Paper 3 Week 1

FORMS OF SUSTAINABILITY MEASUREMENT IN CITIES

In principle, sustainability outcomes are able to be interpreted through an assessment of the sustainability performance against objectives. In practice, assessment is done with indicators, both qualitative and quantitative. To gain an appreciation of the types of indicators and measurement methodology, it is useful to explore thinking from a cross section of research and practice.

In a review of literature presented at the 1998 and 2001 World Conferences on Transport Research (cited in Black, *et al.*, 2002a), it was found that academic research during the period had not progressed the development of indicators at the urban scale.

Most of the practice reviewed however, did show indicators to help assess the economic, social and environmental implications of scenarios or policy were beginning to be applied in Europe; some were aimed at specific elements of sustainability such as environmental capacity and sustainable accessibility and mobility. There was a large number of suburban scale literature, much of it from North America, none of which was focused on targets or performance indicators, however none of the indicators connected through to higher level goals of the system.

A 2001 review by the Institution of Engineers Australia NSW Transport Panel (cited by Black, *et al.,* 2002a) concluded that transport sustainability indicators and analytical techniques were little progressed since the concept of sustainable development was formulated.

The next sub section looks specifically at the approach of the European Commission leading into the practical applications referred to in Black, *et al.,* (2002a).

Observations of the 1996 Expert Working Group on the Urban Environment

The Expert Working Group (Expert Group on the Urban Environment, 1996) observed that indicator choice is more than purely a technical choice, but also a matter of policy choice. Indicators have important consequences and should be accountable to policy processes. Their work states that 'sustainability indicators are seen as definable, measurable features of the world whose absolute levels or rate and direction of change are intended to reveal whether the world (or a city) is becoming more or less sustainable'(section 2.8, point 2) . The process involving indicators was seen as two way. Indicators are implied by policy aims, but indicators also help to define and mould policy aims.

The process of defining indicators influences notions of what is sustainable development. In many policy areas, proposed indicators can be judged against a clear and secure prior understanding from experience. 'Deficient, or an unbalanced set of sustainability indicators, may devalue, or distort, the understanding of sustainable development, rather than put the worthiness of the indicators into question' (section 2.8, point 5). The Working Group concluded that 'any process of choosing sustainability indicators should be explicit, open and transparent, and that the reasoning behind the choice should be made clear to all those with an interest' (section 2.8, point 6). Involvement of local communities is a particularly important response to the problem of choice in sustainability.

A tension exists in selecting between indicators that have ease of measurement and policy significance. Indicators have to be both practically useful and related to policy aims. Weighting minor or irrelevant factors, simply because they are easy to measure was to be avoided. The Expert Working Group concluded that advantages of indicators are:

> directing information collection, and making it accessible to decision-makers and the public; helping decision making by providing quantifiable measures to guide the application of institutional mechanisms and operational tools, particularly in relation to specifying targets; allowing for comparison over time and space; allowing effectiveness to be measured and progress to be assessed; providing a vision and a range of signposts for a desired future state;
>
> (section 2.8, point 8)

A typology of indicators, was described by the Expert Working Group, focusing firstly on environmental indicators and then on quality of life indicators. Environmental quality indicators and environmental performance indicators are of the first type. Also known as primary indicators they measure condition of key environmental features (such as impact e.g. CO_2 emissions or scarcity). Alternatively, features that are indicative of overall measure of quality or basic trends are desirable.

Environmental performance indicators instead measure the influence of human activities on the environment. Environmental performance indicators can be divided into two types. Secondary indicators measure basic quality by proxy and general effectiveness of policy. Tertiary indicators assess direct effects of particular policies, for example, the level of economic activity, public opinion and so on.

In summary, environmental quality indicators quantify sustainability impacts and environmental performance indicators monitor the outcome of policy decisions.

Another type of environmental indicator concerns integration of environmental issues in economic policies. The Expert Working Group identified these as environmental accounting indicators. Economic valuation on environmental costs and benefits is one form; the other is a system of natural resource accounts to measure quality.

Quality of life indicators are the second main group within the typology of sustainability. They convey attributes of sustainability to the community by translating 'technical' environmental indicators to help generate and facilitate community involvement. Quality of life rather than environmental indicators are seen to be of most interest in engaging community into local Agenda 21 strategies. A particular form of quality of life indicator is reported to be the indicator of sustainable lifestyle options. These are an attempt to measure more qualitative elements of sustainability. Subjective values such as personal growth, education, aesthetics and so on are their basis.

The Expert Working Group in the following statement left a standing challenge for practitioners in planning:

> There is an urgent need for experiment and diversity in sustainability policy and practice. Cities are complex enough to display the full range of problems, yet small enough to make changes relatively quickly - and for problems to be containable. Many European cities have already developed innovative approaches. The environmental problems linked to global sustainability, in

> particular, have diverse causes and require diverse solutions at the level of the individual or household. Many innovative projects have been developed at local community level, and it is important that cities establish policy frameworks to foster these. It will be immensely valuable for policy makers to be able to compare (say) a city which keeps building roads to a similar one which actively restricts traffic.
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> (Expert Group on the Urban Environment, 1996, Chapter 4, p. 113)
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> (http://ec.europa.eu/environment/urban/pdf/rport-en.pdf, Jan 2008)

To illustrate the breadth of sustainability performance assessment approaches, a discussion on a cross section of examples follows:

Indicators and Metrics

A distinction can be made between indicators and metrics. Blakely (2006), highlights the difference. He notes that both metrics and indicators are used in society today to assess the direction of social, economic or natural condition of a metropolitan system. Metric is a term that means an objective measure of condition and process trend, whereas indicator is a judgment of performance. The metric tells only about what has changed and does not contain subjective interpretations of cause within the measure. As such, it provides a consistently quantifiable baseline each year, from which subjective interpretations can then be made. Blakely (2006) points out that good metrics have these characteristics:

> - Addresses fundamental components of a regional system that can be measured over time.
> - Clear and understandable.
> - Can be tracked with regularly collected data from reliable sources.
> - Easy to communicate graphically and in text
> - Measures outcomes and not inputs.
>
> (p. 7)

European Sustainability Indicators

The sustainability indicators in practice in Europe in 2007 are based on ten themes. The framework for the sustainable development indicators reflects key challenges of the sustainable development strategy, as well as the key objective of economic prosperity, and guiding principles related to good governance. The themes focus upfront on an

economic dimension and then progress through social, environmental and institutional dimensions. The indicator set is built on three levels. The three levels of indicators reflect the structure of the strategy with overall objectives, operational objectives and actions and also respond to different kinds of user needs. The headline indicators have the highest communication value. These three-levels of indicators are complemented with contextual indicators, which provide valuable background information but which do not monitor directly the strategy's objectives (see Eurostat, http://epp. eurostat. ec.europa.eu, Jan 2008). The ten themes are shown in Table 2.2.

Table 2.2 European Commission indicator themes 2007

1.Socio economic development	6.Climate change and energy
2.Sustainable consumption and production	7.Sustainable transport
3.Social inclusion	8.Natural resources
4.Demographic changes	9.Global partnership
5.Public health	10. Good governance

(Source: Sustainable development indicators, http://epp.eurostat.ec.europa.eu, Jan 2008)

Seven of these themes correspond to the priority areas of the 2001 Commission Communication "A sustainable Europe for a better World" and the 2002 Communication on Global Partnership, while Production and Consumption Patterns and Good Governance arise from the Plan of Implementation of the World Summit on Sustainable Development.

These were revamped following the 2006 renewed European Sustainable Development Strategy (http://eur-lex.europa.eu /LexUriServ/site/en/ com/2005/ com2005_0658en01.pdf, Jan 2008; http://www.consiliu m.europa.eu/ueDocs /cms_Data/docs/pressData/en/ec/90111.pdf, Jan 2008).

Sub-themes and 'areas to be addressed' are a further division of the themes (see example Figure 2.11). The sub-themes mostly monitor progress towards headline objectives while the ´areas to be addressed` facilitate more detailed and diversified

analysis of background factors in each theme. The sub-themes can also address 'slow burning' concerns that may need a very long time to reverse.

THEME 7: SUSTAINABLE TRANSPORT

(Key SDS challenge: Sustainable transport)

Access to data collection for Sustainable transport

Level 1	Level 2	Level 3
	Sub-theme: TRANSPORT GROWTH	
	2. Modal split of passenger transport	4. Volume of freight transport
	3. Modal split of freight transport	5. Volume of passenger transport (*data not yet available*)
	Sub-theme: TRANSPORT PRICES	
1. Energy consumption by transport mode	6. Road fuel prices	...
	Sub-theme: SOCIAL AND ENVIRONMENTAL IMPACT OF TRANSPORT	
	7. Greenhouse gas emissions by transport, by mode	9. Emissions of ozone precursors from transport
	8. People killed in road accidents	10. Emissions of particulate matter from transport
		11. Average CO_2 emissions per km from new passenger cars

THEME 8: NATURAL RESOURCES

(Key SDS challenge: Conservation and management of natural resources)

Figure 2.11 Example of European Commission indicator sub themes 2007

(Source: Theme 7, sustainable development indicators, http://epp.eurostat.ec.europa.eu, Jan 2008)

Australian Sustainability Indicators

The Ecologically Sustainable Development Transport Working Group1991 reported with many recommendations but did not provide any suggestions on analytical tools, evaluation methods or sustainability indicators. The Australian Government State of the Environment Reporting system provides reporting against the Ecologically Sustainable Development National Strategy and that supports Australia's commitment to Agenda 21 for Sustainable Development and the OECD environmental performance reviews. In 1998, the Australian Government began the evolution of the reporting system with the aim to develop a set of environmental indicators that when properly monitored, would help track the condition of Australia's environment and the human activities that affect it. A process to develop State of the Environment (SOE) indicators saw the commissioning of reports to recommend indicators for each of the following major themes: human settlements, biodiversity, the atmosphere, the land, inland waters,

estuaries and the sea, natural and cultural heritage. The "Human Settlements" report provided an extensive review of the indicator options for urban form and urban transport, suggesting indicators shown in Table 2.3.

Table 2.3 2001 SOE sustainability indicators for Australia

Transport and accessibility

Indicator 4.1:	Access to Public Transport Stops
Indicator 4.2:	Car Ownership
Indicator 4.3	Perceived Residential Density
Indicator 4.4:	Driving Licence Holders by Age and Sex
Indicator 4.5:	CBD Parking Supply and Charges
Indicator 4.6:	Fuel Pricing and Taxing
Indicator 4.7:	Average Speed by Mode and Distance
Indicator 4.8:	Mode Choice by Trip Purpose by Area
Indicator 4.9:	Total Time and Distance Travelled
Indicator 4.10:	Perceived Daytime Density
Indicator 4.11:	Economic Costs of Road Accidents
Indicator 4.12:	Fuel Consumption per Transport Output
Indicator 4.13:	Costs of Congestion

(source: Newton, *et al.*,1998, p. 90)

Table 2.4 State of the environment (SOE) 2006 sustainability indicators

HS-20 Journey to work modal split Data on the modal split of journey to work assists in understanding the pattern of private and public transport use. This pattern depicts how accessible public transport is and how well public transport meets the need of commuters. This pattern is also related to the traffic congestion in inner city areas and to localised air pollution.	CO-30 Length and area of coastal and estuarine foreshore altered for human purposes The impact of human settlements on coastal habitats and ecosystems depends considerably on the form of that urban development.
HS-76 Vehicle kilometers travelled Kilometres travelled is an indicator of the accessibility of work and services required by settlement residents.	HS-06 Population density patterns in major cities Population density in major cities is an aspect of settlement patterns that has major implications for the environment of settlements.
A-35 Projections of motor vehicle travel and pollutant emissions	HS-30 Average size of new residential lots in capital cities

Motor vehicle projections are an indicator of trends in the reliance of the community on motor vehicle transport.	The average size of residential lots in capital cities is a surrogate indicator for density patterns in cities. The balance between residential lot size, dwelling floor size and population size contribute to the population density in settlements.
LD-15 Area and proportion of land surface occupied by human settlements, structures and activities that support human settlement The amount of urbanised area and changes in this area over time is an indicator of the level and rate of use of land by human settlements.	HS-51 Average floor area of new dwellings The size of newly built dwellings is an indicator of the liveability of human settlements. This indicates the amount of living space that is available for the inhabitants and will have an effect on settlement density, resource use and energy use.
HS-78 Housing demand (see note1) Demand for housing is an indicator of the pressure to build more housing, placing increasing pressure on the environment through the direct displacement of habitats and as a result of increasing other pressures of human settlements.	note1: Estimated using median house prices (capital cities) and the Real Estate Institute of Australia (REIA) housing affordability index (ratio of median family income to average new loan repayments).

(source: http://www.environment.gov.au/soe/2006/publications/drs/indicator, Jan 2008)

However, when it comes to specific urban planning and urban transport focused sustainability indicators, these are not as well considered given that the role of urban and transport development rests largely with state governments.

The 1998 Organisation for Economic Cooperation and Development (OECD) report (section 2, p. 8) pointed out that while Australia has a well developed strategy, there is a need to press on with increasing the intergovernmental co-operation and into implementation (http://www.environment.gov.au/commitments/oecd /publications/pubs/ oecd.pdf, Jan 2008).

In 2001, the Australian Government endorsed a set of headline sustainability indicators in response to the Ecologically Sustainable Development Strategy. Twenty four indicators were selected to collectively measure Australia's national performance against the core objectives of the Strategy (NSESD). These are reported through to the United Nations Commission for Sustainable Development and to the OECD. Some of the twenty four indicators selected, came from the State of the Environment (SOE)

theme indicator recommendations, however, none were specifically for urban form and urban transport. The SOE theme indicators for "Human Settlements" were introduced to the SOE reporting in 2001 (see Table 2.4).

Approach by OECD Environmental Policy Committee's Task Force on Transport

The Organisation for Economic Co-operation and Development (OECD) Environmental Policy Committee's Task Force on Transport initiated a project on Environmentally Sustainable Transport (EST) in 1994.

Six environmental criteria for the transport sector were developed for the EST initiative as being the minimum number required to encompass the wide range of health and environmental impacts from transport. They include the greenhouse gas criteria which have global effects, local criteria which have a direct effect on health and amenity, together with other environmental stewardship criteria related to biodiversity and intergenerational aspects of the environment. (http://esteast.unep.ch/default.asp?community=est-east&page_id=5E423E42-1FFA-4B5F-9749-B4C414CC92CF, Jan 2008). Table 2.5 lists the criteria and provides quantitative goals for each.

Table 2.5 Agreed list of OECD environmental criteria and targets for environmentally sustainable transport

CO_2 Climate change is prevented by reducing carbon dioxide emissions so that atmospheric concentrations of CO_2 are stabilised at or below their 1990 levels. Accordingly, total emissions of CO_2 from transport should not exceed 20% to 50% of such emissions in 1990 depending on specific national conditions.	***NO_x*** Damage from ambient NO_2 and ozone levels and nitrogen deposition is greatly reduced by meeting WHO Air Quality Guidelines for human health and eco-toxicity. This implies that total emissions of NO_x from transport should not exceed 10% of such emissions in 1990.
VOCs Damage from carcinogenic VOCs and ozone is greatly reduced by meeting WHO Air Quality Guidelines for human health and ecosystem protection. Total emissions of transport-related VOCs should not exceed 10% of such emissions in 1990 (less for extremely toxic VOCs).	***Particulates*** Harmful ambient air levels are avoided by reducing emissions of fine particulates (especially those less than 10 microns in diameter). Depending on local and regional conditions, this may entail a reduction of 55% to 99% of fine particulate (PM_{10}) emissions from transport, compared with 1990 levels.
Noise Noise from transport no longer results in outdoor noise levels that present a health concern or serious nuisance. Depending on local and regional conditions, this may entail a reduction of transport noise to no more than a maximum of 55 dB(A) during the day and 45 dB(A) at night and outdoors.	***Landuse/Landtake*** Land use and infrastructure for the movement, maintenance, and storage of transport vehicles is developed in such a way that local and regional objectives for air, water, eco-system and biodiversity protection are met. Compared to 1990 levels, this will likely entail the restoration and expansion of green spaces in built-up areas.

(Source: OECD, 2002b, p. 45)