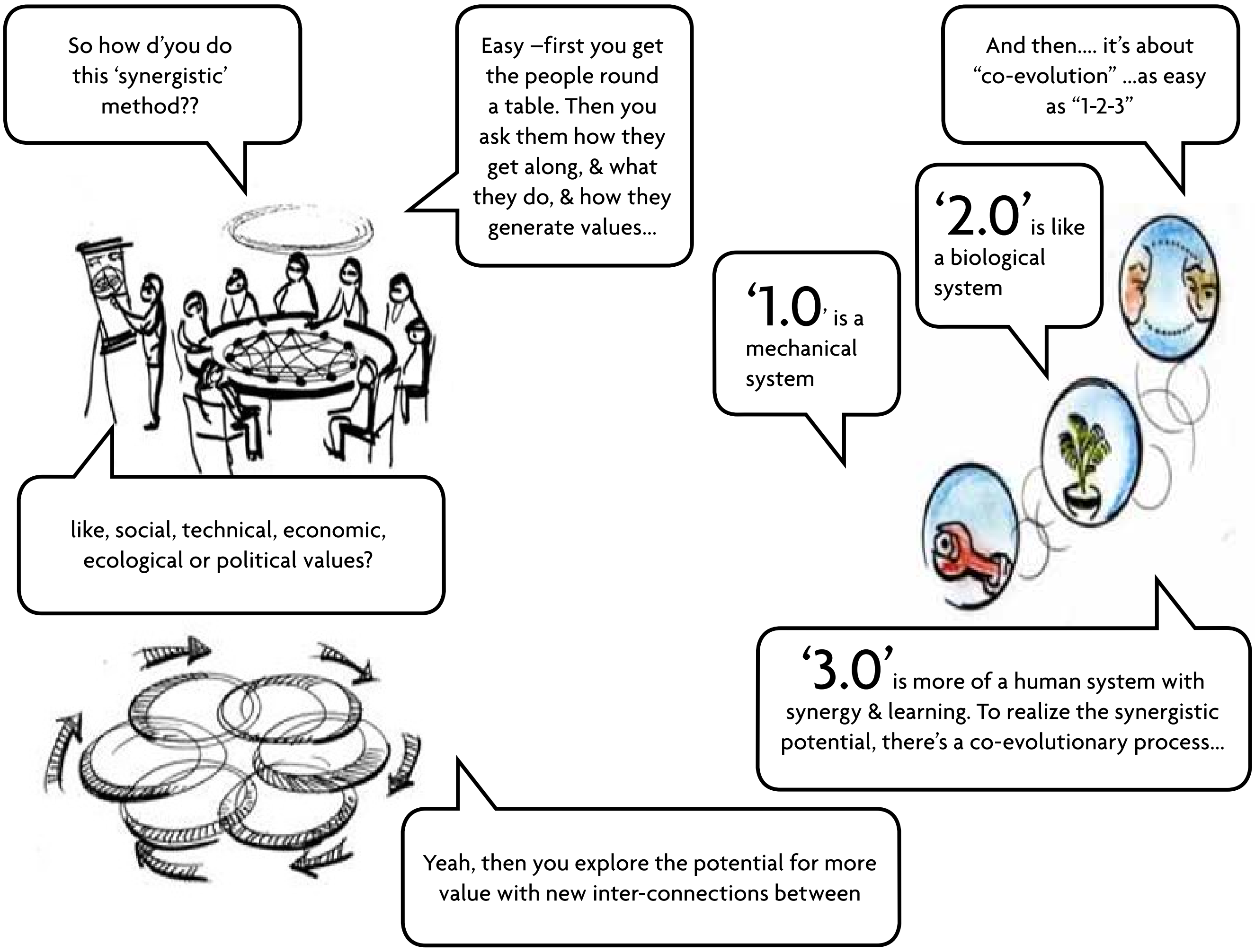
Work is in progress on ways to measure or assess urban-eco-systems services (urban-ESS). One example is now a UK best practice: the Mayesbrook Climate Change Park Project in London[5,6]. "*This is the largest river restoration project in London and the flagship project for the London Rivers Action Plan. The 48 hectare park, one of the largest in east London, used to be mostly short mown grass and lacking amenities, and was used little by people. An Ecosystem Services Assessment quantified the benefits from the proposed work… showing benefits worth up to seven times the estimated £4 million cost.*"[5]

This ecosystems services valuation was one of the first of its kind in the UK, but questions arise as in the Foresight study above. From the estimated urban-ESS benefits, 65 per cent of the total 'benefit' is in 'recreation and tourism', and another 30 per cent is due to property value uplift in the surrounding area. It seems a bit problematic that the 'regulatory services' of climate, flood, soil erosion, nutrients and habitats, are less than 5 per cent of the total, and these come with large bands of uncertainty. A policy-maker might look at this summary list of values, and decide to replace the outdoor park with an indoor leisure centre or industrial food complex. It seems that Mayesbrook and many other cases would benefit from a more synergistic approach, which is more grounded, in both ecosystems and urban systems.

" the synergistic approach doesn't replace existing methods, but it can help with their gaps and shortcomings "

TOWARDS A SUITABLE METHOD

All this suggests the possibility of new ways to work with highly interconnected problems with '3C' complexity – cognitive, collaborative, co-evolutionary. Urban ecosystems – even the humblest pocket park – have a physical aspect, but also a tangle of social, technology, economics, politics and cultural issues. There are inter-connections between global and local levels, or between short term and long term. And most importantly, much depends on the cognitive human factors, as to whether creative thinking, synergy and collaboration, social learning and intelligence can co-evolve. It seems that the Ecosystems Approach seems to aspire to this holistic level of integration, but often lacks the tools and resources.



▲ **Figure 1. Synergistic mapping and the co-evolutionary '1-2-3.0'. The basics of the synergistic mapping method are shown on the left, starting with a group of actors. On the right, the three main levels of co-evolutionary change are shown. (Author's artwork; © Joe Ravetz)**

So what can be done? A method has taken shape over the last decade – the *Synergistic approach* – so called as it's focused on the human factors of creative synergy[7]. As applied with synergistic mapping, the method begins with drawing the problem, with its main components and inter-connections, with as much detail as needed, starting from a flipchart (**Figure 1**, left side). Then it works through a four-stage cycle of questions:

a) **Scoping / landscape mapping:** (questions – what is our problem: who / what is involved, how does the system work: what are the inter-connections?).

b) **Scenario / change mapping:** (questions – what are the drivers of change, trends, alternatives?).

c) **Synergy / idea mapping:** (questions – which are the most creative synergies and opportunities?).

d) **Strategy / pathway / road-mapping:** (questions – which direction to follow, and what to do next: and with what results by which criteria?).

Working through these questions, we can sum up different kinds of systems order and change with three main levels, so titled '1-2-3.0'. For each there is an image of a certain kind of city (**Figure 1,** right side):

1) **1.0: linear change:** 'functional systems' which respond to direct short term change: (i.e. an image of a large and complex *machine*). For instance, a car engine is complex and quite clever, but it changes only with speed, power, fuel mix and so on: it could not reproduce itself or evolve into a different kind of engine. A successful city in this model would be a *clever city*.

2) **2.0: evolutionary change in 'adaptive systems':** evolving with longer term changes and transitions,

but with an evolutionary model of 'winner-takes-all' (with an image of biological jungle). A successful city in this model would be a *smart city*.

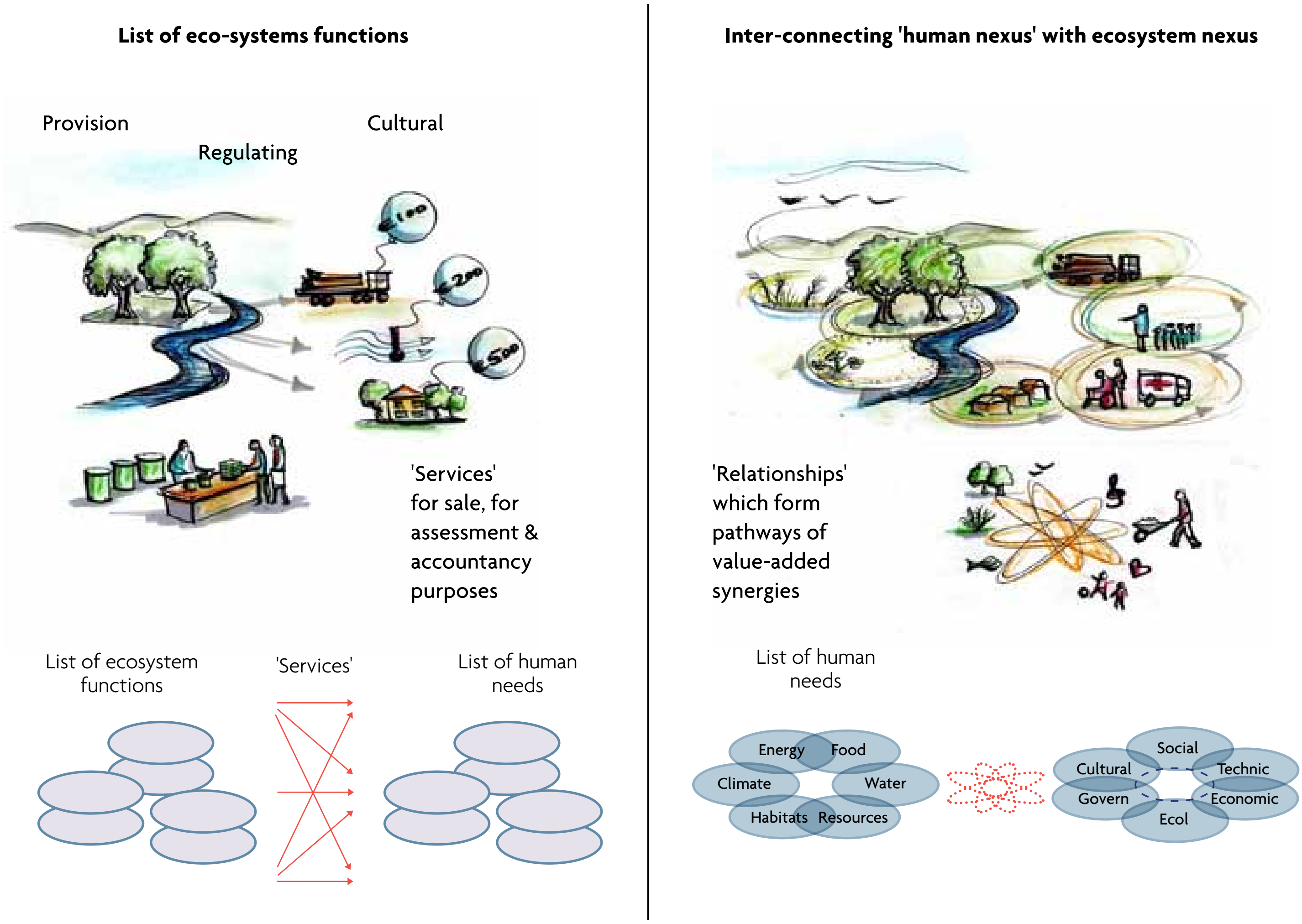
3) **3.0: co-evolutionary change in 'synergistic systems':** these are shaped by human qualities - thinking, learning, questioning, strategy, self-awareness, intelligence (an image of a human situation). This is like a co-evolutionary model of 'winners-are-all', via a learning process for synergy and social intelligence. A successful city in this model would be a *wise city*.

The third model – '3.0' synergistic change – helps to understand many kinds of human system, where there are both technical and cognitive dimensions, and where there is potential for creative synergy and social learning. For example:

- Urban 3.0: a self-organising, responsive city or region that provides livelihoods for all, takes responsibility for its ecological effects and builds a just and equitable society;
- Economy 3.0: systems of livelihood, production, finance and overall prosperity that include social and ecological values, respect global limits, and are creative, resilient, inclusive and self-organising; and
- Governance 3.0: structures for participative decision-making and collective resource management, with citizen empowerment via collaboration, based on social learning and intelligence.

TOWARDS URBAN ECOLOGICAL INTELLIGENCE

Here the focus is an Urban ecology 3.0 model. Broadly this is about mobilising human learning and synergy to organise energy, food, resources and ecosystems, for lower impact and increased value, with enhanced



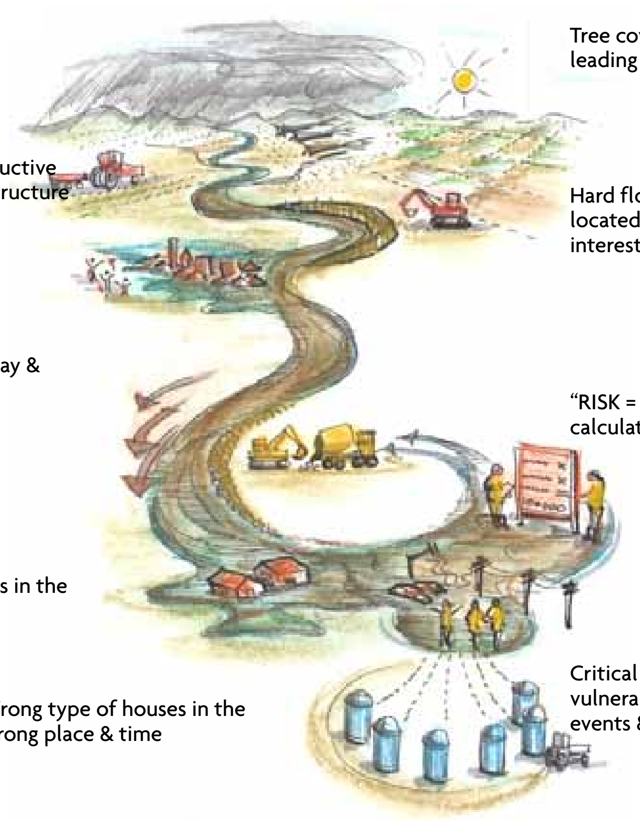
▲ **Figure 2. Urban Ecosystems services: from linear to coevolutionary. On the left the current approach to ecosystems services, as lists of items for exchange is illustrated. On the right are some ways to visualize relationships between a nexus of ecosystems and a nexus of human systems (Author's artwork; © Joe Ravetz)** resilience and capacity. Experience shows that understanding and working with urban ecosystems services is more than a 1.0 linear system of cause and effect, and more than a 2.0 competition and 'winner takes all'. The Ecosystems Approach as above, calls for a more 3.0 synergistic model, but there are problems: often, a 3.0-type response does not fit well in a 1.0 or 2.0 type organisation, or policies facing 3.0-type problems can only offer 1.0- or 2.0-type responses.

One example is the Irwell Country Park in a run-down area of North Manchester[8]. The ecosystems services it provides include amenity, health, flood alleviation, and local microclimate. In social terms it is a problem area of stolen cars, drug trading and illegal waste tipping, needing costly remediation to recover negative economic values. There are conflicts between dog walkers, bird-watchers, cyclists, land managers, security, the youth and the elderly. An extended participation programme with local residents showed that creative social innovation has the potential to turn conflicts into collaboration, for schemes in local food, education, health, ecology, events, markets, cafes, or play schemes. The implication is that the urban ecosystems services and their socio-economic values are not fixed or objective at all – they are more like spaces of opportunity, that reflect the potential for creative collaboration, learning and innovation.

This case and many others raise questions on the application of urban ecosystems services. The concept provides a first take on human–ecosystem interactions, but it could also squeeze both sides into an over-simplistic frame. This is particularly topical for economic valuation of ecosystems: for example, the UK NEA seems to present monetary valuations without bands of uncertainty or confidence[5]. By contrast, the Ecosystems Approach raises the possibility of working with the complexity of human and natural systems: in this case, services are not so much one-way transactions, rather more like processes of social learning and co-evolution. For instance, farmers learn how to work the land, and land use patterns are in coevolution with markets and technologies. Or, food chain managers learn how to match supply and demand, and the technologies are in co-evolution with the markets, and so on[7]. The point is that value is created by complex socio-economic systems, and these are not generally given on a plate or in a formula, rather they can only emerge through social learning and a co-evolution process.

We can visualise the shift from a linear concept of urban ecosystems services, towards a more synergistic model (see **Figure 2**). On the left-hand side is a diagram based on the Millennium Ecosystems Assessment, with checklists of human and ecological systems[9]; the cartoon shows 'services for sale', where prices can be checked for assessment and accountancy purposes. On the right-hand side, a more interconnected picture reflects

“Urban ecosystems – even the humblest pocket park – have a physical aspect, but also a tangle of social, technological, economic, political and cultural issues. ”



▲ **Figure 3a. Urban ecosystems, adaptation and resilience: Linear-evolutionary (1-2.0) model. A typical approach to adaptation and resilience (reactive, short-term, silo-thinking). (Author's artwork; © Joe Ravetz)**

the complexity and dynamic nature of both human and ecosystems services. Rather than services, this is more about relationships between actors and factors, with potential for value through inter-connections. In our country park example, examples of such positive inter-connections included

(a) outdoor lessons for schoolkids,

(b) space for youth to build sheds,

(c) effects on social inclusion and reciprocity,

(d) reduced pollution and damage to the woodland.

Such examples highlight the economic valuation of urban-ESS, as seen in the economics of ecosystems and biodiversity (TEEB), payment for ecosystem services (PES) and other variations[10]. If there are ecosystems services with human or urban benefits that are specific and tangible, tradeable and substitutable, then standard methods of economic valuation and marketisation can be useful. If other kinds of inter-connections are more significant, as in the example above, then a purely economic focus is not enough: we have to include other human factors, such as the capacity to learn, deliberate, collaborate or innovate. In that way the assessment of value added, valuation and evaluation isn't so much a fixed answer, rather a space for opportunities to be explored[11].

"the Ecosystems Approach raises the possibility of working with the complexity of human and natural systems "

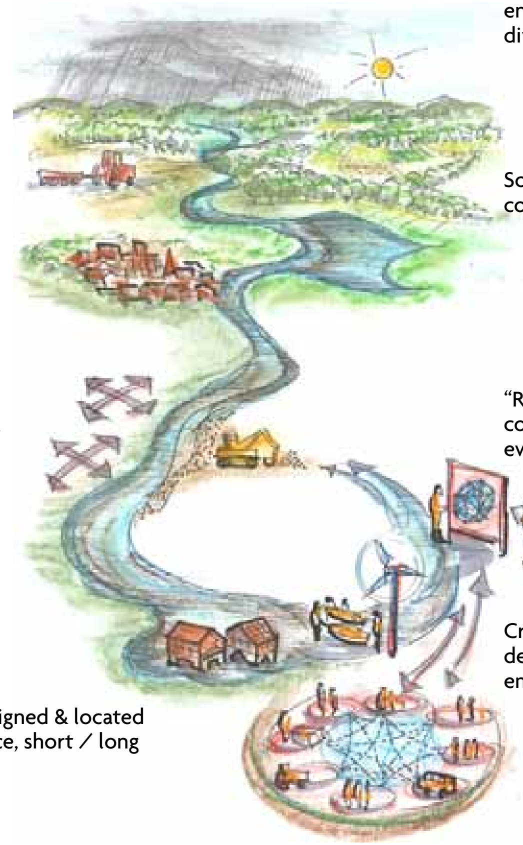
The implications are very topical. To protect and enhance our urban ecosystems services in an uncertain future is more than a linear type of calculation of costs and benefits, and more than a 'winner-takes-all' calculation of market forces. The greater added value is in potential for learning and synergy of all involved. It seems this is already the aspiration of the Ecosystems Approach, which provides the backdrop to ecosystems service assessment: the question is how to turn it into reality, not only for ecosystems, but for urban systems too.

AN 'URBAN ECOSYSTEM SERVICES' ASSESSMENT METHOD

We can now sketch out a next-generation model for urban ecosystems services valuation, assessment and evaluation, based on the synergistic method of mapping and design. The basic principle is that urban ecosystems services interactions are not static but dynamic, under conditions of change and potential. If a town has lived next to a river for 500 years, it will be difficult to assess this relation in any meaningful way; but if conditions change on either side, then the value of the relationship will be much more in focus and relevant to action. The synergistic approach enables a way of exploring such dynamic change and potential risks and opportunities, keeping in mind the interconnections and complexity on either side. The four main steps would therefore include both flow-chart mapping and a matrix analysis to track the detail (some example matrices are in Ravetz, 2015[1]):

1. Scoping/landscape mapping: this would show the combined linkages of urban ecosystems, framed as capabilities and affordances of the main actors or stakeholders, which might be economic, social, technical or cultural. For example, an urban park should be integral to quality of life, which includes the capability of outdoor experience, in general and for particular activities such as pets, children, sport, etc. However, we focus in on the more problematic links, with dysfunctions, misunderstandings and conflict between the stakeholders, on the basis that if everything is fine for everyone, then there are other priorities to investigate.

2. Scenario/change mapping: this would show a systematic review of drivers and the possible outcomes of potential change. For example, gentrification is a key driver of change both in the usage of the park and in the surrounding property market. A full investigation would look at the drivers of change, the dynamics of change and the results in alternative scenarios.



▲ **Figure 3b. Urban ecosystems, adaptation and resilience: co-evolutionary (3.0) model. A more synergistic approach which is pro-active, systems thinking, based on social learning and collaboration. (Author's artwork; © Joe Ravetz)**

3. Synergy/idea mapping: this would be a systematic review of the potential for shared learning and creative collaboration. For the urban park, an intractable social problem with ecological effects (e.g. wrecked cars), might be transformed into a win–win opportunity (e.g. socio-eco community enterprise). Possible 'pathways' of inter-connecting potentials, include:

- Multi-functional infrastructure pathway: a collaboration of government, finance, land managers, infrastructure providers and public services; the added value is via advance procurement, multi-functional design and fiscal channels for costs and benefits from integrated catchment investment;
- Social eco-crowd-source pathway: this is more about the socio-cultural value of ecosystems, where a social media strategy can mobilise investment both of money and social activity; and
- Community farming pathway: social enterprise innovation for urban farming, with new models of linking niche production with social markets and distribution networks.

4. Strategy/road mapping: here the point is that by looking for potential synergies and practical pathways on the urban ecosystems services interface, we can explore the possibility of a very different kind of assessment or evaluation. If necessary, the assessments could be reduced to monetary values with large bands, but it is generally more useful to keep them as synergistic opportunities. The whole calculation can be shown in matrix form, which sets out in detail the tangible and intangible values, the probabilities and contingent factors, the uncertainties on all sides, and the practical realities of collaboration and mobilisation. The assessment can also be turned around for the 'null' case, i.e. not working on a pathway, thereby bringing into focus the added value of action, either for the ecosystems or the urban systems.

Overall there is a shift from valuation models (which tend to assume clear and tangible concepts of value) towards evaluation models (which are more about deliberation on potential values or priorities, for multiple actors, with multiple justifications). An evaluation approach tends to call for a wider view. In this case we look not only at the urban-ESS in that specific park location: but more widely at the prospects for climate change adaptation, and the potential for resilience at various levels on the right (both of these are major questions for another paper). **Figure 3** shows a pictorial view, with a linear model in **Figure 3a**, and a more co-evolutionary model of adaptation and resilience in **Figure 3b**.

CONCLUSIONS

Overall, the synergistic approach is a logical extension of the Ecosystems Approach, and the building of relationships between natural assets/flows, and human needs/demands. The notion of complex adaptive systems is now recognized in ecology: we can now link this more clearly with the dynamic and co-evolutionary potential in human systems. With this, we can go back to tricky joined-up questions of climate adaptation, local biodiversity, flood risk and similar; keeping in the picture the interconnectedness of ecosystems and urban systems, while working towards a practical outcome. **ES**

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