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Taking the economic benefits of green space into account: The story of the Dutch TEEB for Cities project

Johan van Zoest [a,*], Marian Hopman [b]

[a] Technical University Eindhoven and City of Amsterdam, PO Box 2759, 1000 CT Amsterdam, The Netherlands
[b] Ministry of Economic Affairs, PO Box 20401, 2500 EK The Hague, The Netherlands

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ABSTRACT

As municipal management budgets for green space management are under pressure, there is an urgent need for new funding models for urban green space. Inspired by the TEEB study (The Economics of Ecosystems and Biodiversity, 2010), it was hypothesized that the value of ecosystem services that urban green spaces provide, when monetized, will often be larger than the cost of management. This article describes an initiative to develop a tool that makes the financial benefits of green spaces visible in the municipal balance sheet. While the project was successful in producing the desired deliverables (a tool for inclusive finance for urban green spaces, eight in depth cases showing green spaces paying their way, a Community of Practice), it is recognized that the adoption of inclusive finance in municipalities depends critically on urban strategies that have efficiency and resilience at their core.

1. Introduction

In The Netherlands as well as in many other European countries, municipal budgets for green space management have been under considerable pressure in the last three decades. In most Dutch cities, green space managers have shown remarkable resilience to tightening constraints, either by

* Corresponding author. Tel.: +31 20 255 1922.
E-mail address: johanvanzoest@gmail.com (J. van Zoest).

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increasing work efficiency, outsourcing tasks, standardization of workflows, lowering quality norms and a talent for accessing ephemeral budgets. However, the current economic downturn has resulted in budget stress of a magnitude that renders gradual adaptation no longer possible.

Among politicians and professionals the question has arisen whether radically new modes of funding urban green space are feasible, other than traditional tax-based municipal finance. One avenue that is currently being explored is whether green space can pay its way by accounting for the value of the ecosystem services that it produces. Certainly, interest in ecosystem services has grown considerably over the past decade, including in policymaking and especially regarding potential for supporting practical climate change responses. Ecosystem services (ES) include all processes and things nature provides that make human life possible and pleasant, and includes diverse 'services' such as water retention, psychological restoration from stress, food and biomass production, pollination, and air purification (Millennium Ecosystem Assessment, 2005).

More formally, ecosystem services are defined as benefits that humans obtain from ecosystem functions (de Groot et al., 2002), or as direct and indirect contributions from ecosystems to human well-being (TEEB, 2010). Following (Millennium Ecosystem Assessment, 2005), Gómez-Baggethun et al. (2013) classify urban ecosystem services into four categories, viz. provisioning services (goods obtained from green spaces, such as food and water), regulating services (keeping the environment in benign and liveable condition, e.g. moderation of climate extremes and global climate regulation), cultural services (providing an environment conducive to health and human development, e.g. cognitive development, place values and social cohesion), and finally habitat services (providing space for non-human life to prosper). The psychological and health effects of urban green space, *via* biopsychological restoration, in particular, have long been recognized in urban planning (Lachowycz and Jones, 2013).

As professionals grew aware of the importance of ecosystem services in the 1990s, the ES concept was synthesized with ecological network thinking (which developed earlier, in the 1970s) to give rise to the concept of 'green infrastructure' (Benedict and McMahon, 2006). This functional view of urban nature and green space as constituting a life support system rather than 'just' an amenity echoes the ideas of the 19th century parks movement, which saw urban parks (and later allotment gardens, sports parks and playgrounds) as a means to combat urban illnesses, both medical and social (Hickman, 2013). With new conceptualisations of cities as complex socio-ecological systems (e.g. Batty, 2005), green infrastructure is increasingly recognized as a critical factor for the economic success of cities, along with the traditional infrastructures for transport, communication, energy and so on.

Loss of ecosystem services can pose economies enormous costs, being either irreplaceable (such as pollination) or very costly to replace artificially. Conversely, a better integration of green infrastructure in cities can lead to cost reduction. For example, an evaluation of the economic benefits of rainwater runoff reduction by urban green spaces in Beijing showed that 2494 cubic meters of potential runoff was reduced per hectare of green area and a total volume of 154 million cubic metres rainwater was stored in these urban green spaces, which almost corresponds to the annual water needs of the urban ecological landscape in Beijing. The total economic benefit of 1.34 billion Chinese renminbi in 2009 (US$ 1 = RMB 6.83) is equivalent to three-quarters of the maintenance cost of Beijing's green spaces (Zhang et al., 2012).

Another example, relating to public health, concerns a preliminary study in Amsterdam by KPMG, which suggests that adding 10% of green area to an Amsterdam inner city district (Bos en Lommer) could reduce the number of local depression patients by 130. Avoided costs for healthcare and absenteeism are estimated at 800,000 euros. Extrapolated for The Netherlands this would amount to approximately 400 million euros annually (KPMG, 2012).

Green infrastructure could be especially helpful in adapting to or mitigating the effects of climate change in cities (termed 'ecosystem based adaptation' or EBA by the Secretariat of the Convention on Biological Diversity (AHTEG, 2009). With notable exceptions (e.g. New York (http://www.nyc.gov/html/dep/html/stormwater/nyc_green_infrastructure_plan.shtml) and Singapore (http://app.mewr.gov.sg/web/Contents/Contents.aspx?ContId=1342), the majority of cities in the world are in the early phases of adopting EBA, running city greening programs of a sectoral and occasional nature, heavily dependent on political mavericks acting as champions and 'upward' societal pressure (e.g. roof greening subsidies, local tree planting programs). Especially in the Global South, greening programs for

climate change adaptation are mostly community based, closely tied to poverty alleviation schemes, and powered by local champions (Roberts et al., 2011; Carmin et al., 2012; Dodman and Mitlin, 2011; Goldstein, 2012).

With global average temperatures expected to rise by at least 2 °C by the end of this century compared to the pre-industrial average, urban populations are increasingly exposed to disruptive changes and resilience risks. These include risks to food supply, flooding risk (especially in coastal areas and river basins), extreme weather events, and epidemiological risks. Green infrastructure could offer cost-effective opportunities for ecosystem based adaptation, e.g. by reducing temperature extremes in urban heat islands, groundwater fluctuations, and energy consumption for heating by insulating buildings. Urban vegetation and soils can also act as carbon stores, although the amount of carbon a city can offset through its green infrastructure is modest compared to overall city emissions (Pataki et al., 2011). To many economists, a prerequisite to unlocking substantial funding for green infrastructure is to unveil the economic importance of green space by analyzing value creation, financial effects and identification of beneficiaries, including free riders (parties who do not pay for benefits received). Such an economic analysis could provide a foundation for both payment for ES schemes as well as ES-based government expenditure. While methods for monetizing ES have been developed since the 1970s, a landmark study in 2010, the UNEP-hosted study on The Economics of Ecosystems and Biodiversity (TEEB) (TEEB, 2010) boosted worldwide attention to the pricing of nature and, by extension, urban green spaces. Founded in ecological economic theory and illustrated with a rich database of examples, the TEEB study highlights the many ways in which nature enters economies and influences prices, premiums and taxes.

As both the current authors were working at the time in programs to explore new ways of financing green space, the TEEB report inspired us to discuss the possibilities of applying 'TEEB-thinking' to decision making for green spaces at the local level with colleagues and non-governmental experts. Looking for leverage points, we found that the financial paragraph that accompanies municipal decision documents is pivotal. Urban investment decisions affecting green spaces are based on financial analyses that do not account for the benefits of ecosystem services and thus consider green space solely as a cost factor. From the TEEB perspective, this must be considered a bias which can misinform decision makers and might lead municipalities to 'steal from their own purse'. For example, conventional accounting might miss opportunities for cost cutting by better use of trees for water management. For the purpose of this article, we call the practice of calculating the total costs and benefits of green spaces 'inclusive finance'.

While inclusive financial analysis has been mainstreamed in The Netherlands with regard to national infrastructural projects, at the local level this phenomenon has not even reached infancy (Kirchholtes et al., 2012). A tool that quantifies (and monetizes) the benefits of green space and specifies beneficiaries (users, residents, businesses) could – at least in theory – help green space finance in three ways. First, it can inform decision makers by explaining and quantifying the economic contributions of green spaces. Second, by assessing benefits and beneficiaries, it can lay the foundation for new modes of funding (based on the principle that the polluter and the beneficiary should pay). And third, it can open up a path to planning and designing green spaces in a way that optimizes economic benefits to local society.

While the TEEB for Cities initiative emanated from practical considerations (exploring new ways of financing urban green spaces), it touches on deeply held beliefs in mainstream economics about the nature and dynamics of modern economies. Mainstream or neoclassical economics refers to a body of theories based on the thinking of Leon Walrass, Stanley Jevons, Alfred Marshall and other late 19th century economic theorists, who focused at turning classical political economy into a 'true' mathematical science comparable with physics. The tenets of neoclassical economics, such as consumers being highly rational, have met with fundamental criticism (e.g. Keen, 2011), especially after the collapse of Lehman Brothers in 2008, marking the US subprime mortgage crisis which triggered the current global recession (e.g. Orrell, 2012). The tenet that has perhaps been most fiercely debated is market efficiency, as enshrined in the Efficient Market Hypothesis, which essentially holds that goods and services are assigned their true monetary value by the market mechanism. Neoclassical economics sustains the widely held view that public goods, such as urban parks, are outside of (external to)

the economic domain. Lacking price signals, loss of ecosystem functions often is not detected by the current economic incentive system and can thus continue unabated.

The key question driving the TEEB for Cities initiative was not whether a tool for estimating the total benefits of urban green spaces could be constructed. Techniques for valuing public goods have been available in the periphery of economics for decades, for example in ecological economics and welfare economics (see TEEB, 2010 for an overview and technical assessment). Largely unknown in municipal decision making, a recent stream of publications has highlighted the economic value and potential of urban green spaces. While this may have heightened the awareness of politicians and project managers that green spaces represent economic value, it has not elicited sufficient confidence to actually start using inclusive valuation techniques. This is readily explained by the fact that for financial analysts, project managers and politicians, inclusive cost/benefit analysis poses a certain risk compared with trusted conventional methods, as the correctness of the analysis can only be corroborated after time. A certain 'entrepreneurial risk taking' seems unavoidable, but for public officials, this is rocky terrain.

The key question of TEEB for Cities was therefore: in what ways could inclusive finance techniques be made practical and convincing to decision makers? In other words, how can the risks associated with introducing a fundamentally different way of calculating costs and benefits be mitigated? This said, it should be borne in mind that TEEB for Cities was neither intended nor designed as a conventional research project. If in hindsight we can speak of a research strategy, probably 'action research' fits closest to the approach followed, which might be described as 'making a move and seeing what happens'. We believe that this often is a helpful heuristic in exploring 'wicked' problems such as climate change impacts in complex systems. Many cities around the world are facing comparable challenges and are experimenting with greening programs (Roberts et al., 2011). Sharing 'on the ground' experiences (like ours) with other cities may accelerate the evolution of effective planning practices and novel funding mechanisms for green infrastructure.

2. Materials and methods

Pricing nature as proposed by the TEEB approach has raised discussion about both the possibility and the desirability of putting nature into an economic framework (Gomez-Baggethun and Ruiz-Perez, 2011). On one hand, this is criticized as commodification of nature and misguided confidence in the power of markets to allocate goods and services their correct value. On the other hand, TEEB points – in our view rightly – to the error of treating nature as an externality and its benefits to humanity as limitless and free. While we agree that methods for pricing nature by definition will only produce estimates or proxies, awareness of how nature influences prices, premiums, rents and taxes challenges neoclassical economics and neoliberalism.

The TEEB approach inspiring our research is an attempt to quantify the claimed benefits of ecosystems using a variety of methods from ecological economics. In our case, for practical purposes an existing and straightforward methodology was used, which in The Netherlands was developed in the 2000s to account for the social costs and benefits of national infrastructure projects. This methodology was adapted to the scale and specifics of urban green space economics, as described below.

After putting a dot on the horizon (developing an inclusive financial analysis tool), we set out to describe critical paths (how can we make it happen?). Since the initiative group lacked the expertise to build the tool, outside expertise was needed, which meant accessing funding (an estimated 200,000 euros) and finding a party willing formally to commission the assignment. The initiative group could not play this role, as it operated as an informal network of 'well positioned enthusiasts', without budget or hierarchical structure, each member responsible for informing his or her organization.

The initiative group wrote a proposal, which served as a basis for subsequent discussions with potential participants. As the Ministry of Economic Affairs was in the process of preparing a national TEEB study (assessing the economic value of Dutch ecosystems), a 'TEEB for Cities' was welcomed and was fitted into this broader study. The Ministry was willing to provide 90,000 euros, under the provision that local authorities supplied a contribution of equal size, to ensure commitment.

This meant we had to find at least ten municipalities willing to invest 10,000 euros each in the project. Practically all municipalities we approached showed interest, presumably for three reasons. First, the tool to be developed promised to be an instrument that helped increasing financial efficiency (i.e. not losing money due to insufficient accounting). Second, the proposal encompassed the inclusive calculation of a local case using the (concept) tool. And third, there was the multiplier offered by the Ministry.

By June 2011 eleven municipalities had shown interest. To make the necessary arrangements, the municipality of Apeldoorn kindly offered to chair the project and to provide a project leader. The selection and contracting of a bureau was done by AgentschapNL, a government agency specialized in contracting and outsourcing. In a Terms of Reference, prospective bureaus were asked (i) to develop a tool that would enable municipal financial planners to reliably monetize the benefits of green space, (ii) to develop the tool 'bottom up', using cases provided by participants.

With due diligence Witteveen + Bos (W + B), Rotterdam was contracted and work began in autumn 2011. Also part of the project (but not assigned to W + B) was (iii) a public presentation of the overall results in mid-2012 and (iv) growing a Community of Practice out of the project group of municipal contact persons.

W + B set up a three-tiered approach, based on a methodology for inclusive finance the firm had pioneered in the 2000s and which has become standard in The Netherlands:

- Tier 1 – *Reasoning:* In plenary workshops and in the case studies, participants were given guidance and practice in qualitative economic analysis i.e. recognition and description of the effects of the green space under scrutiny on specified actors (residents, property owners, the municipality etcetera).
- Tier 2 – *Calculating:* Using a spreadsheet model tailored to the municipal situation the external benefits of each case were calculated.
- Tier 3 – *Funding:* The emerging picture of benefits and beneficiaries was used to discuss potential alternative funding schemes. For instance, it was mentioned to ask free riders (beneficiaries who do not pay) a contribution, to apply fees and levies to specific users, or to apply a targeted use of real estate tax. Given the political sensitivity of these issues, only voluntary arrangements are debated at this stage. However, it is conceivable (at least in theory), that emerging insights about the distribution of benefits of green spaces in urban society could over time lead to modifications of the local tax system that ensure a more just and efficient payment for local ecosystem services.

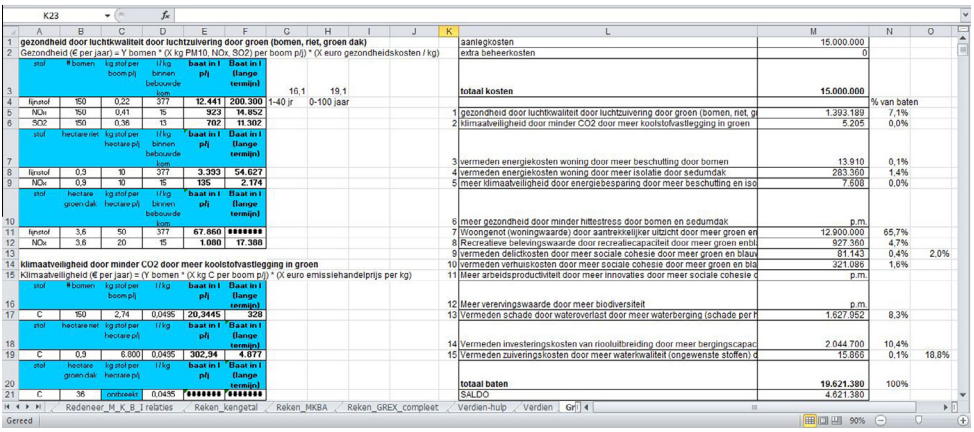
Essentially, the technique developed by W + B tracks changes in physical quality brought about by an intervention and subsequently assigns these changes a monetary value (money saved or gained) using parameters from a scientific database. Thus the tool translates adding specified quantities of green space (or a specified number of trees) into, for example, avoided costs of treating respiratory illness. The basic approach is comparable with assessment techniques such as the Green Infrastructure Valuation Toolkit (http://www.greeninfrastructurenw.co.uk/html/index.php?page=projects&GreenInfrastructureValuationToolkit=true) and the park system assessment developed by The Trust for Public Land (http://www.tpl.org/publications/books-reports/ccpe-publications/charlottemecklenburg-county.html).

3. Results and discussion

The project was finished in spring 2012, with the following products and results delivered.

First, a tool which was distributed among the participants consists of a spreadsheet and a manual (Fig. 1). Users are required to enter relatively simple parameters of the urban green space in question (areas, numbers, volumes) which are then coded into financial terms, using parameters for social cost/benefit analysis that are recorded in a Handbook for the valuation of external costs and benefits. The parameters are regularly updated as science progresses (Leidraad OEI, 2000).

Secondly, a booklet was published ("Green space pays off with TEEB City") describing the project and highlighting eight city cases (downloadable at http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2012/09/20/teeb-stad.html). Taken together, the cases show



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	gezondheid door luchtkwaliteit door luchtzuivering door groen (bomen, riet, groen dak)											aanlegkosten	15.000.000		
2	Gezondheid (€ per jaar) = Y bomen * (X kg PM10, NOx, SO2) per boom pj) * (X euro gezondheidskosten / kg)											extra beheerkosten	0		
3	stof	# bomen	kg stof per boom pj	1 / kg binnen bebouwde kom	baat in € pj	Baat in € (lange termijn)	16,1	19,1				totaal kosten	15.000.000	% van baten	
4	fijnstof	150	0,22	377	12.441	200.300	1-40 jr	0-100 jaar							
5	NOx	150	0,41	16	923	14.852					1	gezondheid door luchtkwaliteit door luchtzuivering door groen (bomen, riet, gr	1.393.189	7,1%	
6	SO2	150	0,36	13	702	11.302					2	klimaatveiligheid door minder CO2 door meer koolstofvastlegging in groen	5.295	0,0%	
7	stof	hectare riet	kg stof per hectare pj	1 / kg binnen bebouwde kom	baat in € pj	Baat in € (lange termijn)					3	vermeden energiekosten woning door meer beschutting door bomen	13.910	0,1%	
8	fijnstof	0,9	10	377	3.393	54.627					4	vermeden energiekosten woning door meer isolatie door sedumdak	283.360	1,4%	
9	NOx	0,9	10	16	135	2.174					5	meer klimaatveiligheid door energiebesparing door meer beschutting en iso	7.608	0,0%	
10	stof	hectare groen dak	kg stof per hectare pj	1 / kg binnen bebouwde kom	baat in € pj	Baat in € (lange termijn)					6	meer gezondheid door minder hittestress door bomen en sedumdak	p.m.		
11	fijnstof	3,6	50	377	67.860	########					7	Woongenot (woningwaarde) door aantrekkelijker uitzicht door meer groen en	12.900.000	65,7%	
12	NOx	3,6	20	15	1.080	17.388					8	Recreatieve belevingswaarde door recreatiecapaciteit door meer groen enbl	927.360	4,7%	
13											9	vermeden delictkosten door meer sociale cohesie door meer groen en blauw	81.143	0,4%	2,0%
14	klimaatveiligheid door minder CO2 door meer koolstofvastlegging in groen										10	vermeden verhuiskosten door meer sociale cohesie door meer groen en bla	321.086	1,6%	
15	Klimaatveiligheid (€ per jaar) = (Y bomen * (X kg C per boom pj) * (X euro emissiehandelprijs per kg)										11	Meer arbeidsproductiviteit door meer innovaties door meer sociale cohesie c	p.m.		
16	stof	# bomen	kg stof per boom pj	1 / kg	baat in € pj	Baat in € (lange termijn)					12	Meer verervingswaarde door meer biodiversiteit	p.m.		
17	C	150	2,74	0,0495	20,3445	328					13	Vermeden schade door wateroverlast door meer waterberging (schade per h	1.627.952	8,3%	
18	stof	hectare riet	kg stof per hectare pj	1 / kg	baat in € pj	Baat in € (lange termijn)					14	Vermeden investeringskosten van riooluitbreiding door meer bergingscapac	2.044.700	10,4%	
19	C	0,9	6.800	0,0495	302,94	4.877					15	Vermeden zuiveringskosten door meer waterkwaliteit (ongewenste stoffen) d	15.866	0,1%	18,8%
20	stof	hectare groen dak	kg stof per hectare pj	1 / kg	baat in € pj	Baat in € (lange termijn)						totaal baten	19.621.380	100%	
21	C	36	ontbreekt	0,0495	########	########						SALDO	4.621.380		

Fig. 1. A screenshot of the TEEB for Cities tool (in Dutch). The table shows the monetary effects of various types of vegetation on the costs of health care and carbon emissions.

a staggering aggregate 54 million euros of credit balance. The biggest 'winner' is a study in Deventer, with a positive balance of nearly 30 million euros.

For example, for the case study in Delft (a town between The Hague and Rotterdam) the calculated costs and benefits amounted to € 17 million and € 27 million, respectively. The project studied concerns the construction of 5000 houses in combination with enlarging of water storage and provision of new green space. Of 180 measures and interventions, varying from using water storage crates under road surfaces to constructing green roofs and green facades, costs and benefits were calculated. Reasoning with benefits and returns (instead of financial constraints) added a new dimension to the design process, yielding new design solutions supported by beneficiaries. 'Moneymakers' were increased quality of living, less water nuisance, improved public health (air quality), increase of recreation, avoided costs of moving house (by more social safety), and energy saving. Beneficiaries included residents, local businesses, the Technical University of Delft, the municipality, project developers, housing corporations, and the water manager.

Lastly, an active Community of Practice formed around the nucleus of contact persons of the participating municipalities, coordinated by the municipality of Apeldoorn, and later by Platform31, a government funded agency that sustains practical research networks concerning social, economic and spatial issues in city regions.

While the TEEB for Cities project succeeded in reaching its stated goals, the key question is whether it got us any closer to the longer-term goal of making inclusive finance for green spaces attractive to Dutch municipalities. What have we learned?

First, the initiative added to, and drew attention to, the growing body of evidence highlighting the economic value of urban nature. For instance, the final results were presented to the Dutch Parliament as part of the larger Dutch TEEB study. But – as was to be expected – providing examples and a tool proved insufficient to elicit a broad range of pilots across municipalities spontaneously. At this stage, application of inclusive finance still seems to be dependent on individual activism by interested officials, project leaders and councillors. To our knowledge, at this moment only Delft and Amsterdam have decided to implement the tool in a number of pilots. (see www.teebstad.nl for up to date information).

Second, we observe that the outreach of our project was limited to the usual suspects i.e. professionals in green space management and planning, while inclusive finance is – or should be – the turf of financial planners and urban economists. As a result, the Community of Practice consists exclusively of professionals from green space departments. As a first course of action, the CoP has decided to turn the rather sophisticated tool developed by W + B into a simplified webtool, thus increasing the ease of application (see www.teebstad.nl).

Third, it appears that the first need of prospective users (green space officials) is to master economic reasoning e.g. translating measures into changes in quality and analyzing beneficiaries. The learning process on which the CoP has embarked seems to be a necessary step before further adoption by this group and maturation of the method is possible.

How does this study test the accuracy or validity of the economic values assigned to green space? To what extent can or should public consultation or participation in ascertaining 'popular' or public valuations play a role? The tool presented here is derived from a class of methods that, at least in The Netherlands, are used to assess the social costs and benefits of large infrastructure projects. At the heart of the TEEB for Cities tool lie tested correlations between relevant variables, as described in the economic literature. The tool thus produces estimates of social costs and benefits, the accuracy of which can only be corroborated post hoc. In that sense, the tool cannot abate the inherent entrepreneurial risk that investing in public space implies. However, the restricted scale of green space projects should allow planners to gauge the willingness to pay for ecosystem services directly with (panels of) stakeholders. In addition, expert opinion could be used to refine the estimates of, for example, cost reductions in public health and water management.

All told, the maturation and adoption of inclusive finance certainly benefits from examples and tools, but are likely to be dependent on comprehensive urban strategies that encourage monetizing externalities. This, in turn, requires a systemic change at the paradigm level i.e. the level that defines the goals of the urban economic system (Meadows, 1997). However challenging this may sound, it may be more a matter of accelerating than of generating. As prices of energy and commodities rise and become more volatile, we expect businesses to be pressed for efficiency in manufacturing and transport, while local governments are increasingly pressed for creating efficient and resilient infrastructures and circular economies (Ellen MacArthur Foundation, 2013; Kok et al., 2013), including green infrastructures that efficiently produce ecosystem services (Hawken et al., 2008).

One easy way for local governments to start the transition process is to practice with inclusive financial accounting in simulations of real life situations. Discovering the differences with conventional techniques helps discovering inefficiencies. Applying outcomes in low risk pilot areas (city labs) can open up opportunities for further testing and maturation, paving the way for broad application in urban strategies.

Reflecting on broader political economic issues, experience up till now seems to indicate that political support for new social cost benefits tools follow partisan divides. In other words, 'green' parties see the outcomes of the tool as new evidence of the value of green spaces, while not so green parties are reluctant to take the outcomes for granted. To a degree, the acceptance of tools like ours will depend on adoption by 'credible pioneers' (such as New York City, mentioned above) and of course, by corroboration of the estimates produced by the tool.

Another issue concerns trade-offs and competing claims of different groups. While in none of the city cases more than one planning scenario was assessed, the TEEB for Cities tool could be useful in estimating costs and benefits of multiple scenarios, reflecting diverging societal claims. It should be remembered however that a cost/benefit analysis will never make politics redundant. It (hopefully) enables better decision making, by elucidating the true costs and benefits of a policy option.

In many cities around the world, greening programs (i.e. increasing the level of ecosystem services) are believed to be an effective strategy to mitigate some of the effects of climate change. Linking back to the implications for EBA in the context of pressing climate change concerns, the construction of new green infrastructure and improvements of existing green infrastructure will be greatly encouraged by making its wider economic significance visible. The TEEB for Cities was developed with that goal in mind. At this stage, it can be regarded, in evolutionary terms, as a 'hopeful monster', undergoing further adaptation and refinement (see www.teebstad.nl).

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