DRAFT – Do not quote

Source images: Inter American Development Bank (2008)

PROJECT “ECO-EFFICIENT AND SUSTAINABLE URBAN INFRASTRUCTURE DEVELOPMENT IN ASIA AND LATIN AMERICA”

Expert Group Meeting
“Developing Eco-efficient and Sustainable Urban Infrastructure in Asia and Latin America”
Bangkok, 10-12 February 2009

Review of current practices and criteria used to integrate environmental and social aspects into urban infrastructure development processes in cities in Europe

Prepared by **Dr. Peter H. Feindt** and **Dr. Andrew Flynn**
Cardiff University
School of City and Regional Planning

NACIONES UNIDAS

CEPAL
ECLAC

UNITED NATIONS
ESCAP
Economic and Social Commission for Asia and the Pacific

1 Executive summary

The provision of efficient and viable infrastructure for transport, water, energy services, electricity, and waste management rank among the foremost challenges to urban governance globally. In Europe, the provision and maintenance of transport and water infrastructures within city boundaries has traditionally been a task of local authorities. But local transport nets are now linked into trans-local webs, resulting in a need for cooperation between local and national governments in many cases. Since the 1980s, many publicly provided infrastructures have been privatised, shifting the modes of governance of urban infrastructure.

In Asian countries, urbanization and population growth make urban infrastructure development more urgent and create more time pressure on planning processes than in most European regions, apart from growth regions like Southeast England, Rhein/Main area in Germany, or the Netherlands.

In the light of the above context key features of the Terms of Reference have been to:
"Review current practices and criteria used to integrate environmental and social aspects into urban infrastructure development processes in cities in Europe, with a view to identifying what are the most successful tools and processes to make eco-efficient choices of urban infrastructure."

The terms of reference require that a diverse literature is investigated. In undertaking this task we have

- drawn upon our own knowledge of the literature,
- undertaken searches in bibliographic databases and
- reviewed the websites of key organisations, cities, networks and projects.

We identify four strategies by which urban governance might be improved so as to better integrate sustainability imperatives. These are: knowledge and reflexivity; processes, participation and self-organisation; resources and integration; and innovation.

Ideally, these strategies should be mutually reinforcing, so creating a virtuous cycle. However, our review of the available literature makes clear that at best there are only partial linkages between these strategies. In order to understand why linkages between knowledge and innovation, for example, can be challenging to sustain in we provide an overview of:

- Indicator sets and how they can be embedded in a wider governance context;
- Key measures of environmental impact, particularly environmental space and the Ecological Footprint, and other indicator sets;
- Established processes and tools for environmental decision making, notably EIA, SEA and Multi-Criteria Analysis.

Having provided the contextual information on indicators and processes, we then analyse how these work in practice. Here the Report makes use of case studies and examples to illustrate the ways in which cities and governments are tackling the challenge of sustainable development. In selecting our examples we have been concerned to avoid those cases which uncritically report on an activity or process. Rather we have sought to portray the challenges that urban managers are grappling with as this seems to be a much more realistic base for lesson learning and the cross-fertilisation of ideas.

Linking initiatives and practices on urban environmental management to the infrastructure development process is not straightforward. Urban infrastructure funding takes place in a context in which national, sectoral and city agendas overlap with one another (and increasingly also with European initiatives). The result is considerable variability and complexity in funding and a pattern of sustainability governance in which indicators and processes sometimes coincide with the infrastructure development process and in others they do not. The result is a patchwork of relationships between indicators and processes.

Key results are, therefore, that:

1. EIA as a project related process is not very much engaged with wider debates on indicators. This is due to the procedural nature of this tool.
2. SEA has much more potential to take up broader SD indicators. This is because it is a more reflexive process, it addresses more strategic issues, and one of its purposes is to identify and prioritise areas of concern.
3. In LA 21 processes a broad range of indicators are in use. This is due to them being community based processes engaging with several scales of time and space and various degrees of detail from strategic considerations to detailed management.
4. Theme and sector specific indicators appear to be most effective. The reason for this is that they are much more sympathetic to the context of local decision-making processes and open up opportunities for local ownership.

In terms of the lessons to be learnt, these include:

- Tools and processes must be developed that are appropriate for local forms of governance and decision making. ‘Parachuting’ in tools is unlikely to be successful;
- When environmental decision making tools and processes work effectively they require commitment from senior leadership and buy-in from middle management; and
- The most innovative model of development in urban councils is one that links together competitiveness and environmental sustainability.

One of the reasons for the variety of relationships that we are able to identity is the considerable innovation in environmental processes and indicators in European cities. Cities are keen to develop tools and indicators that are sensitive to their particular patterns of governance.

Contents

List of figures

List of tables

2 Introduction

2.1 Objectives

The role of cities is becoming ever more important to a growing number of citizens, and as cities grow their influence over their hinterlands continues to expand. We can distinguish a number of key functions for cities relating to economic, social and environmental dimensions. According to (Ravetz 2000a, 9) the environmental function is to “reduce environmental impact and resource use to 'sustainable' levels, and enhance environmental quality and safety”; the economic function is to “enhance long term resilience, competitiveness, employment, and equitable distribution of resources”; and the social function is to ”enhance health, education, security, cohesion, diversity and 'quality of life'”. Each of these three functions is dependent on the others for its successful realisation. Whilst sustained progress on any one of these functions is demanding, that of the environment has proved to be particularly problematic. There is, thus, growing global interest in efforts to better integrate environmental and social features into urban development processes.

In many cases, cities face common problems and opportunities when tackling environmental issues so heightening opportunities for learning experiences. Sharing knowledge is accentuated further as cities frequently show themselves to be highly networked, whether this be through twinning arrangements, networks to tackle particular issues (e.g. climate change), or ad hoc meetings to share more general experiences on development. To further encourage cross-national knowledge exchange UNESCAP has commissioned under the Development Account a project on “Eco-efficient and Sustainable Urban Infrastructure Development in Asia and Latin America”. As part of this work we have undertaken a review of the experiences of Europe in integrating environmental and social aspects into urban infrastructure development processes.

Whilst we have concentrated our attention on those tools and processes that appear to offer the greatest potential to make eco-efficient choices when decisions are being made about urban infrastructure, we have not ignored the reasons why the impact of other tools and processes has been more marginal. As we have sought to emphasise throughout, decision-making processes and regulatory frameworks provide the backdrop against which tools and processes operate and do much to shape infrastructure development patterns.

The general objective of the brief as specified within the Terms of Reference has been to:

> “Review current practices and criteria used to integrate environmental and social aspects into urban infrastructure development processes in cities in Europe, with a view to identifying what are the most successful tools and processes to make eco-efficient choices of urban infrastructure.”

The more specific objectives for the project are:

- "Review what indicators and methodologies are being used in Europe to measure the sustainability, including eco-efficiency, of urban infrastructure projects.
- Analyze the context and circumstances under which cities Europe develop municipal legislation and regulations and how these circumstances affect the real impact of regulations on urban infrastructure development patterns, in particular in terms of environmental and social performance.
- Review current indicators, practices and criteria used in Europe to integrate environmental and social aspects, including eco-efficiency, into urban development processes, including urban planning, and evaluate and analyze their effectiveness.
- Review the developments in the modalities of financing of urban infrastructure in Europe in the last 50 years, and observed trends in terms of efficiency and equity.
- Analyze the results of the different modalities used by national and local governments to finance the development of sustainable urban infrastructure. Of particular interest is the analysis of innovative mechanisms and strategies for financing sustainable infrastructure.
- Review current processes and tools used by national and local governments to integrate environmental and social concerns into infrastructure development processes (such as, but not limited to: Environmental Impact Assessment, Multi-criteria decision making, Integrated Assessment, Sustainability Assessment by investors, Strategic Environmental Assessment), and evaluate and analyze their effectiveness."

2.2 Problem background

The provision of efficient and viable infrastructure for transport, water, energy services, foremost electricity, and waste management ranks among the foremost **challenges to urban governance** globally. In Europe, the provision and maintenance of transport and water infrastructures within city boundaries has traditionally been a task of local authorities. But local transport nets are linked into trans-local webs, resulting in a need for cooperation between local and national governments in many cases. Electricity webs have mostly been developed on a regional or national scale; in many cases, however, cities have founded their own public utilities to provide energy services to households and local business. Since the 1980s, many of them have been privatised, shifting the modes of governance of urban infrastructure.

Historically, the motives to develop urban infrastructures were both **economic development** and **social progress**: attracting business and population, and providing decent living conditions. Urban infrastructures are indispensible to make a city work. From an economic point of view, because of their web-like nature, infrastructures exhibit economies of scale and lend themselves to natural monopolies, constituting a case for either public provision or careful regulation to avoid undersupply and overpricing. But **environmental motives** also played a major role early on. For example, German communities adjacent to the Ruhr river, then a booming steel and coal region, were concerned about toxic substances in their local water resources and founded a regional administration union to improve both water infrastructure and river management.

Environmental, social and economic motives also converge in the provision of efficient and affordable public transport, waste management, and since global recognition of climate change as a paramount concern, also energy services.

Cities' boundaries are often too narrow to include the functional interlinkages in their region. Historically, this has often resulted in **fragmented infrastructures**. Lack of coordination across technologies has more often than not further increased fragmentation. Water, electricity and telecommunication lines have often been developed in a widely uncoordinated manner. In the case of transport, bus and train lines, walking and cycling tracks are often not well connected. It usually takes decades to rectify careless urban planning. The growing importance of regional transport connections has been addressed by regional traffic networks since the 1960s, but it has been taken several decades to close gaps in fragmented regional transport systems.

Since they require large investments that can be made only once or twice in a generation or two developing urban infrastructures call for a **long-term perspective**. In the 21st century, this includes awareness of exhausted natural resources and rising long-term energy prices. **Sustainability**, including eco-efficiency, resource consumption and resource efficiency, is indispensible and poses a key challenge to urban infrastructure development.

The global economic downturn and problems in credit markets add to the **financial challenges**. Public budgets have been strained before the crisis, partly due to debts piled up decades ago, partly due to ambitious investments with high costs of operation.

In Asian countries, **urbanization** and **population growth** make urban infrastructure development more urgent and create more time pressure on planning processes than in most European regions, apart from growth regions like Southeast England, Rhein/Main area in Germany, or the Netherlands.

2.3 Cities and sustainable development

2.3.1 The sustainability challenge

Asian cities face growing demand for urban infrastructure from rising and more prosperous populations. This creates enormous challenges for both optimising the existing and building new infrastructure:

- Economically, cities must find affordable, well-scaled solutions which fit with the existing urban fabric and which are flexible enough to adapt to future developments. Cities must find robust ways to raise the capital needed. They also have to keep operational costs in mind.
- Socially, cities are expected to provide equal and reliable access to high quality urban infrastructure.

- Environmentally, the ways in which water, transport systems, waste disposal and electricity are provided can have enormous impacts on the use of non-renewable resources, ecosystems and the urban environment during both periods of construction, operation and disposal.

Sustainable development requires that all these challenges are met in a balanced way. This requires an encompassing, holistic or 360 degree consideration not only of alternatives, impacts and multiple evaluative criteria. It often also requires planners to consider the decisions of a large number of actors – e.g. public authorities, developers, dwellers, commuters etc, and to anticipate market and technological developments. When it comes to large-scale infrastructure systems, it might also be necessary to build coalitions that guarantee implementation over a long period of time to ensure proper implementation and operation.

It is important to note that sustainable development requires multidimensional optimization. This process "by its very nature cannot have one unambiguously optimal solution, but can be characterized as a internally pluralistic opportunity space surrounded by the domain of unsustainability. Consequently, instead of linear optimization as possible between a maximum of two parameters, sustainability assessment must be based on multi-criteria analysis" (Spangenberg 2002, 299)

2.3.2 Sustainability and urban infrastructure

Urban infrastructure is a key part of a sustainable development for cities. It is often argued that "in order to achieve a more sustainable world, radical policies have to be introduced at a variety of spatial and governmental levels" (Breheny and Rookwood 1993:150). Whilst action at the national (and international) level is undoubtedly important it is also often asserted that "many issues that are part of the sustainability agenda can be addressed only at the local level" (Feitelson 2004:1). The application of this sustainability at the local level is however problematic, particularly in cities (Feitelson 2004:1). From an ecological perspective this is because the relationship between cities and sustainability could be considered to consist of two paradoxical elements. On the one hand cities accumulate wealth, are often the sources of technology and innovation, and it is in "the urban context that more opportunities are offered to tackle the problems structurally" (Nas/Veenma 1998, 3). However, on the other hand cities are "parasitic by nature, skimming off agricultural surpluses and other resources from all over the world, often without full compensation for the natural and social damage inflicted" (Nas/Veenma 1998, 3). So, "the struggle to reduce the scope of the ecological crisis is […] played out in the city, which is the greatest source of air, water, noise and soil pollution" (Girard/Forte *et al.* 2003, 4). In more technical terms, cities are not closed systems. They are part of wider, often global economic and material flows (Spaargaren/Mol *et al.* 2006).

But also with regard to institutional settings and social developments cities are not isolated entities. First, cities operate in a national and international legal framework.

Institutional frameworks are important for urban politics (Keating 1991). Local authorities and city corporations often have limited statutory rights, they are liable to national legal and political frameworks and they might depend on national funds. Legal requirements from local authorities and degrees of local autonomy vary widely. "Nation-state factors play an important role in shaping urban governance" (Pierre 1999, 372). Second, "local governments in Western Europe have become increasingly involved in network building with the local business community [… such] governance processes are not value neutral but reflect and sustain political values beyond partisanconflict" (Pierre 1999, 372). These are expressed through managerial, corporatist, progrowth, and welfare governance models of urban governance which are mainly driven by either professionals, civic leaders, business or the state (Pierre 1999, 388). It is quite telling, however that these typologies are silent about environmental governance. Third, cities are characterised by specific "logics of the city". This means that economic, social and environmental challenges and opportunities are interpreted in specific and different ways in different places. Decision-maker and actors in a city's networks create place-specific "KnowledgeScapes" (Matthiesen 2005) and agree on place specific "logics of appropriateness" (March/Olsen 1989). Demand for urban infrastructure and sustainable the precise local and regional meaning of sustainable development will always be interpreted in this context.

2.3.3 Urban form and density

There are many different ideas about the ways in which cities of the future could become more sustainable (see Bailey 2008 on which the following draws). One of the most popular approaches is to give consideration to the urban form: "The sustainability issue of the city can be approached in a fundamental way by focusing on the lay-out of the city" (Nas/Veenma 1998, 11). Within this perspective the idea of the compact city has arisen, which in contrast to more dispersed forms of development, is regarded "as socially and environmentally more sustainable" (Blowers/Pain 1999, 280). For advocates of the compact city it is a "high-density, mixed-use city, based on an efficient public transport system" (Burton 2000, 1969) involving increasing population densities, intensifying land uses and the re-use of brown field land. The advantage of such forms of development are believed to include "conservation of the countryside; less need to travel by car, thus reducing fuel emissions; support for public transport and walking and cycling; better access to services and facilities; more efficient utility and infrastructure provision; and revitalisation and regeneration of inner urban areas" (Burton 2000, 1969-1970). However the concept of the compact city has been criticised for being "impractical, undesirable and unrealistic" (Blowers/Pain 1999, 281) and the claimed advantages are contested. Research in the UK, for example, indicates that whilst the compact city may improve public transport, reduce social segregation and improve access to facilities, there can be negative impacts on affordable housing, crime levels and walking and cycling (Burton 2000). Meanwhile, others such as Nas and Veenma (1998, 3) argue that "urban environmental problems are strongly rooted in high population density, leading to the concentration of waste, pollution and so on". Furthering concentrating citizens and development in major urban areas will, on this view, simply exacerbate environmental problems.

2.3.4 Regional focus

It is also important to recognise that the environmental impacts of cities will spread far beyond their administrative boundaries (see, for example, Breheny/Rookwood 1993, Ravetz 2000a). In contrast to the notion of the compact city, there is increasing recognition that the core city can be the main focus for economic activity in a much broader spatial conceptualisation of the 'city-region'. This is felt to be a meaningful concept as "urban activity now reaches right across 'city-region' territories, from city centres to remote countrysides" (Ravetz 2000b, 3), with cities exerting influences beyond the city boundary and themselves being vulnerable to outside influences. This, combined with the idea that the state is too detached, has meant that "the region (and in particular the CR [city-region]) is becoming an increasingly important focus within the policy community" (Parr 2005, 556). Whilst debates on the 'city-region' are beyond our remit here it is worthwhile bearing in mind that the broader geography in which cities operate, including how they may impact, and in turn be impacted upon, by social, political and economic relations in their hinterlands will help to shape the environmental sustainability of cities.

With regard to infrastructure provision the connections between cities and their hinterland is obvious. Urban transport systems are not isolated from the regional, national and international transport webs. Water typically has to be provided from an extra-urban source, and the way this is done can have enormous impact on the ecological and economic viability of the sourcing areas. Waste is often stored and processed outside cities. And while energy is often generated inside city boundaries, fuels are extracted from elsewhere. From a policy and planning point of view it is therefore crucial how these connections enter the decision-making process in the form of representation, information and consideration.

2.3.5 Cities, competitiveness and sustainability

In the same way that the political and civil leadership of cities will be cognisant of their immediate hinterlands, so too will they recognise that cities operate in highly competitive economic environments (Savitch/Kantor 2002). For some cities their focus will be on regional competitors, for others their focus will be on a larger national scale, whilst for an increasing number of cities economic competition will be played out on an international stage (Sassen 2001, Sassen 2006). Inevitably, there is likely to be a tension between the perceived need to meet economic, social and environmental imperatives. In order to manage these elements a clear sense of strategic leadership is needed (Savitch/Kantor 2003).

It has, for example, been noted that “the ‘sustainable city’ can only be constructed if the processes of urban planning and governance are able to respond to the wide-ranging and competing interests that constitute the (unsustainable) spatial relations of cities” (Blowers/Pain 1999, 294). To date, this seems rarely to have been the case. Analysts have found that “local authorities currently do not use the powers they have to anything like the full extent” (Hatter 2007, 10). This may be because “rather than seeing urban sustainability strategies as a separate area of governance, they need to be seen as something forged within the wider context of economic regulation, inter-urban competition and wider restructuring of the state (While/Jonas *et al.* 2004), yet also reflecting the local social, political and environmental context” (Cowell 2006, 220). However “[s]ustainable development is only embedded in an authority when leaders (both members and officers) see it as a key corporate issue that affects the corporate performance of the whole organisation and the area as a whole” (Hatter 2007, 10).

As well as problems with the modes of governance, the central objective – the way in which sustainable development is interpreted – may also be problematic:

> Steering from the 'business as usual' towards the 'sustainable development' scenario is no mean feat – the fundamental dynamics of human desire, market forces, political governance, as well as a massive urban form and fabric, all have to be redirected from their current trajectories. To do this needs the traditional qualities of vision, leadership, commitment, expertise and patience, for which there is little substitute. (Ravetz 2000b, 45)

There is, therefore, a major challenge for city governance in seeking to mainstream environmental or more general sustainability commitments. As Ravetz (2000b, 6) has vividly illustrated, although “[c]ities maybe autonomous in some ways […] they are driven by the global system in most other ways. If the sustainable development of the city is like turning round a super tanker the crew cannot ignore the storm-force gale economy around them, or dispute over who is captain.”

In practice, though, cities are likely to face considerable uncertainty or conflict over their developmental trajectories. For example, Hall points out that

> Cities…are faced with twin challenges: first to remain competitive by encouraging older industries to remain viable, encouraging innovation and creativity, and attracting inward investment; secondly, to become models of high quality of life, particularly as best-practice cases of sustainable urban development. (Hall 2003, 55)

Although ideas of what makes a local economy 'competitive' vary between commentators, understandings are generally based around the idea of competitive localities presented in Porter's seminal book “The competitive advantage of nations” (Porter 1990); in which he applied the theory of the competitive advantage of firms to nations and localities. Within this “the central economic imperative is […] to compete and to build competitiveness, through a search for new opportunities and distinctive sources of advantage” (Gordon/Buck 2005, 10).

Under conditions of globalisation competitiveness is increasingly associated with "knowledge industries" (Cooke 2001, Ferranti/Perry *et al.* 2002) and "innovation clusters" (Intarakumnerd/Vang 2006). "It is asserted that the most competitive locations are those containing the highest concentrations of knowledge-based business activity" (Boland 2006, 22). Following Richard Florida's influential work on "creative industries" and the "creative class" (Florida 2002a), it is now argued more often that economic development "is driven by a city's ability to attract creative people" (Boland 2006). This can lead to policies that are focused on particular economic groups, exacerbating issues of inequality and potentially neglecting social or environmental considerations. However, Florida (2002b) argues that creative classes ask for public spaces suitable to social outdoor activities like cycling and jogging, requiring e.g. urban parks and car free cycling paths. Here are new demands arising for urban infrastructure planning and design.

The idea of the competitive city exerts selective pressure on how to interpret the environmental challenges of sustainable development. The notion of a competitive city is inherently connected to an economic growth agenda and therefore displays tensions to those notions of environmental policy which focus on austerity or a critique of economic growth. But it is complemented, to some extent, by the concept of ecological modernisation, which "emphasizes the importance of economic growth to achieve sustainable cities" (Blowers/Pain 1999, 270). The concept holds that the continuous process of investment in new and replacing old infrastructure is used to introduce more environmentally efficient technologies, designs and solutions (Mol 2001, Mol/Sonnenfeld 2000), e.g. a better modal link in public transport.

The pre-eminent interest of decision-makers and elites in competitiveness has driven the development of a wealth of indicators which are used to compare, rank and benchmark cities. Sustainability indicators cannot evade this context. They will often be understood as indicators of quality of life. In some cases, quality of life explicitly constitutes one of the dimensions of sustainability rankings (see section 7.2). Indicators then become part of city marketing strategies rather than the foundation of decision-making, and accordingly need to be handled with caution.

The linking of economic, social and environmental agendas does indicate a shift in thinking amongst innovative cities. For example, in the UK there is evidence of a shift in the focus of the agenda of the Core Cities Group. This group, established in 1995, is a policy network of eight English cities. Its activities are based on a "vision of the distinctive role that big cities must play in national and regional life in the new century" (Core Cities Group 2008). Within this vision the group has traditionally focused on economic elements, however there have been recent signs of a shift from this predominantly economic remit towards one that integrates social and environmental concerns. It was recently stated that: "The key to the future success of all cities will be an ability to combine high levels of economic growth and cultural vitality with securing a sound environmental future" (Nottingham City Council 2007). However, progress on this agenda appears to have been focused solely on climate change issues.

The narrow approach to environmental, and sustainability issues of the Core Cities Group is typical of cities elsewhere in the UK and Europe (for example, the case of the city of Cardiff has been explored in detail in Hooper/Punter 2006). As we shall see, the way in which the link between economic and environmental issues is perceived is important in the shaping of environmental indicators. The dominant approach to environmental management in cities marginalises more radical and wide ranging critiques which point to "present economic development … [as] a cause of environmental and social inequality and the unsustainability of cities" (Blowers/Pain 1999, 270).

2.3.6 Characteristics of the literature reviewed

Before embarking on the literature review it is worthwhile making a small number of observations on the literature that has been analysed. First, the case study is a characteristic of the literature. Whilst individual case studies can be insightful into policy processes or the role of key actors, they do only provide a snapshop in time and not longer term evaluatory studies over time. The latter are far rarer in the literature and where they do occur we make extensive use of them because they provide a richer analysis and better opportunities for lesson drawing between organisations. Second, the case studies are developed independently of one another, so again inhibiting potential learning opportunities. For example, case studies of Strategic Environmental Assessment (SEA) are rarely linked to one another. There is even less attempt made within the literature to link together complementary or adjacent decision making processes. For example, SEA is not linked to Sustainability Appraisal or EIA, the Ecological Footprint is not linked to Environmental Space. This makes the Tables that we have produced that link together environmental indicators and decision making tools particularly useful in providing insights into how techniques can be integrated into the urban development process. Third, the literature is uneven. Some research is contextualised in a conceptual framework but much is atheoretical or empirical in focus. Once again, this impedes opportunities to draw rigorous comparative lessons.

2.4 Analytical framework of the study

2.4.1 Infrastructures as part of urban governance

Infrastructure development is a key element of urban governance. For the purpose of this study, the term governance denotes:

> The exercise of political, economic and administrative authority in the management of a country's affairs at all levels. Governance comprises the complex mechanisms, processes, and institutions through which citizens and groups articulate their interests, mediate their differences, and exercise their legal rights and obligations.
>
> (UNDP 1998)

Integrating environmental and social aspects into urban infrastructure development processes can be understood as a move toward good governance:

> Good governance is among other things participatory, transparent and accountable. It is also effective and equitable and it promotes the rule of law. Good governance assures that political, social and economic priorities are based on broad consensus in society and that the voices of the poorest and the most vulnerable are heard in decision-making over the allocation of development resources.
>
> (UNDP 1998)

Urban infrastructure planning often is a large-scale, high stake and capital intensive activity which therefore tends to favour state actors and large business. It is therefore important to take a broad perspective on actors in line with the notion of good governance:

> Governance includes the state, but transcends it by taking in the private sector and civil society. The state creates a conducive political and legal environment. The private sector generates jobs and income. The civil society facilitates political and social interaction – mobilizing groups to participate in economic, social and political activities. Because each has its weaknesses and strengths, a major objective of our support for good governance is to promote constructive interaction among all three.
>
> (UNDP 1998)

Constructive interaction among state, private sector and civil society includes encouragement of those parts of the population that do not necessarily command all the skills and resources needed to interact with powerful interests and complex, often highly technical issues:

> Good governance occurs when societal norms and practices empower and encourage people to take increasingly greater control over their own development in a manner that does not impinge upon the accepted rights of others.
>
> (UNDP 1998)

Encouraging participation is particularly important for infrastructure planning – to identify and prioritise needs, to maximise the benefit of schemes to the local population and to minimise adverse impacts of large scale infrastructure projects on affected people.

2.4.2 Strategies for Sustainable Development

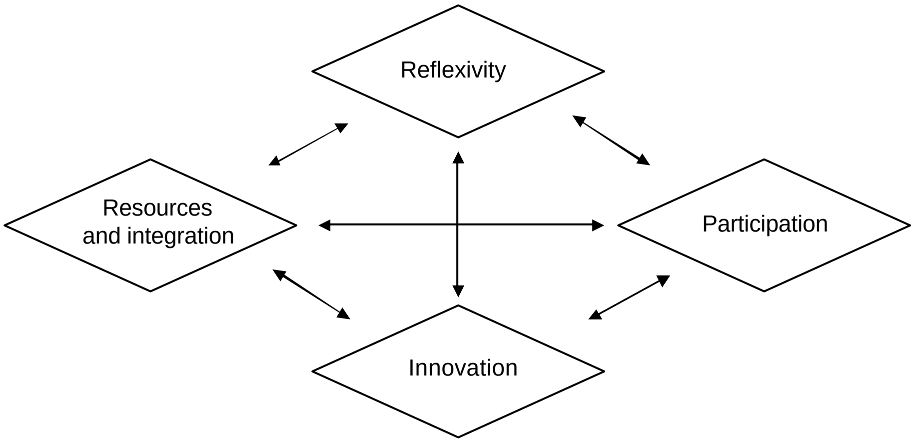
The question is then, how can urban governance be improved to better accommodate sustainability needs? We distinguish four strategies to integrate sustainability into governance frameworks (Minsch/Feindt *et al.* 1998)[1]:

1. Improve knowledge and reflexivity: This strategy builds on sustainability geared reporting and monitoring systems, expert and participatory bodies that bring a sustainability perspective into sectorally driven planning and decision processes, improved structuring of information for decision-making and sustainability oriented research and development.
2. Processes – integration, participation and networked organisations: Sustainable development needs activation and involvement of all groups in society. Good governance will foster networks, encourage the private sector to commit themselves to sustainable business practices, will involve target groups through dialogue, strengthen opportunities for participation through information rights and referenda, provide conflict resolution and create spaces for citizen deliberation and discursive participation – both project related and general.
3. Resources and integrative governance: Units responsible for sustainability should be integrated in all government entities (and all major private sector organisations); NGOs should be given access to information and being compensated for collaboration in planning; environmental concerns should be integrated into all stages of planning and decision-making.
4. Innovation: Technical, organisational and social innovations toward sustainable development can *inter alia* be fostered through procurement, forging of sustainability networks and clusters, and informational measures like best practice, benchmarking and case studies.

These four strategies allow us to think broadly about possible practices and criteria to integrate environmental and social aspects into urban infrastructure development. They also give us a framework to assess the effectiveness of tools and practices to contribute to sustainable infrastructure development.

[1] These strategies have been developed for a study to the German Parliament (Minsch/Feindt *et al.* 1998)

Figure 1: Four strategies for sustainable development



2.4.3 Overview over the argument

Sustainability indicators, monitoring and reporting are of key importance to all four strategies for sustainable development. In chapter 3, we will give an overview of sets of indicators. How indicators are used depends on the wider governance framework. Urban infrastructure development is also embedded in a wider governance context which will be addressed in chapter 6, particularly the funding of urban infrastructure, social and economic contexts and sectoral contexts. Chapter 4 concentrates on construction of two significant measures, namely environmental space and the ecological footprint. The applications of both methods of assessing environmental impacts, along with that of other indicators, are evaluated in chapter 7. Chapter 5 examines two key decision making tools, namely Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA). These have potential to make significant impact on the nature of urban development. The role of SEA and sustainability appraisal in decision making is analysed in chapter 8. In chapter 9 we draw together the key findings from the review and draw lessons for sustainable and eco-efficient development in relation to the four strategies for sustainable development.

3 Sustainability Indicators

3.1 Introduction and overview

The literature on indicators has blossomed in recent years. Policy makers, researchers, citizens and environmental groups have all been keenly interested in finding out whether or not units of government or organisations are becoming more or less sustainable over time. As the UK Sustainable Development Commission (2008) has noted: “Indicators are an effective means of quantifying and measuring progress towards sustainable development.” Already six years ago, leading scholars in the field stated: “The growth in the use of sustainability indicators is nothing short of phenomenal” (Rydin/Holman *et al.* 2003, 581).

For their proponents, environmental or sustainability indicators can “measure, simplify and communicate important issues and trends” (DETR - Department Environment 2000, 5). Their development has been called for at all levels of government, from the international stage, through Agenda 21 (United Nations Economic and Social Development: 2008) to national and local governments. In recent years there has been a proliferation of work on sustainability indicators and of their reporting. The debate about sustainability indicators has involved many disciplines, e.g. ecological economics (Hezri/Dovers 2006). But it has also been noted that when put into practice, sustainability indicators are “socially constructed policy instruments” (Astleithner/Hamedinger 2003)

In this section, we first discuss possible purposes of sustainability indicators. We then distinguish between expert-driven and participatory indicator systems. After reviewing sustainability indicators in the UK as an example we address possibilities for developing indicators at the city level. We discuss progression from sustainability themes to indicators and exploring indicators. We finally take a critical view at methodological and data challenges and issues of governance and indicators.

3.2 Purposes of Sustainability Indicators

There are many different types of indicator. A useful and widely noticed classification has been offered by (Brugmann 1997):

- *integrating indicators or indexes,* to portray linkages between economic, social and environmental phenomena;
- *trend indicators*, linked to targets and thresholds;
- *predictive indicators,* relying upon mathematical forecasting models or, alternatively, *conditional indicators* using 'if/then' scenarios to estimate future conditions;
- *distributional indicators,* measuring intergenerational equity and specifying local, upstream and downstream effects through the use of highly disaggregated data;
- and, depending upon the framework applied, *condition-stress-response indicators* that provide simple causal models for local conditions.”
  (Brugmann 1997, 62) based on (Maclaren 1996, 186)

The various types of indicators reflect different purposes. It is therefore important to clarify what is going to be achieved by an indicator system before one can decide on the usefulness of a certain methodology.

Sustainability Indicators are developed and propagated to serve different purposes:

- performance measurement
- technical assessment
- public education

The growth of sustainability indicators has reflected a wider concern to **measure performance**. Trends in the organisation of national, regional and local governments to contract our services or to work with external bodies has led to much greater attention being given to the setting of targets, measuring performance, and providing rewards (or penalties). So, a sustainability indicator, like any other indicator, is

> "a policy-relevant variable that is specified and defined in such a way as to be measurable over time and/or space… [T]he key feature of an indicator is that measurement can take place and this, in turn, allows comparison" (Astleithner et al 2004, p8).

In addition, indicators have been seen by some as a 'green herring', signifying a focus on measurement rather than action (MacGillivray 1998:93). Despite this, the view that "at the local level, indicators are ideally suited for performance measurement" (Brugmann 1997, 59) is becoming increasing popular (Hemphill/Berry *et al.* 2004a, 726). Whilst such indicators "are not themselves 'the answer'…they can lead us to better answers if they provide trustworthy information about those things in life that we value" (Lawrence 1998:68).

Within the literature on indicators there is a widespread awareness that **indicators are not neutral**. The information that they provide can help to make more informed policy decisions, but assessment requires the selection and weighing of criteria. There is, thus, much discussion of the methodologies to be used in the development of indicators, technical debates around what is (or is not) being measured and of how indicators may best be used in the decision making process. In this section, we follow the lines outlined in the literature but towards the end add two important caveats that should be borne in mind in what follows. First, indicators are social constructs in that they indicate what key groups regard as important features of sustainable development. Second, indicators are used in real-life contexts and so their development, interpretation and implications for action will be intertwined with patterns of urban culture and governance (Astleithner/Hamedinger *et al.* 2004).

Indicators can be used for **educative purposes**, to guide policy or assess performance; however these uses often have contradictory objectives, which can result in confusion (Brugmann 1997, 59). For example, some local governments have sought to use the Ecological Footprint as a means to guide to policy development because it appears to show the environmental pressures arising from different development strategies and at the same time to use the Footprint to communicate with their citizens about the scale of their resource use. Whilst the Ecological Footprint may have a number of different functions, its use at the same time for different purposes can be confusing since it means that data has to presented and interpreted in different ways for diverse audiences. As a matter of good practice those who are promoting or using indicators should be clear as to their intended purpose and audience.

However as sustainability is a contested concept with a proliferation of operational definitions, the choice of measure will never be wholly objective or value neutral. Consequently there tends to be a lack of consensus about the indicators that should be used and how they should be considered (Hemphill et al 2004:726). As Owens and Cowell (2002, 29) have pointed out, decisions about what is 'sustainable' are inseparable from moral and political choices of the highest order". Taking on board the injunction from Owens and Cowell in itself presents a range of issues about desirable ends and the ways of measuring progress towards them. It is therefore essential to remember that, "those developing indicators need to be deliberate in their choice of sources, and accept that reasonable people can disagree" (Lawerence 1997:70).

From a **process perceptive**, it is important to keep in mind that the use of sustainability indicators can generate outcomes in many ways, which can be divided on three groups (Gahin/Veleva *et al*. 2003, 662):

- through the process of developing the indicators;
- by communicating the (publishing and distributing) the indicators;
- "action-oriented steps following development of the indicators".

The following Table 1 summarises the different areas of applicability of sustainability indicators.

Table 1: Areas of applicability of sustainability indicators (based on: Aall/Norland 2002, 33, Bond 2002, Brugmann 1997)

Administrative context	Type of analysis	Practical application
Information and debate	Individual/household evaluation	In education As an element of environmental protection work Publication on municipal home page
Political guidance	National benchmarking Trend analysis Identifying priorities across sectors Performance measurement	In annual reports In municipal planning reports Community strategies
Administrative guidance	Impact assessment	Incorporation in existing systems of impact assessment in administrative procedure

3.3 Expert-driven and participatory indicator systems

Traditionally the development of environmental indicators has been the preserve of experts. In expert-driven indicator systems managers selected what they believed to be the most relevant indicators. Yet as Bell and Morse (2001) point out despite the likely coincidence in views between experts and managers there are very few examples to show that indicators routinely influence policy. For some, the reason why top-down indicators fail to make much of an impact is because experts have been more concerned with improving their measurement than considering their use (Pinfield 1996).

The overly technocratic approach to indicators has meant that too often experts were divorced from the communities to which indicators were to apply. In part, expert-led or top-down indicator systems (usually highly aggregated indexes) have been challenged because they have encountered problems in engaging with communities. As a result, there has been much greater interest in including communities in the formulation of indicators, particularly as this may provide communities with a greater sense of ownership of their environment (see Bell and Morse 1999, 2001). The tension between top-down and bottom-up indicator development has been encapsulated by Fraser et al (2006, p115):

> Indicators form a key element of Logical Framework Analyses that all major national and international funding agencies (e.g. CIDA, DFID, World Bank and UNEP). However, if development experts choose indicators simply to comply with the requirements of funding agencies, then this top-down process may alienate local community members and fail to capture locally important factors.

Amongst the benefits of more participatory forms of indicator development are that they are much more likely to be relevant to local circumstances than those prescribed by external experts. Locally based indicators may also be more adaptable to changing circumstances. To test whether participatory-led indicators do realise the benefits that their advocates claim and to see how they mesh with expert-led indicators Fraser et al (2006) analyse three diverse case studies (forest management in Canada, rangeland management in Botswana and economic transition in the United Kingdom’s Channel Islands). The evidence from the case studies show that there needs to be a process of integrating local knowledge (bottom-up) and scientific research (top-down) to create a hybrid knowledge and indicator ownership. In the case of the Channel Islands Fraser et al (2006, p122) show how initial development of indicators by experts provided the impetus to create a community response and there then followed a series of iterations so that the “[indicator] list has evolved incrementally, slowly involving an increasing number of stakeholders.”

For decision makers there is a difficult balancing act to be performed here in blending expert-driven and participatory indicators. Expert-led indicators systems retain value but must be combined with participatory formulated indicators. Expert-based systems, because they are much more likely to have standard indicators, will allow a government to compare its performance over time and with others. Comparison and the opportunities that it provides for learning are essential features of indicator systems. Meanwhile, the much greater variety of indicators that will emerge from bottom-up processes of indicator formulation will provide a much richer insight as to what issues and values are important to a community. This is in turn, is likely to facilitate a much greater sense of community resource management (Fraser et al 2006).

When we distinguish citizen and expert oriented indicator projects, we must not only look at the profile of the indicator set. There are also potentially very different functions and contexts which are more conducive to either expert or citizen oriented indicators (see Table 2).

Table 2: Citizen and expert oriented uses of sustainability indicators (source: Eckerberg/Mineur 2003, 594)

Use of Local Sustainability Indicators

TABLE 1. A typology of local sustainability indicators

Aspects of indicators	Citizen oriented	Expert oriented
Profile		
• What do they measure?	• Changes clearly linked to individual behaviour	• Changes on a more aggregated levelmore
• How do they grasp sustainable development	• Multi-dimensional	• One dimensional
Function		
• Their purpose?	• Promote understanding of sustainable development	• Measure effectiveness (performance assessment)
• Target group?	• The public	• Experts
Context		
• The political-administrative context?	• Networks, governance	• Formal hierarchies in governmental institutions
• Actors involved?	• Broad range of actors outside as well as inside the administration	• Limited range of actors inside the administration as well as experts

To conclude, it has been noted early on in the debate that there are potential trade-offs between simplicity and participation on the one hand and complexity and depth of understanding on the other (cf. Brugmann 1997, 63). With regard to urban infrastructure one might be inclined to think mainly about indicators that are geared toward experts. But there are also many potential benefits from citizen driven indicator processes. Processes like EIA and SEA are located at the interface of citizen and expert discourses, specialists' reasoning and public scrutiny.

3.4 Sustainability indicators in the UK

Currently, in the UK, 68 indicators are used at a national level to monitor the objectives of the government's sustainable development strategy *Securing the Future* (Sustainable Development Unit 2008a). Data for 46 of these is also available at a regional level

(Sustainable Development Unit 2008 http://www.sustainable-development.gov.uk/ b). However this data is not currently collated at a local level. There are also no set guidelines for measuring sustainability at the local level, with it being the decision of individual local strategic partnerships (Defra 2005:143). Whilst this allows local partnerships to focus on issues of relevance in their area, it also allows for potential bias when selecting indicators, and limits scope to make the comparisons which can be essential to benchmarking and developing good practice. To date, little attempt has been made to benchmark city sustainability performance based around common indicator sets but one exception is the work of the Sustainable Development Commission and we review its contribution later.

The European Commission (2001) has developed ten *European Common Indicators* for monitoring environmental sustainability at the local level, however they focus on environmental issues alone, rather than the wider sustainability issues. Additionally they are yet to be widely embraced in the UK.

3.5 Developing indicators: possibilities for the city level

As a first step in developing indicators Lawrence (1998) has pointed out “it is necessary that you first decide upon the future you would prefer; you need to be able to compare what *is* to what *ought to be* so you know if you are headed in the right direction." (Lawrence 1998:68 emphasis in original). The initial step in developing indicators is to develop a broad idea of 'which sustainability' is to be measured.

The next stage in development is to consider which broad topics should be incorporated (see Bailey 2008 on which this section draws). Due to the complexity of the concept of sustainable development "Instead of 'comprehensive', the watchwords here may need to be 'selective' and 'balanced'" (Carmona/Sieh 2004, 338). From a UK perspective, strategic documents to draw upon are: The *European Common Indicators* developed by the EC; the UK national sustainable development strategy *Securing the Future* which has a range of indicators; and a ‘menu’ of non-prescriptive local indicators set out by DETR (2000) in *Local Quality of Life Counts* relating to the previous UK sustainability strategy. A recent and non-governmental perspective on city level indicators has been developed by Forum for the Future in its *The Sustainable Cities Index*, (2007, 2008), and drawing these sources together it is possible to select the following themes

Figure 2: Cities and sustainability: key themes

Cities and sustainability: key themes

- Environmental quality;
- Pollution;
- Resource use;
- Waste production;
- Social equity, Health and Education;
- Social cohesion;
- Economic activity;
- Business vitality;
- Accessibility.

3.6 From sustainability themes to indicators

Once themes have been established it is possible to begin the next stage of determining indicators. Typical indicators used in UK cities are shown below. It is important to be able to link together sustainability themes and indicators and the possible connections are shown in the figure that follows.

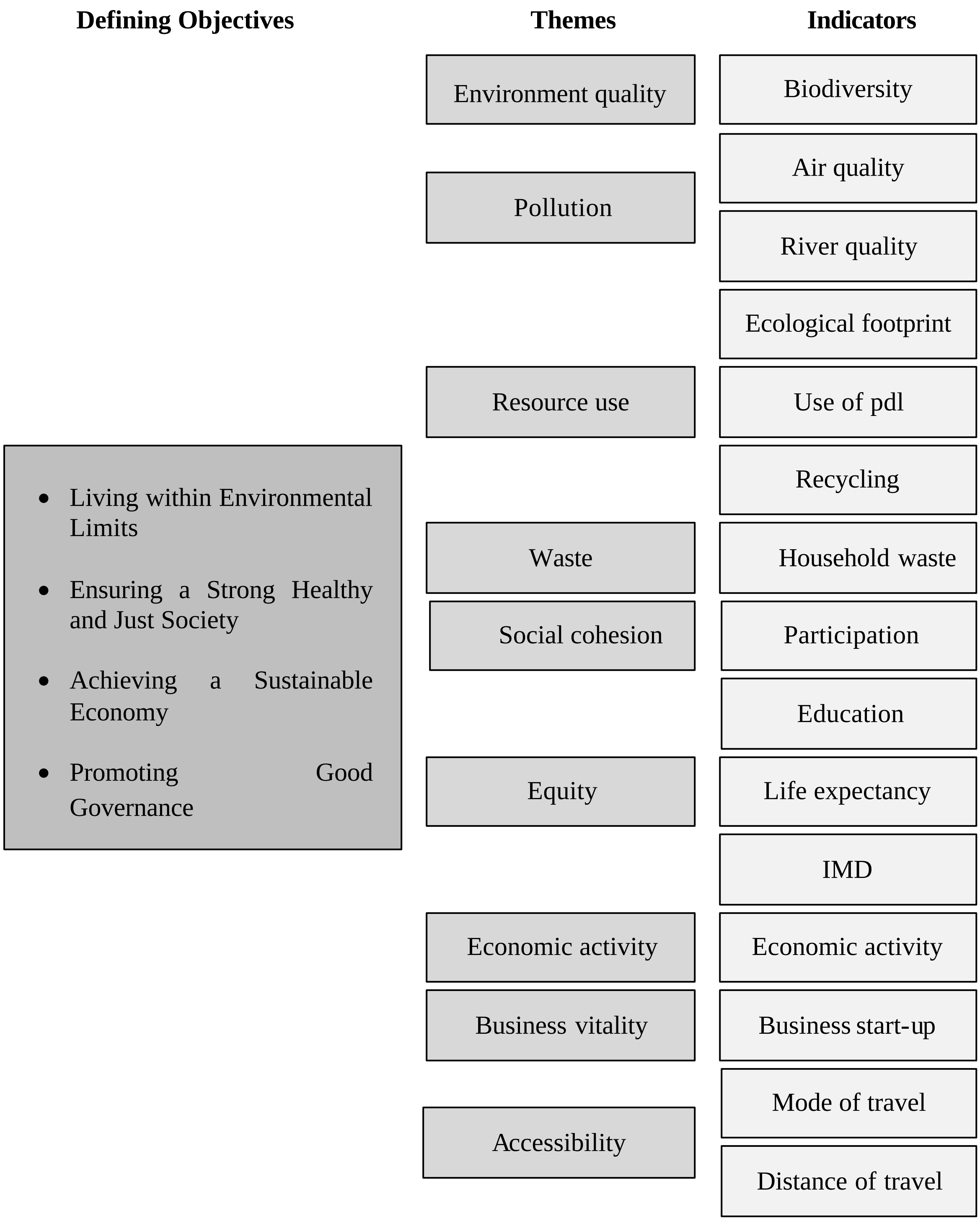
Figure 3: Key UK city sustainability indicators

Key UK city sustainability indicators

1. Biodiversity;
2. Air quality;
3. River quality;
4. Ecological footprint;
5. Use of previously developed land (pdl);
6. Recycling;
7. Household waste;
8. Participation;
9. Education;
10. Healthy life expectancy;
11. Index of multiple deprivation (IMD);
12. Economic activity;
13. Business vitality;
14. Mode of travel to work;
15. Distance of travel to work.

It is important to note that both the themes and indicators link to debates about city competitiveness, rather than, for example, seeking to constrain growth.

Figure 4: Indicator Development: Links to Objectives and Themes



3.7 Exploring indicators

1. Biodiversity: this is often regarded as a key indicator of environmental quality. In the UK a favoured measure is percentage of Sites of Special Scientific Interest (SSSIs) in favourable condition. This makes use of an official conservation designation and also how well managed they are. What it may measure, though, is the amount of SSSIs allocated in a locality, rather than the biodiversity of the area as a whole.
2. Air quality: Air quality has significant impacts on human health and biodiversity. However issues can arise around what is the best measure to use. PM10 is a popular measure as it can result directly from human activities and tends to have an impact close to the locality in which it was produced. Local authorities are also required by the Environment Act 1995 to monitor PM10 so allowing the possibility of comparison between authorities.
3. River quality: River quality will impact upon biodiversity, but will also give an indication of the extent to which activities in both urban and rural areas impact upon their environment. There also tend to be consistent measures of river quality developed at the national level again enabling comparison between councils.
4. Ecological Footprint: Whilst there are debates about the methodologies used and concerns that Ecological Footprints can neglect issues of equity the Ecological Footprint is becoming an increasingly popular measure. There are now consistent measurements for the Ecological Footprint for every local authority in the UK. There is further discussion of the Ecological Footprint in section 4.2.
5. Use of previously developed land: Although a less popular indicator than those discussed above, the re-use of land is a key element of the compact city debate. In addition, this indicator contributes to the wider picture of resource use.
6. Recycling: Not only is recycling a focus of current sustainability policy but the indicator gives an insight into both resource use and an indication of the extent to which residents are willing to act in ways that are deemed sustainable.
7. Household waste: Another current public policy concern, that provides an indication of consumption and of the wastes produced. Moreover, there are standard forms of household waste measurement so allowing change to be tracked over time and between councils.
8. Participation: Community participation is integral to the notion of sustainability.
9. Education: Both a social and economic indicator and typically an education qualification is selected as the measure.
10. Healthy life expectancy: This indicator gives an indication of social condition, as it is influenced by multiple factors, such as lifestyle, quality of the living environment and access to services.

11. Index of multiple deprivation: This is an indicator of overall deprivation and therefore social equity. Although there are numerous debates surrounding the use of IMD and it may result in the 'double-counting' of some issues, such as air pollution, education and life expectancy.
12. Economic Activity: There are a number of potential economic indicators that could be selected but economic activity contains economic and social elements.
13. Business vitality: this indicator illustrates the potential to build a strong and stable economy. Business start-up and closure is seen as an indicator of this and is a good measure for use at the city level.
14. Mode of travel to work: examines the extent to which "Motor transport is now seen as a central problem of sustainable cities in the developed world...it demonstrates the interaction of environmental, social, economic and political constraints that must be tackled if sustainable cities are to be achieved" (Blowers and Pain 1999:279).
15. Distance of travel to work: considers the extent to which people are living in locations that are distant from their place of work. It can provide an important insight into which a city is an organised or dispersed manner.

3.8 Methodological and data challenges

Since "[i]ndicators will only be as good as the data that supports them" (Lawrence 1998:70), the availability of robust and comparable data is often a significant factor in indicator selection. There can often be a pragmatic choice to be made between on he one side an indicator that would be an important measure of environmental performance but is data poor and on the other side an indicator that provides a partial or ambiguous measure of performance and is data rich. In many instances, organisations that use indicators will rely upon data collected for other bodies or use secondary data and then seek to apply it to their own circumstances. When using data from other organisations credibility can be an issue. There are also limitations associated with the use of secondary data. For example "official statistics do not simply exist independent of the actions of those who compile them" (May 2001:86) and "statistics do not, in some mysterious way, emanate directly from the social conditions they appear to describe" (Governments Statisticians' Collective 1993: 163 in May 2001:86). This is especially true of the index of multiple deprivation which looks at a particular social construction of a problem, and subsequently a particular handling of the data. However it is also true of other indicators, for example data used in air quality measures will depend on the location of monitoring stations.

3.9 Governance and indicators

In one of the very rare studies of the relationship between governance and sustainability indicators Astleithner et al (2004) have pointed to the importance of understanding local context when analysing indicator development and interpretation. They argue that indicators must be understood as being part of local cultures and governance structures and that the meanings attributed to indicators will inevitably be context specific. In other words, Astleithner et al (2004) challenge the dominant view of indicators which regards them as objective and neutral and which are aids to decision making. Rather, they conceive of indicators as being socially constructs that tell us something about what is meant by sustainable development by key actors and networks within organisations. To understand indicators means "understanding the networks of relationships between key policy actors and how … [indicators] may fit into or disrupt these relationships" Astleithner et al (2004, p10).

Drawing upon case studies in London (of a regeneration project) and Vienna (of a climate protection programme) Astleithner et al (2004) show how institutions shape indicators. In Vienna they found a

> political-administrative system consisting of strong hierarchies and exhibiting a lack of co-operation and communication across departments. In addition, technicians have the key role in defining and producing indicators.
>
> … Indicators are … seen as instruments to support political decision making via the production of 'objective' and measurable facts. … [There is an] ecological bias in the definition of sustainability" Astleithner et al (2004, p18)

Meanwhile in the London borough of Southwark

> decision making [was opened] up to a wider range of influences with more flux in the roles between actors, less potential for a group of experts to dominate and a corresponding lesser emphasis on objective facts and technical expertise. …[The] use of indicators led to an emphasis on the social side of sustainability indicators, here expressed in terms of 'quality of life'" Astleithner et al (2004, p18-9).

It would be tempting to link models of institutional arrangements with particular types of sustainability indicators. However, to draw such a conclusion based upon two case studies would be dangerous. Rather, what we can point to is that is that institutional context is important in the development and use of indicators.

4 Methodology and measurement

In this chapter, we scrutinise two popular methods or resource use. These are environmental space and ecological footprint. Both seek to analyse citizens' consumption and link it to political and geographical boundaries. Both can also be very effective means of communicating the link between the global and the local. We also give an overview of other methods and measures such as the European Common Indicator framework.

4.1 Environmental Space

Interestingly the Ecological Footprint emerged onto the international stage at a similar time to that of the concept of Environmental Space (Carley/Spapens 1998, Opschoor/Reinders 1991), but their fortunes have subsequently markedly diverged. Both the Footprint and Environmental Space, and related terms, such as the Ecological Backpack, are concerned to link consumption to resource use (Carley/Spapens 1998, 70). Within the different methods there is a desire to ask whether current patterns of resource use are sustainable and equitable. For both approaches the answer is clearly no but they arrive at their conclusions in different ways. According to (D. McLaren/Bullock *et al.* 1998b, 6)

> Environmental space is the share of the planet and its resources that the human race can sustainably take. Or in other words, the share of the earth's resources that humanity can use without depriving future generations of the resources that they will need.

There is a strong moral underpinning to the work of proponents of Environmental Space who are concerned at the extent of social and environmental degradation in parts of the world. Alongside the moral claim that greater attention should be given to more equitable resource distribution is a belief that use of Environmental Space can promote greater resource efficiency (Carley/Spapens 1998, 7-8). This is because the market system will be used to promote innovation and technology.

Environmental space is based on three principles (Carley/Spapens 1998, 8-9):

1. that global and national sustainability can only be achieved if the throughput of natural resources in modern economic processes is reduced to manageable, ecologically sound levels. This implies that environmental space is limited. Environmental space analysis provides insights on those limits "and is sufficiently quantifiable to provide valuable policy guidance."
2. There is a need for equitable global development. This means all countries should have equal access to the world's resources and also equal responsibility for management of those resources. This means lower resource use per capita in developed countries, and a rise in the consumption of resources in the developing world.
3. Production and consumption should enhance quality of life rather than degrade it.

Environmental Space identifies a number of resources that are key for production and consumption, including energy, strategic non-renewable resources (e.g. pig iron for steel, cement), freshwater, wood, land use (providing living space and a source of renewable resources (e.g. food production) (Carley/Spapens 1998, 61). For each of these resources an assessment is then made of their exploitation (usually over a year) by humans without harming the quantity and quality that can be used by future generations. So, whereas the Ecological Footprint converts all impacts into a single unit, the Environmental Space method provides a separate measure of each of its key resources, so identifying the variability of resource use on the environment (D. McLaren/Bullock *et al.* 1998b, 72). However, as the advocates of Environmental Space admit when compared to the Ecological Footprint "it is the more complex approach […] it is also probably more difficult to understand and communicate" (Carley/Spapens 1998, 70).

At a methodological level some of the key work on Environmental Space was undertaken by German Wuppertal Institute for Climate, Environment and Energy (Carley/Spapens 1998, 65-66). The Wuppertal Institute developed a common methodology for assessing Environmental Space at both European and national levels, but also with thematic specifications, e.g. on biodiversity, and at the micro-level of business, households and communities (Spangenberg 2002). This provides the opportunity for comparative assessments of the (un)sustainability of different countries, organisations and cities. Since the notion of Environmental Space is close to that of carrying capacity and provides a quantified measure of sustainable resource use it can potentially strike a resonant chord with the environmental policy community and environmental scientists. The environmental space assessment methodology has been deployed in Local Agenda 21 processes in Germany (Breyer 2001, Spangenberg 2002, Valentin/Gürtler *et al.* 2000, Valentin/Spangenberg 2000). Here it was used as a reflexive concept to inform local participation processes and guide them towards a balanced set of targets and indicators, and "environmental space calculations were used to quantify part of the targets" (Spangenberg 2002, 299). It appeared useful "as a communication tool and as a means of controlling the balance of themes and indicators chosen" (Spangenberg 2002, 299). And:

> In particular, as far as comparability is desired despite the enormous diversity of local situations to be covered, the common categories of environmental space (although specified in a locally specific way) […] offer a compromise between inappropriate harmonization on the one hand and unrelated reports from related areas on the other."
>
> (Spangenberg 2002, 299)

An internet based search shows that in many Local Agenda 21 processes the environmental space concept has been used as a metaphor during the kick-off phase to explain the ecological dimension of sustainable development. But we could find no use of the concept as a fully-fledged indicator system (see below). This is revealing because, in practice, the application of the Environmental Space approach has been severely restricted: its appeal is limited, its proponents have been unable to engender wider interest in the concept and it has methodological flaws. We will discuss each of these in turn below.

First, the approach was pioneered and promoted by Dutch environmental activists, notably Friends of the Earth (Carley and Spapens 1998; McLaren et al 1998), and whilst notions of space and resource use may have a particular affinity in the Dutch context they have not been taken up with any great enthusiasm in other parts of Europe.

Second, in the UK (Duncan McLaren/Bullock *et al.* 1998a) produced an Environmental Space report and although well received made little impact upon public policy or environmental debates. The concept also had little impact on local development decisions in Edinburgh, Scotland (Mittler 1999). Meanwhile there has been far more attention given to the Ecological Footprint. Friends of the Earth Scotland subsequently launched a campaign for environmental justice using an adaptation of Environmental Space (Agyeman/Evans 2004, 157) but in Scotland as well debates on resource use and sustainability have been led by proponents of the Ecological Footprint. There is little evidence to suggest that Environmental Space has been adopted as an indicator or an aid to decision making by national, regional or local governments. Meanwhile Buhrs (2004) has argued that Environmental Space could be incorporated into national green plans but doubts its feasibility because it raises issues of resource reallocation that are likely to raise considerable opposition.

Third, at a methodological level one of the major challenges for advocates of Environmental Space has been in establishing robust sustainable resource use thresholds (Minx/Barrett *et al.* 2006, 42). Ecological literature suggests that such limits cannot be easily estimated and this takes away much of appeal of the Environmental Space approach. Whilst it is not easy to estimate sustainability thresholds it is possible to derive safe minimum standards and these can be measured to provide a basis for informing policy. However, if such an approach is adopted then there is no need to undertake an analysis based upon Environmental Space.

4.2 Ecological Footprint

Ecological Footprint analysis was initially pioneered in the early 1990s in Canada by Professor William Rees and Dr. Mathis Wackernagel (Wackernagel/Rees 1996). Following its early conceptual development, Ecological Footprinting has gained interest amongst academics and practitioners internationally and the method has had constant development been further developed and used for a number of studies (Aall/Norland 2005, EPA Victoria 2003, NAfW 2004, NRG4SD 2004, WSP Environmental and Natural Strategies 2003). In 2004, the WWF published the Ecological Footprint for 148 countries in its fifth Living Planet Report (WWF 2004). The starting point for the Ecological Footprint concept is that there is a limited amount of bioproductive land on the planet to provide for all human resource demands. Sustainable development requires that we live within the carrying capacity of the earth, allowing our economies to develop whilst still ensuring that human needs are met. In a sense, the ecological footprint measures the "ecosystem appropriation by cities" (Folke/Jansson *et al.* 1997).

The Ecological Footprint is an aggregated indicator of global ecological impact, similar to Gross Domestic Product (GDP) in economic terms. It is measured using a standardised area unit equivalent to a world average productive hectare or 'global hectare' (gha), and is usually expressed in global hectares per person (gha/cap). The Ecological Footprint is derived for a defined population usually for one year by estimating the area of land required to support their resource consumption. For example, the demands of that population in terms of their food, travel and energy use. This demand on nature can be compared with the available Earth's biocapacity, which translates into an average of 1.8 gha/cap in 2001 (WWF 2004). However, humanity is currently using 2.2 gha/cap which indicates a situation of 'overshoot' where nature's capital is being spent faster than it is being regenerated (WWF, 2004). Overshoot may permanently reduce the Earth's ecological capacity.

Since its initial conceptual development, the Ecological Footprint has developed a global appeal. As the Ecological Footprint relates to the consumption activities of a defined population it has potentially many applications. In the UK, regional and local governments have shown a strong interest in the Footprint as an indicator of sustainable consumption and a number of studies have been commissioned. Cardiff is one of a small number of UK cities that have conducted an Ecological Footprint, other cities include London, York and Liverpool. In Wales, the Welsh Assembly Government has formally adopted the Ecological Footprint as one of its headline indicators for sustainability (NAfW 2004).

4.2.1 Ecological Footprint Analysis: strengths and limitations

Although the Ecological Footprint is being widely used and applied in the UK and elsewhere, the concept has faced a number of criticisms. Amongst the main points, critics have argued that the Footprint does not accurately reflect the impacts of human consumption (see Ferng 2002, Lenzen/Murray 2001, van den Bergh/Verbruggen 1999); it does not allocate responsibilities of impact correctly (Herendeen 2000, McGregor/Swales *et al.* 2004); and does not provide decision makers with a useful tool for policy making as there is limited understanding of how different consumer activities relate to impact (Ayres 2000, Ferng 2002, Moffatt 2000, van den Bergh/Verbruggen 1999). A more recent critique of the Ecological Footprint concept can be found in McDonald and Patterson (2004, 52-54) and a more general debate can be found in Ferguson (2001) and Van Vuuren and Smeets (2001).

The Danish Environmental Assessment Institute which runs independently under the Danish Environmental Ministry found that: "The ecological footprint rests on a restrictive understanding of sustainability and it makes use of questionable assumptions – the most serious being that we should raise forests in order to solve the problem of carbon dioxide emissions" (Environmental Assessment Institute 2002). The footprint "diminishes significantly when the calculation is based on non-organic renewables" (Environmental Assessment Institute 2002, 40). However, an evaluation of the Institute by five

Scandinavian scientists found that none of the Institute's reviewed reports met all scientific standards (Environment Daily 2003)

On a more positive note the Ecological Footprint approach is useful for a number of reasons. First, the Footprint offers the potential to compare different types of environmental impact. Strategic issues such as transport, waste and energy all adversely affect the environment, and with a Footprint, policy makers can clearly identify and compare the impact of individual consumption activities. The Footprint not only provides valuable insights into natural resource use, as it aggregates impacts into a single measure it also offers policy makers the potential to clearly identify and compare the environmental impact of different activities such as transport, waste and energy. Second, and more challenging, the Footprint provides the potential for policy makers to prioritise their actions in a more informed and integrated manner. Policy makers can thus potentially measure the effectiveness of policies to pursue sustainable development. Third, the Ecological Footprint may be helpful to policy makers because of its communicative power. The Footprint personalises sustainability by assessing the impact of consumption from a consumer perspective (i.e. it takes into account the impact of residents within a defined boundary rather than the industries in a particular locality). It can therefore be a useful tool from which to communicate to people, and for them to appreciate, the link between their local (consumption) activities and global environmental impacts.

4.2.2 Calculating Ecological Footprints

Traditionally, national Ecological Footprints (the "National Footprint Accounts") have been calculated based on a country's domestic production, imports and exports of primary and secondary products together with an estimate of the embodied energy of secondary products (Monfreda/Wackernagel *et al.* 2004). However, this method does not assign accurately the resource flows to final consumption categories as it omits all mutual interrelationships between product sectors and excludes the environmental effects of tertiary products, e.g. services. Recent methodological developments by Stockholm Environment Institute (SEI) have allowed intermediate resource flows to be assigned to final consumption, thereby adding significant strength to the Ecological Footprint calculation (see Barrett/Birch *et al.* 2005, Wiedmann/Minx *et al.* 2006). The Footprinting method then (following Barrett/Birch *et al.* 2005) takes the existing National Footprint Account provided by the Global Footprint Network (WWF 2004) as a starting point. The total Footprint of the United Kingdom is then disaggregated by economic sector and re-allocated to final demand by using Input-Output analysis based on economic supply and use tables. The breakdown of final demand categories includes detailed household consumption activities according to the international 'Classification of Individual Consumption According to Purpose' (COICOP) classification system and a detailed breakdown of capital investment. For a detailed description of this method see Wiedmann/Minx et al. (2006). With this method it is possible to calculate Footprints for sub-national areas or socio-economic groups, and the approach has been successfully used to calculate the Footprint of the UK, Wales and Cardiff (see Barrett/Birch *et al.* 2005, Collins/Flynn 2005, Collins/Flynn 2007).

4.3 Other methods and measures

4.3.1 European Common Indicator (ECI)

The **European Common Indicator (ECI) set** for assessing local sustainability was initiated by the European Commission and the European Environmental Agency in 1999 and sponsored by the European Commission. It comprises ten indicators (Ambiente Italia 2003):

1. Citizens' satisfaction with the local community
2. Local contribution to global climate change
3. Local mobility and passenger transportation
4. Availability of local public open areas and services
5. Quality of the air
6. Children's journeys to and from school
7. Sustainable management of the local authority and local entreprises
8. Noise pollution
9. Sustainable land use
10. Products promoting sustainability

The ECI set was piloted by ten cities, see section 7.4.1 below.

4.3.2 Dashboard of Sustainability

The **Dashboard of Sustainability** has been developed by the Consultative Group on Sustainable Development Indicators, an international team of measurement experts which is coordinated by the Canadian-based International Institute for Sustainable Development (IISD). The Dashboard is conceived as an ongoing project to develop a small number of new indices as components to an internationally accepted sustainable development index (SDI). The Dashboard is accessible as a free, non-commercial software package. The purpose is to illustrate the complex relationships among economic, social and environmental issues. The visual format is allegedly suitable for decision-makers and others interested in sustainable development. The Dashboard project is part of the sustainability indicator initiative of the Bellagio Forum for Sustainable Development, one of the main funders of the work. (IISD no date)

4.3.3 Reference Sustainability System (RSS)

The Reference Sustainability System (RSS) takes a systems approach to assessing the sustainability of cities. It has been developed in the course of an EPSRC-supported project. The methodology represents "the energy, resource and material flows, on which the environmental sustainability of cities depends" in order to assess "the potential of technological and resource management strategies to enhance urban sustainability" (Foxon/Leach *et al.* 1999, 137). Results critically depend on the use of "externality valuation methods compared to physical indicators, the difficulties of aggregating environmental impacts, the question of where system boundaries should be drawn in a life cycle analysis, and the need to consider both distant and local impacts which arise from the end-use demands of urban populations" (Foxon/Leach *et al.* 1999, 137). The methodology was applied "to compare different options for waste-paper management, namely energy recovery through combustion or digestion, materials recovery through recycling, and disposal to landfill, starting from a given set of demands for paper in London" (Foxon/Leach *et al.* 1999, 142).

4.3.4 Indicators for Urban Design

Urban Design, the urban fabric and the built environment are key aspects of sustainable development that are sensitive to urban infrastructure development. Issues in this area are complex and interests manifold. This is mirrored by a plethora of indicators.

A recent review of sustainable urban construction-related indicators included no less than 57 sets of indicators. The concerns addressed by those indicators included environmental impacts of building; health and comfort, quality of building; ageing and consideration of disabled citizens; availability of housing and buildings; readjustment for new business environment, full exploitation of new technological challenges; age of building stock; and activities in refurbishment and renovation (Häkkinen 2007).

The European Thematic Network on Construction and City Related Sustainability Indicators (CRISP) was funded by the European Commission under the 5th Framework Programme and has identified more than 500 indicators in 39 indicator systems (CRISP no date). However, there appears to be a focus on life cycle assessment and material flows; only four out of 26 sustainability indicators for buildings reviewed by the International Energy Agency (IEA 2002) addressed design issues (Frame/Vale 2006, 294).

As Frame and Vale (2006, 287) argue, at neighbourhood scales local authorities face "a dearth of design and assessment tools for the residential built environment and of indicators to monitor progress towards sustainable development". At the same time "local authorities increasingly require an integrated approach to data collection and inclusion of infrastructure service providers in design, assessment and monitoring of urban development and associated environmental effects" (ibid). The authors recommend that "built environment initiatives need to be combined with research into behavioural changes to achieve the desired outcome of a sustainable built environment and to increase the dialogue between communities, developers and local authorities" (Frame/Vale 2006, 288).

4.3.5 Urban density

Infrastructure development is an important driving and steering factor for urban density. However, as Burton (2002) argues and demonstrates, there is a **large number of equally**

plausible indicators for urban density which deliver quite different results when comparing density of English cities. These indicators are not directly integrated in planning on the project level but inform the wider planning discourse that is geared to spatial planning and its implications for infrastructure on a national level.

5 Discussion of established processes and tools

5.1 Environmental Impact Assessment (EIA)

5.1.1 Important steps in EIA

EIA is probably the well known and widely practiced decision making tool. EIA is a process to identify and examine the environmental implications of a proposed development. It is a tool that is designed to prevent or reduce environmental damage before it occurs, and to ensure that the environmental consequences of a development are made available to decision makers. The steps in the production of an Environmental Statement are now well known and outlined in the figure below.

Figure 5: Important steps in EIA (source: Glasson/Therivel *et al*. 2005, 4)

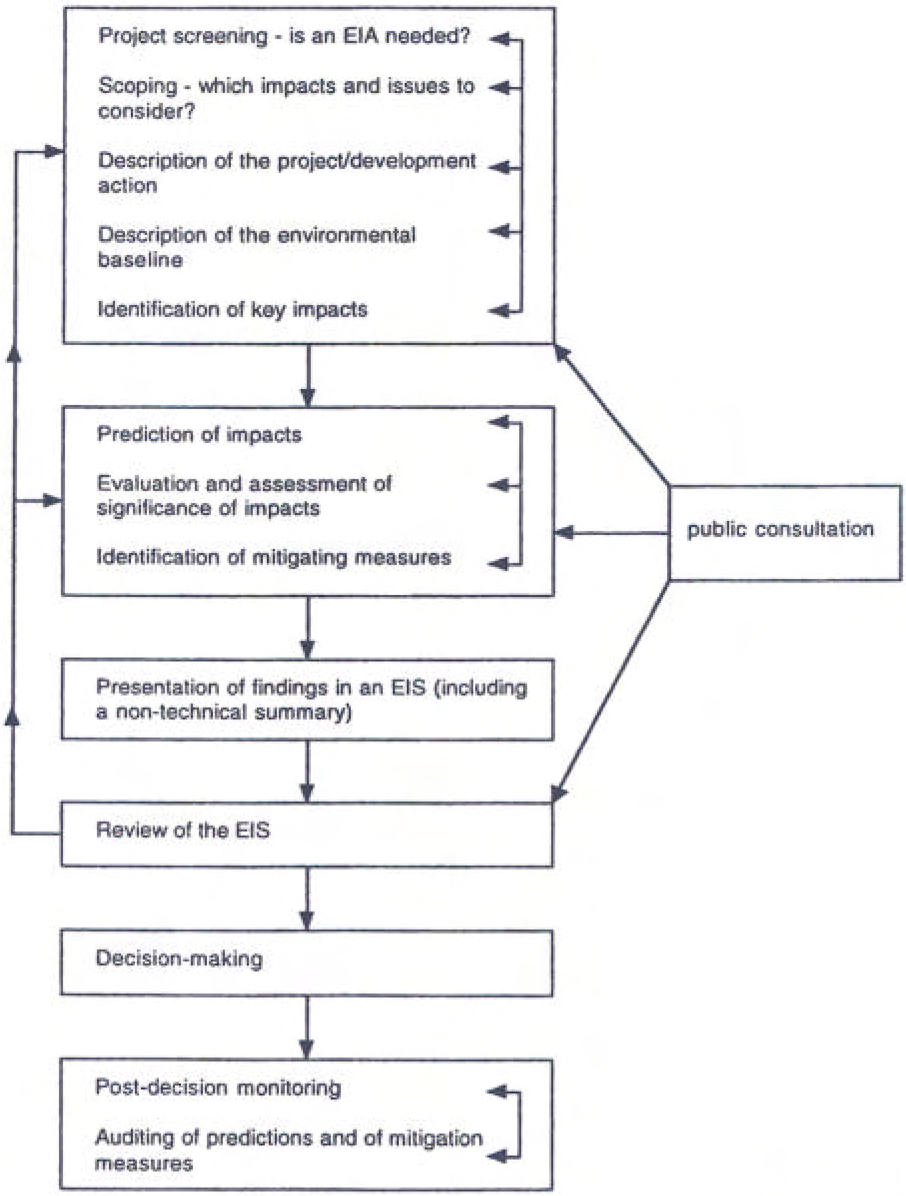


Figure 1.1 Important steps in the EIA process. Note: EIA should be a cyclical process with considerable interaction between the various steps. For example, public participation can be useful at most stages of the process; monitoring systems should relate to parameters established in the initial project and baseline descriptions.

Within the European Union, the EIA practices of member states have been heavily influenced by two Directives. The first, Directive 85/337 (adopted in 1985 and to be fully implemented by 1988), laid the basis for the information that would be required in an EIA and the types of projects to which it would apply. Interestingly, the Directive distinguished between projects where an EIA would be mandatory (Annex I) and which covered a mix of infrastructure developments (e.g. construction of motorways), resource management activities (e.g. transfer of water resources) and industrial plants (e.g. installations for chemical products) and discretionary projects (Annex II) and these covered industrial sectors that would have an obvious environmental impact (such as the energy industry) and excluded the service sector (with the exception of leisure and tourism). The practice of EIA is, therefore, integral to urban development. The purpose of the second Directive 97/11 was to remedy weaknesses that had quickly become apparent in the first Directive. So, for example, the types of projects that were to fall under the legislation were clarified and extended, there was a firmer requirement to consider alternatives and an effort to improve public participation.

Within Europe, the Dutch are regarded as being amongst the most innovative thinkers and practitioners on EIA. The Dutch have focussed particularly on ensuring that environmental statements are of a high quality. Quality takes two interrelated forms: the content (i.e. the information in the environmental statement) and the process by which information is gathered and used (Dotinga no date). The Dutch have also developed an interesting institutional context in which to promote better practice. An independent EIA Commission was founded in 1997 and provides guidance on the framework for the environmental study and statement, and reviews the quality of the final report. Dutch environmental statements cover similar ground to those of other countries but do pay more attention to consideration of alternatives and the identification of the alternative that is most friendly to the environment (in nearly all cases this will be a no development scenario). Despite the efforts of the EIA Commission it judges that 30-40% of all environmental statements lack essential information. The major weaknesses are the elaboration of alternatives (especially the alternative that is most friendly to the environment) and description of effects on the environment (Dotinga no date). When the Commission identifies a weakness in a report it will advise that additional data should be provided. As a result of the oversight and drive to improve quality within the system the EIA Commission believe that EIA is effective in about 80% cases; in other words the environmental statement is providing information that is robust and leads to a better argued outcome (Dotinga no date).

The Commission links a high quality environmental statement to good governance and distinguishes five guarantees (Dotinga no date):

- “a notification of intent. [This] guarantees openness at an early stage and enables public discussion
- description of alternatives, among them the alternative that is most friendly for the environment. [This] ensures transparency in the consideration and balancing of interests
- justification of the decision in the light of the available information. [This] clarifies the role played by environmental aspects in decision making process

- consultation on the scoping guidelines for and the review of the environmental report. [This] guarantees that the public will have an opportunity to make representations twice: at an early stage and in a later stage of plan preparation
- independent advice on the scope and quality of information [This] guarantees the reliability of the information on which public consultation and decision-making are based."

Whilst Dotinga outlines five ideal-type features for EIA in the Netherlands, the practice is rather more complex, particularly in relation to infrastructure projects. In their review of infrastructure planning in the Netherlands Niekerk and Voogd (1999) point to a number of complicating factors, including the search for processes to promote social and political consensus (an important feature of Dutch life), increasing involvement of the private sector in projects, and that traditional forms of expertise are being challenged so that opinions can appear to matter as much as facts in decision making. In the Netherland, the planning of large infrastructure projects, such as motorways or railways, is top-down, led by national government and promoted in national level plans. Once the project level analysis, the EIA, has been conducted there is then a check to ensure that the proposed development remains aligned with national policy. Once a so-called alignment decision has been taken at the level of national government, relevant municipal and provincial authorities must include the decision in their land use and regional plans. Within the Dutch planning system it is assumed lower tiers of government will respect decisions made at a higher tier and if unwilling to do so can be forced (Niekerk/Voogd 1999, 23). In practice, lower tiers of government and other interests will often be able to make their views known to central government early in the policy process so that a more collaborative decision making process emerges (Wolsink 2003). Even so, as Niekerk and Voogd (Niekerk/Voogd 1999, 24) note "impact assessments principally serve national decision-making processes."

The top-down style of decision making has proved rather problematic. Consensus around a development proposal is difficult to build because consultation tends to take place late in the decision making process and be limited. The public (and other statutory consultees) have two formal opportunities to contribute to the EIA process: the establishment of the scoping guidelines, and when the environmental statement is reviewed (Woods 1995, 235). That the Dutch model of EIA is seen to offer insufficient opportunities for consultation is to many external observers something of a surprise since they are more clearly defined and observed than in a number of other EIA systems. The paradox is resolved because of the premium that Dutch society places on achieving consensus and the difficulty of achieving consensus at the local level when key decisions have already been made at the national level. The approach is "not focussed on perceptions and needs of the municipalities and local groups, but mainly on national needs and national perceptions of those needs" (Niekerk/Voogd 1999, 25).

An example of how the exclusion of key actors led to the undermining of a major strategic rail proposal, the Betuwe track, has been provided by Niekerk and Voogd (1999) and Wolsink (2003). The idea between the new train line between the port of Rotterdam in the Netherlands to the German border was to handle the rapid increase in containers. The rail track was strongly supported by central government but alternatives were only weakly outlined and this was criticised in the review of the environmental statement by the EIA Commission. Although the proposal was withdrawn because it was becoming embroiled in controversy it reappeared a short time later but with a different justification: the rail line would enable a modal shift by taking freight traffic off the road. Again, the proposal went through the central government decision making process. Subsequently, though, the project suffered from a series of amendments (the line was to be shortened) that reduced its viability, new information on escalating costs emerged, and estimates as to the amount of freight that were to be transported were dramatically scaled back. Wolsink (2003. p711) has argued that

> The failure of the project is attributed to the central planning approach, with a strong emphasis on the exclusion of stakeholders with a critical perspective. [As a result] [r]elevant information had not been used, the quality of the information that had been used was poor, a good quality cost-benefit analysis of the total impact had failed, and options for alternatives had not been investigated.

5.1.2 EIA and participation

The Dutch experience is typical of many large projects. By the time that analysis reaches the project stage too much has been invested in it by key stakeholders to envisage that the project might be stopped. As a result, for many developers public participation has negative conations. Consulting with the public may raise concerns about a development, spark a high profile debate, and lengthen the time that it takes to make a decision. All of these factors may cost a developer money. As Glasson et al (2005, 158) have noted at the extreme "Public participation may provide the legal means for intentionally obstructing development; the protracted delay of a project can be an effective means of defeating it."

On the other hand, proponents of participation would claim that by including the public in decision making it is possible to clear up misunderstandings that could otherwise have provided the basis for objections; provide the developer with information and insights that can improve the quality of the proposal; and show that the public that their concerns have been listened to, so taking away what can be a catalyst for dissent. Inevitably, the truth about participation lies somewhere in between these two poles: if handled well participation can improve the quality of the decision making process, if mishandled participation can inflame an already difficult situation. Although there is a considerable amount of guidance on public participation amongst EIA practitioners there is recognition that what works well for one community may not necessarily do so for another. Similar types of development proposal may arouse quite different feelings in different communities.

There is, though, a further problem that can be particularly important when analysing urban infrastructure developments. EIA applies to large and potentially environmentally damaging proposals. Such developments because of their scale and impacts will often attract controversy. For some development proposals it is possible for participants to reach a compromise. For example, the size of a housing development might be scaled back or it might be relocated. In other cases, however, compromise is simply not possible.

For instance, a new gas power station is either built or it is not; a dam is built or it is not. It is where compromise is not possible that methods to engage in participatory or inclusive forms of decision making can come unstuck.

In an effort to move away from set piece confrontations during consultation exercises planning consultants are given increasing attention to ways in which they may shift the terms of the debate. Health provides a good example. Health issues are becoming increasingly prominent in a number of contentious planning applications and, perhaps, none more so than energy from waste plants. Typically, the environmental statement will identify health risks from a new plant, a topic that could well lead to local concern. For example, in the proposed Newhaven Energy Recovery Facility in Sussex in the south of England, the environmental statement represented health in a number of ways. A chapter on 'Air quality' provided the worst case scenario for health impact as a result of a Health Regulatory Appraisal (HRA) whereby emissions to air resulting from both construction and operational phases of the scheme were examined. It also considered health in terms of traffic emissions as well as from the actual energy from waste process. Not surprisingly local councils and residents groups expressed concerns about the adverse health effects of the proposal. Although a key concern for objectors health issues had little impact on decision makers (Hill 2007).

However, there are now attempts to reformulate health issues with an interest in the wider health determinants which affect local populations and efforts to determine how a new development may affect not just health, but quality of life and well being (Hill 2007). Rather than simply concentrating on the negative health issues arising from a proposed development Hill would argue that a broader quality of life approach would enable different issues to be raised such as the extent of fuel poverty in the local population. It would then be possible to determine, for example, whether an energy from waste plant might be able to provide cheap energy to low income households and this would mean that the development would have a positive health benefit.

5.2 Strategic Environmental Assessment (SEA) and sustainability appraisal

The drive behind SEA has its origins in EIA. As proponents of EIA have long recognised EIA has a number of faults and SEA is proposed as a means to overcome a number of them (Carys Jones 2005, Dalal-Clayton/Sadler 2005, Fischer 2007). For example, EIA may be good at assessing the impacts of an individual project but it cannot question the plans, programmes and policies that lie behind that project. A key advantage of SEA, since it is concerned with decisions made 'upstream' at the level of plans, programmes and policies, is, therefore, that it enables an earlier assessment of the environmental impacts of decisions. Second, because EIAs consider individual developments they are poor at analysing the interactions between developments. For instance, a new power station may require a major new road to be built and both would require an EIA but unless special arrangements were made they would be considered in isolation from one another when in fact they are closely related. Similarly new road building schemes often 'trigger' new developments but these would be assessed separately. As SEA advocates have pointed out at more strategic levels of decision making it is possible to make more informed decisions about cumulative impacts. Third, in EIA best practice developers should give serious attention to alternatives but when decisions are being made at the project level thinking on alternatives is likely to be severely constrained. For instance, an EIA on a power station might be able to consider alternative designs or even other locations. However, there will be no opportunity to evaluate the feasibility of alternative fuels or the potential for energy conservation. Once again, these sorts of decisions can only be made at the strategic level when considering energy policy, for example.

Not surprisingly, therefore, for many, SEA is simply the application of environmental assessment to polices, plans and programmes. In other words, SEA is EIA at more strategic scales of decision making. However, Rosario and Clark (2000, p4) argue that SEA is more complex, integrated and process driven and so is best conceptualised as:

> "SEA is a systematic, on-going process for evaluating at the earliest appropriate stage of publicly accountable decision-making, the environmental quality, and consequences, of alternative visions and development intentions incorporated in policy, planning, or program initiatives, ensuring full integration of relevant biophysical, economic, social and political considerations."

A further advantage of the Rosario and Clark perspective is that it allows sympathetic consideration of similar processes, notably sustainability appraisal. So, in this section we will also consider sustainability appraisal and how in Britain it has been linked to SEA.

The very breadth of the ambition for SEA may also be its undoing. To be able to collate and analyse the necessary data for a major development plan or programme would in itself be extremely challenging. As EIA practitioners have frequently found out to provide the information to be able to scrutinise a development project is difficult. To then go a stage further and ensure that the data is integrated with other major factors will provide major challenges for both analytical methods and skills. Behind the outward rationality of SEA (and EIA) also lurk important value judgements. For example, who should decide what are 'relevant biophysical, economic, social and political considerations'?

Britain has proved to be particularly innovative in SEA type activities, driven by a combination of European and domestic considerations. For example, in the early 1990s there was a flurry of initiatives. Driven largely by economists, *Policy Appraisal and the Environment* (1991) sought to improve the integration of environmental factors in central government decision by promoting greater awareness of the costs to the environment. However, the scheme found little favour outside a narrow range of government economists. Much wider interest was generated by efforts to promote SEA in local government land use planning through the issuing of guidance documents. Not only did the proposals find a receptive professional audience amongst the planning community, they adopted a much more qualitative approach to SEA than the cost-benefit type thinking behind *Policy Appraisal and the Environment*. Whilst the UK government was making efforts to promote SEA at home it was, like a number of other Member State governments, seeking to stifle attempts to formulate a European SEA Directive.

From 1991 the European Commission had been drafting an SEA Directive but it was not until 2001 that it was finally adopted. Much debate centred on the coverage of the Directive. Should it deal with plans, programmes and policies? There were fears that if policies were brought within the ambit of the Directive, then central government decision making processes might be opened up to scrutiny. In the end the final version of the SEA Directive stated that it would apply to:

> "plans and programmes liable to have significant effects on the environment and which are prepared and adopted by a competent authority … it also applies to amendments to such plans and programmes. Environmental assessment is automatically required for plans and programmes which are prepared for town and country planning, land use, transport, energy, waste management, water management, industry, telecommunications, agriculture, forestry, fisheries and tourism and which provide the framework for subsequent consent for projects (that fall within the EIA Directives). The same applies to the adoption of plans and programmes liable to affect sites protected (under the Habitats Directive) (2001/42/EEC Assessment of the effects of plans and programmes on the environment).

In an important review of the SEA literature Runhaar and Driessen (2007) explore the factors that contribute to SEA impacts on decision making. As they point out there are a number of potential dimensions when assessing impacts (and these are very similar to debates that have been rather longer running in relation to EIA). Direct impacts are those that show the SEA has had an impact on decision making. This may, for example, mean that the final decision and SEA report are closely aligned; that decision makers understanding of environmental issues has been deepened as a result of the SEA; that environmental issues play a more prominent part in decision making (Runhaar/Driessen 2007, 3). Much more difficult to analyse are indirect effects, such as when decision makers anticipate the findings of the SEA and have incorporated it into their decision making frameworks. Not surprisingly most commentators have concentrated on studying direct impacts and in their review of previous studies Runhaar and Driessen (2007, p3) report that typically these showed impacts on decision making were "rather modest". The one exception was found in the work of Therival and Minas (2002) that adopted a different methodology as they compared how British land use plans developed against a business-as-usual baseline and used a different decision tool, sustainability appraisal. Therival and Minas (2002) found that plan polices were changed and the distinctiveness of their results may be accounted for because of three principal reasons. First, sustainability appraisal was developed in conjunction with planning professionals who were often sympathetic to the aims of appraisal. Second the appraisal was subject to external review and potentially to legal review and so key actors recognised that the appraisal process had to stand up to scrutiny. Third, impact was assessed in terms of text and British land use plans are highly textual documents (rather than say map-based) in which words matter for the exercise of local discretion (unlike, for example, land use plans which are more sympathetic to zoning). The implication of the work of Therival and Minas (2002), particularly when placed alongside other studies that have recorded far less impact for SEA upon decision making, is that the context in which SEA is practiced and the form that the tool takes matter. We provide a case study of SEA in relation to land use planning in the City of Newport in section 8.2 below.

The belief that context matters to the effectiveness of SEA is reinforced by Runhaar and Driessen (2007, p4) who having reviewed 15 papers provide a comprehensive list of the factors that may contribute to the effectiveness of SEA on decision making (see table below).

Table 3: Rank order of factors contributing to SEA impact on decision making

Rank	Factor
1=	Flexible SEA that fits into the decision-making context
1=	Stakeholder participation
3=	Transparency of SEA process
3=	Binding character of SEA
5	Quality of the assessment
6=	Values in SEA should reflect values in policy context
6=	'Openness' of decision-makers to environment/sustainability
8=	Tiering of SEA with other assessments
8=	Adequate resources
8=	Effective communication
11	Assessment and mitigation of redistributional effects

Source: based upon Runhaar and Driessen 2007, Table 1, 4

Runhaar and Driessen (2007, 4-5) draw a number of lessons from their review. First, most studies are drawn from experiences in Britain and the Netherlands. These are key countries because they are often regarded as amongst the most innovative in relation to decision making tools. Second, that SEA works best where it is flexible and can fit into, rather than challenge, the decision making context. Third, participation is important because it increases the credibility of the SEA process. Fourth, analysts have identified a relatively large and diverse number of factors that influence the impact of SEA on decision-making. Finally, researchers have been poor at making an explicit link between the context of decision making and SEA so "hampering a good understanding of what factors contribute in what conditions to SEA impact on decision making" (Runhaar and Driessen 2007, p5). In order to redress this weakness Runhaar and Driessen (2007) make their own empirical contribution and we will briefly review this below. We will then follow it with our own analysis of the use of SEA in the Welsh Assembly Government in section 8.4.

Runhaar and Driessen (2007) select four SEA case studies to represent four different types of policy context. These are: 'uncertainty' about the cause of a policy problem or the impacts of alternatives; 'structured' where there is recognition of the policy problem and policy makers have a clear sense of the direction they must pursue; and in between these two types of policy challenge there are cases where there is debate over policy means (but not the problem); and finally, there is substantial agreement over the impacts of alternative policy options but debate over what is at stake. Runhaar and Driessen (2007, 12) found that their case studies "revealed a moderate impact of SEAs on decision-making. Impact was notably related to the extent to which SEA recommendations were in line with the values and interests of the main decision makers.” In terms of drawing lessons about the impact of SEA much

> will depend upon three contextual determinants: (a) degree of consensus about norms and values regarding the policy issue, b(b) certainty about the knowledge base; (c) characteristics of the decision-making process (in particular the ‘openness’ of decision-makers to outsiders or other norms and values. (Runhaar/Driessen 2007, 6)

5.3 Multi-criteria decision making

Multi-Criteria Analysis (MCA) has a number of similarities to other environmental management decision making tools, such as sustainability appraisal and strategic environmental assessment (like the Welsh Assembly Government’s Integration Tool). All are concerned to bring to bear on decision making a holistic approach in which they integrate economic, environmental and social issues; are robust, in that they will stand up to critical scrutiny; and are transparent, as others can follow the line of thinking that has been followed by the analysts. What distinguishes MCA from other approaches is the systems modelling base to the methodology (where methods such as Evamix are popular).

Whilst the MCA community is well established it is marked by a divide between researchers and practitioners. As Beinat (2001, 51) has noted: “most practitioners still rely on simplified and frequently rough MCA implementations, which are a far cry from the sophistication of the largest part of MCA literature.” Within the literature there are a number of unresolved issues, including the nature of methodological assumptions, the role of theory, and the ethical implications of different forms of valuation, that make little impression on practitioners. Of more concern to practitioners has been a much more pragmatic issue: how MCA can best be utilised in decision making. Here the experience is very mixed. In a study of five MCAs in Norway Wenstop and Seip (2001, 63)conclude that it can contribute to decision making, can help make explicit value judgements but rather worryingly that “there was no relationship between the legitimacy and the quality of the studies and their significance for decision-makers.” In other words, politics matter and MCA, like any decision making tool, can become part of the politics of decision making.

Perhaps the best examples how MCA work in practice are drawn from the Netherlands where MCA is inextricably bound up with the EIA process. MCAs will contribute to about one in six of every environmental statement that are produced. MCA is concentrated in highways and railways projects because the Ministry of Transport and Waterways is a long time advocate of the approach (Janssen 2001, 102).

Janssen (2001) has described how MCA contributes to the production of an environmental statement. MCA helps in the generation of alternatives, for example, dividing the building of a new road into sections and identifying alternatives for each section. The alternatives can then be ranked and the optimal route for the road mapped. A key part of the analysis is therefore deciding how to score and weight alternatives.

Despite the sophisticated MCA methodologies that have been developed Dutch experience shows that a weighted summation is by the far most popular approach. Here qualitative scores are usually measured on a plus and minus scale (+ + + / - - -). Quantitative scores are also frequently assigned a plus or minus measure to make it easier for the reader to assess impacts. To help readers obtain a better perspective on impacts assessment criteria are grouped into themes. The groupings are assigned a weight by experts based on their scientific knowledge and by politicians based on their policy preferences. Within the weighting process it is recognised that experts will, like politicians, be making value judgements, for example, an ecologist comparing the loss of a habitat against the retention of agricultural land. Similarly different experts will assign different weights to environmental issues based upon their training (an ecologist and an engineer, for instance, could have different views on the relative significance of water pollution). It is then a relatively straightforward task to sum the scores and the weights, so-called weighted summation, to produce outcomes for different alternatives. The transparency of the method and its relative straightforwardness, at least when compared to other approaches, has led to it being recommended by the Dutch EIA Commission (Janssen 2001, 105). Recent suggestions to use fuzzy logic for assigning weight to the various dimensions (Gagliardi/Roscia *et al.* 2007) have not yet gained practical relevance. As a practitioner and proponent of MCA Janssen (Janssen 2001, 108) is dismissive of further methodological refinement; rather, he sees the future for MCA, and EIA, as moving “from analysis/evaluation to communication” of environmental impacts to stakeholders.

MCA, like SEA and other decision making tools, faces a number of challenges. These cannot simply be resolved by methodological refinement, or even applying the more sophisticated methodologies developed by the research community to practice. First, there are difficulties in deciding which impacts to cover, at which scale and over what time frame. Even where alternatives can be delineated there are still judgements to be made over the boundaries of a study. For example, if a road scheme is broken up into sections, how large should the sections be and how far from the road should impacts be assessed? Second, analysing the environmental impacts of a proposed development can be very complex, for example, the interactions between pollutants or between pollutants and different types of ecosystems. When social and economic issues are also included as part of the analysis then the challenge of providing a comprehensive and meaningful evaluation are magnified. For example, how might people respond to employment opportunities arising from a project that produces relatively high levels of local pollution? Will peoples’ behaviour be consistent over time and space or might it depend on other local employment opportunities and, perhaps, the state of the economy? Third, technical approaches to environmental management suggest that there are technical, managerial solutions; the solution to problems is better information; whereas, from a more radical viewpoint, such approaches deflect attention from issues of power, inequality and economic growth that underlie social and environmental crises.

6 Context and circumstances

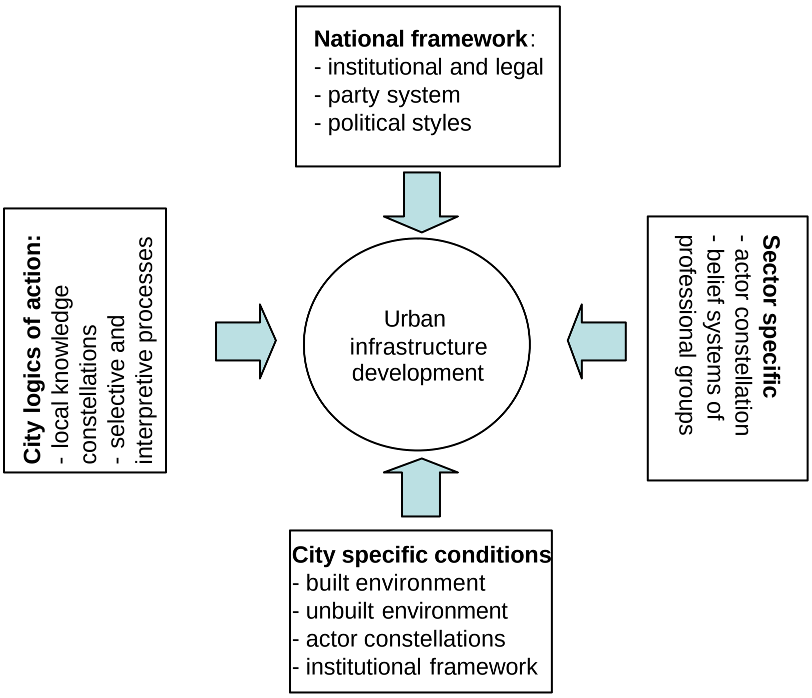
6.1 General framework

Urban infrastructure development in Europe is embedded in national policy and legal frameworks which in turn are increasingly shaped by European initiatives. Comparative literature on cities distinguishes three sets of factors which shape urban development (Cole/John 2001, Zimmermann 2008):

- National framework: this includes the institutional and legal framework but also other relatively stable structures, e.g. the party system; government philosophies and national political styles.
- Policy or sector specific governance structures, including professional attitudes and belief systems of professional groups;
- City specific logics of action, including local knowledge constellations (e.g. experience stored in organisations), or on a procedural level specific selective and interpretive processes; these are connected to city specific conditions including material conditions, actor constellations and institutional frameworks.

However, systematic research on comparative urban governance is only now emerging. There is no systematic comparative literature on urban infrastructure development, particularly with a view to sustainable development.

Figure 6: Framework conditions for urban infrastructure development



We suggest that the analytical framework sketched out in Figure 6 needs to be further refined. For example, the sectoral context includes

- Planning framework (laws and institutions)
- Waste policies
- Water management policies
- Transport policies
- Energy policies
- Taxation
- Competition policies (impact on public utilities)

The city specific conditions include the social and economic context, which is to different degrees linked to the national and global economy, i.e.

- Economic structure and business cycles
- Financial sector institutions
- Public awareness of sustainability issues
- Etc.

The social and economic contexts and circumstances under which cities in Europe develop municipal legislation and regulations are very different. There is little evidence about how these circumstances affect the real impact of regulations on urban infrastructure development patterns, in particular in terms of environmental and social performance. In this report, we can only sketch the context in which cities operate and highlight some recent trends of importance to sustainable urban infrastructure.

6.1.1 General institutional framework

The legal status and competence of communities vary throughout Europe, within and outside the EU. Nevertheless, communities are usually considered the lowest (or basic) level of government and an important site for democracy, particular due to the proximity among citizens and between them and incumbents. Degrees of autonomy and involvement of national governments vary.

For example, in Germany the communities/local authorities are responsible for everything they consider important and which does not fall under the competence of the state or federal government. The communities' rights are guaranteed in the state constitutions, e.g. article 137 of the Hessen constitution. Operational duties and rights are codified in local government codes on a state level. For example in Hessen paragraph 1 of the municipal code acknowledges the communities as basis of the democratic state. The community is to enhance the wellbeing of its inhabitants through free self-administration. Paragraph 2 ascertains that the communities are the exclusive and self-responsible bearers of public administration on their territory unless effective law assigns otherwise. However, in some cases communities have to take on responsibilities of the state or federal government and must act according to the latter's directives. Communities in Germany therefore encounter four types of responsibilities: voluntary, e.g. building a community hall; mandatory without directives, e.g. provision of school buildings; mandatory with directives, e.g. organisation of elections; and state responsibilities (carried out for the state or federal government, e.g. police). The provision of public infrastructure is mostly a mandatory responsibility. The communities are obliged to care for drinking water, energy supply, sewerage and waste management and to maintain local streets. Public transport, parks, sport facilities, theatres, youth clubs, nursing homes or libraries are voluntary responsibilities. Political decisions are made in the local or city council which is elected every four or five years. The council also used to elect the mayor as main representative and the city or community director as head of the administration. In some states both roles were united in the mayor's office. Recent reforms have widely introduced the latter, unitary model and direct election of the mayor by the community's electorate.

The Netherlands also allow municipalities to take on any responsibility on a voluntary basis as long as there are no legal provisions to the contrary. Municipality competences include land planning, transport and urban infrastructure. These are often exercised within national and regional policy frameworks. In the Netherlands the communities are more integrated into the unitary state than in Germany. The mayor is appointed by the Crown while the other members of the municipality's executive are appointed by the council which is locally elected. Of peculiar importance are the waterboards which are responsible for water management. Representation is based on stakeholder status and financial contributions, and the chairman is appointed by the government.

In large cities like London, Stockholm (Eckerberg/Mineur 2003) or Hamburg there are several layers of local government with different, sometimes overlapping tasks and competences.

6.1.2 Framework for urban infrastructure

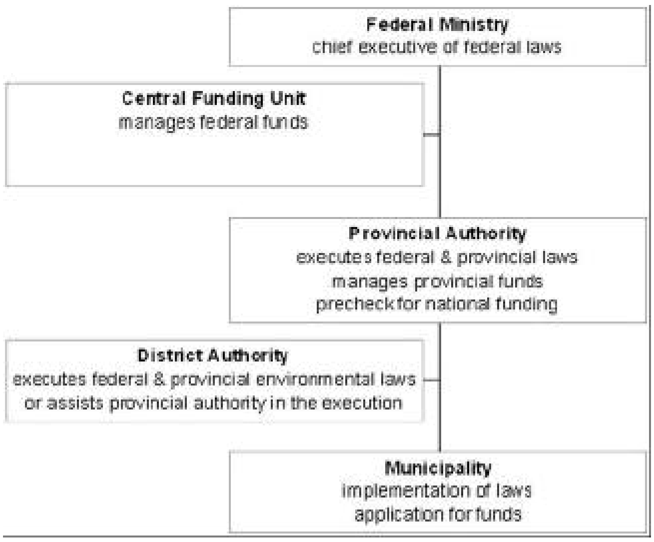
The communities are typically responsible for the maintenance of local roads, drinking water and sewerage, waste management, and energy supply. The costs are usually covered by a mix of local taxes and user fees. To account for differences in budgetary returns, there are usually financial mechanisms in place to redistribute public funds on a national scale. In Germany for example, all taxes are redistributed nationally among states and within states among communities to confine inequalities in tax income per capita to a few percent. In the UK, the national government allocates funds to local authorities on an equal per capita ratio.

Transport infrastructure often serves supra-local purposes. Roads are typically classified for their local, regional, national importance and costs for building and maintenance are allocated accordingly to different levels of government. Local public transport (bus and local trains) is usually funded by the communities. Trains typically run on national railroad tracks. In most countries the state railroads have been privatised or monopolies opened up to competition. An interesting example is Germany where responsibility for all public transport including railroads was devolved to the state level during the 1990s. The federal government allocates funds to the state governments. The latter call for tenders for train services on the existing railroad tracks. State governments include service targets, e.g. frequency and reliability of services and price limits.

In waste management and energy supply communities have to decide on the technologies they want to use. Governments would typically specify environmental and social standards that have to be met. Incentives to choose certain technologies are usually not targeted at communities. In Germany, for example, communities are entitled like private bodies to benefit from incentive programmes for solar panels and other renewable energy programmes.

Water management mostly involves regional cooperation within river catchment areas. This has now been made a requirement by the European Water Framework Directive which also requires encompassing stakeholder participation. Again, steering is done through minimum standards rather than through incentives. But cooperation also plays an important role. In water management a large number of actors and agencies have to cooperate. Figure 7 gives an example from Austria.

Figure 7: Funding of urban water infrastructure in Austria (source: Starkl/Brunner *et al.* 2009, 1033)



Local Agenda 21 processes are voluntary in countries like Germany and Austria. In some cities they have been used to launch initiatives in waste management or public transport. Examples are given below. In the UK local authorities now have an obligation to devise a sustainability strategy. Again, details can be found below.

Within the EU, the national environmental and technological standards which communities have to obey in their infrastructure planning and management are increasingly embedded in European policies and directives. Of particular importance are:

- Waste management directives
- Water framework directive
- Particulate matter directive (strong impact on transport)
- Renewable energy strategy
- Competition policies (impact on public utilities and tendering for public procurement)
- EU Spatial Planning,
- EU Thematic Strategy on the Urban Environment

Many communities have employed unconventional methods to finance their expenditures, for example leasing of public buildings. In some cases this has caused financial problems when conditions on the financial markets changed. Hiwever, we have not found literature that would review general developments in the modalities of financing of urban infrastructure in Europe in the last 50 years and would allow to draw conclusions about trends in terms of efficiency and equity.

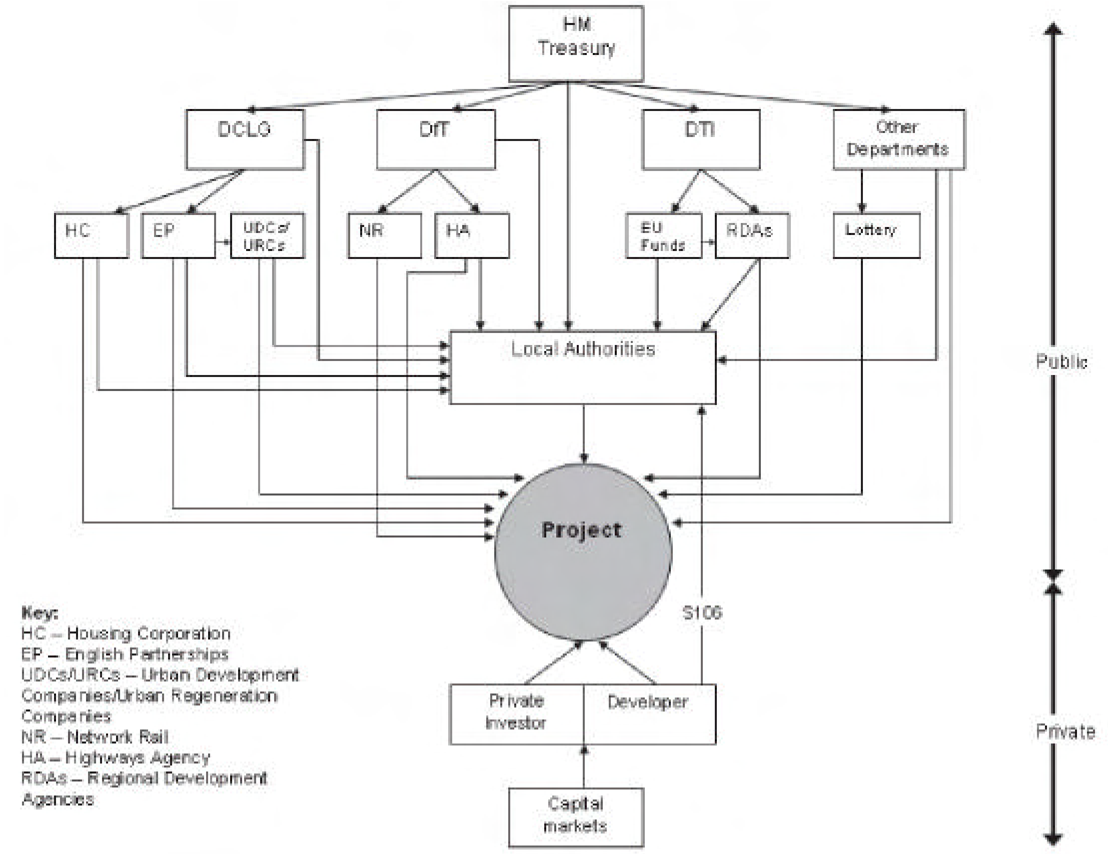
Such practices are in line with a wider shift in the focus of urban governance since the 1980s, which has moved **from managerialism to entrepreneurialism**, i.e. from the local provision of services, facilities and benefits to urban populations to a preoccupation with local development and employment growth (Harvey 1989). This was accompanies by a growth of business sector involvement and the ascendancy of the partnership model in urban development (Ward 2000). In Asian cities this is often matched by an pronounced pro-growth attitude of the ruling elites that prevents effective environmental governance (Lee 2002).

We have found no literature that would systematically assess different modalities used by national and local governments to finance the development of sustainable urban infrastructure. There is little evidence about innovative mechanisms and strategies for financing specifically sustainable infrastructure, probably partly because there is little agreement about the operationalisation of that concept.

6.2 Infrastructure funding in the UK

Infrastructure funding in the UK is characterised by a diversity of funding streams that are available to local governments. Some funders will have responsibility for particular activities (e.g. the Housing Corporation provides finance for housing) whilst others will be a more general source of infrastructure funding (e.g. the EU). It is also important to recognise that funding can be provided by public or private sectors or a combination of the two. In the diagram below the network of funding opportunities to local government demonstrates the variety of funding sources, how funding will be linked to the agendas of funding bodies and the potential for overlapping agendas (and also gaps between funders). Such a dense network of funding opportunities can either demonstrate a rich pattern of governance in which a number of organisations have specialist funding responsibilities and thus can build up expertise and relationships with those that they fund; or it can show a confusing situation in which organisations and funding regimes are ad hoc responses to particular policy problems.

Figure 8: Complexity of infrastructure funding



Source: All Party Urban Development Group (2006).

Central government, particularly the Treasury, has control over, and provides much of the funding for, infrastructure projects. As a report by the Greater London Authority (GLA) notes

> in a current regulatory and financial environment in which 95% of all taxation is set by central government and where all capital expenditure by English regional and local government is subject to Treasury control, the ability of [local or regional government] to adopt mechanisms for public private co-investments is significantly constrained (GLA 2004, 10).

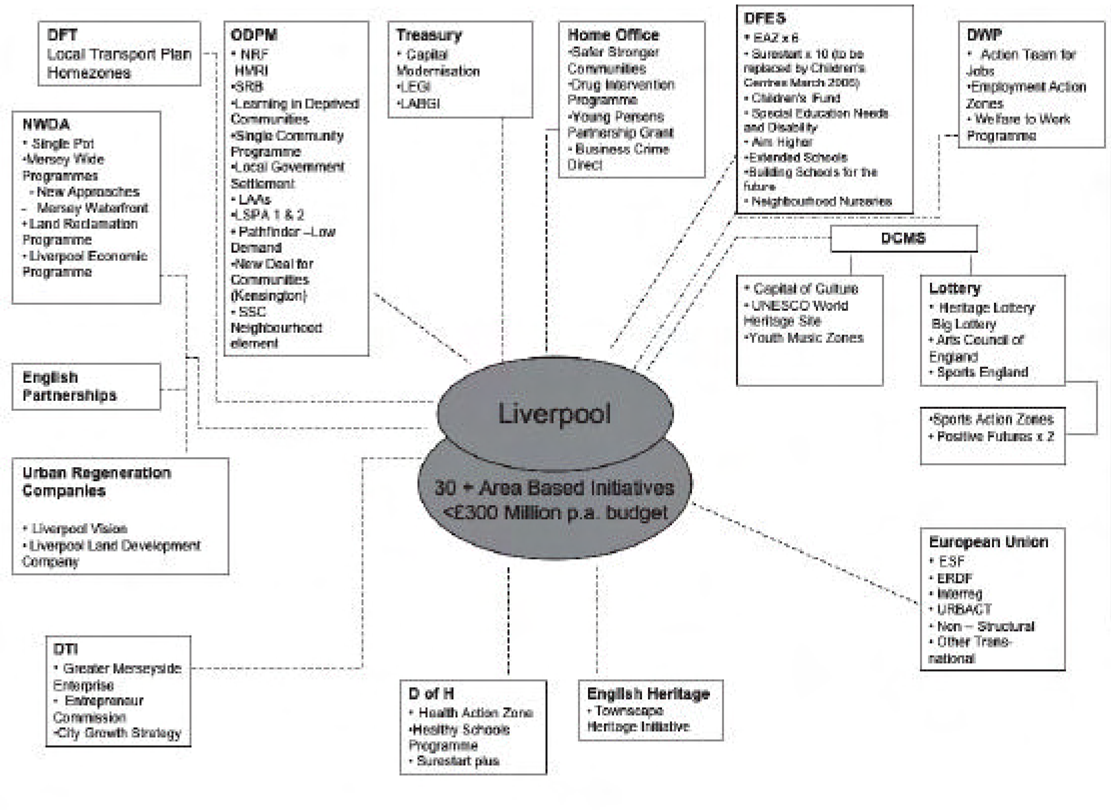
Faced by highly centralised and diversified funding sources, local government has sought to generate its own funding for hard and soft infrastructure via the planning system. There is widespread use of Section 106 Agreements in which developers fund infrastructure, such as roads or schools, that are related to the project for which they have obtained planning permission. Whilst Section 106 Agreements can bring community benefits as an infrastructure funding scheme they are subject to a number of weaknesses. First, development is highly dependent upon the economic cycle. Second, infrastructure funding is driven by private sector development proposals. Third, it is very difficult to achieve long-term and integrated infrastructure development. Fourth, the geographically variable nature of development means that parts of the country that are unattractive to developers will find it difficult to promote infrastructure projects. As has been recognised this can create a further spiral of decline:

> An important consequence of this is that local authorities cannot raise substantial amounts of private capital needed for up-front or forward-funded investment in infrastructure. Without this forward funding, investment risk is significantly greater and private sector actors are less willing to take forward developments, particularly regeneration schemes in marginal areas (All Party Urban Development Group 2006).

According to critics of present funding arrangements an illustration of the difficulties that can be faced by urban councils in funding infrastructure is that of ‘Birmingham Gateway’ a £500 million public-private investment aimed at the redevelopment of the city’s New Street Train Station. The scheme, which would transform the principal access to Birmingham city centre, has received the endorsement of central government after years of lobbying from actors across the West Midlands. However this has not led to the resolution of long-standing funding issues. Of the £340m in public-sector funding required for the project to go ahead, a gap of £140m remains to be filled despite the station’s central position on the national rail network – and the efforts of Birmingham City Council, Advantage West Midlands (the regional development agency),and local private-sector stakeholders (All Party Group on Urban Development).

The diversity of funding opportunities available for one major city, Liverpool, is illustrated below.

Figure 9: Diversity of funding opportunities



Source: Marshall and Finch (2006)

6.3 Legal duties and sustainable development

One of the major lessons of the review that we have undertaken is that despite the plethora of tools, processes and indicators, the voluminous literature; and the rhetoric there is a sense that much remains to be achieved. To date, the expectations and aspirations of those promoting or practising the tools have to a large extent simply not been realised in the way that might have been expected. Change has been both longer term and more fitful. Part of the reason is that large, complex organisations, such as urban councils, have multiple goals and agendas. Sustainable development may be a corporate commitment but its fate is likely to wax and wane over time. It is for this reason that some have begun to explore the idea of using legal responsibilities to ensure that processes or responsibilities cannot move to the margins of decision making.

For example, in the EU there is a legal basis to EIA and SEA. In a Canadian study Hazel and Benevides (2000) explore voluntary and statutory SEA. They conclude that the law does matter. Compliance with the terms of SEA and the quality of the SEA was higher when there was a legal requirement. They suggest that "the impact of a law on government officials may inspire more respect, in part because of the greater public accountability and transparency, and thus the desire to see work well done" (Hazel/Benevides 2000, 65).

In the UK as part of a process of devolution in the late 1990s there has been further innovative thinking. One outcome of devolution was the creation of the Welsh Assembly Government. Wales has traditionally been a poor part of the UK and at a political level economic development interests had long been to the fore. Amongst environmentalists there were fears that devolution would see a further reinforcement of a traditional developmental agenda. However, environmentalists were able to combine with senior decision makers who were keen to promote institutional innovations as part of the devolution process and as a result the Assembly was given a responsibility to promote sustainable development that is unique for a legislative body in Britain and probably in the European Union. The responsibility is laid down in Section 121 of the Government of Wales Act 1998 (and subsequently updated Section 79 of the 2006 Act) and requires the Assembly:

- to make a scheme setting out how it proposes, in the exercise of its functions, to promote sustainable development;
- to keep the scheme under review and in the year following each ordinary election (after the first) to consider whether it should be remade or revised;
- not to delegate the function of making, remaking or revising the scheme;
- to publish the scheme when first made and whenever subsequently remade and, if the scheme is revised without being remade, to publish the revisions or the scheme as revised (as it considers appropriate);
- to consult such persons or bodies as it considers appropriate before making, remaking or revising the scheme;
- to publish an annual report of how its proposals as set out in the scheme were implemented in that year; and
- in the year following each ordinary election, to publish a report containing an assessment of how effective its proposals (as set out in the scheme and implemented) have been in promoting sustainable development.

There are three key elements of Section 121. The first is the statutorily binding nature of the obligation and the fact that the Assembly cannot delegate this function (the scheme has to be approved by the Assembly in plenary session). The second is the inclusive and open nature of the process of producing and maintaining the scheme. The third is that reporting on the Assembly Government's performance on sustainable development is to the Assembly. Section 121 makes no mention of reporting to, or of monitoring by, UK government of the Assembly's sustainability activities.

The sustainable development duty quickly became symbolic of a new politics in Wales and a source of pride to politicians and officials. Here is a classic example of legislation forcing change. The first Minister for the Environment in the Assembly Government commented in interview that:

The legal duty has helped us to mainstream sustainable development. If we look at the policies of the assembly it is apparent that section 121 has had a significant positive impact. Sustainable development is no longer seen as a fringe issue by Assembly officials or politicians but as a cornerstone of all our policies. I see my role as 'champion of sustainable development' as a particular opportunity … In reality I thought it would be much harder to mainstream sustainable development than has proved to be the case. We've been able to get the concept understood and accepted in a comparatively short time. In general, no one wants to be seen as against it, although it has to be said that things are going better in some areas – such as waste management – than in others. Transport continues to be a difficult issue, and we still need to do more to convince traditional thinkers in economic development that there are opportunities in 'greener' approaches. (in: Bishop/Mills 2002)

7 Indicators and methodologies in practice

In this chapter, we review indicators and methodologies for sustainability assessment that have been used in European cities. The chapter is based on a literature review on sustainability indicators and practices used by European cities for urban infrastructure and land use planning and a review of selected cities and their sustainability indicators and practices for urban infrastructure and land use planning. We first introduce the Sustainable Cities Index as an example for comparison across cities. We then turn to London as a case study. The third section discusses several applications of the Ecological Footprint., with Cardiff Council as a case study. Further sections review other indicators in use like the European Common Indicator (ECI). Apart from these most well-known indicators, we also found several examples of sustainable urban design indicators, sustainability indicators for assessing urban regeneration, and indicators specifically for urban infrastructure.

7.1 Comparing cities: the Sustainable Cities Index

In the UK an influential sustainable development charity, Forum for the Future, has in 2007 and 2008 undertaken a ranking exercise of Britain's 20 major cities. The ranking is based upon an evaluation of 13 social, environmental and economic indicators. The indicators are then grouped into themes: environmental performance, quality of life and future proofing (the readiness of cities for future challenges). The indicators show considerable similarity with those outlined above.

Forum for the Future explains the groupings and selection of indicators as follows (Forum for the Future 2008, p6):

> "Environmental impact basket
> This basket gives an indication of the cities' environmental performance through the inclusion of data on air and water quality, resource use and ecological footprint:
> - air quality – the annual mean of Nitrogen Oxides as NO2
> - river water quality – the percentage of rivers where biological and chemical quality was deemed to be good or fair
> - ecological footprint – the impact of services, food, housing,
> - transport and consumables on the environment
> - household waste collected per head.
>
> Quality of life basket
> The data in this basket aims to give an indication of what the city is like to live in and how it is performing on social sustainability:
> - life expectancy from birth
> - resident satisfaction with green space
> - resident satisfaction with local bus services
> - employment – the number of benefit claimants as a percentage of working age population
> - education – percentage of the working age population with NVQ2 or equivalent.
>
> Future-proofing basket

The indicators in this basket aim to reflect the preparedness of the city for the future and readiness to respond to the challenge of sustainability:
- local authority commitments on climate change – local authorities were given points based on three criteria
  - green business per capita
  - biodiversity – percentage of land deemed to favour biodiversity
  - recycling – per cent of household waste recycled or composted.”

Unfortunately the methodology for scoring the indicators is not publicly available.

Table 4: Overall sustainability ranking 2008 for top 10 UK cities

Rank	City
1	Bristol
2	Brighton and Hove
3	Plymouth
4	Newcastle
5	Cardiff
6	Edinburgh
7	Sheffield
8	Leicester
9	London
10 =	Bradford
10 =	Nottingham

The results from the Index have been quickly up and publicised by Council’s to bolster internal policies and to promote their achievements to external audiences. For example, for the 2007 winner, the local paper *The Argus* (20 October 2007) reported under the headline “Brighton and Hove is named most sustainable city in Britain”. The report noted that “The news has been welcomed in the city.” It continued by reporting that the Council leader said: "It's really good that council policy on this is actually translating into eco-friendly measures and that these have been recognised.” The city made good use of the award when promoting itself. For example, Brighton hosted the World Social Marketing Conference in late September 2008 and on the conference website in its Location pages noted “A recent report entitled ‘The Sustainable Cities Index’ written by Forum for the Future, a sustainable development charity, ranked Brighton and Hove as the number one sustainable city out of the UK’s largest 20 cities.” (http://www.tcp-events.co.uk/wsmc/location.html).

One year later, and the local newspaper for Bristol, Evening Post (November 9 2008) was proclaiming in its headline: ‘Bristol is Britain's greenest city’. The loss of its title to Bristol was regarded as newsworthy in Brighton. For instance, the website for Brighton Business, a business promotion body funded by local firms and the council reported that ‘Bristol displaces Brighton as the most sustainable city’. Brighton losing first place was not simply a matter of a dent to civic pride but a potential lost business opportunity as the city has done much to promote itself as providing ‘Sustainable Living by the Sea’.

7.2 Case study: London

Although London was rated as the 9th most sustainable city in Britain in 2008 (and 10th in 2007) by Forum for the Future in its Sustainable Cities Index, it is worth looking at the London indicators in more detail for three reasons. First, London is a genuine 'world city' with a global reach. Second, London aspires to be "an exemplary sustainable world city, the place where the world looks when it wants to how to develop a sustainable future" #(London Sustainable Development Commission 2005, p1). Sustainable development is now part of the profile that London wishes to present to its citizens and to the wider world. Third, the process by which indicators were produced and the audiences for the indicators provide messages that have a wider relevance. It is this latter issue that we will briefly review below.

The process of selecting the indicators to measure the sustainab ility of London was begun by drawing up a long list of over 100 indicators. London's citizens were then consulted on the validity of the indicators, and along with expert input, the list was shortened to 55. Interestingly, in London the indicators are known as Quality of Life Indicators, rather than sustainability indicators, since this has a more meaningful resonance for key stakeholders, such as the business community, citizens, and politicians who can all find sustainability too abstract to be meaningful. Along with the selection of indicators, thought has been given to who might be potential users of the indicators. Key groups that have been identified are: business, public sector, voluntary sector, and households and individuals (London Sustainable Development Commission 2004, 5). The full list of 55 indicators and their target audiences can be found in the table below.

Table 5: London Quality of Life Indicators (source: London Sustainable Development Commission 2004, 42)

Taking Responsibility	Developing Respect	Managing Resources	Getting Results
% turnout at London elections (H)	Unemployment variation by ethnic group (B, P, V)	Ecological footprint (P) Total quantity of household business waste (H, B), Carbon dioxide emissions (H, P, V, B)	Labour Force Participation (B, P)
% participation in formal volunteering (at least once in last 12 months) (V)	Child poverty, workless households with children (P, V)	Index of London bird species (P, V)	Business survival: number of new businesses still trading after 3 years (B)
Child care: day nursery place per 100 children (P, V)	Street crime. (P)	Air quality: total emissions of particulates PM_{10} (tonnes per year). (P)	Life expectancy at birth (years) (P)
Education i) Primary school value added measure ii) Secondary school attainment (P,V)	% respondents very or fairly satisfied with London/their neighbourhood (H)	Carbon efficiency of economic activity (B)	% households living in decent housing (P)
Sign up to Mayor's Green Procurement Code (B)	Travel to school: trips to and from school by main mode (H)	Volume of road traffic (B, P)	% of new housing output that is affordable (P, V)
Household recycling rates % (H)	Gender pay gap (B, V)	Changes to sites of importance for nature conservation (B, P, V)	Infant mortality rate (P)
% market share of Fair Trade products (B, P, V)	% London-based business undertaking Corporate Social Responsibility activities at local level (B)	River/canal water quality (P)	Number of confirmed TB cases per 1000 population (P)
% market share of organic food (B, P, V)	Economic activity rate for disabled persons (B)	Public transport and walking as % of all travel in London (B, P, H)	% of young people (18-24 yrs) in FT education or employment (P)
Share of renewables in energy market (B)	Noise pollution using WHO standards (P)	Emissions of greenhouse gases per capita (P)	Number of fuel-poor households (P, V)
% turnover in new products introduced in last 1/3/5 years (B)	Areas of deficiency in accessible wildlife areas (P, V)	Number of new Building Research Establishment eco-homes and new buildings with BREEAM rating as % all new build (B)	% children with easy access to formal and informal playspace (P, V)
Measure of income inequality (P)	Light pollution (P)	Total waste generated in London per unit of GVA (B)	Satisfaction with public transport (B, P)
% adults surveyed who feel they can influence decisions affecting their local areas (H)	Perception of community safety (H)	Energy consumption per unit GVA (B)	Accessibility to public transport (P)
% London population with access to internet (H)	Accidents for all street and road users per 1000 daytime population (P)	Total quantity of construction waste per unit GVA (B)	% children eating 5+ fruit and vegetables per day (H, V)
Water consumption per household (H)		Alternatively fuelled vehicles (P)	
Number of companies with Green Travel Plans (B)			

Key Audience: B: Business sector; P: Public sector; V: Voluntary sector; H: Households and individuals

Since 55 indicators would be too large a number to work with, the London Sustainable Development Commission, an arms length body that is designed to be a 'critical friend' to policy makers, has identified a short list of 20 headline indicators. Interpretation of the results produced an interesting mix of social, economic and environmental priority areas for action. Priorities emerged where indicators "either show that the London situation is not only worse than the UK, but is also worsening or figures portray a consistently poor performance:

- Electoral turnout
- Business survival
- Ecological footprint, particularly waste

- Labour force participation, particularly women
- Child poverty" (London Sustainable Development Commission 2004, 7)

To date, there is little evidence to show that London has been able to tackle these problems. London, though, is far from unique in identifying the importance of the sustainability agenda but confronting challenges when seeking to make major changes. We look at issues to do with mainstreaming sustainable development in organisations in relation to the Integration Tool and the Welsh Assembly Government and the Ecological Footprint in Cardiff Council. For now, though, it is important to examine why the monitoring data derived from sustainability indicators may not promote the change agenda that indicator proponents had hoped for.

7.3 Ecological Footprint in practice

7.3.1 Applications of EF

In the late 1990s, the Association of Finnish Local and Regional Authorities commissioned calculation of EF for a number of Finnish municipalities to explore and develop the methodology (Hakanen 1999). Another important exploration was the European Common Indicator Project launched by EUROCITIES in collaboration with Ambiente Italia (Lewan/Simmons 2001). In this context, a set of studies calculated the footprint for Turin (Italy), Navarre and Tudela in Spain, Stavanger in Norway, and several Dutch, Swedish and Finnish cities. A review found great variations in use of methodologies and data sources that made it difficult to compare results (Lewan/Simmons 2001, 11).

An early study on the EF of the city of Liverpool (Barrett/Scott *et al.* 2001), funded by the Northwest Development Agency, the City of Liverpool, the Environment Agency, Government Office for the North West, and United Utilities, found urban infrastructures at the top of priorities for action. The authors recommend the city be working particularly on its energy, domestic waste and water consumption.

The city of Oslo had their footprint being calculated to provide evidence for a municipal state of environment report and in the context of a Local Agenda 21 process (Aall/Norland 2002). Researchers from the University of Oslo developed a tailor-made approach for the city, opting for "a bottom-up approach, where the footprint is calculated on the basis of available local data." Where such data were lacking, national per capita data were adjusted to Oslo levels. With regard to infrastructure planning, the authors suggest to use the EF to compare building construction alternatives or the use of alternative energy sources (Aall/Norland 2002, 34f).

Following publication of the first monograph in German on the ecological footprint, the concept was widely taken tom compare the sustainability of Germany, Austria and Switzerland with other nations, mostly using the WWF data. The concept is widely used for consciousness building and many cities offer EF calculators on their websites to motivate citizens to calculate their individual EF. These efforts are matched by campaigns by environmental groups, e.g. the youth branch of the BUND, the German branch of Friends of the Earth (http://www.latschlatsch.de/). The EF concept is also used to calculate the impact of some products. But we found only a few studies on the EF of cities and even less evidence of them being used in planning and decision-making.

In *Berlin* the Inquiry Commission "Sustainable Berlin/Agenda 21" of the State and City Parliament (Abgeordnetenhaus) commissioned a study on the city's ecological footprint (4.9 ha per inhabitant), based on data for 1998 and including a comparison with *Hamburg*. The study was published in 2001 (Schnauss 2001).

An ecosystem-based energy and carbon balance of the City of *Krems* (Lower Austria), carried out for the state government of Lower Austria, also included the ecological footprint which was 25 times the real area of the city (Gruber-Köllersberger/Maier *et al.* 2003, 186).

In *Vienna* the Environmental Protection Unit (Umweltschutzabteilung, MA 22) of the City Council commissioned a study on Vienna's ecological footprint, which was 3.9 ha per inhabitant (Daxbeck/Kisliakova *et al.* 2001, Daxbeck/Kisliakova *et al.* 2002). Consequently the city launched a number of programmes with a view to reduce their ecological footpring by 55 percent, including a climate change programme, the ecobusiness plan Vienna, the EcoBuy Vienna programme on public procurement, an environmental management programme, waste prevention and minimization and organic farming (City of Vienna Webservice 2009). Based on the footprint, the city in their strategic plan announced to introduce a resource management plan and commissioned a study on Vienna's "urban metabolism", resulting in material accounting of the city's material flows (Obernosterer/Reiner *et al.* 2003).

7.3.2 Case study: Cardiff Council and the Ecological Footprint

In one of the very few studies of the influence of the EF on policy outcomes Cowell et al (forthcoming) (and on which this section draws) provide an in-depth analysis of the fortunes of the Footprint in Cardiff Council. A key variable affecting the fate of EF measures is the extent to which proponents secure the commitment of key, corporate decision-makers and technicians. As Collins and Flynn (2007) observed, where an analysis of the EF of a local authority was parachuted in from an external consultancy, or from the 'green ghetto' (Young 1996) of the council's sustainability office, the results generally proved unpersuasive, as unsympathetic and mistrustful officers picked apart the methodology and challenged data anomalies. In Cardiff, the Sustainable Development Unit (SDU), which had lead responsibility for implementing the Footprint made every effort to ensure that it would be mainstreamed across the Council's activities.

The initial decision to embrace the EF was made in 2000 and it was regarded as a device to bolster the Council's emerging Sustainability Strategy. Incorporating the EF into the sustainability strategy proved to be a vital step, even though initially officers had no capacity to actually measure the city's footprint, as it led to Cardiff Council being drawn into wider networks. As Cardiff was the only Welsh local authority at that time to have considered the EF, they were approached informally by WWF Cymru in 2001 about the prospect of participating in a new study. SDU officers were keen to participate, and saw the work as a way of raising the profile of their unit within a strongly pro-development authority (Hooper/Punter 2006); but effective participation meant aligning a wider array of actors around the study, not least to secure the council's matched funding. Officers presented to the Cabinet a case for the Council's participation in the study, and received a positive response with no resistance: "I went to see the deputy leader to talk her through it. She said fine, seems very sensible; exciting piece of work – you have got my authority to involve the sustainability advocates and to work across chief officers and directorates" (anonymous interview with a member of staff in the Sustainable Development Unit in Cardiff Council, Interview SDU 2006).

At this stage, processes of securing institutional support proved mutually reinforcing. Being able to represent the WWF Cymru study as "a high-profile, corporate project that the council is committed to" (Interview SDU 2006) legitimised officers from the SDU in soliciting the involvement of other departments, and securing greater access to senior officers than they had previously enjoyed. It helped also that SDU officers were supported by their Senior Director – "the footprint is one of [his] favourite babies" (Interview SDU 2006). This in turn assisted in getting the EF written into the Council's Policy Action Plan, a key corporate document.

Having ensured that the Footprint was embedded in the Council's corporate strategy, SDU officers then organised numerous meetings and seminars at which staff could learn about, and question, the EF. Staff were also enlisted to provide data to the EF project. This had the twin benefit of providing more robust data and ensuring that across the Council there was buy-in to the project. The EF was not perceived as something to do with the environment or the preserve of the SDU but as a Council-wide initiative.

Undoubtedly, the initial institutionalisation of EF measures depended greatly on the skilful and assiduous deployment of organisational knowledge by SDU officers. Their engagement of senior politicians and officers increased the likelihood that the results of the EF study, when they emerged, would become positive features, on which commitment to action might be based. The reality, though, proved much more complex.

When Cardiff's initial EF results were released at a series of internal workshops and scrutiny meetings during 2004, SDU officers realised quickly that it was "not a good news story" for the Council's dominant development agendas. The results highlight that in 2001 Cardiff residents had a higher EF (5.59 gha per capita) than the Wales (5.25 gha/cap) or UK average (5.35 gha/cap) (Barrett/Birch *et al.* 2005); moreover, in almost all sectors, Cardiff's EF was increasing. That the EF seems to increase with income (Wiedmann/Minx *et al.* 2006) challenged comfy win-win conceptions of sustainable development. This was evident in issues such as waste, where Cardiff's waste footprint per capita was found to be 17% larger than that for Wales and the UK. This difference has been attributed to the city's relative prosperity but also the increase in executive and single occupancy dwellings, which have proliferated through the Council's regeneration strategies, whose occupants tend to have higher levels of disposable income and therefore consume more (Collins/Flynn 2005). These were all troubling results for a council committed to boosterist discourses of international competitiveness (Hooper/Punter 2006).

Sustaining support for the EF across the Council came to depend on how the results, the model, and any consequences were represented. Rather than suggesting that business-as-usual was implicated in environmental crises, SDU officers stressed the importance of presenting the EF results in ways that were 'non-threatening'. So, in meetings with other officers and in more open council debates, the managerial value of the EF was emphasised, rather than its implications for policy goals. As a result, between 2002 and 2007 advocates of the EF were able to ensure that commitments to it became embedded in a series of corporate documents.

Support for the EF in key Council policy documents was not, however, being translated into pressures for policy change. Whilst many staff were sympathetic to the EF, officers believed it had little relevance for them. There is little evidence to suggest that officers were using EF data to provide evidence in policy debates. Departmental managers saw commitments to 'measure and use' the EF as symbolic, rather than obligatory, and insufficient to displace attention from those key performance indicators or financial constraints which actually fettered day-to-day decisions.

The SDU have not found it easy to provide either a strategic level input to the Council or more tactical guidance and support for middle managers. In practical terms, the prospects of extending the agency for EF across the council became dependent on a technology – the REAP (Resource and Energy Analysis Programme), a computer-based programme. REAP was developed in 2005/6 by the Stockholm Environment Institute to enable the comparison of the sustainability consequences of policy choices. SDU staff have put a lot of work into making REAP work but feel that it has yielded little. According to one member of staff 'REAP is not viable. The input does not give the appropriate amount of output.' For staff this is particularly frustrating as they had wished to show the benefits of REAP to their 'host' department land use planning. At present, the department is revising the Council's land use plan and SDU staff sought to use REAP to inform transport and housing issues. According to SDU staff: 'REAP did not say anything that was not commonsense. The Ecological Footprint increases if housing is located away from a transport hub. REAP data is simply too coarse.' Disillusionment with REAP is spreading to the EF more generally and now SDU staff are putting more effort into ensuring that the land use plan is developed in compliance with SEA rules.

7.4 Other indicators in practice

7.4.1 European Common Indicator (ECI)

The **European Common Indicator (ECI) set** for assessing local sustainability was initiated by the European Commission and the European Environmental Agency in 1999 and sponsored by the European Commission. It comprises ten indicators (Ambiente Italia

2003): Citizens' satisfaction with the local community, Local contribution to global climate change, Local mobility and passenger transportation, Availability of local public open areas and services, Quality of the air, Children's journeys to and from school, Sustainable management of the local authority and local enterprises, Noise pollution, Sustainable land use, Products promoting sustainability. Ten cities participated in the ECI Initiative:

- Bristol (United Kingdom),
- Oslo (Norway),
- Stockholm (Sweden),
- Diputación Foral de Bizkaia, Zaragoza, Vitoria-Gasteiz, Barcelona (Spain),
- Ferrara (Italy),
- Tampere (Finland),
- Gdansk (Poland).

A survey found that participating city representatives, when asked for the usefulness of the indicator set, ranked prioritisation ("offering a rational basis for sustainability priorities in the decision-making and process") and policy integration ("supporting the integration of sustainability issues with other policy priorities") higher than communicative purposes (Ambiente Italia 2003, 138). Oslo was particularly noted with regard to tangible outputs. In the Norwegian capital indicator 4 helped to identify "missing structures in relation to services and specifically the public transport system" (ibid, 142). The Waste Agency mapped gaps in the network of recycling points. Indicator 7 helped to put environmental management systems on the agenda.

In Stockholm, the relatively detailed ECI set was mainly driven to inform administrators while a simpler set of indicators was used for communication purposes in the wider LA 21 process and an even more specific set of indicators for management purposes (Eckerberg/Mineur 2003, 605).

7.4.2 Material Flow Analysis

Material flow analysis (MFA) focuses on the efficiency of resource usage, measured as urban metabolic efficiency. It was applied as part of a pilot study on Tipperary Town, Ireland (Browne/O'Regan *et al.* 2005).

The integrated sustainable cities assessment method (ISCAM) simulates alternative scenarios and calculates the divergence of current or business as usual (BAU) trends from more sustainable scenarios. It "can be applied to the built environment, travel and transport, land and ecology, waste and economy, each of which may be measured by specific key indicators. An important aspect of indicator selection in an integrated assessment (IA) framework is that they are cross-sectoral and indicate horizontal and vertical effects." (Browne/O'Regan *et al.* 2005, 49). ISCAM was also applied to Tipperary Town, Ireland (Browne/O'Regan *et al.* 2005).

7.4.3 Urban regeneration

Different sets of sustainability indicators have been used to assess the outcome of urban regeneration. These encompass for example several indicators for economy and work, resource use, buildings and land use, transport and mobility and benefits to the community (Hemphill/Berry *et al.* 2004a, Hemphill/McGreal *et al.* 2002). The set has been deployed to compare Belfast, Dublin and Barcelona (Hemphill/Berry *et al.* 2004b).

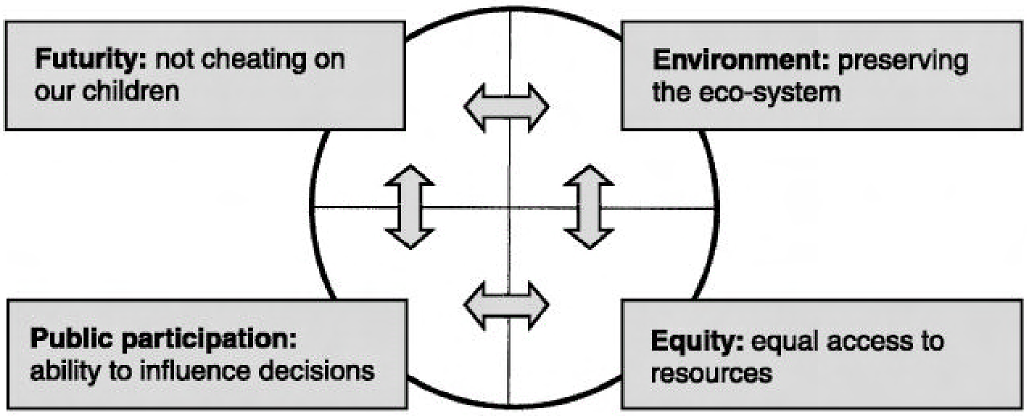
7.4.4 Example for Urban Design Indicators: SEEDA checklist

"The South East England Development Agency (SEEDA) (<www.sustainability-checklist.co.uk>) is an example of a web-based checklist tool for local authorities, landowners and developers to use when planning or building large developments, from estates to urban villages and regeneration projects. The checklist aims to help users identify good practice for their development by considering positive measures that can be taken to reduce environmental impacts and enhance social and economic benefits. The key issues are presented under ten headings that 'represent the underlying principles of sustainability': outward focus—impact on the wider community; land use, urban form and design; transport; energy; buildings; infrastructure; natural resources; ecology; community; and business. Performance indicators enable users to identify what needs to be done to achieve 'good' practice and 'best' practice and also use scores to help them understand how close they are to achieving best practice." (Frame/Vale 2006, 297)

7.4.5 Example: Sustainable Urban Design Framework BEQUEST

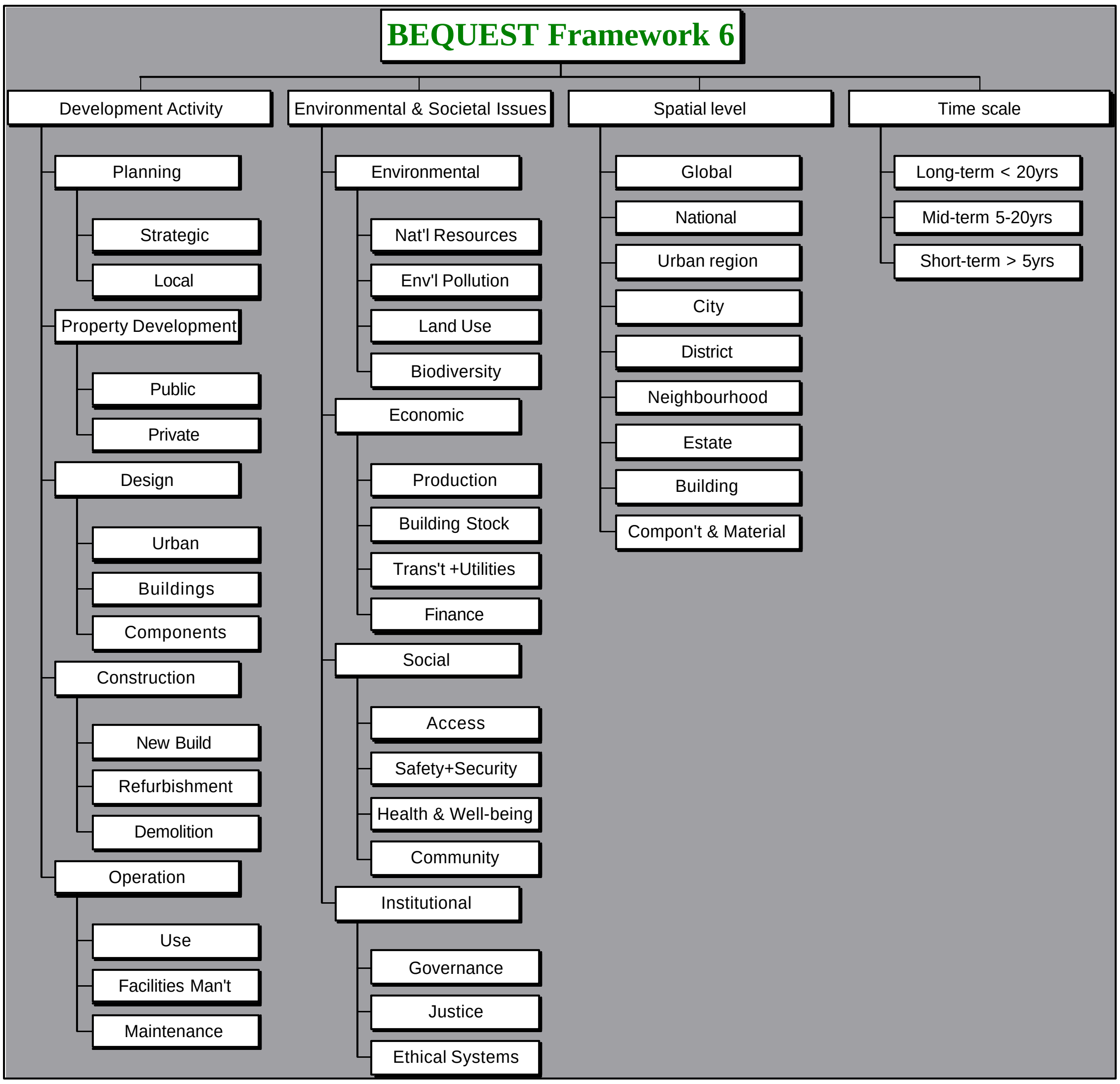
The international network **BEQUEST** (Building Environmental Quality Evaluation for Sustainability through Time), funded 1998-2001 by the European Commission, developed a framework for structuring information on Sustainable Urban Development that "links together socio-economic and technical dimensions as well as planning, property, design and construction interests, in time and space" (Bentivegna/Curwell *et al.* 2002, 83). The framework is based on the PICABUE model of sustainable development (**Error! Reference source not found.**).

Figure 10: PICABUE model of sustainable development (source: Bentivegna/Curwell *et al*. 2002, 87)



The BEQUEST model builds on the assumption that Sustainable Urban Development takes place in the context of an existing urban fabric and is therefore best perceived as a "relative, adaptive process" (Bentivegna/Curwell *et al.* 2002, 92). It integrates all stages of planning and development, a broad range of economic, ecological and social issues, as well as various spatial and time scales (see **Error! Reference source not found.**). The authors identify a number of "impediments to implementation of the vision and method […], including lack of demand, lack of capacity, absence of agreed targets and indicators together with other policy problems undermining full sustainability assessment and evaluation of urban re/development proposals" (Bentivegna/Curwell *et al.* 2002, 83). Uptake of the model seems slow. A recent article by one of the co-creators states that "the full potential of the *BEQUEST Framework* (and Toolkit) is still being investigated" (Curwell 2008).

Figure 11: BEQUEST framework for Sustainable Urban Development (source: Bentivegna/Curwell et al. 2002, 91)



7.5 Infrastructure specific assessments

When it comes more specifically to infrastructure planning, the literature is dominated by calls for more complex measures to assess their sustainability. Recent developments in indicators for urban water management and infrastructure are manifold and can only be touched upon here.

7.5.1 Water infrastructure

For the **management of urban water systems** a detailed understanding of their short- and long-term behaviour "appears absolutely necessary to evaluate indicators and criteria used in various methodologies aiming at assessing sustainability" (J. L. Bertrand-Krajewski/Barraud *et al.* 2000, 323). However, there are "methodological problems associated with modeling, decision-making tools, definition of objectives, metrology, and multidisciplinarity" (ibid.). The approach was further developed in Lyon, France, in the context of the Water Framework Directive (J.-L. Bertrand-Krajewski/Becouze *et al.* 2008).

In the context of the EU Water Framework Directive, assessing sustainability "is affected by numerous conflicting interests" (Brunner/Starkl 2004, 441). Since the legal framework now requires both stakeholder involvement and evidence based decision-making, the question is whether the plethora of fragmented indicators can be integrated "into one common indicator of the overall sustainability by means of a codified multi-criteria decision support methodology (DSM). Practitioners in urban water management, however, usually object to the use of a codified DSM, as in the legal context (negotiations between the stakeholders, tendering procedure) it might jeopardize the feasibility of the decision making process" (Brunner/Starkl 2004, 441). An encompassing approach would require integrating the choice of the decision support methodology into the cooperative process (ibid).

Sweden has launched a national research program on 'Sustainable Urban Water Management' (1999-2005). For example, one of the projects developed a set of eight indicators for urban water and wastewater systems, based on systems analysis (Hellström/Jeppsson *et al.* 2000, 319):

A. Health and hygiene criterion
1. Risk for infection: Microbial risk assessment

B. Social and cultural criterion

2. Acceptance: Action research and assessment scales

C. Environmental criteria

3. Eutrophication Life-cycle assessment, computer-based
4. Spreading of toxic compounds to water modeling, material-flow analysis, and
5. Spreading of toxic compounds to arable soil exergy analysis
6. Use of natural resources

D. Economic criterion

7. Total cost: Cost-benefit analysis

E. Functional and technical criterion

8. Robustness

Parts of this framework have been applied to communities in Sweden, albeit with a focus on environmental assessment. The choice of technology depends on the prioritization of the multiple criteria (Hellström 2008).

In **Austria**, the Federal Government commissioned the development of **guidelines for funding for urban water infrastructure** to "increase the transparency of the planning process, ensure the adequate treatment of ecological problems, and foster stakeholder involvement, but keep the process as simple as possible, and require minimal changes of the current guidelines" (Starkl/Brunner *et al.* 2009). The proposed guidelines were tested in two case studies with ca. ten villages each in two different provinces. Based on these experiences, new technical guidelines were issued (Technical Guidelines 2006).

An environmental sustainability based budget allocation system for regional water quality management was developed by Kao and colleagues and piloted in Taiwan (Kao/Pan *et al.* 2009).

7.5.2 Transport

For **transport planning** Black/Paez *et al.* (2002) suggest "drawing on hierarchical diagrams from decision theory" in order to "show the link between higher-level policy objectives for sustainability and lower-order actions, measurable attributes, and performance indicators." This however, requires a complicated analytical framework that "includes descriptive statistics, exploratory and graphical methods, spatial mapping, spatial statistics (to identify geographical patterns and to identify outliers in the data), regression analysis, travel preference functions based on Stouffer's intervening opportunity model, and linear programming" (Black/Paez *et al.* 2002). The model has been applied to Sydney, Australia, but notions about policy and planning uptake remain vague.

7.5.3 Waste

In **waste management**, life cycle assessment tools have been developed to help cities and regions developing integrated waste management strategies. Again, informed decision-making requires multiple methods, including for example a municipal waste prognostic tool and a waste management system assessment tool which must also include several subsystems like temporary storage collection, transport and treatment, disposal and recycling (den Boer/den Boer *et al.* 2007). As Winkler and Bilitewski (2007) suggest, research organisations, industry associations and governmental institutions have now developed various life cycle assessment models for solid waste management. A comparative study modelled on the waste management system of Dresden, Germany revealed not only "variations in the results [but also] differences in the conclusions" (Winkler/Bilitewski 2007, 1021). In other words: Infrastructure decisions are sensitive to the assessment methods and models informing them.

7.6 Conclusions: Purposes in practice

The assessment of practical experiences highlights that the usefulness of different indicators for different purposes is debated. Early in the debate, Brugman (1997) found, based on case studies of Santa Monica, Cal. and Seattle, Wash., that sustainability indicators are "ideally suited for performance measurement", but he warns that "indicators are a sub-optimal tool for technical assessment and even public education".

A guidance on EF for local authorities, sponsored by WWF UK, when discussing benefits and applications, also accentuates recognition of trends, comparison and benchmarking, but also its usefulness for public procurement and as a "strategic institutional management tool" that, combining EF with scenario analysis, allows comparison of environmental impacts and eco-efficiency of investments across sectors (Bond 2002, 16f). As Eckerberg and Mineur in their study on Sweden state:

> "local sustainability indicators indeed play very different roles. Inspired by various systems developed at international and national level, they can be used as a tool for communication, for monitoring and evaluation, for comparison across time or space—or with other municipalities nationally or internationally, for follow-up of internal work, or as a way to identify problems and assess performance more widely within the local territory." (Eckerberg/Mineur 2003, 609)

The reason for this is the political functions of sustainability indicators: "The profile of the indicator systems may shape local sustainability policies, since they can both operationalise and define sustainable development. Those dimensions that are not measured will most likely not be discussed" (Eckerberg/Mineur 2003, 609)

If introduced and monitored thoroughly, sustainability indicator systems would trigger major changes in the perception of problems and policies. This explains while they are taken up only hesitantly and if there is an actor coalition in favour. As Starkl and colleagues found in the case of water management in Austria, "a general observation about the policy-making process was a conservative attitude of policy-makers. They prefer simple constraints (precautionary principle) and flexible negotiations (delegation) to complex assessment and decision-aid methodologies." (Starkl/Brunner *et al.* 2009, 1030)

This experience reproduces the trade-off between detailed indicator systems favoured for purposes of assessment and monitoring and more general and aggregate indicators favoured by policy-makers and for public communication.

When it comes to urban infrastructure planning, sustainability indicators or indicator systems are used in some cities, but they are not widely deployed. Where they are used they mainly serve purposes of strategic planning like identifying trends or priorities, as Table 6 shows.

Table 6: Indicators and methodologies in practice – selected cases

City	Indicator (source)	Approach	Context	link to infrastructure planning
Liverpool	EF (Barrett/Scott *et al*. 2001)	Expert-driven	Pilot study	Identified environmental priorities; Co-sponsors
Oslo	EF (Aall/Norland 2002)	Experts; available local data	Agenda 21 Environmental Reporting	compare building construction alternatives or the use of alternative energy sources (suggested)
Oslo	ECI set (Ambiente Italia 2003)	Experts; available local data	Agenda 21 Environmental Reporting	Helped identifying gaps in public transport and recycling infrastructure and improving environmental management
Tipperary Town, Ireland	material flow analysis (MFA) and integrated sustainable cities assessment method (ISCAM) (Browne/O'Regan *et al*. 2005)	high data requirements, need for proxy analysis and disaggregation, difficult collation of settlement-specific data	Research project	Identified trends and needs for housing, waste and transport
Palermo, Italy	Dashboard of Sustainability (Beccali/Federico *et al*. 2007)		assessment of waste management systems	Within SEA framework
No reference cases found	BEQUEST framework for Sustainable Urban Design (Bentivegna/Curwell *et al*. 2002, Curwell 2008)	benchmark the current situation, identify a range of possible best practice policy and physical development options and select the optimum for the situation under consideration	Urban design	City planning

8 Processes and tools in practice

In this chapter, we review which processes and tools are used to contribute to decision-making on urban infrastructure and land use planning. We first give some examples how sustainability indicators or indicator sets are linked into planning processes and tools. We then discuss three case studies in more detail: sustainability appraisal and land use planning in the City of Newport, the linking of sustainability appraisal and SEA in Cardiff, and the use of the Integration Tool for SEA by the Welsh Assembly.

8.1 Linking Sustainability Indicator sets to other planning processes

We have found several examples how sustainability indicators are linked to other planning processes.

In the Italian province of Trento, several sustainability indicators were used as part of the Strategic Environmental Assessment (Diamantini/Geneletti 2003) for the regional plan (Diamantini/Zanon 2000). In the first phase, a set of pressure-state-response indicators based on the OECD system was developed that encompassed more than 130 indicators. The overall sustainability of the province was assessed by using more integrative indicators like EF and environmental space; finally, goals were defined and corresponding performance indicators derived (Diamantini/Zanon 2000, 306-=308).

In Sweden, the use of sustainability indicator systems has been shaped by the widespread adoption of environmental management systems (EMS), especially EMAS and ISO 14000 (Eckerberg/Mineur 2003).

To foster LA 21 processes, the Swedish Association of Local Authorities (SALA) has developed a set of 25 indicators that can be used to compare different municipalities (Eckerberg/Mineur 2003, 598).

Example: ‘Stockholm Environmental Programme—on the way to a sustainable development’.

“This comprehensive programme aims to guide local environmental work for a period of five years (2002–2006). The focus in the programme is on local environmental protection policies that through six broad headings are linked to the 15 NEQOs. The headings are: environmentally effective **transport**, safe goods, sustainable **energy** use, ecological planning, environmentally effective **waste** management and sound indoor environment. The six different themes in the programme each have a number of indicators related to them that in turn are linked to the Driving—Pressure—State—Impact—Response model (DPSIR). The DPSIR model is a framework describing the causal chain of actions of environmental problems and thus legitimates the developed indicators. It was adopted by the European Environmental Agency as an extension of the PSR (Pressure State-Response) model developed by the OECD.”(Eckerberg/Mineur 2003, 603)

In the following sections, we discuss the use of sustainability indicators in planning processes in more detail.

8.2 Case study: Sustainability appraisal and land use planning in the City of Newport

Newport City Council is a relatively poor area in South Wales. It is outperformed by two much larger nearby cities, Cardiff to the West and Bristol to the east. The city has long suffered from economic decline and an inability to attract inward investment. The Council's land use plans have been intended to help promote economic growth and have tended to marginalise environmental issues. However, the Council quickly embraced the sustainability agenda promoted by the Welsh Assembly Government and could not ignore the requirements of the SEA Directive. Partly because it lacked the internal expertise and partly because it wished the analysis to be seen to be independent the council employed a team of consultants to undertake the appraisal.

8.2.1 The approach

The sustainability appraisal required a number of steps to be undertaken.

The first stage in the appraisal was to explore the local vision for 'sustainable development' in Newport, through a review of key national and local documents and strategies. These included:

- EU commitments to sustainable development and those developed by the UK Government
- National perspectives developed by the Welsh Assembly Government and
- the Newport City Council vision of sustainable development.

The outcome of the review was a set of appraisal criteria linked to the four broad themes of sustainable development for the UK

- Social progress that meets the needs of everyone;
- Effective protection of the environment;
- Prudent use and conservation of natural resources;
- Maintenance of high and stable levels of economic growth.

These were then combined with the objectives for sustainable development in Wales in the Sustainable Development Scheme for Wales.

From this work detailed sustainability objectives were developed, which form the basis of the appraisal criteria, grouped under the four broad themes of sustainability. Where possible the sustainability objectives were disaggregated into discrete themes to allow for easier monitoring of the Plan. A key issue to emerge from the review was the importance of regeneration in Newport, which does not figure very highly in the national documents. The local economy has been badly affected by long-term structural change and by the recent job losses, and regeneration of the economy, the town centre and derelict sites is an important local imperative.

The second stage of the appraisal was to assess the aims and objectives of the plan and each policy against the appraisal criteria. A matrix based assessment was used with a five point appraisal scale, with detailed notes to elaborate the appraisal of each policy.

The third stage of work was to undertake the Policy and Proposals Impact Matrices, with a detailed appraisal of each policy according to the sustainability objectives derived from the review. An example of how this relates to a key urban development issue – new housing sites is given below.

Table 7: Sustainability appraisal as part of Newport's SEA

Impacts

Very positive	::
Positive	:
Neutral	
Negative	–
Very negative	– –
Variable/unknown	?

Sustainability Appraisal Criteria

		Maintenance of high and stable levels of economic growth						Prudent use and conservation of natural resources											Effective protection of the environment						Social progress that meets the needs of everyone			
		Recognition of potential impact of plan policies beyond Newport's boundaries	Consultation and community engagement	Encouraging local economic development to support Newport's economy	Ensuring an adequate supply of land to meet employment needs	Promoting regeneration of brownfield sites	Promoting central area regeneration	Encouraging energy efficiency in building construction and use	Encouraging walking and cycling	Promoting attractive and viable alternatives to car transport	Promoting integrated, efficient and environmentally friendly transport	Constraining overall traffic growth	**Minimising adverse waste impacts**	Minimising water consumption and promoting Sustainable Drainage Systems	Protecting air, water, soils and minerals	Prudent use of greenfield land	**Ensuring strategic sites contribute to regeneration objectives**	Making efficient use of previously developed land or buildings	Enhancing poor or degraded environments	Protecting and enhancing biodiversity of habitats and species	Conserving Newport's landscape, countryside and open spaces	Promoting community health and safety	Conserving the character of Newport's historic buildings and protecting archaeological heritage	Conserving Newport's built environment & townscape	**Protecting Welsh cultural heritage and traditions**	Enabling access to open space and countryside for Newport's communities	Improving access to services & amenities for Newport's communities	Ensuring an adequate supply of land to meet housing needs
H1(8) **603**	Transton Rd																											:
H1(26) **949**	Bideford Road (Phase 3)					:												:	:									:
H1(43) **1013**	South of Percoed Reen, Duffryn														–	–		–			–							:
H1(44) **1014**	Monmouthshire Bank Sidings, Maesglas					:	:		:									:	:									:
H1 (45) **1015**	Crindau (1015)					:	:											:	:									:
H1(46) **1016**	St Cadoc's Hospital					:				:								:								:		:
H1(47) **1017**	Herbert Road					:	:											:	:									:
H1(50) **1141**	Whitehead Works, Cardiff Road					:	:		:									:	:									:
H1(51) **1142**	Former Pirelli Works, Corporation Road					:	:		:									:	:									:
H1(52) **1143**	Site of St Joseph's, Tredegar House					:												:										:
H1(53) **1144**	Former Llanwern Steelworks			:		:										:		:	:									:
H1(54) **1145**	Expansion Area, North of Steelworks												–		–	–		–			–					–		:

Notes & Comments

The 12 sites included in this assessment are the Deposit UDP Housing Sites identified in the report on *Housing Land Availability, January 2003*. The sites are marked on the Newport City Council Housing Land Availability Maps, *January 2003* that accompanied the study, in orange. These are the new sites allocated in the Deposit UDP and its Proposed Changes. The other sites in the "Housing Land Availability" report include those with current or lapsed planning permission, subject to a S.106 agreement, under construction, allocated in the Adopted Usk Riverfront Local Plan, or Pre-Fab replacement or regeneration schemes. These sites were not assessed as they were considered to be committed for the purposes of this assessment. Numbers in **bold** are the Site Reference numbers.

Objective - Housing: *"To ensure that there is an adequate supply of land for housing, bearing in mind the principles of sustainability and the need to create of maintain viable communities."*
The objective is fundamental in ensuring the broad sustainability objective of social progress that meets the needs of everyone.

H1(8) - 603, Traston Road: Land off Traston Road is a 0.90 ha greenfield site with full permission for 27 units. Although undeveloped, it lies between existing housing and Spytty Park Leisure Centre in Liswerry. Provided that there is no significant loss of habitats or biodiversity, its allocation is broadly consistent with sustainability objectives.

H1(26) - 949, Bideford Road, Phase 3: 1.08 ha brownfield site with capacity for 35 units. This small site lies between existing housing and the railway land, and supports the sustainability objectives of making efficient use of previously developed sites, promoting central area regeneration and regeneration of brownfield sites.

H1(48) - 1013, South of Pencoed Reen, Duffryn: 19.43 ha greenfield site with capacity for 480 dwellings. The site will form an extension to the Little Pencarn/Duffryn housing sites, between the Celtic Horizon housing, now under construction, and the mainline railway. It lies adjacent to an established housing and employment area. The site has been proposed for development for some years and falls within the Duffryn Phase 3 Master Plan. Although quite well related to employment facilities, the site not very accessible to Newport City Centre and local facilities. The supporting text states that, "The Master Plan indicates that the land can be brought forward in a sustainable way." Minimum net densities should be specified in the Plan.

H1(44) - 1014, Monmouthshire Bank Sidings, Maesglas: 11.30 ha brownfield site with capacity for 450 dwellings. Full permission granted with conditions. This large site is in the ownership of Railtrack, and most of it has remained unused for many years, although 6ha to the south is still operational land. Together with the adjacent Whitehead Works the sites provides potential for a major brownfield development close to Newport City Centre. Its allocation strongly supports the sustainability objectives of making efficient use of previously developed sites, promoting central area regeneration and regeneration of brownfield sites.

H1(45) - 1015, Crindau: 7.11 ha brownfield site with capacity for 250 units. Outline permission granted with conditions. The Newport Development Board Strategy for Crindau sought the creation of a prestigious waterside development, with realignment of Lyne Road and navigable use of Crindau Pill as principal components for regeneration of the area. The site is adjacent to an allocated site in the Adopted Usk Riverfront Local Plan, and is within 1 km of Newport City Centre. The allocation strongly supports the sustainability objectives of regenerating central areas and brownfield sites, and making best use of previously developed land.

H1(46) - 1016, St Cadoc's Hospital: Part of the hospital site at Caerleon is likely to be released. The supporting text in the Plan indicates the following land uses: leisure & recreation - 5ha; housing - 8ha; Health Trust - 4 ha; rail station - 1 ha. The report on *Housing Land Availability, January 2003* suggests a housing area of 5.20 ha with capacity for 250 units, for which applications have been submitted. This brownfield site is within and well-related to the existing urban area of Caerleon. Its allocation thus supports the sustainability objectives of making efficient use of previously developed sites, promoting brownfield site regeneration and alternatives to car transport.

H1(47) - 1017, Herbert Road: 2.02 ha brownfield site with capacity for 50 units. The site is adjacent to the Glebelands site allocated in the Adopted Usk Riverfront Local Plan, and is within the Newport Development Board area. Although it is within 1km of Newport City Centre, its location on the east bank of the River Usk means that access on foot is via busy road bridges and is not particularly attractive. Its allocation strongly supports the sustainability objectives of making efficient use of previously developed sites, promoting central area regeneration and regeneration of brownfield sites. Minimum net densities should be specified.

H1(50) - 1141, Whitehead Works: 18.62 ha brownfield site with capacity for 400 units. Closure of the Whitehead steelworks between Cardiff Road and Docks Way provides a large brownfield site, within the existing urban area and within 1 km of Newport City Centre, and its development can be linked to that of the Monmouthshire Bank sidings. Its allocation thus strongly supports the sustainability objectives of making efficient use of previously developed sites, promoting central area regeneration and regeneration of brownfield sites. Minimum net densities should be specified.

H1(51) - 1142, Former Pirelli Works, Corporation Road: 10.50 ha brownfield site with capacity for 200 units. Closure of the former cableworks has created a large development site east of the River Usk, within walking distance of Newport City Centre. Its allocation thus strongly supports the sustainability objectives of making efficient use of previously developed sites, promoting central area regeneration and regeneration of brownfield sites. Minimum net densities should be specified.

H1(52) - 1143, Site of St Joseph's School, Tredegar House: 3.68 ha site in the Marshfield ward with capacity for 100 units. The provision of a new Roman Catholic Comprehensive School in Duffryn will lead to vacation of this site. The site is close to employment facilities at Cleppa Park and Tredegar Park near the M4 Junction 28. It is also well related to sports and leisure facilities, though less well located in relation to local shopping or Newport City Centre. The development of this brownfield site is consistent with the sustainability objectives of the Plan. Minimum net densities should be specified.

H1(53) - 1144, Former Llanwern Steelworks: The housing allocation for this major brownfield site is 24 ha with a capaicty of 600 units in this Plan period. Total capacity is estimated at 1,850 dwellings. The phasing of most of the housing development for the next plan period is inevitable with a site of this scale. The allocation strongly supports the sustainability objectives of making efficient use of PDL, enhancing degraded environments and ensuring an adequate supply of housing land. Minimum net densities should be specified.

H1(54) - 1145, Expansion Area, North of Steelworks: The housing allocation for this major greenfield site is 44 ha with a capacity of 1,100 units in the Plan period. Total capacity is estimated at 4,000-5,000 dwellings. The allocation has considerable negative impacts in sustainability terms, including adverse impacts on landscape, habitats, soils, greenfield land. The allocation of this strategic site can only be justified provided there are guarantees written into the Plan that its development will contribute to regeneration objectives, and that excellent public transport links will constrain overall traffic growth. Minimum net densities should be specified and only land required in this Plan period should be allocated.

8.2.2 Findings

In their report the consultants were able to demonstrate that a proposed eastwards expansion of the urban area of the City could be justified because of the importance of regeneration in strategic policies for the area and its likely contribution to economic development and growth for Newport as a whole. There were, though, a number of safeguards to ensure that development was as sustainable as possible, including community facilities, and that development of the Eastern Expansion Area should also contribute to the regeneration of inner city sites.

The report and its findings had a significant effect in shaping the future development of the land use plan. This was because throughout the preparation of the appraisal report there were considerable elements of learning and knowledge sharing taking place between the participants. The consultants did not envisage that their work was part of a rationalist decision making approach, in which information was analysed in a scientific manner and then presented to clients. Rather, they sought to work with councillors and officers in what has been termed a “collaborative consensus-making approach” and one which others are seeking to pursue in relation to appraisal and land use planning (Therivel/Partidario 2000, 276).

8.3 Case study: Linking sustainability appraisal and SEA in Cardiff

The purpose of Sustainability Appraisal (SA) is to evaluate the environmental, social and economic effects of the local land use plan. The appraisal examines the strategy, policies and detailed proposals in the plan to ensure that the decisions made will accord with the principles of sustainable development. This means identifying sustainability impacts and seeking to further accentuate positive features and minimise negative aspects. Undertaking the appraisal process helps to test the robustness and compatibility of plan objectives and policies and that the plan can contribute to more sustainable development.

In Britain, sustainability appraisal runs alongside the EU’s Strategic Environmental Assessment requirements since they are regarded as related processes. The SEA Directive requires the formal environmental assessment of plans and programmes, like local land use plans, whilst sustainability appraisal is broader and includes an assessment of economic and social factors. The process that is followed in Cardiff is outlined in the two figures below.

Figure 12: Cardiff Council process for identifying sustainability issues and setting objectives

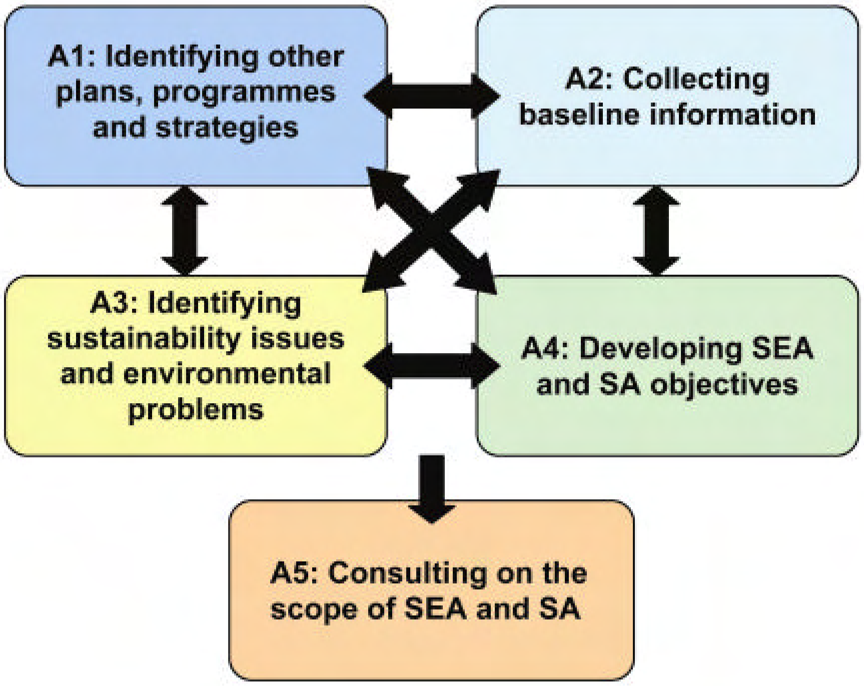
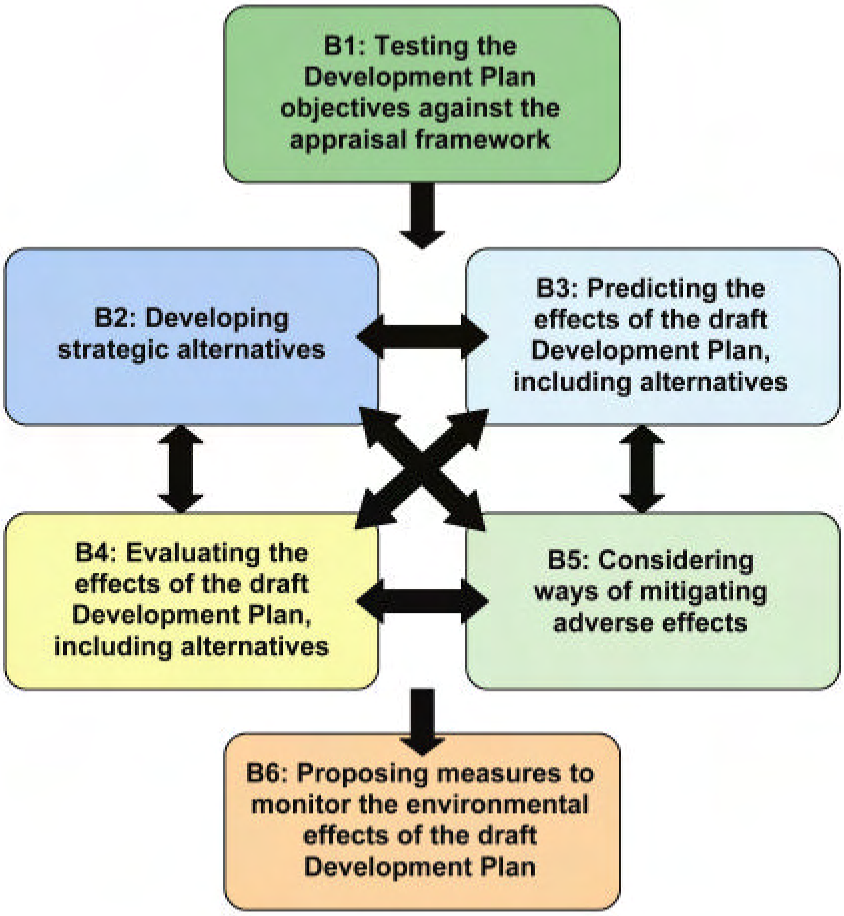


Figure 13: Cardiff Council appraisal process



The development of the latest version of the land use plan in Cardiff is ongoing. Signs so far, however, indicate that the development orientation of the Council that was highlighted in a number of contributions to *Capital Cardiff* (Hooper/Punter 2006) are unlikely to be altered by the sustainability appraisal/SEA process. On major developments with significant sustainability implications a traditional developmental perspective largely prevails.

8.4 Case study on SEA in practice: How the Integration Tool Brings Sustainable Development into the Heart of Policy Making

The Integration Tool is designed as an integrated appraisal mechanism to be used by officials when developing policies and evaluating projects. It was developed with the Assembly by Forum for the Future. The Tool asks decision makers a number of standard appraisal questions such as what is being proposed, why, and the potential risks. What it then adds is a set of questions about how a policy will contribute to a set of Assembly objectives. It works as an integrative tool in two ways. First, it encourages officials to see how their work contributes to broader goals. Second, appraisal is a group activity involving individuals from outside the source of the policy, so again encourages thinking beyond departmental boundaries. An example of the application appraisal framework for a grant fund is provided below.

Figure 14: The Welsh Assembly Government Integration Tool

Forum for the Future

The Welsh Assembly Government Integration Tool

- The Assembly's guiding themes are sustainable development, equality and social inclusion. Its current key areas are: helping more people into jobs; improving health; developing strong and safe communities; and creating better jobs and skills.
- This tool is based on these themes, areas and the objectives of the Strategic Agenda "Wales: A Better Country" (Sept 2003). It is designed to make sure that the development and implementation of an activity, be it policy, strategy, programme or project is contributing in the round to addressing the needs of Wales.
- The tool should be used to help stimulate dialogue, generate new ideas and encourage 'joined-up' thinking.
- There is a commitment from cabinet to take this forward through any new consultation produced by the Assembly from April 2005

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Wales: A Better Country

Key Objectives

1. Promoting the economy
2. Action on social justice for communities
3. Action in our built and natural environment
4. Strengthening Wales' cultural identity
5. Ensuring better prospects in life for future generations
6. Supporting healthy independent lives
7. Promoting openness, partnership and participation

Pages 1&2 should be completed by the sponsoring organisation or division

Please complete all the unshaded sections

Completed By	Division	Date

Pages 3&4 should be completed by an Appraisal Group drawn either from a vertical slice through a division or a cross section of the organisation as a whole.

Pages 3&4 must <u>not</u> be completed prior to the Appraisal Group meeting.

The Appraisal Group should consider and come to a consensus on what contribution the activity makes to the aim outlined in each question before completing the explanation.

The Appraisal Group process should take approximately two hours

Please complete all the unshaded sections

Appraisal Group	Division	Date

Please use the following scale when considering what contribution the activity makes

U	Undermining:- significantly undermines the objective	F	Fair:- makes some direct or significant indirect contribution to the objective.
P	Poor:- does not fully explore the potential to contribute to the objective.	G	Good:- makes a significant positive contribution to the objective
N	Neutral:- does not contribute to the objective	E	Excellent:- makes a close to optimal contribution to the objective

Checked By	Division	Date

Approved By	Division	Date

What do you want to achieve in undertaking this project or policy?

The fund is directed at those groups whose members are from disadvantaged communities that are within isolated and or socially excluded sectors in Welsh society. The fund will aim to develop their capacity to deliver the organisations aims and objectives and, in particular, to compete on an equal footing for funding from established funding streams. In the short term the fund will provide the opportunity for such groups to raise awareness of their issues, build networks, and enhance their communication tools. In the Long term the fund will assist them to grow and seek recognition in their own right. We expect these to be small locally based groups/communities, or those working in a wider circle, but who have been unable to access mainstream funding.

What lessons have been learnt from previous similar activities in Wales or elsewhere?

This type of grant scheme must be easy to access with simple documentation. The nearest example to the fund - acceptance of its need and the likleyhood it will be oversubscrcibed

What evidence have you gained from best practice and innovation in Wales or elsewhere?

Evidence from community groups that funding is not available or accessable at local level this froms a a major part of the reason for creating the fund

What are the measures of success? The number of successful applicants and the number who go on to attract mainstream funding and the outcomes included in the terms of reference.
How will the policy or project be implemented? An ongoing bidding system possibly run through an intermediary organisation.
How have you determined the extent of any other related internal or external activities or proposed activities? CFAP is the only similar scheme of which we are aware.
How much will it cost? It is proposed that the fund will begin in 2006-07 between £150,000 and £200,000.
What are the sources of finance and have these been agreed? WAG funding
What are the staffing implications? The Minister is inclinded to have the fund externally administered. Staffing implications will be negligible. If this is not the case then staffing of ½ HEO which is already available
How are you going to communicate your policy? (e.g language requirements, accessible information) A full consultation and through equality commissions and networks
What are the significant milestones? Consultation, Launch, roll-out, review
What are the ongoing commitments? Funding for the initial 3 years
What arrangements are in place for monitoring and evaluation? The scheme will have an in built monitoring process and will be evaluated every 6 years starting in 3 years
What are the significant risks associated with this project or policy and how will they be managed? Under subscription whilst the fund becomes known – Targeted publicity
How have you considered the ways in which this project or policy might target specific areas and communities, and their different needs? It is aimesd at certain specific communities and needs – disadvantaged communities.
What collaboration would be needed in different areas of Wales to take the policy forward? Working with various networks County Voluntary Councils, Volunteer Bureaux,Wales Council for Voluntary Action and the stutory bodies
What are the long-term (25+years) impacts and implications and how are you addressing these? None
What are the UK, European and global implications for and of the project or policy? None

The Integration Tool has been promoted internally and externally and has generally been well received. In what follows we draw upon interviews with key person interviewees in the Welsh Assembly Government who explain their experiences of the Tool. A number of interviewees have seen the Tool as one of the Assembly's major achievements. One interviewee from an NGO claimed that the Tool showed the way the Assembly was trying to work, that it was trying to break down barriers between divisions and that this would never have happened before.

There were, however, also misgivings about the Tool. Criticisms focussed on a number of issues. One was that the Assembly goals in the Tool were drawn from *Wales: A Better Country* and this adopted something of a pepperpot approach to policy and so the Tool could not be regarded as a sustainability appraisal mechanism. One interviewee commented "It may have value as a policy tool, but it doesn't contribute much to sustainable development." A second criticism is that the Tool promotes gameplaying by officials: "someone who knows their way around it can use it in many ways if they wish." (interview) Third, there is uncertainty as to when the Integration Tool is to be applied: some interviewees saw it as an iterative process that ran alongside policy development, whilst others saw it as a one-off to be undertaken before a document went out to public consultation. Fourth, the Tool runs into glass ceilings and glass walls. The appraisal results do not reach Ministers and nor are they evaluated centrally.

In summary, the Tool represents a considerable effort of time and resources to improve decision making and as such appears to have gained considerable legitimacy within the Assembly. As yet, though, there is little to show as to what it has achieved or that it has made any impact at senior political or managerial levels. In the words of one interviewee:

> I am not entirely certain what the policy integration tool is designed to do. … I seem to recall that there were some training courses [but] it hasn't really been embedded in professional development.

Later the interviewee returned to the theme of appraisal and commented:

> The actual individual who is developing the policy has to apply the integration tool but as [for] the results. I've never seen a submission going up [to Ministers], and I mean I am copied in from submissions across the department and the whole of the Assembly. … It doesn't go back up there [to Ministers]. … I have never been in meetings where Ministers have actually said 'Well what were the results of the integration tool?' It's almost implicit that you have applied it but there is no failsafe to say yes or no you haven't. (interview)

In terms of the lessons that can be drawn from the experience of the WAG and its Integration Tool there are four points. First, as much guidance on best practice has suggested (e.g. Partidario/Clark 2000, 7) the model of SEA has been developed to be sympathetic to the context in which it is to be used. Second, it would seem that the Integration Tool and the Policy gateway summarise results and provide for some generalised cross-fertilisation of ideas between major policy documents, like 'Wales: A Better Country' and narrower policy developments (like the Environment Strategy). Policy and decision making become more structured (Runhaar/Driessen 2007). Third, however, interviewees suggested that the process needs to become a) more embedded and regular; and b) more specified in the types of synergies and connections it is attempting to make if the Integration Tool is to make a systematic impact on decision making. Fourth, it is clear that the UK Framework for sustainable development and its principles and priorities, have not so far provided a basis for the operation of the Integration Tool. It is, therefore, difficult to claim that the Integration Tool works a mechanism that is part of tiered approach to SEA binding together different scales of government to promote more sustainable outcomes.

9 Conclusions

In the concluding section we proceed in three steps. We first analyse if there are typical combinations of indicators or indicator sets on the one hand and certain processes/tools on the other. We then assess the effectiveness of the various possible combinations before we finally draw some lessons to be possibly learned from this review.

9.1 Combinations of indicators and processes/tools in practice

As Table 8 shows, we have found a relative limited range of combinations of indicators and processes/tools. Several findings deserve to be highlighted:

1. In EIA, only theme or sector specific indicators are used. There is potential for including the Ecological Footprint, particularly where resource consumption issues may be to the fore, such as in tourism-related developments, but these are not yet practiced.
2. SEA because of its broader and more strategic approach appears to be open for a wide range of indicators, depending on the scope and scale of the exercise.
3. Environmental Management Systems mainly rely on theme or sector specific indicators or on material flow analysis.
4. There is a wide range of indicators used in LA 21 processes and sustainability strategies. As with SEA, this can be explained with the more comprehensive nature of these processes and the various scopes and scales included.
5. Water management appears to be the one area of urban infrastructure development where innovative links between sustainability indicators and funding are underway. This is probably driven by the EU Water Framework Directive.
6. In regeneration, some theme specific sustainability indicators have been developed.

Sources for the cases mentioned in Table 8, in addition to cases discussed in the text above: Trento regional strategy (Diamantini/Geneletti 2003, Diamantini/Zanon 2000), Stockholm, SALA (Eckerberg/Mineur 2003), Austria funding for urban water infrastructure (Starkl/Brunner *et al.* 2009), Material flow analysis for substance management in the context of LA 21 in Vienna (Hendriks/Obernosterer *et al.* 2000), Krems (Gruber-Köllersberger/Maier *et al.* 2003), Dashboard of SD in Padova (Scipioni/Mazzi *et al.* 2009), Footprint in EMS (Best Foot Forward no date), EF in Oslo (Aall/Norland 2002)

Table 8: Overview of combinations of indicators and processes/tools in practice (example)

	Environmental space	Footprint	European Common Indicators (ECI)	Theme specific indicator system	Sector specific indicator systems	PSR indicators	Other broad indicator systems	Material Flow Analysis	Dashboard of Sustainability
EIA	-	Debated, no examples found	-	Case specific, e.g. biodiversity, air pollution, water quality	Mostly variations of cost benefit analysis	no examples found	no examples found	no examples found	no examples found
SEA	Trento regional strategy	Trento regional strategy	no examples found	Case specific, e.g. biodiversity, air pollution, water quality	Possible, e.g. housing targets, quality of life indicators, but system still in its infancy	Trento regional strategy	E.g. where SEA linke to land use system, links to land use indicators, e.g. Cardiff will be linked to local SD indicators	no examples found	no examples found
EMS	-	Example from private sector, Best Foot Forward	-	e.g. energy efficiency of buildings, transport etc.	Stockholm Sundsvall	Using language of environmental effects	Sweden: SALA	Vienna	no examples found
LA 21 SD Strategy	Several German cities	Oslo Krems Vienna Berlin	Stockholm Oslo	Yes	Vienna substance strategy	Stockholm	Sweden: SALA	Krems, Vienna becomes more important as cities think about carbon management	Padova
Funding urban water infrastructure	no examples found	no examples found	no examples found	yes	Austria technical guidelines	no examples found	Sweden	Sweden Austria	-
Evaluating regeneration	-	-	no examples found	Belfast, Dublin, Barcelona	Yes	-	no examples found	no examples found	no examples found

9.2 Effectiveness

Based on the findings on the previous section, we can now assess the links between indicators and urban development, urban infrastructure and land use planning.

In the following Table 9, we have denoted the effectiveness of the various indicators in the different processes in which they may be found to operate.

We have used a simple four step scale to clearly illustrate the differences in effectiveness. The scale is as follows:

++	very effective
+	effective
-	limited effect
--	ineffective

If no examples were found, we have concluded that the indicator is not effective in practice for the process. In some case we have found no examples but our analysis would suggest that such links could be made. When this occurs, we have indicated this in the table. For many combinations of indicators and processes/tools we have found only a few examples. Therefore the judgement has been made on the effectiveness of the relationship in these examples rather than their wider applicability or their often limited uptake.

How can we interpret the results? Several observations deserve to be highlighted:

5. EIA as a project related process is not very much engaged with wider debates on indicators. This is due to the procedural nature of this tool.
6. SEA has much more potential to take up broader SD indicators. This is because it is a more reflexive process, it addresses more strategic issues, and one of its purposes is to identify and prioritise areas of concern.
7. In LA 21 processes a broad range of indicators are in use. This is due to them being community based processes engaging with several scales of time and space and various degrees of detail from strategic considerations to detailed management.
8. Theme and sector specific indicators appear to be most effective. The reason for this is that they are much more sympathetic to the context of local decision-making processes and open up opportunities for local ownership.

Table 9: Evaluation of effectiveness of indicators and processes/tools

	Environmental space	Footprint	European Common Indicators (ECI)	Theme specific indicator system	Sector specific indicator systems	PSR indicators	Other broad indicator systems	Material Flow Analysis	Dashboard of Sustainability
EIA	--	-	--	Potential ++ Practice -	When in practice: +	--	--	--	--
SEA	+	+	Potential + Practice --	++	Potential ++	+	++	Potential ++ Practice --	Potential + Practice --
EMS	--	+	--	++	++	-	+	Potential ++ Practice -	--
LA 21 SD Strategy	+	++	-/+	++	++	-/+	-	-	++
Funding urban water infrastructure	--	Potential ++ Practice --	--	++	++	--	+	Potential ++ Practice +	--
Evaluating regeneration	--	--	Potential + Practice --	++	++	Potential + Practice --	Potential + Practice --	Potential + Practice --	Potential + Practice --

If we interpret the results with a view to the four reform strategies for sustainable development introduced in section 2.4.2, the following observations deserve to be noted:

1. There is now a wide range of sustainability indicators and indicator sets available. While issues of data availability and validity deserve continuous attention, there is a toolkit which communities, policy-makers and planners can use to deepen their understanding of their city's sustainability issues, creating a huge potential for learning and reflexivity.
2. The actual uptake of these indicators in decision-making and planning is limited. As a result, reflexivity of planning processes is not as good as it could be.
3. With a view to infrastructure planning and development, we have found some ambitious indicator sets which are, however, mainly driven by sector specific concerns. This will improve the effectiveness of such indicators for management and monitoring, e.g. of water resources. But the ambition to introduce a wider sustainability perspective is often not fulfilled.
4. Correspondingly, citizen involvement and participation in urban infrastructure related indicator systems is variable and modest at best.
5. It can be reasonably assumed that the uptake of sustainability indicators is limited by their potential to change priorities and agendas. Since indicators are always introduced in contexts of interest and power, they can be expected to reflect existing power and interest constellations which are shifting only slowly.
6. Indicators can still trigger innovations – new technical solutions, organisational or behavioural change, displaying novelty local or beyond – if they contribute to a change in perceptions held by decision-makers and the wider public about problems, priorities and their long-term self-interest. Indicators are also part of norm-building and engagement processes where vested interests are not necessarily touched upon immediately.
7. The probability that indicators foster innovations is higher when they are coupled with inclusive and participatory processes. Only such participatory indicator processes create links between the four strategies towards sustainability: reflexivity, participation, integration and innovation

9.3 Lesson-drawing

Finally we summarise a few lessons that we suggest could be learned from the findings.

1. Cities and governments in Europe are highly innovative in the breadth and nature of the tools and processes that they use to incorporate the environment into decision making. For example, Local Agenda 21 has highlighted opportunities for citizen engagement, and also how other stakeholders, particularly the business community may be encouraged to work with local councils on a shared programme to improve the sustainability of a community. Tools, such as the Ecological Footprint, have also gained widespread attention and many cities have conducted Footprint studies of their citizens' resource consumption.

2. There have also been a number of methodological innovations to improve the effectiveness of tools and processes. For instance, there have been developments in the ways in which citizens can be encouraged to participate in public consultation exercises in EIA. There have also been significant developments in the measurement of the Ecological Footprint.
3. When making decisions on the types and tools and processes that are to be promoted we can distinguish between voluntary initiatives and legally required efforts. Examples of voluntary efforts to promote more sustainable decision making include, the Ecological Footprint and environmental indicators. Examples of tools that must be used by councils when considering major development decisions are EIA and SEA.
4. All of the tools and processes that we have reviewed have been designed to ensure that sustainability and environmental issues are more fully taken into account when organisations make key decisions. The variety of the tools and processes that have been developed and used by government shows that from their own learning experiences a single tool or process approach is not sufficient. Tools and processes must be developed that are appropriate for local forms of governance and decision making. Similarly the variability with which tools and processes are implemented (and the very mixed experiences of EU Member States in complying with the EIA Directives provide a good lesson here) shows that mainstreaming the environment into organisations and processes is both difficult and long term.
5. To ensure that environmental decision making tools and processes work effectively requires commitment from the senior leadership of an organisation, buy-in from middle management, and a commitment to delivery across the organisation as a whole. For example, the experience of Cardiff Council with the Ecological Footprint shows how a process can be developed that binds together senior politicians and officers in a common goal. Commitment cannot be seen as temporary or only applying to part of an organisation as this will provide mixed messages both inside and outside of the organisation.
6. The use of environmental decision making tools and processes to facilitate a change in organisational culture is very challenging. One experiment, therefore, has been to use legislative power to try and force through change in organisational behaviour. For example, the Welsh Assembly Government has a legal duty to promote sustainable development in all of its activities. This has undoubtedly influenced the outlook of senior politicians and officials, led to experimentation with new practices (e.g. the Policy Integration Tool) and widespread use of the language of sustainable development within the organisation. Critically evaluating the extent to which a legal duty has been a significant factor in helping to promote a shift in corporate culture (i.e. the mainstreaming of sustainable development) is a much more challenging issue.
7. Today, the most innovative model of development in urban councils is one that links together competitiveness and environmental sustainability. For example, we can see how environmental indicators shape our notions of both sustainability and competitiveness. In the UK reporting on the ranking cities in the Sustainable Cities Index becomes a matter of civic pride and

competitive advantage. Cities seek to distinguish themselves from potential competitors through the quality of life that they can offer to their citizens. This is believed to be important in attracting and retaining high quality employment and employees. Notions of competitiveness will be continually constructed and reshaped by individual cities as they take account of their local circumstances and as economic, social and environmental conditions change over time.

10 Bibliography

Aall, C./Norland, I. T., 2002. *The Ecological Footprint of the City of Oslo - Results and Proposals for the Use of the Ecological Footprint in Local Environmental Policy*. Available from: http://www.prosus.uio.no/publikasjoner/Rapporter/2002-11/Rapp11.pdf [Accessed

Aall, C./Norland, I. T., 2005. The Use of the Ecological Footprint in Local Politics and Administration: Results and Implications from Norway. *Local Environment*, 10, 159–172.

Agyeman, J./Evans, B., 2004. Just sustainability': the emerging discourse of environmental justice in Britain? *The Geographical Journal*, 170, (2) 155-164.

All Party Urban Development Group, 2006. *Loosening the leash: how local government can deliver infrastructure with private sector money*.

Ambiente Italia, 2003. *European Common Indicators. Towards a Local Sustainability Profile*: Ambiente Italia. Available from: http://euronet.uwe.ac.uk/www.sustainable-cities.org/indicators/ECI%20Final%20Report.pdf [Accessed 16 January 2009].

Astleithner, F./Hamedinger, A., 2003. The Analysis of Sustainability Indicators as Socially Constructed Policy Instruments: benefits and challenges of â€˜interactive researchâ€™. *Local Environment*, 8, (6) 1-1.

Astleithner, F./Hamedinger, A./Holman, N./Rydin, Y., 2004. Institutions and indicators - The discourse about indicators in the context of sustainability. *Journal of Housing and the Built Environment*, 19, (1) 7-24.

Ayres, R. U., 2000. Commentary on the utility of the Ecological Footprint concept. *Ecological Economics*, 32, 347–349.

Bailey, R., 2008. *Governing Sustainability: A City-Region Approach?* . MSc Dissertation, School of City and Regional Planning, Cardiff University.

Barrett, J./Birch, R./Cherrett, N./Wiedmann, T., 2005. *Reducing Wales' Ecological Footprint - Main Report.* : Stockholm Environment Institute, University of York; published by WWF Cymru, Cardiff, UK. Available from: http://www.walesfootprint.org [Accessed 15 January 2009].

Barrett, J./Scott, A./Lindfield, S., 2001. *Ecological Footprint of Liverpool: Developing Sustainable Scenarios.*

Beccali, G./Federico, G./Iadicola, G./Rizzo, G./Traverso, M., 2007. Integrated approach to the assessment of waste management systems within the SEA framework. *International Journal of Environmental Technology and Management*, 7, (1-2) 68-84.

Beinat, E., 2001. Multi-Criteria Analysis for Environmental Management. *Journal of Multi-Criteria Decision Analysis*, 10, 51.

Bentivegna, V./Curwell, S./Deakin, M./Lombardi, P./Mitchell, G./Nijkamp, P., 2002. A vision and methodology for integrated sustainable urban development: BEQUEST. *Building Research and Information*, 30, (2) 83-94.

Bertrand-Krajewski, J.-L./Becouze, C./Dembélé, A./Cren-Olivé, M. C./Barillon, B./Dauthuille, P./Chapgier, J./Grenier-Loustalot, M.-F./Marin, P., 2008. *Priority pollutants in stormwater: the 'ESPRIT' project*: 11th International Conference on

Urban Drainage, Edinburgh, Scotland, UK, 2008. Available from: http://www.esprit-rhodanos.fr/publications/full-paper-esprit-v5.pdf [Accessed 15 January 2009].

Bertrand-Krajewski, J. L./Barraud, S./Chocat, B., 2000. Need for improved methodologies and measurements for sustainable management of urban water systems. *Environmental Impact Assessment Review*, 20, (3) 323-331.

Best Foot Forward, no date. *Carbon Footprint*. Available from: http://www.bestfootforward.com/carbon_footprint [Accessed 28 January 2009].

Bishop, K. D./Mills, L., 2002. Planning for Wales - work in progress: an interview with Sue Essex AM'. *Town and Country Planning*, 71, (5) 129-130.

Black, J. A./Paez, A./Suthanaya, P. A., 2002. Sustainable urban transportation: Performance indicators and some analytical approaches. *Journal of Urban Planning and Development*, 128, (4) 184-209.

Blowers, A./Pain, K., 1999. "The unsustainable city?" *In:* S. Pile, C. Brook, *et al.*, eds. *Unruly Cities? Order/Disorder* London: Routledge 247-298.

Boland, P., 2006. Competitive cities: unpacking the theoretical debates. *In:* A. Hooper and J. Punter, eds. *Capital Cardiff*. 15-30.

Bond, S., 2002. *ecological footprints. A guide for local authorities*: WWF-UK. Available from: http://www.gdrc.org/uem/footprints/wwf-ecologicalfootprints.pdf [Accessed 4 January 2009].

Breheny, M./Rookwood, R., 1993. Planning the Sustainable City Region. *In:* A. Blowers, ed. *Planning for a sustainable environment: A report by the Town and Country Planning Association* London: Earthscan, 150-189.

Breyer, K., Hemkes, B., Schlegel, W., Valentin, A., 2001. *Lokale Agenda 21-Acht Schritte zur zukunftsfähigen Kommune.* Düsseldorf: IKG-EKvW, AQU im DGB-BW, LV VHS NRW.

Browne, D./O'Regan, B./Moles, R., 2005. A comparative analysis of the application of sustainability metric tools using Tipperary Town, Ireland, as a case study. *Management of Environmental Quality*, 16, (1) 37-54.

Brugmann, J., 1997. Is there a method in our measurement? The use of indicators in local sustainable development planning. *Local Environment*, 2, (1) 58-72.

Brunner, N./Starkl, M., 2004. Decision aid systems for evaluating sustainability: A critical survey. *Environmental Impact Assessment Review*, 24, (4) 441-469.

Buhrs, T., 2004. Sharing Environmental Space: The Role of Law, Economics and Politics. *Journal of Environmental Planning and Management*, 47, (3) 429-447.

Burton, E., 2000. The Compact City: Just or Just Compact? A Preliminary Analysis. *Urban Studies* 37, (11) 1969-2001.

Burton, E., 2002. Measuring urban compactness in UK towns and cities. *Environment and Planning B: Planning and Design*, 29, (2) 219-250.

Carley, M./Spapens, P., 1998. *Sharing the World.* London: Earthscan.

Carmona, M./Sieh, L., 2004. *Measuring Quality in Planning: Managing the performance process.* London: Spon press.

Carys Jones, M. B., Jeremy Carter, Stephen Jay, Michael Short and Christopher Woods ed. 2005. *Strategic Environmental Assessment and Land Use Planning. An International Evaluation*. London: Earthscan.

City of Vienna Webservice, 2009. *Ökologischer Fußabdruck - ein Maß für Nachhaltige Entwicklung*. Available from: http://www.magwien.gv.at/umweltschutz/nachhaltigkeit/fussabdruck/vergleich.html [Accessed 10 January 2009].

Cole, A./John, P., 2001. *Local Governance in England and France.* London: Routledge.

Collins, A./Flynn, A., 2005. A new perspective on the environmental impacts of planning: a case study of Cardiff's International Sports Village'. *Journal of Environmental Planning and Policy* 7, (4) 277-302.

Collins, A./Flynn, A., 2007. Engaging with the ecological footprint as a decision-making tool: process and responses. *Local Environment* 12, (3) 295-312.

Cooke, P., 2001. Regional Innovation Systems, Clusters, and the Knowledge Economy. *Industrial and Corporate Change*, 10, (4) 945-974.

Core Cities Group, 2008. Available from: http://www.corecities.com/coreDEV/coreindex.htm [Accessed 12 January 2009].

Cowell, R., 2006. Environment limits and the pursuit of a sustainable city. *In:* A. Hooper and J. Punter, eds. *Capital Cardiff 1975 - 2020: Regeneration, Competitiveness and The Urban Environment.* 219-239.

Cowell, R./Collins, A./Flynn, A., forthcoming. Evaluation and Environmental Governance: The Institutionalisation of Ecological Footprinting. *Environment and Planning A*.

CRISP, no date. *European Thematic Network on Construction and City Related Sustainability Indicators*. Available from: http://crisp.cstb.fr/ [Accessed 12 January 2009].

Curwell, S., 2008. BEQUEST - An International Cross-cultural Cooperation and Information Exchange. *In:* R. L. Raymond J. Cole, ed. *Buildings, Culture and Environment*. 202-227.

Dalal-Clayton, B./Sadler, B., 2005. *Strategic Environmental Assessment. A Sourcebook and Reference Guide to International Experience.* London: Earthscan.

Daxbeck, H./Kisliakova, A./Obernosterer, R., 2001. *Der oekologische Fussabdruck der Stadt Wien (Projekt Footprint). Endbericht*: Ressourcen Management Agentur. Im Auftrag der Magistratsabteilung 22 - Umweltschutz der Stadt Wien. Available from: http://www.magwien.gv.at/umweltschutz/nachhaltigkeit/pdf/fuss-studie.pdf [Accessed

Daxbeck, H./Kisliakova, A./Obernosterer, R., 2002. *The Ecological Footprint of the City of Vienna*.

den Boer, J./den Boer, E./Jager, J., 2007. LCA-IWM: A decision support tool for sustainability assessment of waste management systems. *Waste Management*, 27, (8) 1032-1045.

DETR - Department Environment, T. a. R., 2000. *Local Quality of Life Counts*. Available from: http://www.sustainable-development.gov.uk/publications/pdf/localqolc.pdf [Accessed 10 January 2009].

Diamantini, C./Geneletti, D., 2003. Implementing sustainability through strategic environmental assessment: Indications from the experience of the Autonomous Province of Trento, Italy. *In: Sustainable World.*

Diamantini, C./Zanon, B., 2000. Planning the urban sustainable development: The case of the plan for the province of Trento, Italy. *Environmental Impact Assessment Review*, 20, (3) 299-310.

Dotinga, F., no date. *EIA and SEA in the Netherlands: quality and guarantees.*

Eckerberg, K./Mineur, E., 2003. The Use of Local Sustainability Indicators: case studies in two Swedish municipalities. *Local Environment*, 8, (6) 591–614.

Environment Daily, 2003. Bjørn Lomborg back in the firing line. *Environment Daily*, 28/08/03.

Environmental Assessment Institute, 2002. *Assessing the Ecological Footprint. A look at the WWF's Living Planet Report 2002*. Available from: http://imv.net.dynamicweb.dk/Default.aspx?ID=110 [Accessed 10 January 2009].

EPA Victoria, 2003. *EPA Victoria and Eco-footprint*: Environment Protection Authority, Victoria, Australia. Available from: http://www.epa.vic.gov.au/eco-footprint [Accessed 12 January 2009].

Ferguson, A. R. B., 2001. Comments on eco-footprinting. *Ecological Economics*, 37, 1-2.

Ferng, J. J., 2002. Toward a scenario analysis framework for energy footprints. *Ecological Economics*, 40, (53-69).

Ferranti, D. d./Perry, G. E./Lederman, D./Maloney, W. F., 2002. *From natural resources to the knowledge economy : trade and job quality*: World Bank. Available from: wbln0018.worldbank.org [Accessed 9 January 2009].

Fischer, T. B., 2007. *Theory and Practice of Strategic Environmental Assessment. Towards a More Systematic Approach.* London: Earthscan.

Florida, R., 2002a. *The Rise of the Creative Class. And How It's Transforming Work, Leisure and Everyday Life.* Basic Books.

Florida, R., 2002b. The Rise of the Creative Class. Why cities without gays and rock bands are losing the economic development race. *Washington Monthly*, (May 2002). Available from: http://www.washingtonmonthly.com/features/2001/0205.florida.html [Accessed 8 January 2002].

Folke, C./Jansson, A./Larsson, J./Costanza, R., 1997. Ecosystem appropriation by cities. *Ambio*, 26, (3) 167-172.

Foxon, T. J./Leach, M./Butler, D./Dawes, J./Hutchinson, D./Pearson, P./Rose, D., 1999. Useful indicators of urban sustainability: Some methodological issues. *Local Environment*, 4, (2) 137-149.

Frame, B./Vale, R., 2006. Increasing uptake of low impact urban design and development: The role of sustainability assessment systems. *Local Environment*, 11, (3) 287-306.

Gagliardi, F./Roscia, M./Lazaroiu, G., 2007. Evaluation of sustainability of a city through fuzzy logic. *Energy*, 32, (5) 795-802.

Gahin, R./Veleva, V./Hart, M., 2003. Do Indicators Help Create Sustainable Communities? *Local Environment*, 8, (6) 1-1.

Girard, L./Forte, B./Carreta, M./De Torro, P./Fabiana, F. eds., 2003. *The Human Sustainable City: Challenges and Perspectives from the Habitat Agenda*. Aldershot: Ashgate.

GLA, 2004. *Financing the Future: a report on innovative financing mechanisms for major regeneration projects in London'*. London: GLA.

Glasson, J./Therivel, R./Chadwick, A., 2005. *Introduction to Environmental Impact Assessment.* 3rd ed. London: Routledge.

Gordon, I./Buck, N., 2005. Introduction: Cities in the New Conventional Wisdom. *In:* N. Buck, I. Gordon, *et al.*, eds. *Changing Cities: Rethinking Urban Competitiveness, Cohesion and Governance.* Hampshire: Palgrave Macmillian, 1-21.

Gruber-Köllersberger, M./Maier, R./Punz, W., 2003. Ökologisches Profil der Stadt Krems an Hand einer Strukturanalyse und ausgewählten Stoffflüssen. *Wiss. Mitt. Niederösterr. Landesmuseum*, 15, Available from: http://www.biologiezentrum.at/pdf_frei_remote/WM_15_0157-0193.pdf [Accessed 9 January 2009].

Hakanen, M., 1999. *Some Finnish Ecological Footprints at the local level.* The Association of Finnish Local and Regional Authorities.

Häkkinen, T., 2007. Assessment of indicators for sustainable urban construction. *Civil Engineering and Environmental Systems,* 24, (4) 247-259.

Hall, P., 2003. The Sustainable City in an Age of Globalisation. *In:* L. Girard, B. Forte, *et al.*, eds. *The Human Sustainable City: Challenges and Perspectives from the Habitat Agenda.* Aldershot: Ashgate, 55-70.

Harvey, D., 1989. From Managerialism to Entrepreneurialism: The Transformation in Urban Governance in Late Capitalism. *Geografiska Annaler. Series B, Human Geography,* 71, (1) 3-17.

Hatter, W., 2007. Mainstreaming Sustainable Development. *Local Economy,* 22, (1) 6-11.

Hazel, S./Benevides, H., 2000. Towards a Legal Framework for SEA in Canada. *In:* Partidario and Clark, eds., 47-68.

Hellström, D., 2008. Comparison of environmental effects and resource consumption for different wastewater and organic waste management systems in a new city area in Sweden. *Water environment research* 80, (8) 708 -718.

Hellström, D./Jeppsson, U./Kärrman, E., 2000. A framework for systems analysis of sustainable urban water management. *Environmental Impact Assessment Review,* 20, (3) 311-321.

Hemphill, L./Berry, J./McGreal, S., 2004a. An indicator-based approach to measuring sustainable urban regeneration performance: Part 1, conceptual foundations and methodological framework. *Urban Studies,* 41, (4) 725-755.

Hemphill, L./Berry, J./McGreal, S., 2004b. An Indicator-based Approach to Measuring Sustainable Urban Regeneration Performance: Part 2, Empirical Evaluation and Case-study Analysis. *Urban Studies,* 41, (4) 757–772.

Hemphill, L./McGreal, S./Berry, J., 2002. An aggregated weighting system for evaluating sustainable urban regeneration. *Journal of Property Research,* 19, (4) 353-373.

Hendriks, C./Obernosterer, R./Muller, D./Kytzia, S./Baccini, P./Brunner, P. H., 2000. Material flow analysis: A tool to support environmental policy decision making. Case-studies on the city of Vienna and the Swiss lowlands. *Local Environment,* 5, (3) 311-328.

Herendeen, R. A., 2000. Ecological Footprint is a vivid indicator of indirect effects. *Ecological Economics,* 32, 357-358.

Hezri, A. A./Dovers, S. R., 2006. Sustainability indicators, policy and governance: Issues for ecological economics. *Ecological Economics,* 60, (1) 86-99.

Hill, L., 2007. *Considering Health Risk When Planning for Energy from Waste: Could the integration of Health Impact Assessment with the Environmental Impact Assessment process help address public perception of risk associated with energy from waste development?* . MSc dissertation, Department of Planning, Oxford Brookes University.

Hooper, A./Punter, J. eds., 2006. *Capital Cardiff 1975-2020 : Regeneration, Competitiveness and the Urban Environment.* Cardiff University of Wales Press.

IEA, 2002. *Resources of Annex 31 to the international research project 'Energy Related Environmental Impact of Buildings*. Available from: http://www.uni-weimar.de/scc/PRO/info.html [Accessed 12 January 2009].

IISD, no date. *The Dashboard of Sustainability.* Available from: http://www.iisd.org/cgsdi/dashboard.asp [Accessed 7 January 2009].

Intarakumnerd, P./Vang, J., 2006. Clusters and Innovation Systems in Asia. *Science, Technology and Society,* 11, (1) 1-7.

Janssen, R., 2001. On the Use of Multi-Criteria Analysis in Environmental Impact Assessment in the Netherlands. *Journal of Multi-Criteria Decision Analysis*, 10, 101-109.

Kao, J.-J./Pan, T.-C./Lin, C.-M., 2009. An environmental sustainability based budget allocation system for regional water quality management. *Journal of Environmental Management*, 90, (2) 699-709.

Keating, M., 1991. *Comparative urban politics: power and the city in the United States, Canada, Britain and France.* Aldershot: Edward Elgar.

Lee, Y.-s. F., 2002. Tackling Cross-Border Environmental Problems in Hong Kong: Initial Responses and Institutional Constraints. *The China Quarterly*, 172 986-1009.

Lenzen, M./Murray, S. A., 2001. A modified Ecological Footprint method and its application to Australia. *Ecological Economics*, 37, 229-255.

Lewan, L./Simmons, C., 2001. *The use of Ecological Footprint and Biocapacity Analyses as Sustainability Indicators for Subnational Geographical Areas: A Recommended Way Forward. European Common Indicator Project*: EUROCITIES/Ambiente Italia (ECIP). Available from: http://old.bestfootforward.com/downloads/Use%20of%20EF%20for%20SGA%20-%20Main%20Report.PDF [Accessed 15 January 2001].

London Sustainable Development Commission, 2004. *2004 report on London's Quality of Life indicators.* London: GLA.

Maclaren, V. W., 1996. Urban sustainability reporting. *Journal of the American Planning Association,* 62, (2) 184-202.

March, J. G./Olsen, J. P., 1989. *Rediscovering Institutions. The Organizational Basis of Politics.* New York: Free Press.

Marshall, A./Finch, D., 2006. *City leadership: giving city regions the power to grow'.* London: Centre for Cities, Institute for Public Policy Research.

Matthiesen, U., 2005. *KnowldgeScapes. Pleading for a Knowledge Turn in Socio-Spatial Research.* Erkner: IRS.

McDonald, G. W./Patterson, M. G., 2004. Ecological Footprints and interdependencies of New Zealand regions. *Ecological Economics,* 50, 49-67.

McGregor, P. G./Swales, J. K./Turner, K. R., 2004. The impact of Scottish consumption on the local environment: an alternative to the Ecological Footprint? Fraser of Allander Institute, University of Strathclyde. Quarterly Economic Commentary. *Economic Perspectives*, 29, (1) 29-34.

McLaren, D./Bullock, S./Yousuf, N., 1998a. *Tomorrow's World. Britain's Share in a Sustainable Future.* London: Earthscan.

McLaren, D./Bullock, S./Yousuf, N., 1998b. *Tomorrow's world. Britain's share in a sustainable future.* London: Earthscan.

Minsch, J./Feindt, P. H./Meister, H.-P./Schneidewind, U./Schulz, T., 1998. *Institutionelle Reformen fuer eine Politik der Nachhaltigkeit.* Berlin et al.: Springer.

Minx, J./Barrett, J./Wiedmann, T., 2006. *Review of Resource Flow Methodologies.* London: Defra.

Mittler, D., 1999. Environmental space and barriers to local sustainability: Evidence from Edinburgh, Scotland. *Local Environment*, 4, (3).

Moffatt, I., 2000. Ecological Footprints and sustainable development. *Ecological Economics*, 32, 359-362.

Mol, A. P. J., 2001. *Globalization and Environmental Reform: The Ecological Modernization of the Global Economy*. Cambridge: MIT Press.

Mol, A. P. J./Sonnenfeld, D. A. eds., 2000. *Ecological Modernisation around the World: Perspectives and Critical Debates*. London and Portland, Oregon: Frank Cass.

Monfreda, C./Wackernagel, M./Deumling, D., 2004. Establishing national natural capital accounts based on detailed Ecological Footprint and biological capacity assessments. *Land Use Policy*, 21, (3) 231-246.

NAfW, 2004. *Sustainable Development Indicators for Wales 2004*: National Assembly for Wales, Statistical Bulletin 18/2004. Available from: http://www.wales.gov.uk/keypubstatisticsforwalesheadline/content/sustainable/2004/hdw20040323-e.htm [Accessed 15 November 2008].

Nas, P./Veenma, M., 1998. Introduction. *In:* K. Aoyagi, P. J. M. Nas, *et al.*, eds. *Towards Sustainable Cities: Readings in the Anthropology of Urban Developments.* Leiden: Leiden Development Studies,

Niekerk, F./Voogd, H., 1999. Impact Assessment for Infrastructure Planning: Some Dutch Dilemmas. *Environmental Impact Assessment Review*, 19, 21-36.

Nottingham City Council, 2007. *Core Cities Summit*. Available from: http://www.nottinghamcity.gov.uk/corecities/city_leaders_to_gather_for_core_cities_summit.htm [Accessed 5 January 2009].

NRG4SD, 2004. *International Seminar on Sustainable Development Indicators - Bases for developing common indicators at a regional level*: Network of Regional Governments for Sustainable Development (NRG4SD), ENCORE, Basque Government, Carlton Hotel, Bilbao, Basque Country, November 9-10, 2004. Available from: http://www.nrg4sd.net/ENG/Events/Other/BilbaoNov2004.htm [Accessed 17 January 2009].

Obernosterer, R./Reiner, I./Smutny, R., 2003. *Urbanes Ressourcenmanagement: Fallstudie Wien. Teilbereich Schadstoffmanagement diffuser Metallemissionen (Projekt Ökopolis). Endbericht* Available from: http://www.magwien.gv.at/umweltschutz/pool/pdf/metall.pdf [Accessed 10 January 2008].

Opschoor, H./Reinders, L., 1991. Towards sustainable development indicators. *In:* O. Kuik, Verbruggen, H. , ed. *In search of indicators of Sustainable Development.* Dordrecht: Kluwer Academic Publishers, 7–27.

Owens, S./Cowell, R., 2002. *Land and Limits: Interpreting sustainability in the planning process.* London: Routledge.

Parr, J., 2005. Perspectives on the city-region. *Regional Studies* 39, (5) 555-566.

Partidario, M. R./Clark, R. eds., 2000. *Perspectives on Strategic Environmental Assessment*. Boca Raton, Florida: Lewis Publishers.

Pierre, J., 1999. Models of Urban Governance. The Institutional Dimension of Urban Politics. *Urban Affairs Review,* 34, (3) 372-396.

Porter, M. E., 1990. *The Competitive Advantage of Nations.* London: Collier Macmillan.

Ravetz, J., 2000a. *City Region 2020: Integrated Planning for a Sustainable Environment.* London: Earthscan

Ravetz, J., 2000b. Integrated assessment for sustainability appraisal in cities and regions. *Environmental Impact Assessment Review,* 20, (1) 31-64.

Runhaar, H./Driessen, P. P. J., 2007. What makes strategic environmental assessment successful environmental assessment? The role of context in the contribution of SEA to decision-making *Impact Assessment and Project Appraisal,* 25, (1) 2–14.

Rydin, Y./Holman, N./Wolff, E., 2003. Local Sustainability Indicators. *Local Environment,* 8, (6) 581-589.

Sassen, S., 2001. *The Global City : New York, London, Tokyo.* updated 2d ed. Princeton: Princeton University Press.

Sassen, S., 2006. *Cities in a World Economy.* updated 3rd ed. Thousand Oaks, Ca: Pine Forge Press.

Savitch, H. V./Kantor, P., 2002. *Cities in the International Marketplace: The Political Economy of Urban Development in North America and Western Europe.* Princeton: Princeton University Press.

Savitch, H. V./Kantor, P., 2003. Urban Strategies for a Global Era. *American Behavioral Scientist,* 46, (8) 1002-1033.

Schnauss, M., 2001. *Der ökologische Fußabdruck der Stadt Berlin.* : Erstellt im Auftrag der Enquetekommission "Lokale Agenda 21 / Zukunftsfähiges Berlin" des Abgeordnetenhauses von Berlin, 14. Wahlperiode, Juli 2001 (Veröffentlicht als KDrs 14/105a). Available from: http://www.agenda21berlin.de/fussabdruck/ [Accessed 10 January 2008].

Scipioni, A./Mazzi, A./Mason, M./Manzardo, A., 2009. The Dashboard of Sustainability to measure the local urban sustainable development: The case study of Padua Municipality. *Ecological Indicators,* 9, (2) 364-380.

Spaargaren, G./Mol, A. P. J./Buttel, F. H. eds., 2006. *Governing Environmental Flows. Global Challenges to Social Theory.* Cambridge, MA and London: MIT Press.

Spangenberg, J. H., 2002. Environmental space and the prism of sustainability: frameworks for indicators measuring sustainable development. *Ecological Indicators,* 2, (3) 295-309.

Starkl, M./Brunner, N./Flögl, W./Wimmer, J., 2009. Design of an institutional decision-making process: The case of urban water management. *Journal of Environmental Management,* 90, (2) 1030-1042.

Sustainable Development Commission, 2008. *Indicators*. Available from: http://www.sd-commission.org.uk/pages/indicators.html [Accessed 22 January 2009].

Technical Guidelines, 2006. *Technische Richtlinien fur die Siedlungswasserwirtschaft.* Wien.

Therivel, R./Partidario, M., 2000. The Future of SEA. *In:* M. R. Partidario and R. Clark, eds.,

UNDP, 1998. *Internet Conference Forum on Public Private Interface in Urban Environmental Management*. Available from: http://www.gdrc.org/u-gov/governance-define.html [Accessed 29 January 2009].

Valentin, A./Gürtler, M./Spangenberg, J. H., 2000. Sustainability and urban policy in Germany: retrospect and prospect. *In:* N. Low, B. Gleeson, *et al.*, eds. *Consuming Cities. The Urban Environment in the Gobal Economy after the Rio Declaration.* London, New York: Routledge, 110–131.

Valentin, A./Spangenberg, J. H., 2000. A guide to community sustainability indicators. *Environ. Impact Assessment Rev*, 20, 381–392.

van den Bergh, J. C. J. M./Verbruggen, H., 1999. Spatial sustainability, trade and indicators: an evaluation of the 'Ecological Footprint'. *Ecological Economics,* 29, 61-72.

van Vuuren, D. P./Smeets, E. M. W., 2001. Ecological Footprints: reply to A.R.B Ferguson. *Ecological Economics,* 37, (2-3).

Wackernagel, M./Rees, W. E., 1996. *Our Ecological Footprint. Reducing Human Impact on the Earth.* Gabriola Island BC: New Society Publishers.

Ward, K. G., 2000. A Critique in Search of a Corpus: Re-Visiting Governance and Re-Interpreting Urban Politics A Critique in Search of a Corpus: Re-Visiting Governance and Re-Interpreting Urban Politics. *Transactions of the Institute of British Geographers, New Series,* 25, (2) 169-185.

Wenstop, F./Seip, K., 2001. Legitimacy and Quality of Multi-Criteria Environmental Policy Analysis: A Meta Analysis of Five MCE Studies in Norway. *Journal of Multi-Criteria Decision Analysis,* 10, 53-64.

While, A./Jonas, A. E. G./Gibbs, D., 2004. The environment and the entrepreneurial city: searching for the urban 'sustainability fix' in Manchester and Leeds. *International Journal of Urban and Regional Research,* 28, (3) 549-569.

Wiedmann, T./Minx, J./Barrett, J./Wackernagel, M., 2006. Allocating Ecological Footprints to Household Consumption Activities by Using Input-Output Analysis. *Ecological Economics,* 56, 28-48.

Winkler, J./Bilitewski, B., 2007. Comparative evaluation of life cycle assessment models for solid waste management. *Waste Management,* 27, (8) 1021-1031.

Wolsink, M., 2003. Reshaping the Dutch planning system: a learning process? *Environment and Planning A*, (35) 705-723.

Woods, C., 1995. *Environmental Impact Assessment. A Comparative Review.* Harlow: Longman.

WSP Environmental and Natural Strategies, 2003. *Towards a Sustainable London - Reducing the Capital's Ecological Footprint. Phase 1 Report: Determining London's Ecological Footprint and Priority Impact Areas for Action*: WSP Environmental Ltd, London and Natural Strategies LLC, Oakland CA. Available from: http://www.londonremade.com/lr_footprinting.asp [Accessed 10 December 2008].

WWF, 2004. *Living Planet Report 2006.* Gland, Switzerland: World-Wide Fund for Nature International (WWF), Zoological Society of London, Global Footprint Network.

Young, S., 1996. *Promoting participation to community-based partnerships in the context of LA21: a report for practitioners'*. European Policy Research Unit Paper no.1/96, Department of Government, University of Manchester.

Zimmermann, K., 2008. Eigenlogik der Staedte - eine politikwissenschaftliche Sicht. *In:* M. Loew and H. Berking, eds. *Eigenlogik der Staedte*. Frankfurt/Main: Campus,