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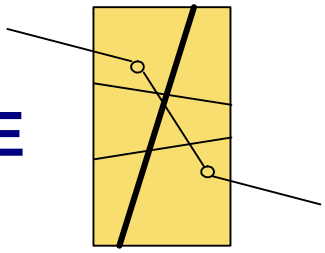
TISSUE



Trends and Indicators for Monitoring the EU Thematic Strategy on Sustainable Development of Urban Environment

Final report
Summary and recommendations

Specific Targeted Research
Programme: Integrating and Strengthening
the European Research Area
Activity: Policy Support and Anticipating Scientific
Technological Needs
Contract: SSP1-CT-2003-502427

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Summary and recommendations

Tarja Häkkinen, ed.

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Keywords sustainable development, urban environment, indicators

Abstract

Trends and Indicators for Monitoring the EU Thematic Strategy on Sustainable Development of Urban Environment (TISSUE) belonged to the 6th framework programme area "Integrating and Strengthening the European Research Area" and to the activity "Policy Support and Anticipating Scientific Technological Needs". This report summasises the main results of the project.

The overall goal of the project was the following:

1) to analyse demand and define appropriate trends which should be measured to properly determine progress towards sustainable development of the urban environment at local level;

2) to carry out comparative research on existing sets of indicators to determine whether they: i) are able to provide the information needed to monitor developments at local level on the trends identified in the first step; ii) can be used to assess trends at the EU level; iii) their implementation is viable;

3) to define the set-up needed for a harmonised set or subset of indicators and for effectively utilising the information from existing indicators to build an adequate picture at EU level and identify gaps to be filled. Make recommendations for further research;

4) to collect indicators and structure the indicators into a database.

The indicators considered were urban environment indicators in use or being developed at EU level (e.g. European Common Indicators, Urban Audit), National level in the 15 EU member states and candidate countries, and at regional and/or local level in use across EU. **TISSUE** outlined the urban indicators considering the following main areas: sustainable urban transport, sustainable urban design**,** sustainable urban construction**,** sustainable urban management and sustainable urban environment (energy, emissions, air quality, noise, wastes, biodiversity).

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Avainsanat sustainable development, urban environment, indicators

Tiivistelmä

Tässä julkaisussa esitetään yhteenveto EU:n komission kuudennessa puite-ohjelmassa toteutetun TISSUE- (*Trends and indicators for monitoring the EU thematic strategy on sustainable development of urban environment*) hankkeen tuloksista.

TISSUE-hankkeen tavoitteena oli

1) analysoida kaupunkien kestävän kehityksen huolenaiheet ja trendit
2) kerätä ja vertailla kaupunkien kestävän kehityksen indikaattorisysteemeitä ja indikaattoreita
3) analysoida eri indikaattoreiden soveltuvuutta kaupunkien kestävän kehityksen seurantaan sekä laatia ehdotus harmonisoitavaksi indikaattorisysteemiksi. Ehdotettujen indikaattoreiden avulla tulisi voida seurata kaupunkialueiden temaattisen strategian toteutumista ja kestävää kehitystä paikallisella tasolla.
4) laatia verkkoon TISSUE-selain, jonka avulla voidaan etsiä indikaattoreita eri tarpeisiin.

TISSUE-hanke analysoi ja vertaili kaupunkien kestävän kehityksen trendejä ja indikaattoreita neljän pääteeman suhteen. Pääteemoja olivat:
1) kaupunkialueiden kestävä hallinto (*Sustainable urban management*)
2) kaupunkialueiden kestävä liikenne (*Sustainable urban transport*)
3) kaupunkialueiden kestävä rakentaminen (*Sustainable urban construction*)
4) kaupunkialueiden kestävä aluesuunnittelu *(Sustainable urban design)*.

Preface

TISSUE FINAL REPORT
SUMMARY AND RECOMMENDATIONS
April 2005 (04.042005)

Specific Targeted Research
Programme: Integrating and Strengthening the European Research Area
Activity: Policy Support and Anticipating Scientific Technological Needs
Contract: SSP1-CT-2003-502427

Project Coordinator:
VTT – Valtion teknillinen tutkimuskeskus (Finland)

Partners:
ISIS – Istituto di Studi per l'Integrazione dei Sistemi (Italy)
CSTB – Centre Scientifique et Technique du Bâtiment (France)
ECONCEPT – Forschung Beratung Projektmanagement (Switzerland)
CEI – Cesky Ekologicky Ustav (Czech Republic)
TNO – Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek (the Netherlands)
AMBIENTE ITALIA Istituto di Ricerche (Italy)
UNN – University of Northumbria at Newcastle (the United Kingdom)
CEMR – The Council of European Municipalities and Regions
UBC – Union of Baltic Cities
REC – The Regional Environmental Center for Central and Eastern Europe
ICLEI – ICLEI European Secretariat GmbH
EUROCITIES ASBL

Contents

Foreword

Within the 6th Environment Action Programme, the Commission will develop a Thematic Strategy on the Urban Environment. The work will include the development of appropriate indicators and other monitoring tools to assess the effectiveness of the strategy. This task was taken as a premise for the 6th framework project **TISSUE**, which started in the beginning of 2004.

The main objective of the project was to define the set-up needed for a harmonised set of indicators to monitor the sustainable development of urban environment.

TISSUE belonged to the 6th framework programme area "Integrating and Strengthening the European Research Area" and to the activity "Policy Support and Anticipating Scientific Technological Needs". **TISSUE** collected research organisations from seven European countries including VTT (Finland), TNO (the Netherlands), UNN (the UK), CSTB (France), Ambiente Italia and ISIS (Italy), ECONCEPT (Switzerland) and CEI (Czech Republic). In addition, five organisations representing cities and local municipalities were members of the project. These include the ICLEI Europe, REC (The Regional Environmental Center for Central and Eastern Europe), EUROCITIES, CEMR and the Union of Baltic Cities. VTT was the coordinator of the project.

Participant name	Participant short name	Country
Technical Research Centre of Finland VTT	VTT	Finland
Institute of studies for the integration of systems	ISIS	Italy
Centre Scientifique et Technique du Bâtiment (French Scientific and Technical Building Institute)	CSTB	France
Econcept AG	ECONCEPT	Switzerland
The Czech Environmental Institute	CEI	Czech Republic
the Netherlands Organisation for Applied Scientific Research	TNO	the Netherlands
Ambiente Italia Research Institute	AMBIENTE ITALIA	Italy
The Council of European Municipalities and Regions	CEMR	Belgium
Sustainable Cities Research Institute, Northumbria University	UNN	UK
Union of the Baltic cities	UBC	
The Regional Environmental Center for Central and Eastern Europe	REC	
International Council for Local Environmental Initiatives	ICLEI-EUROPE	
	EUROCITIES	

The final report of the project includes the summary of the results, conclusions and recommendations for future work. The final report summarises the project results concerning trends and indicators for monitoring the sustainable development of urban environment. In addition the final report presents the final conclusions and recommendations of the **TISSUE** project concerning the use of a harmonised set of indicators and further needs to implement the indicators in order to monitor sustainable development of urban environment.

TISSUE started summarising the key results of sustainable urban development related projects and thematic networks within the 5th framework programme of the European Commission and concluded the general state-of-the-art of sustainable urban indicators paying attention to the different levels of approach (EU, national, city, neighbourhood, built environment, construction) and to the

different levels of decision-making. **TISSUE** outlined the urban indicators considering the following main areas: sustainable urban transport, sustainable urban design**,** sustainable urban construction**,** sustainable urban management and sustainable urban environment (energy, emissions, air quality, noise, wastes, biodiversity).

This report presents the main outcomes of the project. The report includes five parts:

- Part 1 introduces the background and context of sustainability indicators of urban environments
- Part 2 introduces the relevant sustainable urban trends and concerns selected by the TISSUE project
- Part 3 describes the relevant existing sets of indicators to monitor sustainable development of urban environments
- Part 4 introduces the set of indicators selected by the TISSUE project
- Part 5 presents the conclusions and recommendations formulated by the project.

All deliverables of the project can be downloaded from the **TISSUE** web page:

http://cic.vtt.fi/projects/tissue/

PART 1:
Background and context

1 Introduction

1.1 Project objectives

Within the 6th Environment Action Programme, the Commission will develop a Thematic Strategy on the Urban Environment. The work will include the development of appropriate indicators and other monitoring tools to assess the effectiveness of the strategy. This task was taken as a premise for the project.

The problem addressed to the project [1] was to analyse a vast range of urban indicator initiatives in use and under development in research and policy-led contexts, and to find out from these initiatives – which have different origins, detailed objectives and ambitions and are often developed independently from each other – a harmonised set or subset of compatible indicators that can be aggregated to provide an adequate picture at EU level of trends towards Sustainable Development of the urban environment. The focus is linked to the preparation of the EC Thematic Strategy on the Urban Environment, and consideration needs to be given to whether information from existing indicators will be adequate to monitor the urban sustainable development or whether further indicators will need to be developed.

The overall goal of the project was the following:

1) **to analyse demand and define appropriate trends** (in consultation with the Commission) which should be measured to properly determine progress towards sustainable development of the urban environment at local level;

2) **to carry out comparative research on existing sets of indicators** to determine whether they: i) are able to provide the information needed to monitor developments at local level on the trends identified in the first step; ii) can be used to assess trends at the EU level; iii) their implementation is viable (good balance between the indicators' ability to measure the trends and the costs of data collection and elaboration);

[1] Scientific support to policies, FP6, Specific programme 'Integrating and strengthening the European Research Area. Area 1.2.1 (i) Policy-oriented research. DETAILED TASKS DESCRIPTION (first year).

3) **to define the set-up needed for a harmonised set or subset of indicators** and for effectively utilising the information from existing indicators to build an adequate picture at EU level and identify gaps to be filled. Make recommendations for further research;

4) **to collect indicators and structure the indicators into a database.**

The indicators considered were urban environment indicators in use or being developed at EU level (e.g. European Common Indicators, Urban Audit), National level in the 15 EU member states and candidate countries, and at regional and/or local level in use across EU.

The objective of the project was to make recommendations about the usability and usefulness of different sets of indicators. This was assessed from the following points of view: (1) how these indicators serve for monitoring the sustainable progress and the effectiveness of undertaken actions at different levels (neighbourhood, city, local-regional, state) (2) what is the methodological level of indicators enabling the rightful comparisons, (3) what is the need of common indicators versus specific indicators which consider area-specific premises, (4) what are the needs for further development to serve for the stated needs of the Commission. When formulating recommendations, **TISSUE** also took into account that the acceptance and implementation readiness of the cities are among the main bottle-necks and problems for the common usage of urban environment indicators.

Figure 1 introduces the main tasks and results of the project.

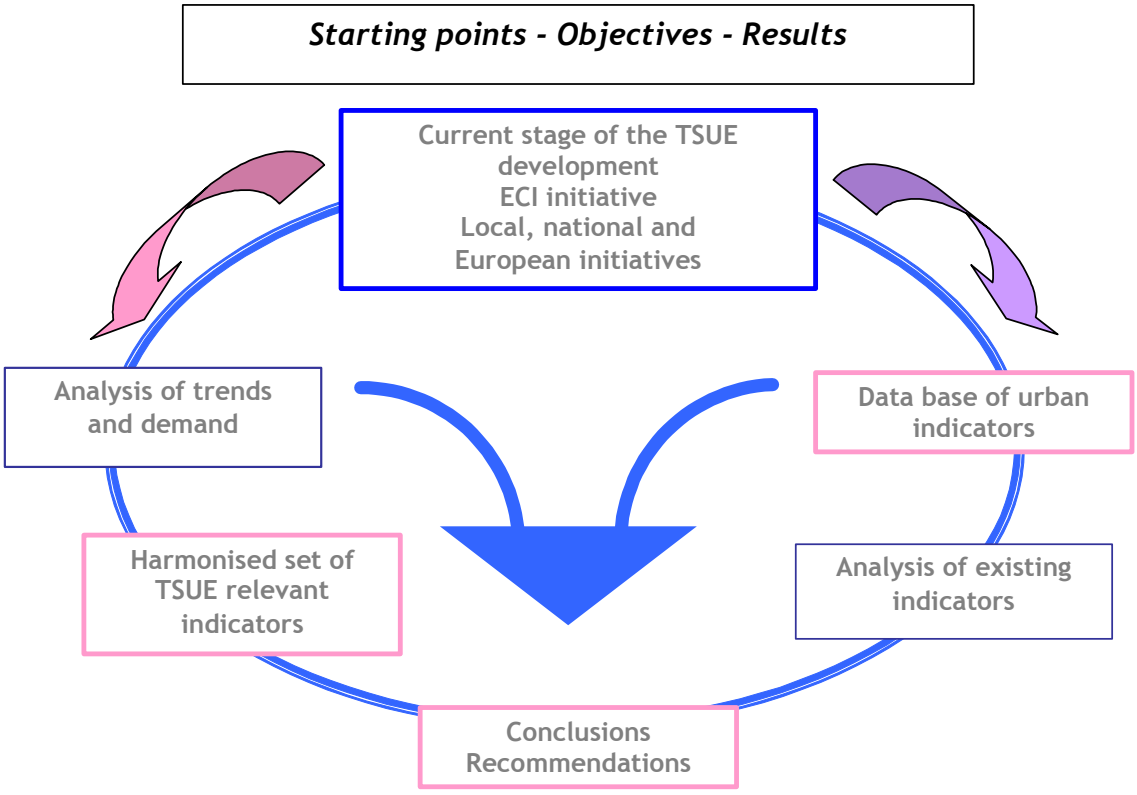

Figure 1. Main tasks and results of ***TISSUE****.*

2 Background

2.1 Sixth Community Environment Action Programme

The Sixth EU Environmental Action Programme (EAP) establishes major environmental objectives and priorities for the next 10 years and beyond and sets out the actions that need to be taken over the coming 5 to 10 years to achieve these objectives. Whilst it focuses on actions and commitments that need to be made at the Community level, it also identifies actions and responsibilities that need to be addressed at the national, regional and local levels and in the different economic sectors. The Programme aims at:

- emphasising climate change as an outstanding challenge of the next 10 years and beyond and contributing to the long term objective of stabilising greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system;
- protecting, conserving, restoring and developing the functioning of natural systems, natural habitats, wild flora and fauna with the aim of halting desertification and the loss of biodiversity, including diversity of genetic resources, both in the European Union and on a global scale;
- contributing to a high level of quality of life and social well being for citizens by providing an environment where the level of pollution does not give rise to harmful effects on human health and the environment and by encouraging a sustainable urban development;
- better resource efficiency and resource and waste management to bring about more sustainable production and consumption patterns, thereby decoupling the use of resources and the generation of waste from the rate of economic growth and aiming to ensure that the consumption of renewable and non-renewable resources does not exceed the carrying capacity of the environment.

The Programme proposes five priority avenues of strategic action to help us meet the environmental objectives: Improving the implementation of existing legislation, integrating environmental concerns into other policies, encouraging market to work for the environment, empowering citizens and changing behaviour and greening land-planning and management decisions.

Four priority areas for action are as follows:

- Tackling climate change; with an objective to stabilise the atmospheric concentrations of greenhouse gases at a level that will not cause unnatural variations of the earth's climate.
- Nature and bio-diversity – protecting a unique resource; with an objective to protect and restore the functioning of natural systems and halt the loss of biodiversity in the European Union and globally as well as to protect soils against erosion and pollution.
- Environment and health; with an objective to achieve a quality of the environment where the levels of man-made contaminants, including different types of radiation, do not give rise to significant impacts on or risks to human health.
- Sustainable use of natural resources and management of wastes; with an objective to ensure the consumption of renewable and non-renewable resources does not exceed the carrying capacity of the environment as well as to achieve a de-coupling of resource use from economic growth through significantly improved resource efficiency, dematerialisation of the economy, and waste prevention.

Thematic Strategies are actions foreseen within the 6th EAP. This concept was introduced as a specific way to tackle seven key environmental issues, which require a holistic approach because of their complexity, the diversity of actors concerned and the need to find multiple and innovative solutions.

The Seven Thematic Strategies will be developed according to a common approach independently of the specific content requirements relating to their subject matter: TS1: Clean Air For Europe (CAFE), TS2: Soil protection , TS3: Sustainable use of pesticides, TS4: Protect and conserve the marine environment, TS5: Waste prevention and recycling, TS6: Sustainable use of natural resources, TS7: Urban environment (TSUE).

2.2 Thematic Strategy on the Urban Environment (TSUE)

2.2.1 Introduction

The thematic strategy on the urban environment is a tool with help of which the Community aims to contribute to the realisation of the goals of sustainable development of cities and high quality of life for Europe's urban citizens (Fig. 2).

The overall aim of the Thematic Strategy on Urban Environment (TSUE) is to improve the environmental performance and quality of urban areas and to secure a healthy living environment for Europe’s urban citizens, reinforcing the environmental contribution to sustainable urban development while taking into account the related economic and social issues.

In order to fulfil the mandate set out in the 6th EAP, the Thematic Strategy for the Urban Environment will focus on four cross-cutting themes which are essential to the long-term sustainability of towns and cities, which have clear connections to the economic and social pillars of sustainable development and where the most significant progress can be achieved. These themes, which have been determined in consultation with the EU Expert Group on the Urban Environment and other stakeholders, are

- sustainable urban management,
- sustainable urban transport,
- sustainable urban construction and
- sustainable urban design.

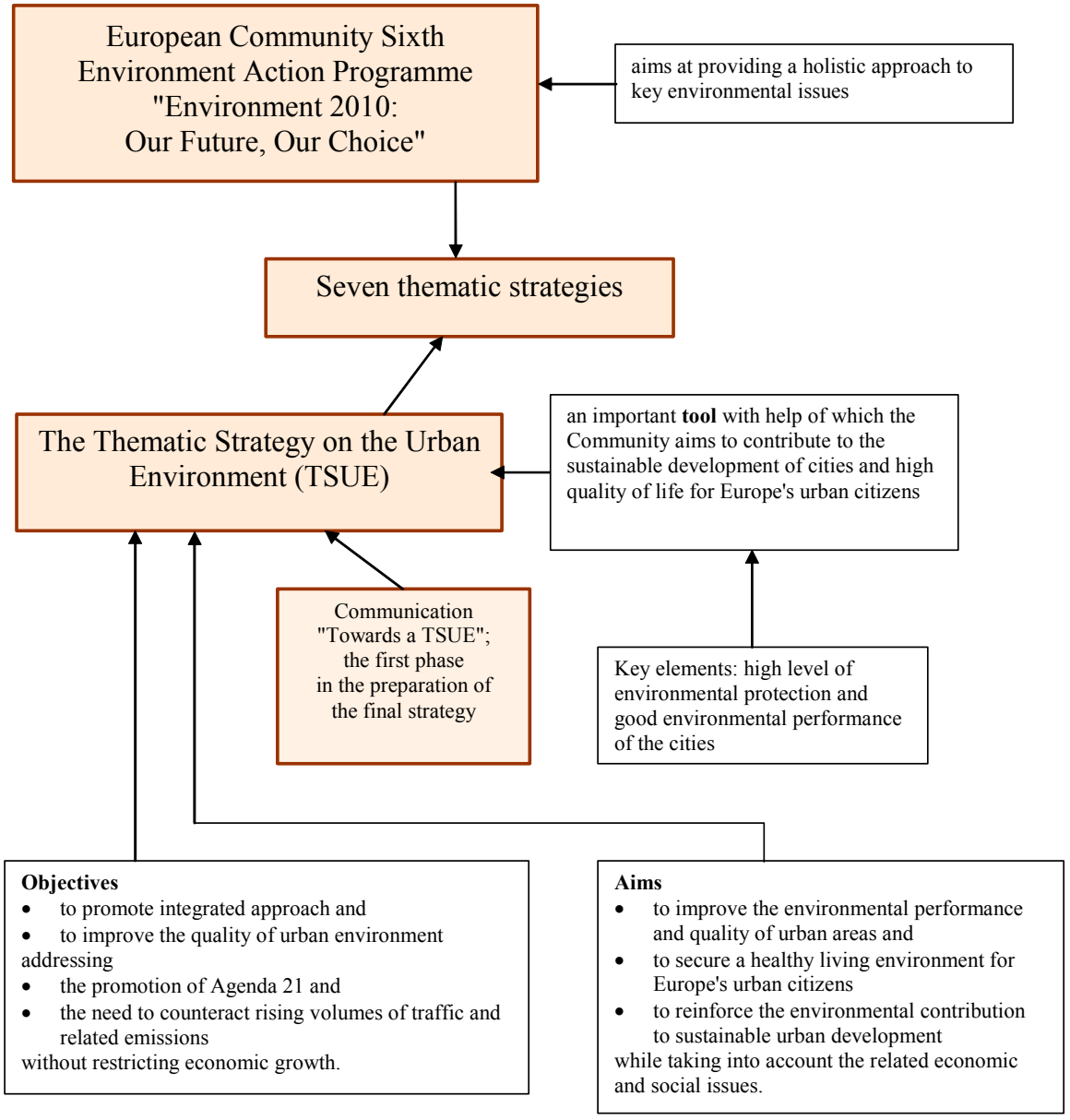

Figure 2. The Role and Position of the Thematic Strategy on the Urban Environment with regard to the Sixth Environment Action Programme.

2.2.2 Sustainable urban management

Sustainable urban management is a process through which the sustainable development of urban areas, their immediate environs and the regions within which they are located may be secured. It seeks to minimise the negative impacts of urban areas on ecological cycles at all levels, applying the precautionary principle, and to improve ecological conditions to make cities healthy places to live. It

- focuses upon the preservation of the natural environment within its social and economic context, integrating the environment into other policies, and recognising the interrelated nature of the social, the economic and the environmental, and the need to secure equitable and just policy outcomes.
- requires reformed organisational structures which enable integrated policy approaches to urban problems to be developed, and is based on the best available information on the state of environment, using the most suitable approaches and tools which meet the specific needs of the urban areas in question. Local authorities are the natural hosts of sustainable urban management.
- develops a culture of learning, understanding and respect within organisations and amongst individuals involved in the processes of sustainable development policy making, and involves the participation of stakeholders, interest organisations and citizens in an open and inclusive decision making process.
- is a continuing cycle of problem analysis, planning and programming, implementation, monitoring, progress assessment, and evaluation that builds on accumulated knowledge and experience, ensuring that new policy approaches learn from past performance, and recognises the need for long term vision in policy making.

Proposed SUM actions are the following.

- Each capital city and every other city and town of over 100.000 inhabitants should adopt an environmental management plan for the urban area as a whole, together with targets related to the key environmental impacts, and should implement an environmental management system to manage this process and deliver these objectives. The Commission believes that there

could be a requirement at the EU level to this effect. This point will be the subject of further consultations.

- The Commission will develop guidelines for the implementation by local authorities of such management systems. Member States will be encouraged to ensure that local authorities have the necessary support, such as training and advice to implement an environmental management system.
- The Commission will explore opportunities for training, research and exchange of experience on sustainable urban management.

2.2.3 Sustainable urban transport

A sustainable urban transport system supports the freedom of movement, health, safety and quality of life of the citizens of current and of future generations. It is environmentally efficient; and supports a vibrant, inclusive economy, giving access to opportunities and services to all, including less affluent, elderly or disabled urban citizens and non-urban citizens. It achieves these objectives by, amongst others:

- promoting a more rational use of private cars, and favouring clean, quiet energy efficient vehicles powered by renewable or alternative fuels;
- providing a regular, frequent, comfortable, modern, competitively priced, well linked network of public transport;
- strengthening the share of non-motorised transport (walking and cycling);
- making the most efficient use of land;
- managing transport demand through the use of economic instruments and plans for behavioural change and mobility management;
- being actively managed, in an integrated manner, with the participation of all the stakeholders;
- having quantified short, medium + long-term objectives, with an effective monitoring system.

Proposed SUT actions are the following:

- Each capital city and every city and town of over 100.000 inhabitants should develop, adopt, implement and regularly revise a sustainable urban transport plan, with short, medium and long-term targets. The Commission believes

that there could be a requirement at the EU level to this effect. This point will be the subject of further consultations in 2004, amongst others in the context of a specific working group of experts and stakeholders.

- All Member States will be encouraged to:
  - set out a clear framework policy on sustainable urban transport;
  - evaluate the impacts of new urban transport infrastructure projects on the sustainability of the town's transport system;
  - closely follow the guidelines on the use of structural funds.
- In the framework of the White Paper on European Transport Policy, the Commission is preparing a Directive focussing on the procurement of low energy and low emission road vehicles by public authorities. The aim of this will be to encourage the purchase of cleaner and more efficient vehicles, but it will not set new vehicle standards or encroach on existing vehicle tax incentive frameworks.
- In the framework of the Alternative Fuel Strategy, the Commission will propose an Action Plan promoting the market development for alternative fuels, in particular natural gas and hydrogen.
- The Commission will continue to develop and expand the CIVITAS programme, urban research initiatives and the exchange of good practice and experience.
- The Commission will develop the transport-related capacities of the 250 or more local and regional Energy agencies and other agencies in Europe to support the implementation of sustainable urban transport and promote best practices.
- The Commission will identify a basic set of sustainable urban transport indicators, making use of the work of the European Conference of Ministers of Transport in this field.
- The Commission will continue promotional activities such as the European car free day and mobility week. The need for guidance and training on sustainable urban transport issues and the contribution of new working methods such as tele-working will be assessed.

2.2.4 Sustainable urban design

Sustainable urban design is a process whereby all the actors involved (national, regional and local authorities, citizens, community based organisations, NGOs, academics and enterprises) work together to integrate functional, environmental and quality considerations to design and plan a built environment that:

- creates beautiful, distinctive, secure, healthy and high quality places for people to live and work in that foster a strong sense of community, pride, social equity, integration and identity;
- supports a vibrant, balanced, inclusive and equitable economy that promotes urban regeneration;
- treats land as a precious resource that must be used in the most efficient way possible, reusing land and empty property within the urban area in preference to seeking new land outside and avoiding urban sprawl (compact cities and, at the regional level, concentrated decentralisation);
- considers the relationship between cities and their hinterlands and wider regions;
- ensures that new developments are located strategically, accessible by public transport, and respecting the natural environment (biodiversity, health, environmental risk);
- has sufficient density and intensity of activity and use so that services such as public transport are viable and efficient whilst respecting a high quality living environment (privacy, personal space and minimising adverse effects such as noise);
- promotes a mixed land use to make best use of benefits of proximity in order to minimise the need to travel between home, shops and employment;
- has a green structure to optimise the ecological quality of the urban area (biodiversity, micro climate and air quality);
- has high quality and well planned infrastructure including public transport services, streets, paths and cycle ways to promote accessibility, particularly for disadvantaged communities, and to support a high level of social, cultural and economic activity;
- makes use of state of the art resource saving approaches such as low energy housing, fuel efficient transport, district heating and recycling systems;
- respects and enhances existing cultural heritage and communities.

Proposed SUD actions are the following.

All Member States will be encouraged to:

- ensure that their land use planning systems achieve sustainable urban settlement patterns and take into account environmental risks, and to undertake a review to assist this;
- develop incentives to encourage the reuse of brownfield land over the use of greenfield land, create national databases of brownfield land and set challenging targets for its reuse, and provide support for the reuse of empty properties in urban areas;
- set minimum residential land use densities to encourage higher density use and limit urban sprawl;
- evaluate the consequences of climate change for their cities so that inappropriate developments are not begun and adaptations to the new climatic conditions can be incorporated into the land use planning process.

The Commission will prepare guidelines on "high density, mixed use" spatial planning, and will propose definitions of brownfield and greenfield land. The Commission will explore the possibility of developing other guidelines on specific urban design issues.

The Commission will explore opportunities for training, exchange of experience and further research on sustainable urban design.

The European Environment Agency (EEA) will continue to monitor land use and land cover changes as a priority data set for the future. Urban sprawl and land use will be the subject of a special report by the EEA.

2.2.5 Sustainable urban construction

Sustainable construction is a process where all the actors involved (e.g. owner, financier, engineer, architect, builder, material supplier, permitting authority) integrate functional, economic, environmental and quality considerations to produce and renovate buildings and a built environment that is:

- attractive, durable, functional, accessible, comfortable and healthy to live in and use,
- promoting the well-being of all that come into contact with it.

- resource efficient, in particular with respect to energy, materials and water, favouring the use of renewable energy sources and needing little external energy to function, making appropriate use of rain and ground water and correctly handling waste water, and using materials that are environmentally friendly, that can be readily recycled or reused, that contain no hazardous compounds and can be safely disposed of.
- respecting the neighbourhood and local culture and heritage.
- competitively priced, especially when taking into account longer-term considerations, such as maintenance costs, durability and re-sale prices.

Proposed SUC actions are the following.

The Commission will develop a common methodology for evaluating the overall sustainability of buildings and the built environment, including life-cycle cost indicators. This will also be applicable to the plans for new building and significant renovations. All Member States will be encouraged to adapt and adopt this methodology and to use it in support of best practice. The Commission will then propose further non-energy-related environmental performance requirements to complement Directive 2002/91 on the energy performance of buildings, taking into account the methodology of this Directive.

As indicated in Directive 2002/91, the Commission, assisted by the Committee established by the Directive, will examine possible ways to address the renovation of smaller buildings and general incentives for energy efficiency.

All Member States will be encouraged to develop and implement a national sustainable construction programme, and set high performance requirements using European harmonised standards and the Eurocode. Local authorities will similarly be encouraged to promote sustainable construction.

All Member States, local authorities and other public purchasers will be encouraged to introduce sustainability requirements in their own tendering procedures for buildings and other construction works and in relation to the use of public funds for buildings and other construction works. They will be encouraged to develop fiscal incentives for more sustainable buildings.

The Commission will explore opportunities for training, guidance, exchange of experience and further research on sustainable construction.

The Commission will consider measures to tackle the growing levels of construction and demolition waste as part of the Thematic Strategy on the Prevention and Recycling of Waste.

The Commission will develop the environmental labelling of construction materials (EPDs and/or EU eco-label), and will propose an EU eco-label and/or a harmonised EPD for buildings and/or building services.

2.3 Sustainability indicators

2.3.1 Criteria, requirements and functions

An indicator can be defined as something that helps us to understand where we are, where we are going and how far we are from the goal. Therefore it can be a sign, a number, a graphic and so on. It must be a clue, a symptom, a pointer to something that is changing.

Indicators are presentations of measurements. They are bits of information that summarize the characteristics of systems or highlight what is happening in a system. A more rigorous definition is given by the International Institute for Sustainable Development (IISD): "An indicator quantifies and simplifies phenomena and helps us understand complex realities. Indicators are aggregates of raw and processed data but they can be further aggregated to form complex indices."

According to OECD terminology, indicator is "a parameter, or a value derived from parameters, which points to, provides information about, describes the state of a phenomenon/environment/area, with a significance extending beyond that directly associated with a parameter value". According to Gudmundsson (1999), indicators are "selected, targeted, and compressed variables that reflect public concerns and are of use to decision-makers".

Reviewing a selection of literature on social, environmental, health and sustainability indicators, Mac Laren (1996) identifies a list of criteria, which is commonly used in the process of selecting indicators. The criteria are as follows:

- scientifically valid;
- representative of broad range of conditions;
- responsive to change;
- relevant to the needs of potential users;
- based on accurate accessible data;
- based on data that are available over time;
- understandable by potential users;
- comparable with indicators developed in other jurisdictions;
- cost-effective to collect;
- attractive to the media; and
- unambiguous.

In addition to satisfying this criteria for each indicator threshold and target values, or at least desirable trend direction, should be determined.

Most of the points suggested by MacLaren are included in the following criteria for environmental indicators defined by the OECD (1999) (Table 1), which describes an ideal indicator in terms of policy relevance and utility for users, analytical soundness and measurability.

Table 1. Environmental indicators defined by the OECD.

OECD-CRITERIA FOR ENVIRONMENTAL INDICATORS
POLITICAL RELEVANCE AND UTILITY FOR THE USERS
An environmental indicator should – provide a representative picture of environmental conditions, pressures on the environment and society's responses; – be simple, easy to interpret and be able to show trends over time; – be responsive to changes in the environment and related human activities; – provide a basis for international comparisons; – be either national in scope or applicable to regional environmental issues of national significance; – have a threshold or reference value against which to compare it so that users are able to assess the significance of the values associated with it.
ANALYTICAL SOUNDNESS
An environmental indicator should – be theoretically well founded in technical and scientific terms; – be based on international standards and international consensus about its validity; – lend itself to being linked to economic models, forecasting and information systems.
MEASURABILITY
The data required to support the indicators should be – readily available or made available at a reasonable cost/benefit ratio; – adequately documented and of known quality; – updated at regular intervals in accordance with reliable procedures.

By far the most extensive and comprehensive criteria have been developed by an international group of practitioners and researchers who gathered in Bellagio, Italy. The Bellagio principles (Table 2) for assessment of sustainable development serve as guidelines for the whole of the assessment process including the choice and design of indicators, their interpretation and

communication of the result. They are interrelated and should be applied as a complete set.[2]

Table 2. Bellagio principles for assessment of sustainable development.

BELLAGIO PRINCIPLES
Principle 1. Guiding Vision and Goals: Assessment of progress toward sustainable development should be guided by a clear vision of sustainable development and goals that define that vision
Principle 2. Holistic Perspective: Assessment of progress toward sustainable development should: – include review of the whole system as well as its parts – consider the well-being of social, ecological, and economic sub-systems, their state as well as the direction and rate of change of that state, of their component parts, and the interaction between parts – consider both positive and negative consequences of human activity, in a way that reflects the – costs and benefits for human and ecological systems, in monetary and non-monetary terms
Principle 3. Essential Elements: Assessment of progress toward sustainable development should: – consider equity and disparity within the current population and between present and future generations, dealing with such concerns as resource use, over-consumption and poverty, human rights, and access to services, as appropriate – consider the ecological conditions on which life depends – consider economic development and other, non-market activities that contribute to human/social well-being
Principle 4. Adequate Scope: Assessment of progress toward sustainable development should: – adopt a time horizon long enough to capture both human and ecosystem

[2] Hardi; Zdan (1997); see also http://iisd1.iisd.ca/measure/1.htm)

BELLAGIO PRINCIPLES
timescales **thus** responding to needs of future generations as well as those current to short term decision-making – define the space of study large enough to include not only local but also long distance impacts on people and eco-systems – build on historic and current conditions to anticipate future conditions – where we want to go, where we could go
Principle 5. Practical Focus: Assessment of progress toward sustainable development should be based on: – an explicit set of categories or an organising framework that links vision and goals to indicators and assessment criteria – a limited number of key issues for analysis – a limited number of indicators or indicator combinations to provide a clearer signal of progress standardising measurement wherever possible to permit comparison – comparing indicator values to targets, reference values, ranges, thresholds, or direction of trends, as appropriate
Principle 6. Openness: Assessment of progress toward sustainable development should: – make the methods and data used accessible to all – make explicit all judgments, assumptions, and uncertainties in data and interpretations
Principle 7. Effective Communication: Assessment of progress toward sustainable development should: – be designed to address the needs of the audience and set of users – draw from indicators and other tools that are stimulating and serve to engage decision-makers – aim, from the outset, for simplicity in structure and use of clear and plain language

BELLAGIO PRINCIPLES
Principle 8. Broad Participation: Assessment of progress toward sustainable development should: – obtain broad representation of key grass-roots, professional, technical and social groups, including youth, women, and indigenous people – to ensure recognition of diverse and changing values – ensure the participation of decision-makers to secure a firm link with adopted policies and resulting action
Principle 9. Ongoing Assessment: Assessment of progress toward sustainable development should: – develop a capacity for repeated measurement to determine trends – be iterative, adaptive, and responsive to change and uncertainty because systems are complex and change frequently – adjust goals, frameworks and indicators as new insights are gained – promote development of collective learning and feedback to decision-making
Principle 10. Institutional Capacity: Continuity of assessing progress toward sustainable development should be assured by: – clearly assigning responsibility and providing ongoing support in the decision-making process – providing institutional capacity for data collection, maintenance and documentation supporting – development of local assessment capacity

2.3.2 Frameworks and typologies of indicators

Framework for the development of environment statistics (FDES)

Between 1978 and 1982 the UN-Secretariat launched the first phase of a programme for the development of environmental statistics and identified in a survey following approaches which were used to organise environmental statistics:

- the media approach which organises environmental issues from the perspective of the major environmental components of air, water, land/soil and the man made environment;
- the stress-response approach which focuses on impacts of human intervention within the environment (stress) and the environment's subsequent transformation (environmental response). This approach was first developed by Statistics Canada;
- the resource accounting approach which aims at tracing the flow of natural resources from their extraction (harvest) from the environment through successive stages of processing and final use, to their return to the environment as waste or to the economic sector for recycling; and;
- the ecological approach which includes a variety of models, monitoring techniques and ecological indices. In this approach national boundaries are not used as units of analysis but rather the ecosystems. This method is mainly based on estimation and assumptions.

The findings of the first phase of implementation revealed that the most commonly used approaches were the media and the stress-response approaches. Based on the findings, the UN developed the FDES (Table 3) which is a combination of both approaches and related methodologies. The available information about environment is organised in form of a matrix with components (sectors) of environment as rows and events, activities, impacts, responses, inventories and background conditions as columns.

Table 3. Framework for the development of environment statistics (FDES).

Information Categories				
Components of the environment	**Social and economic activities, natural events**	**Environmental impacts of activities/events**	**Responses to environmental impacts**	**Inventories, stocks and background conditions**
1. Flora				
2. Fauna				
3. Atmosphere				
4. Water				
5. Freshwater				
6. Marine water				
7. Land/soil				
8. Surface				
9. Sub-surface				
10. Human settlements				

Basic structure of the FDES

Pressure-state-response framework (PSR) by OECD

The Pressure-State-Response (PSR) launched by OECD is similar to the FDES. It is based on a concept of causality which implies that human activities exert pressures the environment and change its quality and the quantity of natural resources. Society responds to these changes through environmental, general economic and sectoral policies. The responses form a feedback loop to pressure through human activities. In a wider sense, these steps form part of an environmental policy cycle which includes problem perception, policy formulation, monitoring and policy evaluation. While the PSR framework has the advantage of highlighting these links, it tends to suggest linear relationships in the human activity-environment interaction. This should not obstruct the view of more complex relationships in ecosystems and in environment-economy interactions.

OECD's PSR model provides a classification into indicators of environmental pressures, environmental conditions and societal responses. Indicators of environmental pressures describe pressures from human activities exerted on the environment, including natural resources. Indicators of environmental conditions relate to the quality of the environment and the quality of natural resources. Indicators of societal responses show the extent to which society responds to environmental concerns.

Driving force-state-response framework (DSR)

In this framework developed by CSD and UN, Driving Force indicators represent human activities, processes and patterns that impact on sustainable development, state indicators indicate the "state" of sustainable development, and response indicators indicate policy options and other responses to changes in the state of sustainable development.

Driving force-pressure-state-impact-response (DPSIR) framework

The EUROSTAT/EEA DPSIR-approach differs from the previously mentioned approaches in two aspects: (i) The three categories, *driving force, state, response* is broken down into 5 categories listed below, and (ii) The lines are not media oriented (air, land, water) but policy oriented.

Driving forces (D) are underlying factors influencing a variety of relevant variables. They represent social, demographic and economic developments in societies and the corresponding changes in life styles and overall levels of consumption and production patterns. The major driving forces are population growth and changes in needs and activities of individuals. The driving forces provoke changes in overall levels of production and consumption and thereby exert pressure on the environment. The exerted pressure may manifest itself in various ways, e.g., the excessive use of natural resources; changes in land use; and emissions (of chemicals, waste, radiation, noise) to air, water and land. **Driving force indicators** describe social, demographic and economic development in societies and the corresponding changes in life styles, levels of consumption and production patterns. Primary driving forces are population growth and changes in the needs and activities of individuals. These provoke

changes in production and consumption levels, and this is how driving forces exert pressure on the environment.

Pressure (P) indicators describe the variables which directly cause (or may cause) environmental problems and developments in the release of emissions, use of resources and land. The Pressure component therefore gives information on emissions, application of chemical and biological agents, and the use of land and other resources. The pressures exerted by society's patterns of production and consumption are subsequently transformed in a variety of natural processes that may result in changes in the state of the environment.

State (S) indicators show the current condition of the environment and describe physical phenomena (like temperature or level of noise in certain area), biological phenomena (like wildlife resources present) and chemical phenomena (such as concentrations of harmful substances). The State component gives information on the level, quality and/or quantity of physical phenomena, biological phenomena and chemical phenomena in a given area at a given point in time. Changes in the state of the environment may have environmental and economic impacts on ecosystems, and eventually on human health and the economic and social welfare of a society.

Impact (I) indicators describe impacts caused by the changed state of the environment, for example with regard to bio-diversity, available resources and provision of adequate conditions for health. The Impact component presents data on the impact of the change of the state of the environment on the foregoing factors.

Response (R) indicators describe responses by groups in society as well as governmental attempts to prevent, compensate or adapt to changes. Response component refers to the reaction of the government, institutions, groups of people and individuals to undesired impacts on the environment in order to prevent, mitigate, ameliorate or adapt to changes in the environment. For example, responses may seek to change and/or redirect prevailing trends in consumption and production of goods and services, improve the monitoring and control of pollutants or to develop cleaner technologies.

EUROSTAT focuses on Driving force (e.g. sectoral trends), Pressure and Response indicators, and on linking such indicators to standard socio-economic statistics. Complementary to this effort, the European Environment Agency (EEA) concentrates on state and impact indicators, and on a comprehensive description of the full PSR chain.

According to this systems analysis view, social and economic developments exert Pressure on the environment and, as a consequence, the State of the environment changes, such as the provision of adequate conditions for health, resources availability and biodiversity. Finally, this leads to Impacts on human health, ecosystems and materials that may elicit a societal Response that feeds back on the Driving forces, or on the state or impacts directly, through adaptation or curative action.

Obviously, the real world is far more complex than can be expressed in simple causal relations in systems analysis. There is arbitrariness in the distinction between the environmental system and the human system. And, moreover, many of the relationships between the human system and the environmental system are not sufficiently understood or are difficult to capture in a simple framework. Nevertheless, from the policy point of view, there is a need for clear and specific information on Driving forces and the resulting environmental Pressures, on the State of the environment and Impacts resulting from changes in environmental quality and on the societal (policy) Response to these changes in the environment. In order to meet this information need, environmental indicators should reflect all elements of the causal chain that links human activities to their ultimate environmental impacts and the societal responses to these impacts (Fig. 3).

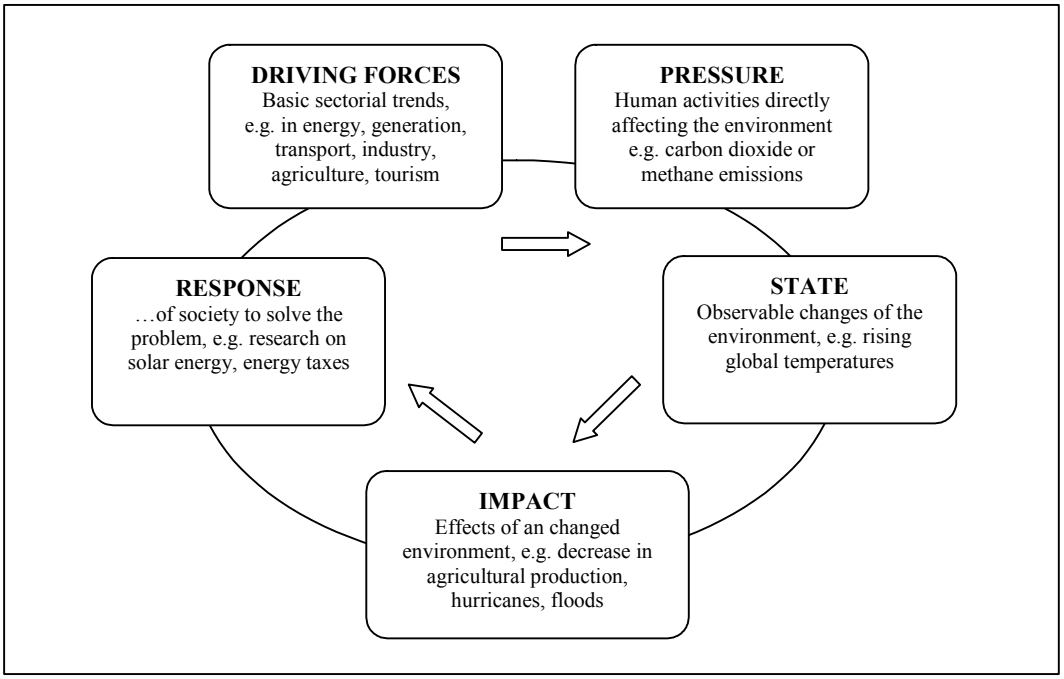

Figure 3. DPSIR Model.

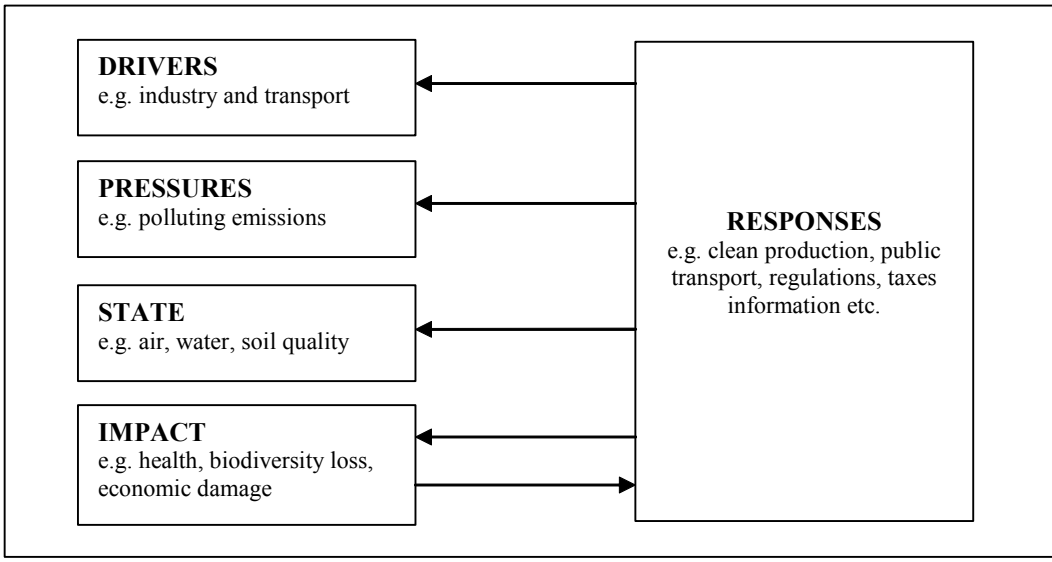

Figure 4. The DPSIR Framework for Reporting on Environmental Issues [3].

The DPSIR framework is useful in describing the relationships between the origins and consequences of environmental problems, but in order to understand their dynamics it is also useful to focus on the links between DPSIR elements. For instance, the relationship between the 'D' and the 'P' by economic activities is a function of the eco-efficiency of the technology and related systems in use, with less 'P' coming from more 'D' if eco-efficiency is improving. Similarly, the relationship between the Impacts on humans or eco-systems and the 'S' depends on the carrying capacities and thresholds for these systems. Whether society 'Responds' to impacts depends on how these impacts are perceived and evaluated; and the results of 'R' on the 'D' depends on the effectiveness of the Response.

EEA typology of four environmental indicators

The EEA has defined another tool which works together with the DPSIR framework, known as the Typology of four Environmental Indicators (Table 4).

[3] OECD Environmental Indicators. Development, Measurement and Use. Paris. 2003.

Table 4. EEA typology of environmental indicators.

Descriptive indicators (Type A – What is happening to the environment and to humans?)
Most sets of indicators presently used by nations and international bodies are based on the DPSIR framework or a subset of it. These sets describe the actual situation with regard to the main environmental issues, such as climate change, acidification, toxic contamination and wastes in relation to the geographical levels at which these issue manifest themselves.
Performance indicators (Type B – Does it matter?)
The indicators mentioned above all reflect the situation as it is, without reference to how the situation should be. In contrast, performance indicators compare (f)actual conditions with a specific set of reference conditions. They measure the 'distance(s)' between the current environmental situation and the desired situation (target): 'distance to target' assessment. Performance indicators are relevant if specific groups or institutions may be held accountable for changes in environmental pressures or states.
Efficiency indicators (Type C – Are we improving?)
It is important to note that some indicators express the relation between separate elements of the causal chain. Most relevant for policy-making are the indicators that relate environmental pressures to human activities. These indicators provide insight in the efficiency of products and processes. Efficiency in terms of the resources used, the emissions and waste generated per unit of desired output. The environmental efficiency of a nation may be described in terms of the level of emissions and waste generated per unit of GDP. The energy efficiency of cars may be described as the volume of fuel used per person per mile travelled.
Total welfare indicators (Type D – Are we on whole better off?)
Some measure of total sustainability is needed in order to answer this question, for example, a kind of 'Green GDP', such as the Index of Sustainable Economic Welfare (ISEW). These are, however, currently outside of the EEA's work programme and therefore not further investigated here.

2.4 Aalborg Commitments

The **Aalborg Commitments** were agreed at the Aalborg+10 conference, which took place in the city of Aalborg in June 2004 to commemorate the 10-year anniversary of the Aalborg Charter and to renew the commitment towards local sustainability. Some 2300 local authorities in the course of the last decade signed the Aalborg Charter.

The Aalborg Commitments were drafted by the partners of the European Sustainable Cities & Towns Campaign led by the Conference consortium consisting of CEMR, Aalborg and ICLEI. The European Commission supported the initiative. The objective of the new political document was to give new impetus to the Europe wide bottom up process of achieving local sustainability by developing and agreeing a more practical commitment to local sustainability that would be in line with the changed circumstances ten years after the Aalborg Charter.

The Aalborg Commitments were designed to strengthen ongoing local sustainability efforts. They have two main objectives: First, they aim to raise awareness and highlight the need for local governments across Europe to act in an integrated way to meet the growing challenges of sustainability. Second, they are designed as a practical and flexible tool for local action and achievements. On signing the Aalborg Commitments local governments enter a target-setting process in dialogue with local stakeholders and incorporating existing sustainability action plans. Since June 2004, more than 160 local authorities have signed up to the Commitments.

The Aalborg Commitments cover the wide range of local sustainability issues. The Commitments are organised according to ten thematic areas, in each of which 5 challenges have been identified. By signing the Aalborg Commitments, the local government agrees to undertake a baseline review of the current situation within 12 months. It agrees to enter into a local, participatory, target-setting process with a view to developing prioritised tasks addressing the 10 themes within 24 months of signature of the Commitments. The local government agrees to a monitor process and to make the results of that process available to its citizens. Also a European wide monitoring process is foreseen. As such, signature of the Commitments is a challenge for many cities and towns.

Aalborg Commitments deal with targets. The relationship between targets and indicators can be characterised in such a way that while indicators are qualitative or quantitative measures, targets are stated destinations, which can be expressed with help of indicators.

The targets pointed out by the Aalborg Commitments are summarised in the following (Table 5).

Table 5. Targets stated in the Aalborg commitment.

1. GOVERNANCE
We are committed to energising our decision-making processes through increased participatory democracy. We will therefore work to 1. further develop a commonly shared long-term vision for a sustainable city or a town. 2. build participation and sustainable development capacity in the local community and municipal administration. 3. invite all sectors of local society to participate effectively in decision-making. 4. make our decisions open, accountable and transparent. 5. cooperate effectively and in partnership with other cities and towns and other spheres of government.
2. URBAN MANAGEMENT TOWARDS SUSTAINABILITY
We are committed to implementing effective management cycles, from formulation through implementation to evaluation. We will therefore work to: 1. strengthen Local Agenda 21 or other local sustainability processes and mainstream them into the heart of local government. 2. deliver integrated management towards sustainability, based on the precautionary principle and in line with the EU Thematic Strategy on the Urban Environment. 3. set targets and time schemes in the framework of the Aalborg Commitments and create and follow the Aalborg Commitments monitoring review. 4. ensure that sustainability issues are central to urban decision-making

processes and that resource allocation is based on strong and broad sustainability criteria.

5. cooperate with the European Sustainable Cities & Towns Campaign and its networks to monitor and evaluate our progress towards meeting our sustainability targets.

3. NATURAL COMMON GOODS

We are committed to fully assuming our responsibility to protect and preserve the natural common goods.

We will therefore work, throughout our community, to:

1. reduce primary energy consumption, and increase the share of renewable and clean energies.
2. improve water quality, and use water more efficiently.
3. promote and increase biodiversity, and care for designated nature areas and green spaces.
4. improve soil quality, and preserve ecologically productive land.
5. improve air quality.

4. RESPONSIBLE CONSUMPTION AND LIFESTYLE CHOICES

We will therefore work, throughout our community, to:

1. avoid and reduce waste, and increase re-use and recycling.
2. manage and treat waste in accordance with best practice standards.
3. avoid unnecessary energy consumption, and improve end-use energy efficiency.
4. undertake sustainable procurement.
5. actively promote sustainable production and consumption.

We are committed to strongly promoting and facilitating the prudent use of resources and to encouraging sustainable consumption and production.

5. PLANNING AND DESIGN

We are committed to a strategic role for urban planning and design in addressing environmental, social, economic, health and cultural issues for the benefit of all.

We will therefore work to:

1. re-use and regenerate derelict or disadvantaged areas.
2. avoid urban sprawl, achieving appropriate urban densities and prioritising brownfield site over greenfield site development.
3. ensure the mixed use of buildings and developments, with a good balance

of jobs, housing and services giving priority to residential use in city centres.
4. ensure appropriate conservation, renovation and use/re-use of our urban cultural heritage.
5. apply requirements for sustainable design and construction and promote high quality architecture and building technologies.

6. BETTER MOBILITY, LESS TRAFFIC

We recognise the interdependence of transport, health and environment and are committed to strongly promoting sustainable mobility choices.

We will therefore work to:

1. reduce the necessity for private motorised transport.
2. increase the share of journeys made by public transport, on foot and by bicycle.
3. promote attractive alternatives to the use of private motor vehicles.
4. develop an integrated and sustainable urban mobility plan.
5. reduce the impact of transport on the environment and public health.

7. LOCAL ACTION FOR HEALTH

We are committed to protecting and promoting the health and wellbeing of our citizens.

We will therefore work to:

1. raise awareness and take action on the wider determinants of health, most of which lie outside the health sector.
2. promote city health development planning, which provides our cities with a means to build and maintain strategic partnerships for health.
3. reduce inequalities in health and address poverty, which will require regular reporting on progress towards reducing the gaps.
4. promote health impact assessment as a means for all sectors to focus their work on health and the quality of life.
5. mobilise urban planners to integrate health considerations in their planning strategies and initiatives.

8. VIBRANT AND SUSTAINABLE LOCAL ECONOMY

We are committed to creating and ensuring a vibrant local economy that gives access to employment without damaging the environment.

We will therefore work to:

1. adopt measures that stimulate and support local employment and business start-ups.
2. cooperate with local businesses to promote and implement good corporate practice.
3. develop and implement sustainability principles for the location of businesses.
4. encourage markets for local and regional produce.
5. promote sustainable local tourism.

9. SOCIAL EQUITY AND JUSTICE

We are committed to securing inclusive and supportive communities.

We will therefore work to:

1. take measures to alleviate poverty.
2. ensure equitable access to public services, education, employment opportunities, training and information.
3. foster social inclusion and gender equality.
4. improve community safety and security.
5. secure good housing and living conditions.

10. LOCAL TO GLOBAL

We are committed to local action for global peace, justice, equity and sustainable development.

We will therefore work to:

1. strengthen international cooperation and develop local responses to global problems.
2. reduce our impact on the global environment, in particular on the climate.
3. promote the availability and consumption of fair trade products.
4. promote the principle of environmental justice.
5. improve local understanding and awareness of global sustainability.

3 Aspects and developments of sustainable urban environment

3.1 Sustainable urban design

Sustainable Urban Design (SUD) is one out of four fields of concern of the Thematic Strategy on Urban Environment (TSUE), and it is strictly related to the concept of Sustainable Urban Land Use. In the following sections introduce the main aspects of sustainable urban design.

Role of car in the shaping of cities

The coming of widespread car usage after World War II changed the accessibility to urban centres, transforming areas like old town centres where public transport routes radiated from by making it congested and the least accessible of all locations. The car altered and increased mobility of the people using it, and because of its demand for space, it also shaped the environment in which it operates. The effects of increased mobility had become more and more serious over the years: on one side, people's behaviour has been affected in that the total number of trips taken has increased, as well as the number of activities (jobs and leisure) available and likely to be chosen. On the other hand, widespread car ownership transformed the city centres from being the most accessible locations (in the 1960s and 1970s especially) into the least ones. Indeed, the road patterns in most city centres is featured by a spider's web shape that concentrates congestion in the town centre, inasmuch as a large proportion of journeys within the town are forced to pass through the centre. Congestion and decreased accessibility in the city centre has spurred development in suburban areas. This low-density living and car dependency creates a major drawback, i.e. the difficulty maintaining a sense of community in a car-dependent society (Schiller, 2001). This unfavourable trend is likely to continue, considering that EU15 car population is projected to grow in the next 50 years by 25% – going from 169 million in 1998 to 211 million (ECMT 2002).

Consumption of land and space

The population growth in Europe is almost steady, but European cities are experiencing continuous growth in the consumption of space, infrastructure,

energy and natural resources. Per capita urban land consumption is increasing, including the land that has been converted from rural to urban use to provide for jobs, recreation and entertainment, shopping, parking, transportation, storage, government services. In many cases, the consumption of natural and agricultural area took place once urbanisation was already advanced. Land consumption by urban expansion is increasingly affecting the surrounding landscape, which is mainly formed by agriculture, forest and natural areas, In the context of a intense urban development, natural areas have important environmental functions and increase the quality of life of the urban dwellers. Transport network and corridors are still the major consumers of space. The densification of the transport network and the length per capita has increased steadily over the last few decades and is likely to follow a similar trend over the coming years (EEA, Murbandy/Moland database).

Land resources in most of Europe are relatively scarce, and achieving a sustainable balance between competing land uses is a key issue for all development policies. Lack of up-to-date and historical land coverage data (e.g. GIS data) hampers the accurate assessment of land consumption by transport. However, the increasing length of roads, particularly motorways, and the development of other roads shows that more and more land is being used for transport. It is estimated that, in 1998, road and rail infrastructure claimed around 0.82 % of total surface area in the EU15, with road as the biggest land consumer.

Urban sprawl and sub-urbanisation

Urban growth is accompanied by **urban sprawl** – a relative shift in the location of activities (housing, industries, retail and other services) towards the peripheries of the urban agglomeration. This was and currently is an established trend that affects the growth of modern cities, which is time after time associated with a gradual decrease in density at the centre, and a decrease in the rate of density reduction depending on distance from the centre. Urban sprawl results in more traffic: passenger transport demand is expected to grow 40% above 1990 levels in 2010 and a 25% increase in car ownership is expected over the same period. Urban sprawl is geared by land use and transport patterns, and so largely influenced by current consumption trends. It can be basically assessed by taking account of global trends in the housing, retail and business/industry sector, in

order to understand why this phenomenon has steadily marked the development of urban areas over the last decades.

With regard to the **housing sector**, in all EU15 countries there is a growing share of the population with house ownership. This, in combination with high taxes on house purchase in some EU countries, reduces the geographical mobility of persons, with consequences for commuter volumes and congestion. Another factor which influences geographical mobility is the dimension of the public/social housing stock, that in some countries is declining due to privatisation policies. In addition, from around 1960 on, the European **retail sector** has experienced an important development at the urban peripheries and in suburban areas. This evolution was basically spurred by the considerable emigration flux towards the outskirts of the agglomerations (suburbanisation of houses and workplaces), the increasing economies of scale in the retail sector, the changes in the shopping behaviour of consumers, problems in the inner city centres (congestion, parking, high ground prices, scarcity of parcels and buildings), the intention of urban planning to improve services in the urban agglomeration and, finally, the internationalisation of the retail sector. The new peripheral retail centres are the result of two tendencies, namely the introduction of new retail techniques – self-service and hard discount – and, secondly, the appearance of shopping centres, combinations of retail businesses and warehouses. Urban centres have, however, usually succeeded in maintaining their position by specialising, offering a wider high-quality products selection. The new retail locations have a traffic-attracting effect as well as enhancing the urbanisation of the area. In most cases the peripheral plants are not planned, and this causes a concentration of economic and residential functions along a traffic axe. However, new trends in the retail sector respond also to the intention of diversifying – shopping centres become also leisure centres, sports centres, cultural centres and congress centres.

Current urban development in Western Europe has been characterised also by the shift of **industries** to suburbs or even to foreign countries. Indeed, tendency for jobs to increase faster in the suburbs and on the urban fringes than in the centres and inner districts of metropolitan areas is characteristic of all developed countries. Nowhere this is more true than in the USA, but decentralisation of employment is also taking place in most European cities. The location of high-tech and often footloose enterprises is relatively independent of the location of

raw materials and markets. It is becoming increasingly important that expansions not only fit well within the individual metropolitan districts, but that they can also function well within the regional networks of several urban centres (multi-core urban areas). "Gates" – namely nodes of internationally oriented, multimodal and goods-intensive activities – are becoming increasingly strategic in the development of trans-national transport and information networks. Nearby these nodes all kinds of economic activities locate themselves in order to have a fast connection to the rest of Europe or to be accessible for a big market. At the moment this trend is especially evident in the North West European area, where internationally oriented airports and railway stations are increasingly taking the status of urban poles re-shaping the spatial structure of the surroundings.

Sub-urbanisation trends are likely to continue. At the moment, rural areas and small provincial towns are still attractive residential areas for many families. Due to demographic and social trends, the number of households will keep increasing in the next decades. Besides, individualisation trends (more single people and single-parent families due to divorce), changing activity patterns and greying of the population, will lead to more space per resident. In addition, increasing car ownership enlarges the outer limit of possible residential areas for commuters, where many of these commuters prefer living. In some cases suburbanisation will cause more urban sprawl as well as higher travel distances as most of the working places are still in the city. In other cases, suburbanisation of working places, shops and leisure time facilities might possibly cause increasing traffic from the city to suburbanisation areas.

Accessibility to basic services and facilities

Urban sprawl, growing car ownership, the concentration of work and shopping in out-of-town locations have resulted in continuing increases in journey length for all purposes, but particularly for commuting. Trends in trip lengths in some EU 15 countries (the United Kingdom, Denmark and Belgium) showed a growth in travel during recent decades. Increases in income and car ownership have led many people to choose to live out of town while working places and shopping areas are increasingly located on greenfield sites. This development has led to longer trips with people living further away from work, leisure activities, shopping centres and schools. Access to basic services is, therefore, becoming more and more dependent on cars (EEA, Indicator Fact sheet – TERM 2001 14

EU), and a large fraction of the population has difficulty in accessing even basic services. Data from a recent United Kingdom survey indicated that a sizeable majority of people in no-car households are disadvantaged in accessing basic services and facilities, whereas data from a study conducted in the Netherlands showed that, often, public transport is not a realistic alternative to the car to gain access to these services. Furthermore, about 26 % of EU households do not own a car, although national differences are enormous: 4 % of households in Italy and Luxembourg cannot afford a car, whereas Portugal and Greece the figure is more than 20 % (EEA, 2002). Together, these developments proved being not capable of giving an incentive to shift towards more environment friendly transport modes. (Indicator fact sheet TERM 2001 16 EU – Access to transport services)

Nevertheless, locations of offices, residential areas, schools, etc., can be influenced by policy-makers in such way that travel distances are lessened and/or environment friendly modes are promoted (e.g. building shopping areas close to train and bus stations). In so doing, the incentive for using cars to reach everyday destinations can be minimised. Indeed, easy access to work, education, health, shopping and leisure is increasingly considered an essential component of economic and social development. Emphasis has been recently placed on ensuring accessibility not only for car owners, but also for people who do not own a car (EEA, 2001). It is generally recognised that providing access for everyone, with the least impact on the environment, should be achieved, at the urban planning level, through a better spatial mix of economic activities backed by improvements in public transport, cycling and walking facilities, and by restrictions on parking. Indeed, sufficient availability of alternative modes (both in vehicles and infrastructure) and careful spatial planning by locating everyday destinations at places that are easily accessible, especially without a car, can significantly benefit the environment by shifting transport volumes away from private and towards public transport (EEA, 2001).

According to the European Common Indicators study (ECI, 2003), basic services and facilities are essentially primary public health services, public schools, bakeries and groceries of all kinds, recycling facilities or services for solid waste as well as collective transport routes that have a minimum frequency during a business day. The latter element of the ECI accessibility index – accessibility to public transport – is an important component of sustainable

transport strategies. Finally, the need to provide accessibility by conventional transport means may be also progressively reduced by developments in telecommunications and e-commerce which provide additional easy accessing to services.

According to the Final Report of the Working Group on Urban Design for Sustainability (Final Report, 2004, page 10), "urban design is defined as, first, the physical design and planning of the built environment (physical infrastructure, building complexes, spaces and urban areas) in relation to the natural environment in and around built-up areas and, second, the production of concepts and models that serve the purpose of guiding the sustainable development of settlements". **Sustainable Urban Design** can help to create more accessible land use patterns, improve transport options, create more liveable communities, reduce public service costs and achieve other land use objectives, mitigating the impacts of the current urban sprawl and sub-urbanisation trends.

Compact city strategies

While there are cultural and geographical differences, in the EU 15 there is a common process of urban development in both large and small urban centres with a change in the functions of city centres and the growing importance of urban periphery, with the development of polycentric urban systems. In this respect there is a continuity between the objectives of urban design for sustainability and the broader regional spatial development aims set out in the European Spatial Development Perspective. Effective land use and transport integration is increasingly being achieved by interlocking policies, planning methodologies and organisation of processes or structures.

Two basic integrated land use and transport strategies are the **monocentric and polycentric strategies**. Broadly, monocentric development strategy puts the focus on revitalisation or strengthening of the city centre while polycentric development strategy concentrates investments in the development of well located sub-centres. The choice between monocentric or polycentric strategies depends, however, on the city size. For smaller cities the monocentric urban form is much more sustainable than a polycentric urban form. Smaller cities that opt too early for the polycentric urban model are in fact encouraging urban

sprawl. On the other hand, larger cities that pursue the monocentric urban model, focusing all attention on the city centre, might lose control over developments at the periphery. Uncontrolled urban sprawl will be the result, when a polycentric strategy could limit this tendency. Thus, harmonisation of city strategies should be pursued depending on the context. This in particular requires effective spatial planning at the regional level and coordination of policies typically promoted in each region of Europe by a great variety of national, regional and local institutions, with different responsibilities, covering different issues at different scales. A synonymous of polycentric strategies which is easily found in the literature is "decentralised concentration", usually taken as an alternative spatial development strategy to compact monocentric cities in that development pressures are directed to new centres away from the existing major centres. However, decentralised concentration can be seen as an extension of the compact city idea to the metropolitan regional context, rather than as an alternative vision of urban form. The aim of "polycentric development" or decentralised concentration is always to increase densities to reduce pressure on land and resources as well as to make public transport links more effective and feasible and increase the overall integration of the urban region.

On a smaller spatial scale, "**clustering**" or "**compact development**" refers to land use patterns in which common destinations are grouped close together, usually within convenient walking distance. Clustering improves accessibility by reducing travel distances and improving transportation options. It is somewhat different from density, which refers to the overall number of people or businesses in a given area, but does not necessarily mean that they are grouped efficiently together. For example, rural areas have low densities, but common destinations such as schools, shops and other public services can be clustered together in villages and towns. This increases accessibility by making it easier to run several errands at the same time, increases opportunities to interact with neighbours, and creates transportation nodes (rideshare stops, bus stops, etc.). An appropriate density of development, whilst stressed by the EU Working Group on Urban Design for Sustainability, is currently being enacted in several EU15 cities in order to ensure an increased density in areas affected by urban sprawl as to avoid excessive land consumption. Measures of urban development targeted to an increased settlement density are also increasingly targeted to consider the use of 'maximum standards' to discourage low-density developments, while adjusting density in central areas to maintain acceptable

quality of life levels – preserving green areas among existing and new urban areas – develop decentralised nodes in large urban areas, and finally promoting the use of current available technologies to adjust densities to quality of life.

Alongside the "compact city strategy", we shall mention the "short cycles strategy" as a complementary more than alternative strategy. Indeed, both the compact cities and short cycles approaches aim to an integrated sustainable development or urban and rural areas in the context of wider decentralised concentration or polycentric regional strategies (TSUE Working Group on Urban Design for Sustainability, 2004). The short cycles strategy is associated with the environmental thrust of Local Agenda 21 and an emphasis on achieving local environment sustainability through more efficient use of natural resources and recycling, greater local autonomy and a smaller ecological footprint. One model of its realisation is in a spread out, low density city (with space for horticultural production and recycling associated with large, single family housing plots) but, within the European context, it is more commonly envisaged as an urban system consisting of a series of small, compact new settlements and greenfield site developments, a sort of ecological approach to decentralised concentration. It is important to note that while the short cycles model implies lower overall or gross densities than the compact city approach, the population may still be concentrated in smaller, high density settlements (urban villages).

Mixing land uses

Mixing homes and jobs – as was once characteristic of town centres – is a strategy seeking to minimise trips lengths. Whether it will prove effective in reducing travel under current circumstances is an open question, although it was advocated since the early 90's in the European Union's Green Paper on the Urban Environment, and there are signs that thinking amongst many policy makers is moving in the same direction. To be fully effective in reducing travel it will be necessary to mix opportunities for living and working with opportunities for recreation, shopping and local services. This may be achieved by ensuring that homes themselves and their neighbourhood offer scope for exercise, sport, home entertainment, walking, cycling and opportunities for eating, drinking and meeting people.

Mixed land use is especially featured in different historical urban fabrics, usually city centres. The morphology of these urban spaces may vary (medieval alleys or neo-classic boulevards), but the pattern of activities is the same, i.e. a complete mixing. Most projects dealing with urban renovation belong to the mixed land use, because they use existing constructions without adding anything new in terms of morphology. Historically, of course, one of the key concerns of planning has been to separate uses, but the rationale of this separation has declined with the shift from manufacturing to services and other less objectionable economic activities. In addition, the use of zoning policies to support small and medium enterprises which are often priced out of city centres but are critical to urban vitality and to the development of new technologies and services is increasingly common to many EU15 cities – often seen as part of a wider mixed use strategy for revitalising existing town centres and for converting newer shopping malls to become mixed use centres – and is habitually recommended as a good practice for sustainable land use that aims at encouraging a city's economic development while stemming urban sprawl.

Short distance and public transport-oriented development

The integration of land use and transport measures taking public transport, walking and cycling as pivotal elements is called "short distance structure development" (TRANSPLUS, 2004). The creation of a pedestrian and cycling friendly approach to site development, and the facilitation of "door-to-door" travel without using the car, encouraging the use of alternative transport modes are the key objective of such a policy. Short distance structure development can be an important pre-requisite for the successful promotion of walking and cycling. Possible measures achievable in the context of a short-distance structure development include the short-distance mixed-use development (the urban structure is of prime importance to promote walking and cycling as short travel distance is a main reason for choosing non-motorised modes), and the development of a walking/cycling strategy, where the hierarchical city-wide cycle network should be created in an attractive environment connecting different locations and facilities. These measures often include the improvement of safety and attractiveness of cycle tracks and foot paths, and the enhancement of information and orientation - improved information system can link together the different parts of the city and encourage people to walk, cycle or use public transport, and finally the creation of a pedestrian and cyclist friendly urban

design, which consists of various measures supporting each other. Planning for pedestrians requires high quality design in a confined space and, thus, conscious interactions with buildings and open spaces.

Strategies of **public transport-oriented development** aiming at creating residential and commercial areas designed to maximize access by transport and non-motorised transportation featuring additional facilities are one of the strategies to implement integrated land use planning and transport. A neighbourhood adapted along principles of public-transport oriented development has a centre with a rail or bus station, surrounded by relatively high-density development, with progressively lower-density spreading outwards. The neighbourhood is designed for enabling cycling and walking paths with adequate facilities and attractive street conditions, which have traffic calming features to control vehicle traffic speeds. Mixed-use development is another main feature of such a strategy, i.e. the inclusion of shops, schools and other public services, and a variety of housing types and prices in the neighbourhood itself. Additional parking management measures are enforced to reduce the amount of land devoted to parking compared with conventional development.

Public transport oriented development is recognised to reduce transportation costs and externalities, increase travel choice, and reduce land paved per capita, whilst helping achieve TDM (Transport Demand Management) objectives, i.e. a more efficient use of transportation resources. Basically, such a strategy can help create liveable communities – physically and socially more desirable places to live. These benefits are reflected in higher property values and increased commercial activity, which can result in increased tax revenue. Moreover, it can provide increased accessibility and agglomeration, which reduces transportation costs and increases productivity. It is, in fact, recognized that average vehicle ownership, vehicle travel, and vehicle expenditure per household decline with increasing residential densities and proximity to public transport nodes and routes (Victoria Transport Policy Institute, 2003).

Development of greenfield and brownfield areas

Suburban and peripheral development alters the spatial structure, functional relationships and social perceptions of areas that already exist, often with destabilising effects on areas that are still viable. Outer-edge or peripheral

development is often easier that inner city development. The former involves the assembly of land, often at a relatively low initial costs, from a small number of owners; there are few existing uses to be displaced; and outer-edge development tends to be spread out over many jurisdictions eager to compete for new residential and commercial construction and the related tax revenues. The latter involves more complex and costly site assembly, the problem of contaminated land, the possibility of conflicts with existing users in communities, and a less certain market. This cost imbalance contributes to the trend to inner urban decline and abandoned cores even as peripheral areas become more crowded. In addition, because urban redevelopment is usually within a large municipality, developers and builders often have to deal with a more complex and slow bureaucratic regime. The small size of most firms in property development and construction only reinforces these considerations (OECD, 1996).

However, if edge cities and **greenfield site developments** evolve and are restructured spatially, socially and ecologically – namely adopting the "short cycles" strategies – they may contribute to a more balanced and sustainable pattern of metropolitan development. By making edge cities more accessible internally to pedestrians and externally to mass transport, by decreasing the space given to parking, by adding housing and a variety of services, greenfield developments in the urban fringe can emerge as well-rounded, complex units better capable of supporting the basic social needs of people for communication, interaction and companionship. From the ecological point of view these edge cities may ensure local environmental sustainability through a series of small, compact town-size settlements with easy access to natural areas and space for natural recycling processes in their immediate surroundings.

On the other side, governments at municipal level increasingly understand that dispersion, with its squandering of energy, pollution, and restriction of choices for lower income groups must be reconfigured for the broader ecological health of urban regions. Thus, housing redevelopment has formed recently the centrepiece of urban sustainability strategies in a diversity of situations, equally important in cities suffering difficulties of growth or decline. A twin focus on altering environmental outcomes in both existing and planned new space, balancing Greenfield and brownfield development, is increasingly required. **Brownfield developments** concern derelict or underused land that have real or perceived contamination problems. They are one of the negative results due to

the breakdown of core industries during the periods of industrial changes in Europe. They now often require intervention to bring them back into beneficial use after having lost their original function. The review of national approaches for the redevelopment of brownfields in Europe made quite clear that the problem has been recognised particularly in industrialised countries and specific actions have been taken. However, such actions may not always be based on a national strategy but rather relate to single or regional efforts to cope with the issue. It appears that the legal frameworks in many countries have not yet sufficiently integrated the needs arising from the viewpoint of environmental protection / restoration with the viewpoint of spatial and urban planning. In many countries there is still no specific emphasis on the reuse of brownfields in the urban and spatial planning regimes (CLARINET, 2002). Traditionally industrial countries provided figures regarding the extent of brownfields on the national level – in Germany 128.000 hectares, in the United Kingdom 39.600 ha, in France 20.000 ha, in the Netherlands between 9.000 and 11.000 hectares, and in Belgium / Walloon about 9.000 hectares of brownfields were estimated or identified. For other countries, like Greece, Austria and Denmark the problem of brownfields is identified as relevant, but there is no data available yet.

Current local and national planning practices still involve a significant level of development on greenfield sites. For instance, in Germany alone, an estimated 129 hectares per day of greenfield land is lost for building purposes. A likewise trend is registered in the EU 15, especially because of (OECD, 1996):

- insufficient information concerning the number of brownfields and vacant sites in cities, and about the economic, social and environmental outcomes of redevelopment;
- the contradictory practice of permitting greenfield development whilst attempting to redress the serious environmental, economic and social problems associated with urban brownfield;
- the inflexibility of policy and legislation which inhibits the redevelopment of brownfield sites.

However, specific schemes for brownfield rehabilitation exist in France (Nord-Pas de Calais, Lorraine), Germany (Northrhein-Westphalia), the Netherlands and the United Kingdom as well as in some ACC countries (e.g. in Poland, Katowice mining region). Activities at the programme level have to take account of constraints and requirements such as time scales attached to land acquisition,

land valuation difficulties, and legal matters, along with the technical and economic risks for the developer. As brownfields are often located in mixed urban areas, many traditional industrial regions and cities have given priority to strategic land use planning issues either at the urban level, or sometimes at the regional level (e.g.: the Thames Gateway in London, IBA Emscher Park in Germany, Mission du Bassin Minier in France). As far as the revitalisation of derelict industrial sites is concerned, to date direct financial support of projects by the European Regional Development Fund (managed by the REGIO directorate general) is the main instrument used.

Availability and accessibility of green and open space

Public open areas include public parks, gardens, open-air sport facilities or open spaces, for the exclusive use of pedestrians and cyclists, accessible to the public free of charge. Access to public open areas is essential in a sustainable community for the quality of life and the viability of the local economy. Accessibility to these areas is defined as such when they lie within a 300-m distance or 15-minute walk from the reach of people's settlements (EEA, 1998; European Commission, 1997). Urbanisation, however, exerts environmental pressures, both on the nature areas in cities forests, large parks and wetlands) and beyond the boundaries of cities.

The use of the landscape around cities by the urban population depends on the accessibility and availability of nature areas, mostly forests and beaches. The amount of forests within a one-day trip (ca 50 km distance from town limit) around major urban areas varies greatly, with large areas accessible mostly in countries in central, eastern and northern Europe. In the same countries, people in smaller urban areas also have easier access to forests. While most people live within 15 minutes' walk of at least one green area, urban green space amounts to an average of only 1.4% in the EU (EEA, 1998). A series of surveys and studies (EEA, 1998a and WHO, 1997) showed that the access to green space varies considerably all over the EU 15, and highlighted that more and more existing green spaces within the urban areas are built up, threatening biodiversity, as well as the quality of life and health of city dwellers. The proportion of urban land taken by green areas in European cities ranges from around 70% in Turku, Oslo and Gothenburg to only 2% in Seville and Bratislava – showing that areas with a

sizeable proportion of green land taken by urban area are extremely vulnerable and exposed to fragmentation.

Attractiveness of city centres and amenity of streets and neighbourhoods

City and town centres are at the heart of social, economic and cultural life. Some of them are very distinctive because of their historical legacy and cultural heritage they are endowed with. They often have the widest range of higher order services and facilities, each with their local identity and different range of services. Strategies to promote and enhance the attractiveness of city centres (and other town districts) are encompassed by a wide range of urban design practices, often coupled with integrated land use and transport measures that aim at enhancing cluster development, that keep clusters small and well defined, such as "urban villages" with distinct names and characters, or the concentration of activities in that area/district so that pedestrian and transportation travel is encouraged by creating "nodes" of high-density, mixed development that are linked by a convenient transport service. This help retain strong downtowns and central business districts, if development density within walking distance (0.25 to 0.50 miles) of high capacity transport stations and corridors is encouraged, and high quality pedestrian and cycling facilities in those areas is provided.

Development of city centres and downtown areas is currently focused in existing cities and towns to promote vital and viable centres, offering a mix of uses, which are accessible to the greatest number of people, by a range of means. Many examples of revitalisation of abandoned buildings in city centres, converted into mixed-use facilities and provided with an ample range of transport option (light trolley lines, buses, walking area, cycling paths) helped retain the liveability and the vibrancy of the area. Besides, these practises have proved being effective in increasing community http://www.vtpi.org/tdm/tdm58.htm traffic safety and health conditions by reducing total per capita vehicle travel, encouraging shifts to safer modes, and reducing traffic speeds. Some studies indicate that more pedestrian-oriented land use patterns can increase community cohesion and reduce crime, particularly if there are special programs and design features to address security concerns. Successful examples of city centre revitalisation can be found all over Europe: in the city of Évora (Portugal) a thorough plan for the revitalisation and valorisation of cultural heritage was accomplished in the years gone by. Equally, the city of Tübingen (Germany) has decided to increase the

value of the whole district of Tübingen Sudstadt, an inner city areas improved and made more attractive, thanks to preservation of the historical centre from motorised traffic, with a large pedestrian area or with traffic reduction (TRANSPLUS, 2001). A current trend in developing such practices of renovating decaying central districts and/or enhancing attractiveness of other neighbourhood areas has seen the increasing involvement of neighbourhood associations, business associations and developers, often as result of the community's strategic plan.

Role of ICT in the design of sustainable cities

Global networks such as the Internet, together with mobile computing, have made wide-area computing over virtual communities a reality. Today, urban networks are increasingly based on electronic forms of communication. Within the development of sustainable cities, planning and design related matters have emerged to promoting the use of ICT to bring about sustainable cities. The impact of globalisation and the ICT has made cities around the globe more competitive. There is an increasing pressure on cities to be endowed with constant communication, business and entertainment whilst providing a high quality physical environment. It is projected that the development of ICT initiatives such as, 'teleworking' (increased 'virtual' interaction and/or home working with new settlement) and urban design ideas such a "televillages" or "telesuburbs" could lead to a significant reduction of commuter traffic that undermines quality of life in most modern cities. Furthermore, ICT can be used for data generation and management and thus enable citizens to make more efficient use of citywide facilities and transportation on a day-to-day and minute-by-minute basis. In fact the so-called "sustainable city" offers the potential for more efficient use of all resources, buildings, transport, energy, etc. and ICT is now seen as a central element of the sustainable city. However, there is little evidence of these effects being realised to date (ASPECT, 2000).

ICT is particularly important for urban planning at present. Municipalities, in particular, profit from the use of ICT to facilitate planning work for the provision of information and the enactment of information systems (e.g. geo-spatial databases, digital maps being more often used to provide environmental and planning information) which eases the analysis of complex planning data and contributes to a better quality of information. Moreover, the ICT can prove being a extremely useful tool for creating scenarios, simulations of planning

outcomes, in a way that planners are able to choose the most sustainable development option. Another chief respect of the use of ITC in planning is the dissemination of information / planning participation via the Internet and thus promoting transparency of activities and public awareness of planning and sustainability issues. Moreover, planning citizens' participation is supported so that a better collaboration between public administration and civil society can be achieved, while citizens are asked to comment on local and strategic urban planning choices.

In this context, a key element of a vision for a sustainable urban development supported by more effective use of ICT is the provision of an interactive virtual urban planning environment, which could consist of a number of workspaces, like the design review workspace, the public participation workspace, safety and security workspace, the environmental quality assessment workspace (aural, visual, pollution, flood, air, water, etc.), the sustainable community evaluation (Agenda 21) workspace, the urban transport planning and mobility workspace, and the accessibility assessment workspace. This environment may allow the planners, developers, legal executives, community groups and environmental groups to jointly explore scenarios and reach consensus on complex social, economical environmental and sustainability issues.

To build the intelligent cities and integrated information systems three main types of electronic services with relevance to sustainable urban development have been identified (INTELCITY, 2003):

- Information: user-friendly and timely information is vital to involving citizens in governance at all levels. As ICT facilitate data generation and management, they can provide well-structured information, which enables planning decisions to be taken by considering ecological, economic and social restrictions to development. A drawback of the use of ICT for data generation and management consists in the production of highly aggregated information which might be too complex necessitating interpretation and/or mediation for collective decision-making.
- Communication (exchange of information): the role of ICT in this process is to support and enable the measures, particularly their efficiency based on effective organizational integration within and between the institutions responsible for their implementation.

– Transaction, i.e. provision of services involving ICT use, such as applying for permits, electronic forms, etc.

Nowadays the ICT is mostly used for information only. However some municipalities actively use the Internet to support a sustainable urban development, e.g. by providing a database for vacant inner-city building lots and thus promoting an infill development. Additionally, there is still insufficient information on urban ICT infrastructure and its impact on urban development. The effects of ICT on the built environment such as effects on urban sprawl or geographical polarisation are considered still to be of little importance. The development of urban sprawl, for instance, seems to depend more on the adopted policy and the effectiveness of the instruments of control than on ICT-development. The most important effect seems to be the possible improvement of ecological conditions such as the reduction of air pollution and noise. Despite the little effects on the built environment of cities, consequences on the development of urban society are possible. On the one hand ICT might lead to a further individualisation and isolation of society. Existing spatial disparities may be exacerbated, cities and urban spaces might lose their functions, agglomeration advantages and spatial concentration might decrease. On the other hand a better access to information, greater transparency of decisions, public involvement and democracy might be strengthened. Benefits for society might result form better crime control and improved management of unemployment and a renaissance of location and centrality might be possible as well.

ICT will only be able to support a sustainable urban development if certain conditions are fulfilled (INTELCITY 2003) in the near future, and namely:

– A high accessibility of ICT needs to be guaranteed by low cost of equipment;
– ICT knowledge and awareness have to be encouraged by ICT training for city administrations and the public;
– ICT development will have to be based on local skills and knowledge;
– The legislative framework will have to stimulate ICT development;
– An organised system of collecting and processing data regarding sustainable urban development is needed.

3.2 Sustainable urban transport

Mobility is a multifaceted phenomenon and therefore there are many different ways of measuring the development and impacts of mobility. How mobility is measured is of much importance. Mobility is in the first place something that satisfies preferences of people and is therefore perceived as desirable. Making trips to reach a destination is therefore usually regarded as favourable. The vehicle-kilometres that are often needed to reach a destination are however perceived much less favourable, due to the direct relationships between vehicle-kilometres and unfavourable side effects of mobility.

The selection of indicators is dependent on the purpose of data collection. Conventional transportation indicators mostly consider traffic-based measurements such as traffic-volumes, number of vehicle-kilometres, average traffic speeds and roadway level-of-service. These indicators evaluate transportation system quality in terms of motor vehicle movement. Counting points along roads can collect most of these measurements. While these kinds of data are able to register the actual movements of vehicles, it remains unknown why these movements are made. To understand the purpose of travel more thoroughly, it is needed to introduce mobility-based and accessibility-based measurements, which describe transport demand of individuals and evaluate transport system quality based on the ability of people and businesses to reach desired goods, services and activities, the ultimate goal of the transport system. Examples of such indicators are trips per person, total travel per person (trip-kilometres), the modal split of trips and kilometres, average travel times and average distances between destinations. Household surveys are used to collect mobility-based and accessibility-based indicators. Most research (and policy documents) on travel behaviour uses a mix of mobility and accessibility indicators. The following indicators are most used: (1) kilometres (vehicles, passengers), mostly by mode, often by motive and (2) the number of trips, mostly by mode, but often by purpose of trip.

The impacts of transport are the prime interest within the context of the Thematic Strategy on the Urban Environment. Since the 1970s there is a growing attention for impact indicators. The sustainability debate requested more information on the side effects of transport. Measuring the development and impact of individual mobility became more comprehensive than the

traditional small focus of transport engineering. Nowadays, municipalities and (supra)national governments are defining a wide range of objectives to be achieved in the field of transport and consequently a similar wide range of impact indicators have been developed. The OECD listed a number of objectives that appear regularly in cities' policy statements.

- Economic efficiency (low travel time, operating costs and direct payments)
- Safety (reducing the loss of life, injuries and damage to property resulting from transport accidents).
- Sustainable use of resources (reduction of carbon dioxide emissions, the consumption of non-renewable fossil fuels, materials and land.
- Accessibility (number of destinations that are accessible against reasonable costs in terms of time and money).
- Environmental protection (low noise, atmospheric pollution of differing kinds, vibration, visual intrusion, severance, fear and intimidation, and the loss of intrinsically valuable objects, such as flora and fauna, ancient monuments and historic buildings)
- Economic regeneration (reinforcing the land use plans of the area)
- Equity (equally distribution of transport benefits)

Consequently, travel behaviour research has given more attention to these impact categories. However, much of the impacts are related to mobility-based indicators. For example, the volume of vehicle kilometres determines largely the volume of impacts such as safety, carbon dioxide emissions, energy consumption, noise and pollution. More thorough impact assessments require a lot of local data. For example, to make a more detailed noise-nuisance estimate, it is needed to know, for each side of the road, not only the traffic volumes and the composition of the passing car fleet, but it is also needed to know the distances to houses, trees and so on. Due to the required detail of the data, most impact assessments limit themselves to mobility-indicators only and provide estimates for some environmental indicators and traffic safety indicators.

The question is therefore which mobility and accessibility indicators are most appropriate to monitor the development of transport and moreover of transport impacts. The Thematic Strategy positions itself clearly as an addition on the White Paper on Transport: Time to Decide. While the White Paper puts the emphasis on technological innovation, the thematic strategy argues that to tackle the problems in urban areas it is needed to add another two elements:

a reduction of traffic volumes and a modal shift towards sustainable modes. These three elements should therefore be leading in monitoring urban transport in relation to the Thematic Strategy on the Urban Environment.

A reduction of traffic volumes and a modal shift towards sustainable modes aim to decrease the number of vehicles kilometres since especially car-kilometres are one of the most direct origins of many transport impacts on the environment. Two major elements determine the number of vehicle-kilometres within a city: travel demand of individual citizens and the modal split. Travel demand can be measured in trips or trip kilometres. The latter is the most appropriate when it comes to impact assessment. The number of trip-kilometres per person (or sometimes also called passenger-kilometres) is directly related to the impact on the urban environment. Also modal split can be measured by measuring the distribution of trips or trip kilometres among the transport modes. Again the latter is most appropriate when it comes to travel impacts.

Technological innovation aims to introduce more sustainable transport techniques into our transport fleet. Cars are becoming cleaner, more silent, safer and less energy consuming because of new technology. To measure this tendency it is needed to monitor the type of vehicles used within a city, for example in terms of fuel type, weight and technological innovation of the propulsion system (catalyst etc.). In general the age of a car is a good predictor of the level of technological innovation.

In order to achieve a reduction of traffic volumes and a modal shift towards sustainable modes it is needed to change the supply of transport. The urban transport system should reduce car-dependency and enable people to use sustainable transport modes. Hence, it should be designed in favour of public transport and the slow modes. The transport system is a complex system and hundreds of indicators are possible. It is however most important to include an indicator that measures the accessibility and performance of public transport and an indicator that measures the development of pedestrian and bicycle streets. Car ownership rates are a good proxy for the car dependency within cities.

Figure 5 shows the relationship between the different aspects of the transport system and the negative impacts of transport as described in the Thematic

Strategy on the Urban Environment. For each box one or more indicators are included in the set of harmonised **TISSUE** indicators.

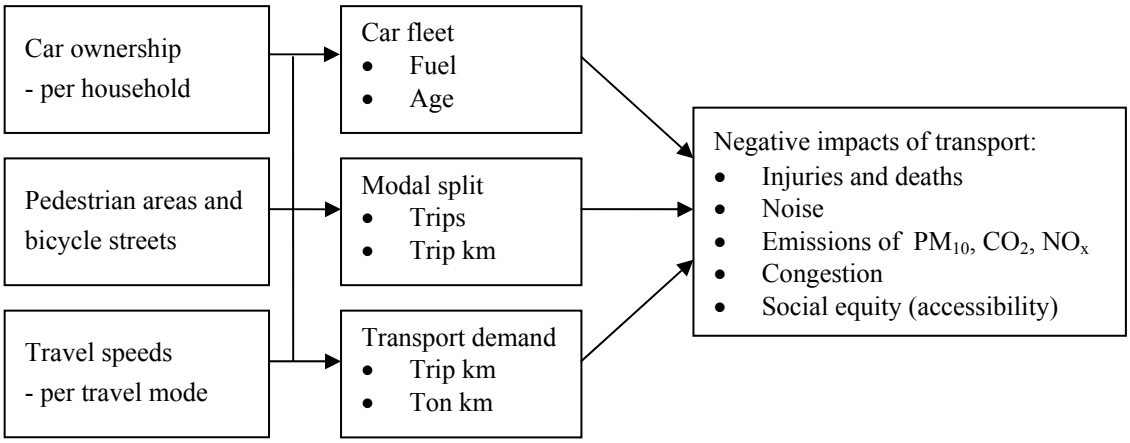

Figure 5. The most important variables and relationship between aspects of the transport system on basis of the TSUE.

3.3 Sustainable urban construction

The construction sector as a whole encompasses
- production of building materials and products,
- construction of buildings and other constructive assets,
- maintenance of buildings and building services,
- renovation of buildings.

Sustainable urban construction includes environmental, cultural and socio-economic dimensions. This section introduces the aspects of sustainable construction and shows the aspects that have been selected by the **TISSUE** project to indicate sustainable urban construction.

The CIB [4] Compendium of Building Performance Models [5] and the thematic network PEBBU (Performance Based Building [6] – the 5th framework) have used the following basic framework to outline buildings:

A	**Building Performance**
A 1	Safety
A 1.1	Structural Safety
A 1.2	Fire Safety
A 1.3	Safety in Use
A 2	Comfort
A 2.1	Acoustical Comfort
A 2.2	Visual Comfort
A 2.3	Hygrothermal Comfort
A 2.4	Structural Serviceability
A 3	Health & Hygiene
A 3.1	Air Quality
A 3.2	Water Supply and Other Services
A 3.3	Waste Disposal
A 4	Service Life
A 4.1	Structure
A 4.2	External Enclosure
A 4.3	Internal Enclosure
A 4.4	Built-in Furnishings and Equipment
A 4.5	Services
B	**Cost and Environmental Performance**
B 1	Life Cycle Costs
B 1.1	Investment Costs
B 1.2	Service Costs
B 1.3	Maintenance Costs
B 1.4	Disposal and Value
B 2	Environmental Impact from Land Use
B 3	Environmental Impact from Building

[4] International Council for Research and Innovation in Building and Construction
[5] http://www.auspebbu.com/outline.cfm
[6] http://www.pebbu.nl/

B 3.1	Embodied Environmental Impact
B 3.2	Recycling
B 3.3	Environmental Impact from Use of Building
B 3.4	Environmental Impact because of users
C	**Construction Process**
C 1	Design
C 2	Site Operations
D	**Operation**
D 1	Usability
D 2	Maintainability

The environmental performance of buildings can be assessed on the basis of the environmental impacts because of construction and use of buildings. However, the environmental performance can also indicated indirectly. For example:

- Building performance, especially the adaptability of a building, may indirectly express an environmental loading because of the presumed effect on the service life of a building and thus also on the consumption of resources.
- Durability and service life of the building and its parts reflect the consumption of resources.
- Accessibility may indicate an environmental impact of a building. For example the accessibility with using the means of public transport and/or bicycle and pedestrian traffic expresses the influence of the use of the building on traffic-related environmental loadings.

One can also indicate the environmental performance of a building with reference to environmental risks caused by the building and/or building process. An environmental risk may occur because of the use of materials which potentially contaminate environment when released into air or water and/or in the case of fire or other specific condition possible with regard to the building. An environmental risk may also be related to building process.

Buildings affect not only the outdoor environment but also the health and comfort of users of buildings. Indoor air quality of a building depends on the use of the building, the ventilation of the building and the material-based emissions.

There are voluntary and national methods which classify the indoor conditions such as for example the Finnish system [7] which divides the indoor conditions into three classes on the basis of a number of parameters. These parameters concern the concentrations of particles and gaseous compounds, air temperature, relative humidity, and air velocity. These kinds of systems are in use; some owners state the indoor air related requirements with help of these systems when building new office buildings.

The above mentioned environmental indicators are used in the assessment of environmental performance of buildings. However, when assessing or monitoring sustainable urban construction, some important aspects are very difficult to take into account. For example:

- The classification systems of indoor climate cannot be used in order to assess the sustainable urban construction. It would be too time consuming to assess and monitor the indoor climate of individual buildings. However, it is possible to take this aspect into account with help of process related indicators.
- Also other building performance related consequential indicators are very difficult to make use of for the monitoring purpose of cities if considering the whole building stock. For example the adaptability, service life and durability of buildings affect significantly the use of material resources for building, but it would be impossible to assess these aspects with regard to the building stock within a city.
- As mentioned above, the environmental impacts of buildings also depend on location. The location-related environmental aspects of buildings depend on the distance of buildings to public transport services, bicycle routes and other services needed by the users of buildings. This is an important aspect for an owner to take into account as making decisions about the location of a new building or real estate. However, in this report this aspect is dealt with in connection with urban design.

[7] The Finnish classification of indoor air, construction works and surface materials of buildings. http://www.sisailmayhdistys.fi/sisailmatietoutta/sisailmastoluokitus.html

Socio-economic aspects and indicators of buildings

Social indicators of buildings are to describe how buildings interact with sustainability concerns on the community level. Community concerns that have relevance on buildings and their location are for example:

- urban sprawl, mixed land use, access to basic services including public transport, availability of green and open space, attractiveness of city centres, development of brown-fields, the availability of housing; social segregation; cultural quality and protection of cultural heritage, safety, noise and air quality in built environment.

TISSUE-project considered these aspects as sustainable urban design related aspects. Building level social aspects include for example (ISO TS 21929, draft):

- quality of buildings as a place to live and work,
- building-related effects on health and safety of users,
- Health, comfort and productivity of the users of buildings are influenced by the indoor conditions of buildings.
- Social aspects of buildings include those aspects that offer safety to the users with respect to the effects of the natural outdoor environment, burglary and fire.
- barrier-free use of buildings,
- The social aspects of buildings can also be indicated on the basis of the equal suitability of the observed buildings for different kinds of users (e.g. elderly people, children, parents with young children and disabled).
- access to services needed by users of a building,
- architectural quality of buildings and protection of cultural heritage,
- All buildings have significant influence on the cultural characteristics of a community on the basis of their architectonic and historic quality including their contextual consistency with their surroundings. This can be taken into account when indicating the social effects of buildings; for example when comparing the sustainability effects of new construction, renovation and restoration.

The above mentioned aspects are formulated with regard to individual buildings. With regard to the whole building stock within a city, the following aspects can be addressed and indicated:

- The availability of housing can be indicated, for example, on the basis of the number of households living in sub-standard housing conditions, the number of homeless people.
- The quality of building stock can be indicated based on a group of indicators including for example the average age, the renovated areas per total areas, the building facilities (for example the share of buildings connected with sewerage treatment system, provided with safe drinking water, warm water, central heating, waste collection and waste sorting)
- The accessibility to services can be assessed on the basis of the share of houses located in certain distance apart from public transportation services, grocery shops, schools and kindergartens etc.
- The possibilities for tele-work can be assessed on basis of the share of houses having broad-band access.
- The barrier-free use of buildings can be assessed on the basis of the share of apartment buildings supplied with a lift (though barrier-free use also depends on many other issues).

However, it seems that there are no good-quality indicators in use in order to assess the socio-economic quality and cultural quality of building stock based on the performance of buildings. This problem is based on the fact that cities do not have statistical detailed information of buildings.

Process-related aspects and indicators of buildings

The assessment and monitoring of building stock may be difficult, if the assessment should be based on detailed information of building performance of individual buildings. With regard to this problem, process-related indicators may help, because it means less collection of information.

According to the ISO TS 21929 (draft), the environmental performance of a new building can be indicated by the effective use of methods and tools that support the consideration of environmental aspects, including for example
- environmental target setting methods,
- service life design methods and tools,
- environmental assessment tools and

- design methods for energy-efficiency and assessment methods for energy consumption.

Process related issues can also be used to indicate the social aspects of new construction or refurbishment. The social aspects of buildings include building-related possibilities to support social cohesion; for example design for common spaces in the building and design for common areas in the neighbourhood in order to promote social relationships.

The following list presents examples of process-related subject matters that can be used to indicate the social sustainability of construction process:

- Co-operation with the users of the building and the neighbours
  - users' participation in the process;
  - ability to maintain good relations to the neighbourhood and to listen the neighbours' views;
- Ensuring the thorough consideration of users' needs in the design and construction process. Users' needs may concern
  - availability of needed services;
  - building performance including indoor conditions, safety, adaptability, barrier-free use and usability;
  - economic and environmental aspects.
- Ability to support social cohesion in the process, for example
  - consideration of the different social and cultural groups of users and their special needs;
  - making use of local labour.

Also indicators that express the good maintenance, preserving and making use of existing valuable buildings can be used.

Classification methods for sustainable building

The researches and practitioners together have developed environmental assessment and classification systems for buildings in a number of European countries. These systems are in use for example in the countries listed in the following table (Table 6).

Table 6. Environmental assessment and classification systems.

BREEAM	UK
HQE® approach	France
EcoEffect	Sweden
ECOPROFILE	Norway
PromisE	Finland

These tools provide a wide coverage of environmental, economic and building performance issues, which are deemed to be relevant to sustainability. Normally certificates or labels are given on the basis of assessment; some require external auditors.

These tools can be used by city authorities as they are acting as building developers or representing owners. These tools are developed for the following purposes:

- target setting,
- identifying essential sustainability issues and developing sustainable building concepts,
- assessing and classification of buildings and using the achieved certificates or labels in marketing.

This section introduces the main features of the assessment and classification systems used in France, in the UK and in Finland. These indicator systems were not assessed and reported by **TISSUE**, because the systems are not developed from the point of view of cities and the systems are not used by municipalities to assess the whole building stock. However, it is important to deal with the aspects included within these kinds of systems in order to explain and justify the suggested building-related sustainability indicators.

PromisE system in Finland

PromisE [8] is an Environmental Assessment and Classification System for Residential, Office and Retail Buildings in Finland. There are two systems, the other one of which is for existing buildings and the other for new buildings [9].

The system was developed in cooperation with researchers, practitioners, representatives of standardisation and building authorities. The system is used in order to assess the environmental performance of buildings and to set requirements for new buildings.

The PromisE system includes four main categories: Health of users, consumption of natural resources, environmental loadings and environmental risks. The systems includes a 5-stepped classification. The value of an indicators has to be selected between the E-level, which represents normal level, and the A-level, which represents excellent level. The indicators as well as the categories has been weighted in such a way that the final result can be expressed in terms of one class (A, B, C, D or E). The weighting took place in working seminars in cooperation with different actors of building sector.

The PromisE-system includes the following categories:

HEALTH OF USERS
Management of indoor climate
Indoor air quality
Management of moist damages
Illumination
CONSUMPTION OF NATURAL RESOURCES
Energy consumption
Water consumption
Land use
Materials consumption

[8] www.promiseweb.net
[9] The eco-efficiency and life-cycle methods of building. Final report of REM research project. Authors Tarja Häkkinen et al. Published by The Finnish Confederation of Building Industry RT. Helsinki 2004.

Service life
ENVIRONMENTAL LOADINGS
Emissions into air
Wastes
Sewage
Bio-diversity
Environmental loadings from traffic
ENVIRONMENTAL RISKS
Environmental risks of building site
Environmental risks of building

BREEAM system in the UK

BREEAM assesses the environmental performance and sustainability of buildings in the following areas [10]:

- management: overall management policy, commissioning site management and procedural issues;
- energy use: operational energy and carbon dioxide (CO_2) issues;
- health and well-being: indoor and external issues affecting health and well-being;
- pollution: air and water pollution issues;
- transport: transport-related CO_2 and location-related factors;
- land use: greenfield and brownfield sites;
- ecology: ecological value conservation and enhancement of the site;
- materials: environmental implication of building materials, including life-cycle impacts;
- water: consumption and water efficiency.

The method can be used to assess the environmental performance of both new and existing buildings. It is regarded by the UK's construction and property sectors as the measure of best practice in environmental design and management. The system of indicators is used for target setting, in design for sustainable buildings and for the assessment of buildings. According to the

[10] http://products.bre.co.uk/breeam/index.html

methodology, credits are awarded in each area according to performance. A set of environmental weightings then enables the credits to be added together to produce a single overall score. The building is then rated on a scale of PASS, GOOD, VERY GOOD or EXCELLENT. The BREEAM system covers all kinds of building types with specific versions relating to offices, homes, industrial units, retail units and school.

Certification scheme for non-residential HQE® building projects in France [11]

The French building research institute CSTB developed in 2002 an assessment and certification system for sustainable buildings which follows the so-called HQE® (Haute Qualité Environnementale / High Environmental Quality) approach. The assessment system focuses on environmental and health aspects of buildings. The HQE® Association was also involved in the development of the system.

After the development of the system there was a testing period in 2003 and during the first half of 2004. After testing in pilot projects the system will become official. The certification scheme deals with new non-residential buildings, focusing on four categories: offices, schools, hotels and shopping centres. CSTB has dealt with non-residential buildings, while QUALITEL Association in France is developing a corresponding certification system for multi-unit residential buildings.

The national certification scheme for non-residential buildings developed by CSTB includes two aspects: the environmental quality of the building, described on the basis of 14 environmental issues of concern, and the environmental management system of the building project. These two aspects formulate a framework including performance criteria and management requirements.

The management system can be defined as the set of organisational elements that enables the building owner to prioritize the 14 environmental issues and to

[11] The text is based on the presentation "Certification scheme for non-residential HQE® building projects" written by Sylviane Nibel, CSTB. July 2004.

organise the project in order to achieve them, while managing the quality of the operational processes, namely brief, design, and construction works.

It is the responsibility of the building owner to define the specific environmental objectives for his project, carrying out a prioritization of the 14 issues in the upstream phase. This prioritization will necessarily reflect the own environmental strategy of the building owner, but it must also be consistent with the features of the local context, the needs of interested parties and the regulation constraints.

The environmental quality of the building is structured according to the 14 environmental issues defined by the French HQE® Association in 1997, including interactions with building site, eco-construction, eco-management, comfort and health. Three levels of performance have been defined. These include "basic" – corresponding to the current regulation or the normal practice –"good" and "very good".

List of the 14 French environmental issues of concern is as follows:

SITE and ECO CONSTRUCTION
ISSUE 01 : Relation between the building and its immediate surroundings
ISSUE 02 : Integrated choice of construction products, systems and processes
ISSUE 03 : Low-impact construction site

ECO- MANAGEMENT
ISSUE 04 : Energy management
ISSUE 05 : Water management
ISSUE 06 : Activity waste management
ISSUE 07 : Maintenance – Environmental performance conservation

COMFORT
ISSUE 08 : Hygrothermal comfort
ISSUE 09 : Noise and acoustics
ISSUE 10 : Lighting
ISSUE 11 : Odours

HEALTH
ISSUE 12 : Health conditions of spaces
ISSUE 13 : Indoor air quality
ISSUE 14 : Sanitary quality of water

Sustainable construction from the point of view of standardisation and building regulations

The European Directive on Energy Performance of Buildings

The European Directive 2002/91/EC on Energy Performance of Buildings came into force 16 December 2002 and it will be implemented in the legislation of member states by 4 January 2006.

Four main elements define the requirements that need to be integrated into national legislation:

- Establishment of a methodology for an integrated calculation of the overall energy performance of buildings;
- Definition of minimum energy efficiency requirements per member state based on this methodology;
- Energy efficiency certification of new and existing buildings;
- Regular inspection of heating and air conditioning systems.

The building sector is responsible for about 40 % of Europe's total primary energy consumption. Thus the energy performance directive is an important step for the European Union in order to reach targets required by the Kyoto Agreement. The EU is committed to reduce the CO_2 emissions by 8 % by 2010 in relation to the base year of 1990.

In addition to the aim of improving the overall energy efficiency of new buildings, large existing buildings will become a target for improvement, as soon as they undergo significant renovation. The Directive also concerns existing buildings if the total useful floor size exceeds 1000 m^2 and an investment in renovation exceeds 25 % of the building (without land) value or 25 % of the building envelope are subject to renovation.

Building certificates are required upon construction, change of ownership or tenant. Such certificates shall remain valid for no longer than 10 years. They have to include recommendations for improvements in energy performance as well as comparisons to standards or benchmarks. In buildings occupied by public authorities and institutions, the certificate is to be displayed in public. Heating and cooling equipment has to be inspected by qualified personnel,

boilers between 20–100 kW regularly, boilers >100 kW every two years (for natural gas 4 years). If the boiler is > 20 kW and older than 15 years, the total heating system shall be examined for efficiency and sizing to enable suggestions for replacement or improvements. Air conditioning systems with a rated cooling output >12 kW are to be inspected regularly for efficiency and correct sizing. As for boilers, suggestions shall be included to improve energy performance or on alternative solutions. The European Directive 2002/91/EC does not define requirements for the insulation level of buildings.

However, it is important to notice that buildings larger than 1000 m^2, which are the subject to the Directive, represent roughly 28 % of the total area of building stock. The group of single-family houses represents the largest share of buildings (45%). Multi-family houses cover 26 % of the total building stock and non-residential buildings 29 % [12].

As shown in several studies the main energy saving potential lies in the existing building stock. Newly built houses are generally already built in compliance to national performance standards and therefore exhibit inherently small savings potential in CO_2 emissions. The demolition rate in the building stock can be estimated to be approx. 0.5–1 %. New building activity can be assumed to be 1 % of the total living area per year thus resulting in a slight increase of the building stock (EUROFYS).

On the basis of the EC standardisation mandate M/330 EN and with reference to the Directive 2002/91/EC on the energy performance of buildings, CEN is developing an integrated and interacting methodology for the calculation of the energy uses and losses for heating and cooling, ventilation, domestic hot water, lighting, natural lighting, passive solar systems, passive cooling, position and orientation, automation and controls of buildings, and auxiliary installations necessary for maintaining a comfortable indoor environment of buildings; this is an important sustainability component specifically aimed at the 'use phase' of the construction's life cycle. The standards under the mandate M/330 are being prepared by the CEN/TC89 "Thermal performance of buildings and building

[12] Mitigation of CO2 emissions from building stock. Beyond the EU Directive on the Energy Performance of Buildings. Report established by ECOFYS for EURIMA & EuroACE.

components", CEN/TC156 "Ventilation for buildings", CEN/TC169 "Light and lighting", CEN/TC228 "Heating systems for buildings" and CEN/TC 247 "Building automation and building management".

CEN/BT/WG 174 Integrated environmental performance of buildings

CEN/BT WG 174 "Integrated environmental performance of buildings" will start its work in the near future. The objective of work is to develop standardised methods for the assessment of sustainability of buildings and building products in the construction industry within the specified limited scope. Standards will address the harmonised methodology with core indicators for assessment of environmental performance, health & comfort performance, life cycle cost performance of buildings in the context of the integrated building performance.

6th Framework programme and methodologies to assess sustainability of buildings

The 6th Framework programme will continue to carry out the development of sustainability methodologies for buildings (Integrating and strengthening the European Research Area Scientific Support to Policies (SSP)). The objective is to develop a methodology to assess the overall sustainability of new and renovated buildings: with the objective to raise awareness of the relative performance of buildings and to enable the implementation of incentives for the promotion of sustainable construction. The work must build on and complement existing sustainability methodologies.

ISO/TC 59 SC17 Building construction – Sustainability in building construction

The foremost aim of international standardization is to facilitate the exchange of goods and services through the elimination of technical barriers to trade. ISO is a legal association, the members of which are the National Standards Bodies of some 130 countries. The principal deliverable of ISO is the International Standard.

ISO/TC59 /SC17 Building construction / Sustainability in building construction makes standardisation in the field of sustainability of the built environment. The

environmental, economic, and social aspects of sustainability are included as appropriate. The work is carried out by four working groups:

- WG 1: General Principles and Terminology
- WG 2: Sustainability Indicators
- WG 3: Environmental Declarations of Building Products
- WG 4: Framework for Assessment of Environmental Performance of Buildings.

3.4 Sustainable urban management

The Commission's Communication of February 2004 identifies sustainable urban management as a key issue for improvement of the overall quality and sustainability of urban areas and environments in Europe. Two kinds of indicators are required for the monitoring of the sustainable development of urban environment:

- general indicators; for monitoring how the European cities and their urban environments are managed in general
- specific indicators; showing how cities respond to specific actions, measures, suggestions and/or duties stipulated in the TSUE strategy

The situation for the monitoring of Sustainable Urban Management is rather different, because there are no absolute thresholds and quantitative targets for the single aspects and also no good aggregate methods for the assessment of the overall management quality and it's effects and effectiveness. As a consequence, the monitoring and indicators in the field of urban management must concentrate on the process and implementation rather than on the content, achievement of objectives and quality. Phenomena and variables will be measured, which everybody agrees upon in principle, – like adoption of integrated plans, local agendas, public participation in planning – but with which it is much more difficult to reach a consensus, how much of it (e.g. of plan integration or public participation) is needed and whether the pertinent local arrangements contribute to the achievement of agreed objectives and are of good quality.

For the moment being (December 2004), important political questions concerning the implementation and the institutional set-up of the strategy have not been decided yet. The most prominent and important example is the

uncertainty whether the suggested Environmental Management Systems (EMS) and Plans (EMP) for all larger cities in the EU will be mandatory or not.

TISSUE pointed out three groups of concerns and trends as relevant for sustainable urban management:

- Concerns and trends with regard to the resources, measures and policy integration;
- Concerns and trends with regard to the perceptions, attitudes and behaviour of citizen;
- Concerns and trends with regard the perceptions, attitudes and behaviour of local firms and public institutions.

The **TISSUE** indicators selection puts most weight on the first group and suggest indicators for measuring the adoption, relevance and impact of different local planning instruments and environmental management tools. The second priority and selection focus is the citizen's participation in planning and their satisfaction with the state of the urban environment. Finally there is also one indicator measuring the environmental and social commitment of local firms and organisations.

Adoption of local plans and environmental management systems

All European cities have and use different kinds of local plans and tools for management of their urban environments. **TISSUE** suggests gathering data and information on their adoption, relevance and impact as the most important management-related indicators. Three questions are important and will be addressed below in connection with this suggestion:

- Which local plans and management tools should be monitored?
- Which data and information about them should be gathered?
- How is the necessary data and information supposed to be gathered?

TSUE relevant local plans and management tools

The three most important local policy sectors in connection with the TSUE are clearly transport, environment and land-use. Specific sector plans refer to one of these sectors only, integrated plans combine any of these. In the context of TSUE, urban transport plans on one side and urban environmental management

plans and systems on the other play an important role. European cities with more than 100.000 inhabitants should develop, adopt, implement and regularly revise

- Sustainable Urban Transport Plan (SUTP) with short, medium and long-term targets, providing a long-term vision for transport and mobility development in the entire urban agglomeration.
- Environmental Management Plan (EMP) defining targets for environmental impacts, and implement an Environmental Management System (EMS) for monitoring the progress towards more sustainability of the urban environment.

The decision whether this will happen on a voluntary base or whether there should be a pertinent directive and reporting obligation at the European level is a political one and should be taken in the next few months.

"In the context of the approach proposed by the Communication of February, an **Environmental Management Plan** (EMP) is understood in the broad sense of the term as organisation of all urban matters related to the environment. It should aim towards environmental sustainability by supporting a more comprehensive or holistic approach to public policy, so tackling the contradictions arising from sectoral policy compartmentalisation. Coherent and coordinated management will not only address potential conflicts, but will also highlight positive opportunities for creation of synergy between policy sectors in pursuit of sustainability. Finally, the issue of policy integration goes beyond public administration to include the public, investors, developers and other actors. This suggests that planning processes may need to include special arrangements to bring government departments into partnerships with other actors. Based on the existing experiences, it is felt that the proposed European EMP can fit with existing plans as an “umbrella plan” that provides an over-arching (i.e. all-embracing) environmental strategy for the city, and that moves cities to a higher level of integration. The EMP should assure the definition and management of the Municipality’s environmental plans (waste, water management, etc.), and integrate environmental considerations in the city administration’s non-environmental plans (e.g. spatial planning, tourism, education, industry, trade, procurement).

The **Environmental Management System (EMS)** is a way to ensure that the plan is implemented by affecting decisions on a day to day basis. The system has a key role in ensuring that the town or city's environmental obligations are met by ensuring that the objectives in the plan are taken into account in day to day decision making and that progress in meeting them is regularly assessed. The management system could involve an initial review, allocation of responsibilities, objective and target setting, resource allocation to meet objectives, auditing and monitoring with corrective measures as appropriate, progress reporting and independent external verification/certification. The Community has developed the voluntary EMAS. Other examples of environmental management systems are ISO 14001, eco-budget, CLEAR, eco-Procurement or eco-label. No particular management system is proposed in the Communication of February 2004[13].

The long quotation above and the envisaged "umbrella character" makes clear that EMPs and EMSs are not necessarily new instruments developed from the scratch for the purposes of implementation and monitoring. They can and will build upon and integrate existing local plans and management tools which were designed for other purposes. Some of these plans and instruments – e.g. integrated transport, environment and land-use plans, or Local Agendas 21 come very close to the scope and purposes of the EMPs and EMSs and might even be considered as functional equivalents.

Regarding their internal hierarchy and mutual relationship EMS are larger and entail EMP. Some cities or urban areas could endorse EMP only without EMS, but not the other way round. EMPs are seen as instrumental tools for the implementation of EMS.

Relevant data and information

For the monitoring of sustainable development of urban environment, both quantitative data and information about the number of implemented plans and management tools as well as qualitative data and information about their

[13] Interim Report of the Working Group on Urban Environmental Plans and Systems, p. 36

relevance and impact should be collected. If there will be no pertinent directive and reporting obligation, the monitoring focus will lie on adoption rates and quantitative data and information in the first place. An obligation and official registration and/or approval procedure would make it necessary and also easier to include qualitative data and information on the relevance and impact of adopted plans and management tools.

Process and means of data collection

The collection of necessary data and information must combine voluntary bottom-up approaches with official top-down (registration, validation, approval, certification) elements and mechanisms. Good example of the first is the LASALA project[14] which develops and promotes the idea of self-reporting and self-evaluation. It offers the cities possibilities for comparisons and benchmarking with other cities. Since voluntary self-reporting and self-evaluation serves motivational and promotional purposes in the first place – and could lead to positive biases and distortions of different kinds, we recommend some kind of centralised validation (registration, approval, certification, control) of the EMP and EMS – regardless whether they are mandatory or not. The cities/urban areas should submit their EMP and EMS to some central institution which would check their content and whether they fulfil all necessary requirements. This validation procedure could be used as one important source of information for the monitoring and the calculation of values of pertinent indicators.

Public participation in urban planning and citizen's satisfaction with the state of urban environment

"Public participation" is a difficult concept with changing forms, contents, platforms and attributed relevance and normative desirability. For the purposes of the **TISSUE** project three different approaches to the quantification and measurement of public participation in local environmental planning processes are discussed below.

[14] For details see http://www.localevaluation21.org/

- Legal or legalistic approach to public participation
  One possibility for monitoring of public participation in local and environmental planning can be derived from the following definition: ”Public participation is the extent to which laws, regulations, and guidelines, as well as institutions and organisations provide opportunities for public access to information and public participation in the opinion forming and decision making process”.

- Prerequisite/investment approach to public participation
  Another approach to public participation in local environmental planning is more input oriented and tries to quantify pertinent institutional prerequisites and investments. As such institutional prerequisites we see for example financial expenditures and investments in citizen's information and participation, existence of explicit participation strategies and pertinent awareness raising campaigns. Measured can be also the time which people invest for this participation or number and activities of associations, networks and organisations with pertinent aims and purposes.

- Subjective approach via perceived participation chances and satisfaction with the state of urban environments
  Yet another and probably the easiest approach is to quantify and measure the subjective perceptions of the citizens about their information on local environmental issues and on their chances to participate and contribute in pertinent opinion forming and decision making processes. Since no good harmonised data and information of this kind are available, a larger representative survey would be needed to obtain such data and information. The concern to measure and monitor citizens satisfaction with the state of urban environment is also obvious and self-explanatory. Again, no good data and information of this kind is available, but could be collected by the means of the same representative survey.

Sustainable management of local firms and organisations

Sustainable management of urban environment is a collective endeavour and partnership process, requiring also commitment and active participation of local firms and organisations. An indicator is needed which would show how local firms and organisations endorse their responsibility towards the environment and

the local community. It can be measured as the number or percentage of private and public organisations that use a recognised environmental or social management/reporting/auditing system. One example of such recognised system is EMAS and will be briefly described in the next paragraph; the other relevant and widely spread system is ISO 14001. Reporting systems with stronger focus on social responsibilities are SA 8000 (Standards for Social Accountability) and the new – yet not sufficiently formalised and institutionalised – CSR (Corporate Social Responsibility) framework.

The Community Eco-management and Audit Scheme (EMAS)

The *Community* Eco-management and Audit Scheme (EMAS) is a management tool for companies and other organisations to evaluate, report and improve their environmental performance. The scheme has been open for participation by companies since 1995 and was originally restricted to companies in industrial sectors. Since 2001 EMAS has been open to all economic sectors including public and private services. In addition, EMAS was strengthened by the integration of ISO 14001, and by considering more strongly indirect effects such as those related to financial services or administrative and planning decisions. Participation in the scheme is voluntary and extends to public or private organisations operating in the European Union and the European Economic Area (EEA) – Iceland, Liechtenstein, and Norway. The core of the EMAS scheme is the so-called "continuous improvement circle" or ”PDCA-circle“ (plan-do check-act). The elements of this circle are presented in the following diagram (Figure 6).

Figure 6. The core of the EMAS scheme described with help of the so-called "continuous improvement circle".

PART 2: Trends of sustainable urban development

1 Trend selection approach adopted in TISSUE

A "trend" can be defined as a general direction or tendency to which something tends to move or change. A second possible meaning, which is not relevant for the **TISSUE**-project, understands under the term a general line of orientation or popular taste at a given time.

One of the most prominent characteristics of cities and urban environments is their nested interrelatedness and systemic complexity. An attempt to select these trends with the help of a "reality oriented" rationale, based on the cities, their functions, potentials, problems, "drivers" of change and their determining effects on other variables, leverage points of policies, etc. would require too much resources and is not feasible in the framework of the **TISSUE** project. Instead of it, **TISSUE** follows a simple and pragmatic course and select the relevant trends with the help of a slightly modified OECD-PSR approaches which is described below. "Relevant" means for **TISSUE** in the first place relevance for the TSUE and problems, issues and trends mentioned in the following six documents:

- European Academy of Urban Environment, Initial Analysis Report, September 2003, Berlin
- Communication from the Commission, Towards a thematic strategy on the urban environment, Brussels, Feb. 2004
- Working Group Sustainable Urban Management, Draft Final Report
- Working Group Sustainable Urban Transport, Draft Final Report
- Working Group Sustainable Urban Construction, Draft Final Report
- Working Group Sustainable Urban Design, Draft Final Report

The following table (Table 7) recapitulates the content of the six above mentioned documents in terms of problems, issues and trends pointed out. Brackets mean that the pertinent problem, issue, trend can be attributed to more than one priority theme.

Table 7. Sustainable urban development problems, issues and trends.

Problems, issues and trends mentioned in relation with sustainable urban management (SUM)
• **ownership** of utilities, such as energy and water companies • decreasing resources of local authorities, centralisation of competences • security and reliability of basic services and infrastructure (also -> SUC) • insufficient co-operation beyond administrative boundaries • insufficient horizontal and vertical co-operation • insufficient public participation and social alienation • lack of knowledge and commitment to sustainability issues • lack of institutional and personal capacity and willingness to learn • shift from area-wide planning to project based planning (also -> SUD) • separation of planning and implementation (also -> SUD) • problems with **public/private partnership**
Problems, issues and trends mentioned in relation with sustainable urban transport (SUT)
• suburbanisation (also SUD) • urban density (also SUD) • spatial structure, location of activities (also SUD) • safety • motorisation, car- and vehicle ownership • air pollution, noise and impacts of transport on health and life quality • traffic accidents, safety, security • affordability and access to basic opportunities and services (also SUM, SUD) • car use, modal split and pertinent shifts • technical quality and maintenance of vehicles • tele-work, substitution of traffic by communication and information (also SUD) • fuels and energy consumption in transport and pertinent changes • time spent in transport and time-use in general • procurement of low energy and low emission vehicles by public authorities • urban nodes in a global network • growth of light commercial vehicles

Problems, issues and trends mentioned in relation with sustainable urban construction (SUC)
• energy efficiency of buildings; "pre-occupancy" and "post-occupancy" energy targets • production and recycling of construction waste, soil sealing • take-off from the Earth-crust, consumption of non-renewable resources • maintenance, renovation and life-cycle costs of buildings • affordability of housing and spatial segregation • indoor thermal comfort and air quality • retrofitting, refurbishment and renovation • identity, character and diversity of the built environment • cultural heritage of cities • flexibility to cater for unknown future needs (also SUD, SUM) • life span of buildings and public spaces
Problems, issues and trends mentioned in relation with sustainable urban design (SUD)
• functional and spatial division of labour • low settlement density, unclear boarder between settlement and free-space • urban sprawl, suburbanisation • increase in transportation, energy and land-use • inefficient and wasteful patterns of land-use (also SUM) • traffic generation through bad land-use planning (also SUT) • de-centralisation of urban development • growing crime and insecurity (also SUM) • declining city neighbourhoods (also SUC) • social and ethnic segregation • amenity and attractiveness of city centres (also SUC) • open and green space, abandoned and derelict land

Because of the complexity of the cities and urban environments, which make it difficult to identify the drivers of change, **TISSUE** did not consider the DRIVER-level and to followed the OECD PSR (Pressure-State-Response) scheme. A second important choice is the decision to distinguish between concerns, trends and indicators. The main **TISSUE** objective and selection criteria is the identification of trends and indicators that allow the monitoring of urban environment with reference to (i) actions expected as a direct effect of the

TSUE and (ii) those "wide" concerns/trends that the TSUE aims at influencing with its actions/policy measures. First kind of direct TSUE effects will be measured with the help of RESPONSE indicators expressing efficiency in doing things, the second one with the help of PRESSURE and STATE indicators related to the problems and state of urban environment. Pressure and States trends/indicators should clearly be related also to phenomena wider than the only 4 priority areas identified by the TSUE will also include local policies or citizen behaviours. Response trends/indicators should clearly be related to actions directly implemented by the TSUE. In order to reflect these and other requirements, the **TISSUE** trend selection approach was based on the following structure (Table 8).

Table 8. TISSUE trend selection approach.

Type of concern/trend	*Differentiation into subgroups*
PRESSURE concerns and trends related to pressures and problems within urban environments	• Sustainable Urban Transport related PRESSURE concerns and trends • Sustainable Urban Construction related PRESSURE concerns and trends • Sustainable Urban Design related PRESSURE concerns and trends
STATE concerns and trends with regard to the state of sectors of urban environment	• Quality of the Urban Environment related STATE concerns and trends • Healthy Living related STATE concerns and trends • Environmental Performance related STATE concerns and trends
RESPONSE concerns and trends with regard to urban management and policy responses at different levels of state activity	• RESPONSE concerns and trends related to resources, institutions, implemented measures and policy integration • RESPONSE concerns and trends related to perceptions, attitudes and behaviour of citizen • RESPONSE concerns and trends related to perceptions, attitudes and behaviour of firms and enterprises

2 Relevant trends to monitor the sustainable development of urban environment

Based on the described structure and after several rounds of discussion within the **TISSUE** consortium and also with help of the representatives of the city networks the following concerns and trends were selected and considered as relevant for the TSUE. The detailed descriptions of the selected trends are presented in APPENDIX 1.

The following table (Table 9) lists the titles of trends, which the **TISSUE** project assessed as relevant with regard to TSUE. A trend expresses direction or tendency in which something tends to move or to change. The following trends either express issues that are changing – for example 'car dependency' is increasing – or issues about which expectations or needs are changing – for example 'availability and accessibility of green and open space' is a common objective, the importance of which is increasing.

*Table 9. **TISSUE** trends and concerns.*

PRESSURE concerns and trends	
Sustainable Urban Design	
Concern	**Land use**
Trends	Urban sprawl and suburbanisation
	Consumption of land and space
	Car dependency
	Demand for the accessibility of basic services and facilities
Concern	**Urban design**
Trends	Densification and clustering of settlements, demand for mixed land use (“compact city strategies”)
	Demand for short-distance and public transport oriented development
	Demand for balanced development of greenfields and brownfields
	Demand for attractiveness of city centres and amenity of streets and neighbourhoods
	Demand for availability and accessibility of green and open space
	ICT-contribution to sustainable design of cities and communities
Concern	**Infrastructure supply and traffic circulation**
Trends	Traffic volume
	Traffic circulation, congestion
	Infrastructure supply
	Demand for traffic restriction zones

Sustainable Urban Transport	
Concern	**Development of transport demand in relation to activity patterns**
Trends	Transport demand
	Demand for accessibility, transport quality
	Demand for affordability
Concern	**Supply, quality and use of transport means and services**
Trends	Demand for balanced modal split
	Demand for transport safety
	Demand for vehicle park
	Demand for public Transport System Quality
	New transport technologies
Concern	**Infrastructure supply and traffic circulation**
Trends	Traffic volume
	Traffic circulation, congestion
	Infrastructure supply
	Traffic restriction zones
Sustainable Urban Construction	
Concern	**Environmental pollution and consumption of resources of buildings**
Trends	Demand for environmental and energy efficiency of buildings
	Demand for new methods (environmental declarations of products, environmental assessment and classification of buildings)
	Demand for efficient maintenance and management of buildings
Concern	**Healthy living and working conditions, productivity**
Trends	Demand for good-quality indoor climate

Concern	**Building services for ageing, disabled and other special groups**
Trends	Demand fro barrier-free built environment and good accessibility
Concern	**Increasing mobility and changes in the living standard**
Trends	Demand and availability of housing and buildings
Concern	**Individuality and Changes in business and technological environment and productivity**
Trends	Demand for new services
	Improving client orientation
	Improving potentials for the use of new technological and ICT solutions
Concern	**Age of building stock**
Trends	*Increasing renovation*
STATE concerns	
Concern	**Quality of the Urban Environment:**
	Energy Availability,
	Water Availability,
	Indoor conditions,
	Biodiversity Quality.
Concern	**Healthy Living Environment:**
	Air quality,
	Water,
	Soil quality,
	Acoustic Environment Quality,
	Green and Open Spaces Quality.

Concern	**Environmental Performance:**
	Energy consumption and efficiency,
	Water consumption and efficiency,
	Food and materials consumption,
	Release of emissions,
	Wastes production, collection and treatment,
	Waste water treatment.
RESPOND concerns	
Concern	**Resources, institutions, implemented measures and policy integration:**
	Capacity and resources for TSUE and management of urban environment,
	Co-operation between cities and suburban communities,
	Development of urban focus and integration of urban environment in key national policies,
	Co-operation and co-ordination of different policies at local level,
	Co-operation and co-ordination of different policies at local level,
	Acceptance and implementation of other relevant constituent TSUE-measures,
	Public debate and policy discourse on urban environment issues.
Concern	**Perceptions, attitudes and behaviour of citizen:**
	Citizens perceptions and attitudes,
	Citizens behaviour.
Concern	**Perceptions, attitudes and behaviour of firms and enterprises:**
	Perceptions and attitudes of firms and enterprises,
	Behaviour of firms and enterprises.

PART 3:
Existing sets of indicators

1 Introduction

The main objective of the **TISSUE** project was to define a set-up needed for a harmonised set of indicators to monitor the sustainable development of urban environment. **TISSUE** developed a proposal for a set of sustainable urban indicators. The development of indicators was based on

- the selection of sustainable urban development related concerns and trends (introduced in Part 2)
- the assessment of existing sets of indicators on European, national and local level.

This part of the report introduces the assessment approach and procedure of existing sets of urban indicators. The purpose of the assessment of existing sets of indicators was to enable the development of the **TISSUE** indicator set. The assessment was done in terms of usability **and validity**. This means that the indicators set should be "usable" and "valid" both:

- from a general or basic quality point of view, i.e. usable and valid according to general quality criteria (ability to provide right information, reliability, ease of use, availability of information, scale of implementation)
- from specific **TISSUE** quality point of view, i.e. usable and valid with regard to the measurement of the **TISSUE** trends.

The work started with collection of sets of indicators. The information was saved in to the **TISSUE** internet browser (Fig. 7). **Sets of indicators** were described according to the following outline:

Description

- Name of the indicators system
- Description and aims: brief description of the set and the project or initiative that has developed the system
- Main developer name
- Other developer names
- Type of developer: the choice is between European level, national level, EU-25 and regional level
- Area of application: the choice is between international level, all the European territory, only in the national territory and at regional level

- Main focus of the indicators set: it indicates which trends and concerns of the following **TISSUE** relevant issues is addressed by the indicators belonging to the set:
    a. Sustainable Urban Transport (Pressure trends)
    b. Sustainable Urban Construction (Pressure trends)
    c. Sustainable Urban Design (Pressure trends)
    d. Quality of Urban Environment (State trends)
    e. Healthy living environment (State trends)
    f. Environmental performance (State trends)
    g. Sustainable Urban Management (Response trends)
- Users of the indicator set

Coverage

- Cities: the choice is between professionals/scientists, government European, government national, government regional, government local and private businesses
- City size: the number of cities for each of the following population classes: small (less than 100,000), medium (between 100,000 and 500,000), large (between 500,000 and 1,000,000) and very large (more than 1,000,000)
- Location of cities included: the number of cities for each of the country represented

Further information

- References
- Reference web address
- Remarks: any other useful information; this section also contains the name of the cities that have implemented the set, when this information is available
- Member of consortium: name of the person that has inputted the information
- Date: date of the last modify done to the datasheet

Individual indicators datasheet contains the following information:
- Name
- Definition
- Unit: unit of measurement

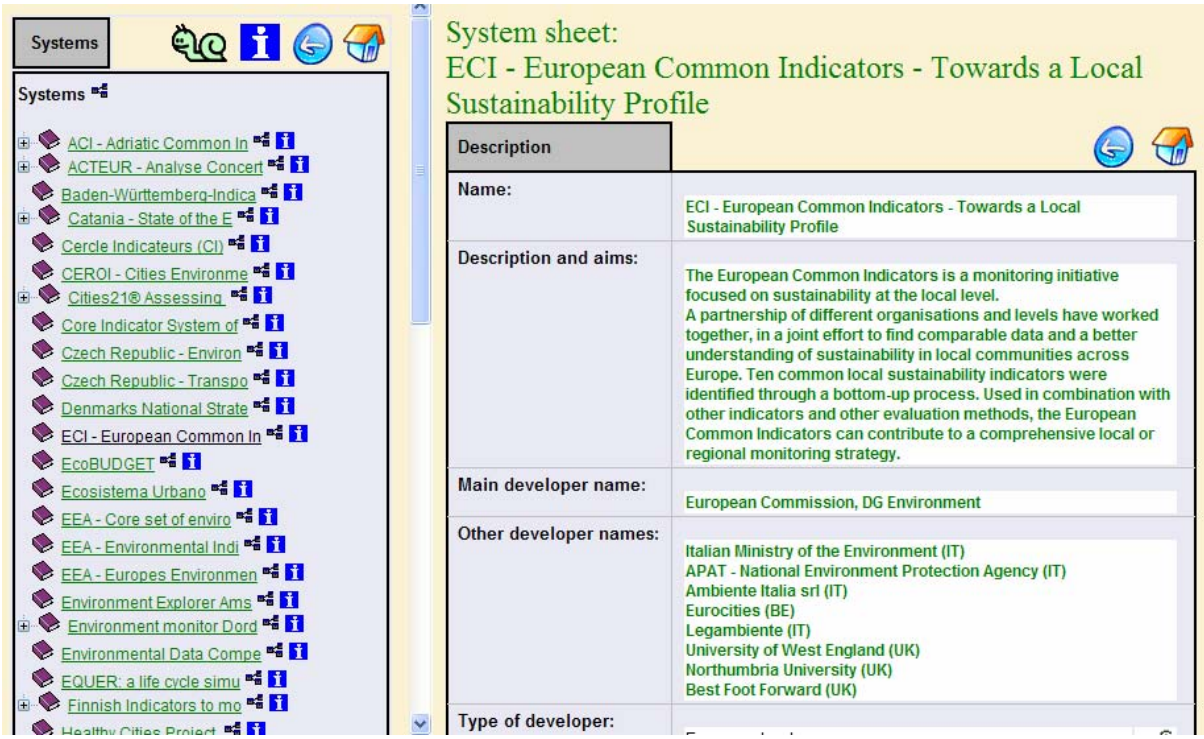

*Figure 7. Example of system datasheet on the **TISSUE** browser (see http://cic.vtt.fi/projects/tissue/index2.html).*

2 Coverage of the selected indicators sets

The **TISSUE** browser includes 57 set of indicators [15]. Three of the selected sets were developed on international level, 13 on European level, 18 on national level and 23 on regional or local level. 46 of the studied sets monitor the sustainable urban transport related trends, 32 sustainable urban construction trends, 48 sustainable urban design trends and 23 monitor sustainable urban management related trends. In addition, all most all (52) of the chosen sets monitor urban environment trends (the state of urban environment). **TISSUE** studied the coverage of the selected sets of indicators with regard to European countries and sustainable urban trends.

a) Coverage of countries

The following Figures 8–11 show the coverage of European countries per trend categories sustainable urban transport, design, management and urban environment [16].

[15] The list of indicators sets and their indicators is provided in TISSUE Deliverable 2.2 "Overview on indicators in European practice".

[16] With regard to sustainable urban construction category the corresponding study was carried out in terms of sustainable urban concerns.

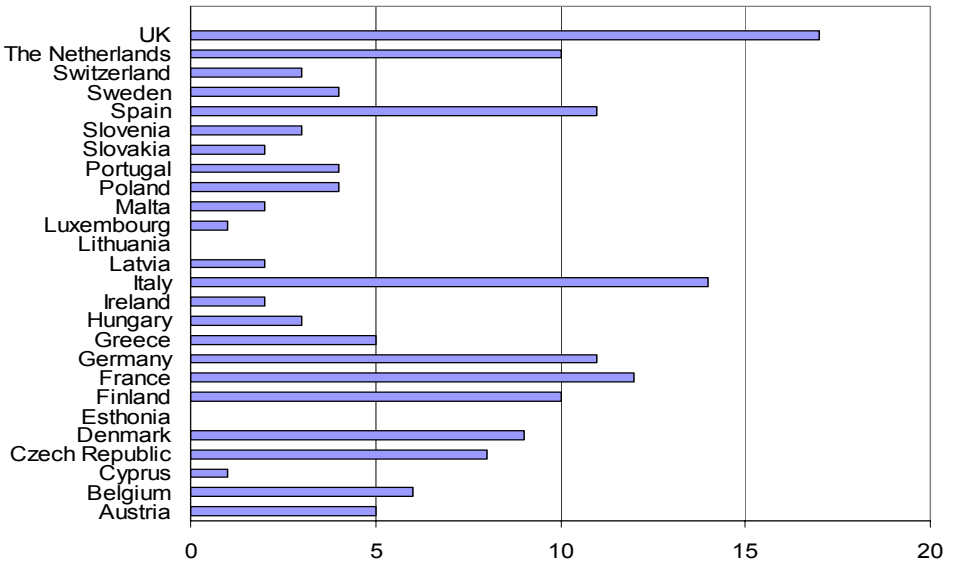

Figure 8. Coverage of countries by indicators sets related to sustainable urban transport.

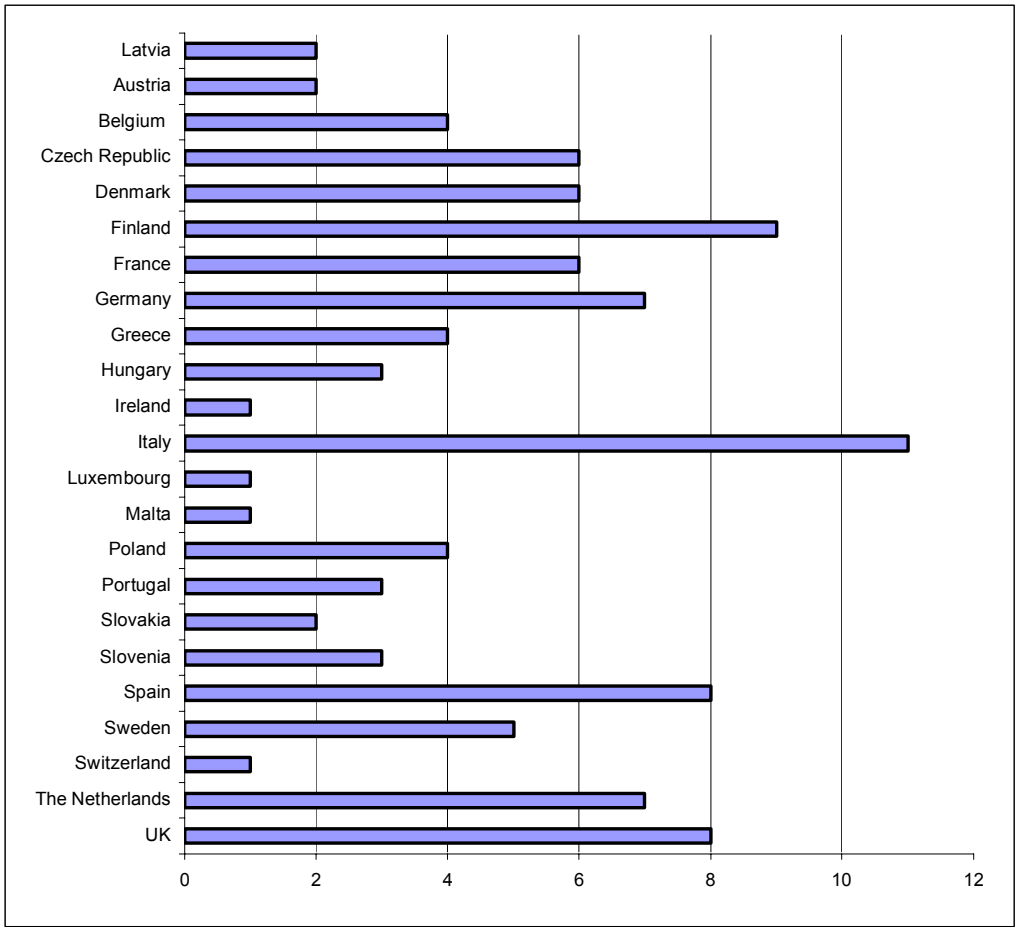

Figure 9. Coverage of countries by indicators sets related to sustainable urban design.

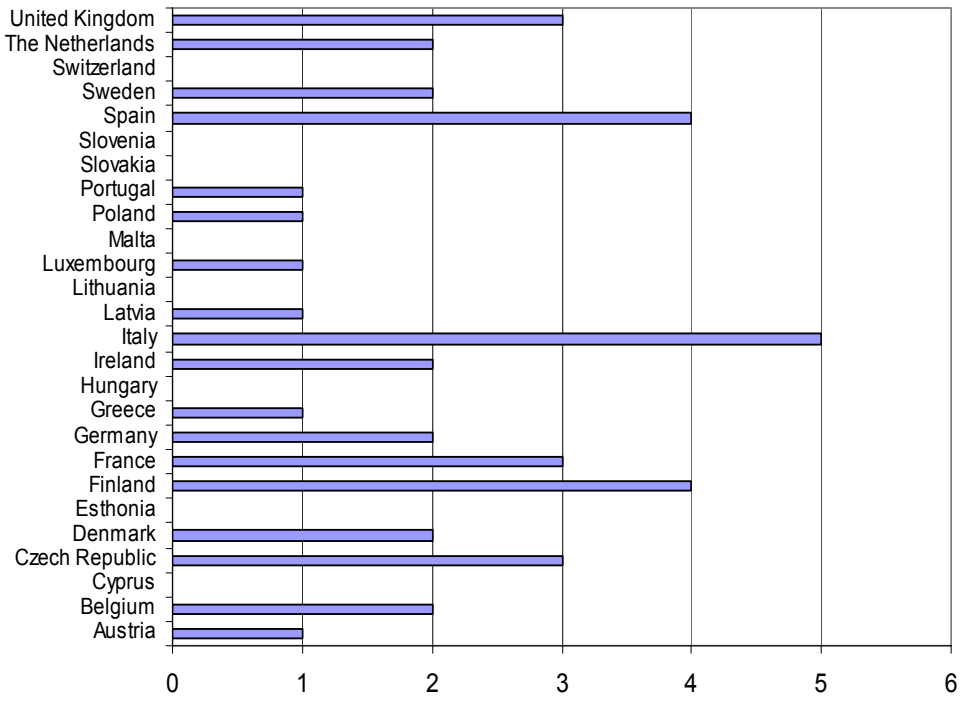

Figure 10. Coverage of countries by indicators sets related to sustainable urban management.

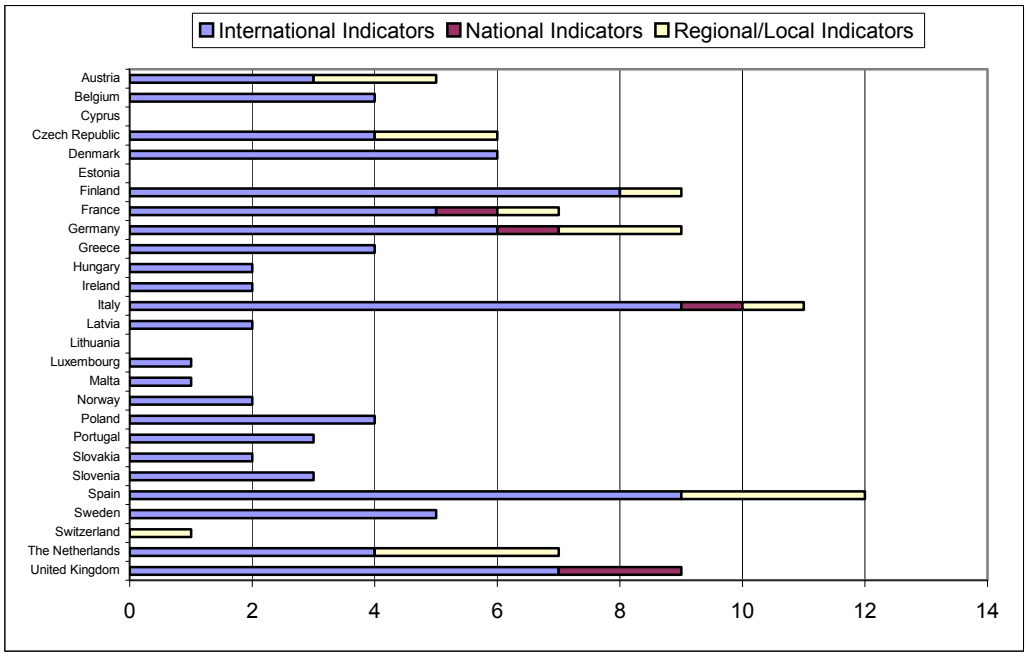

Figure 11. Coverage of countries by indicators sets related to sustainable urban environment (state of urban environment).

It seems that some countries are more represented than others. The UK, Italy, France, Spain, The Netherlands, Germany and Finland are well represented. On the other hand new members of the European Union are not well represented by the studied sets of indicators.

b) Coverage of regions

To examine the coverage of regions the European countries were grouped into four regions:

- **Northern Europe** (Denmark, Sweden, Finland),
- **Central Europe** (Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Slovakia, Slovenia, Poland),
- **Southern Europe** (Portugal, Spain, Italy, Greece, Malta) and
- **Western Europe** (UK, The Netherlands, Austria, Belgium, France, Germany, Luxembourg, Switzerland, Ireland).

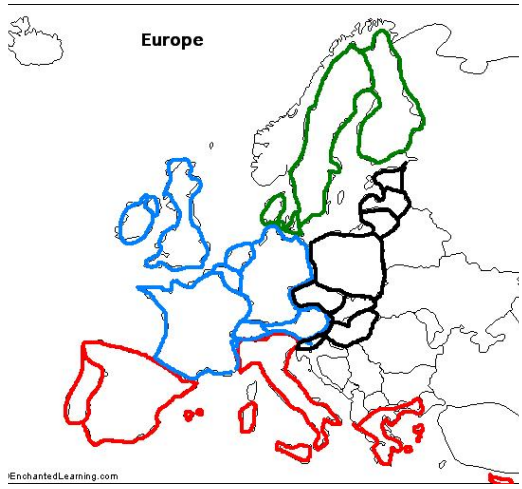

Figure 12. Division of Europe in four regions.

The Figures 12–16 show the coverage of the studied sets of indicators with regard to the different parts of Europe.

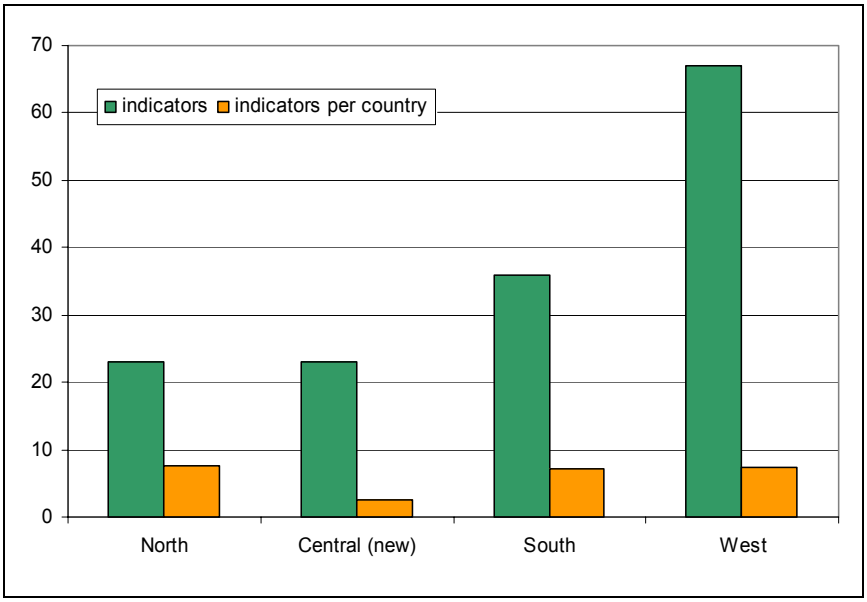

Figure 13. Coverage of European regions by SUT sets. The cities from the new Central European member states are included on average three times less in the 57 indicator sets than cities from the other three regions.

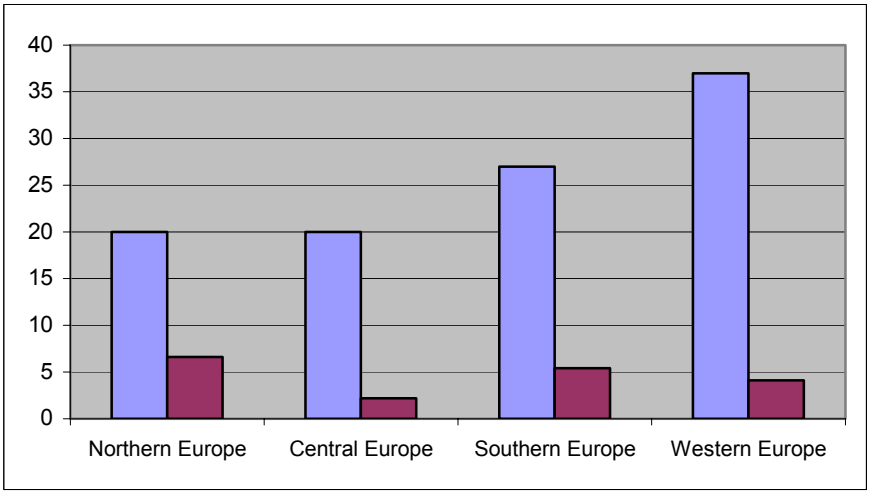

Figure 14. Coverage of European regions by the studied sets of indicators with regard to sustainable urban design. A country from Central Europe is included on average three times less in the 48 indicators sets than cities from Northern and Southern Europe and twice less than cities from Western Europe.

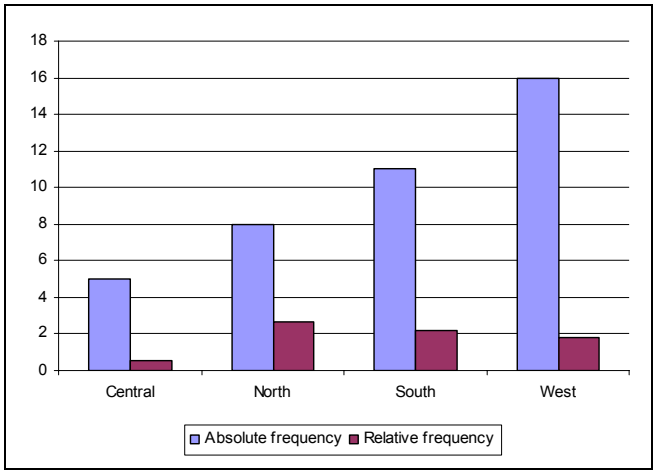

Figure 15. Coverage of European regions by the studied sets of indicators with regard to sustainable urban management.

c) Coverage of trends

The analysis of the **coverage of trends** per trend category shows that the sets included in the TISSUE browser cover the trends selected within the TISSUE project framework except from:

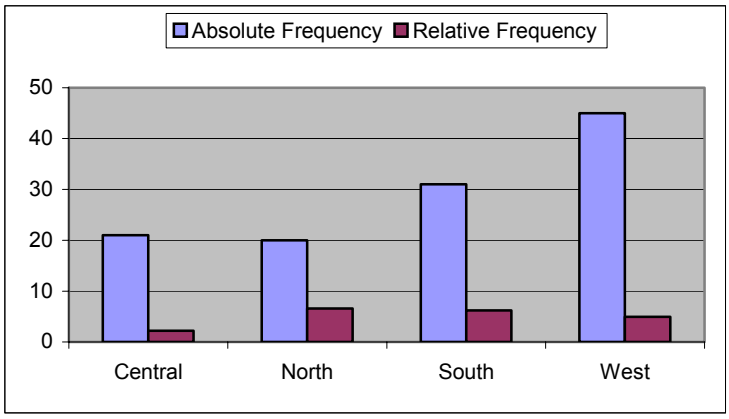

Figure 16. Coverage of European regions by Urban Environment State related indicators sets. The relative frequency is broadly similar in all areas of Europe except for the new EU member countries of Central Europe where the relative frequency of indicators roughly one third of that of other European regions.

- Sustainable urban transport:
  Concern: Supply, quality of use of transport means and services, Trend: Traffic volume
- Sustainable urban construction:
  Concern: Technological and information and communication technological development
- Sustainable urban design:
  Concern: Urban design, Trend: ICT contribution to sustainable design of cities and communities
- Sustainable urban management, Response
  Concern: Cooperation and conflict resolution between cities and suburban communities, Trend: Institutional set-up, co-operation platforms and institutions; Concern: Exchange of experiences between cities, Trend: Participation in national and international city networks
- Urban environment, State Concern: Resources consumption and efficiency, Trend: Wood consumption [17]; Trend: Food consumption.

The trends are covered [18] by (Figure 17):
- 178 indicators for SUT (on average 15 indicators per trend),
- 156 indicators for SUC (on average 11 indicators per trend),
- 175 indicators for SUD (on average 17 indicators per trend),
- 65 indicators for SUM or R (on average 5 indicators per trend),
- 453 indicators for Urban Environment or S (on average 13 indicators per trend).

[17] The trend about wood consumption has a strong geographical dimension. Especially in some Northern European countries and also in some Central European countries the natural wood production significantly exceeds the consumption of wood. Thus the use of wood, for buildings for instance, means the use of renewable resources instead of using non-renewable resources.
[18] These numbers are higher than the real number of indicators because some indicators that monitor more than 1 trend have been counted twice or three times.

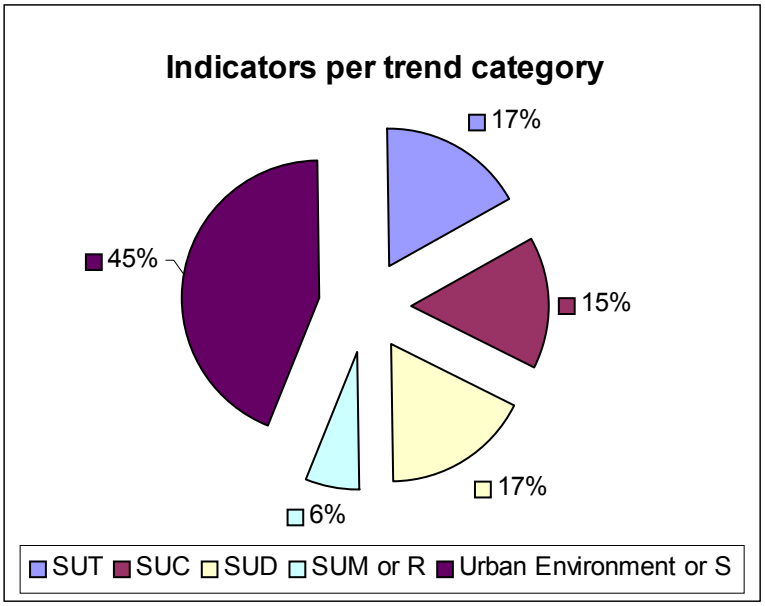

Figure 17. Coverage of trend per level of developer (International/European, National, Local/Regional).

However, all trends emphasised are not covered equally. The trends that are covered very well by the studied sets of indicators include the following:

- Transport Demand (40 indicators)
- Modal split (38 indicators),
- Consumption of land and space (41 indicators)
- Availability and accessibility of green and open spaces (40 indicators),
- Adoption of integrated environmental management plans (EMAP)
- implementation of integrated environmental management systems (EMAS) (27 indicators),
- Air quality (68 indicators),
- Energy consumption (45 indicators),
- Waste collection and disposal (50 indicators).

TISSUE analysed the existing gaps by comparing the relevant trends with the indicators existing in the indicators sets studied. The identified weaknesses are listed and commented in Appendix 2.

PART 4:
TISSUE INDICATORS

1 Introduction

The main objective of the **TISSUE** project was to define a set-up needed for a harmonised set of indicators to monitor the sustainable development of urban environment. **TISSUE** developed a proposal for a set of sustainable urban indicators. The development of indicators was based on

- the analyses of sustainable urban development related concerns and trends (introduced in part 2)
- the assessment of existing sets of indicators on European, national and local level (introduced in part 3).

The following sections present the **TISSUE** set of indicators. The indicators are divided in the following thematic groups:

- Urban Transport Indicators
- Urban Design Indicators
- Urban Construction Indicators
- Urban Management Indicators
- Urban Energy Indicators
- Urban Greenhouse Gases Indicators
- Urban Air Quality Indicators
- Urban Noise Indicators
- Urban Waste Indicators
- Urban Water Indicators
- Urban Biodiversity Indicators.

Each indicator is described in terms of definition and measurement, policy relevance and consensus and feasibility:

- Definition and measurement, showing the suggested definition, metrics of the indicator, data from which it is compiled and compilation methodology.
- Policy relevance of the indicator, in relation to urban sustainable development and in particular to the Thematic Strategy of Urban Environment.
- Consensus and feasibility, which illustrate to what extent there is a general consensus on the adoption of the indicator, as it emerges in particular from being adopted in practice by several cities, and how far the concrete

application of the indicator to the generality of European cities seems feasible.

The indicators shown in this report are recommended for an "harmonised" application throughout Europe. However, a gradual approach is suggested, by defining two categories according to the relevance of the indicator for monitoring purposes in the short-term – CORE 1 indicators – or in the medium-long term – CORE 2 indicators -, when more advanced indicators could become feasible (thanks to technological, organisational or cultural innovations) and useful for a more sophisticated monitoring of Urban Environment.

In practice CORE 1 indicators are relevant for the TSUE monitoring purpose and would be readily feasible, with a reasonable effort of the institutions concerned with the collection of data and compilation of the indicators.

CORE 2 indicators are equally relevant for the TSUE, and even in some case more advanced indicators, but they are still not easily applicable due to shortcomings in data availability or other practical aspects. In any case, the setting up of a list of CORE 2 indicators alongside the more immediate CORE 1 list is considered a good way of influencing the data gathering of cities and towns in the future.

2 Summary of the TISSUE CORE 1 and CORE 2 indicators

The following Table (Table 10) shows the summary of the selected indicators for monitoring the sustainable development of urban environment. Table 10 introduces the selected indicators by

- short definition
- units
- recommended measurement frequency
- assessed feasibility and recommended responsibilities
- trends measured and by
- showing
  - the corresponding Urban Audit indicators
  - the connection to EU legislation
  - the relevance in terms of EU policy goals
  - the corresponding Aalborg Commitments.

Table 10. ***TISSUE*** *– Harmonised set of urban indicators.*

Indicator	**Definition**	**Units**	**Trends measured**	**Urban Audit indicators** **EU legislation** **EU policy goals**	**Aalborg Commitments**	**Time scale and spatial units**	**Feasibility and responsibilities**
SUSTAINABLE URBAN TRANSPORT							
Passenger transport demand	Average distance travelled per person per day	Km/person/day	SUT: increasing passenger volumes	Urban Audit: Total km driven in public transport per capita per day. The TISSUE indicator includes also private car journeys	Reduce the necessity for private motorised transport and promote attractive alternatives accessible for all	Yearly Larger Urban Zone	CORE 1: high feasibility Regional government Local governments
Modal split	Share of each transport mode in the total number of trips	%	SUT: split of private vs alternative transport modes	Urban Audit: Percentage of journey to work by each transport mode The TISSUE indicator includes also trips for purposes other than work	Increase the share of journeys made by public transport, on foot and by bicycle	Yearly City Core + commuting trips from/to the Larger Urban Zone	CORE 1: high feasibility (based on local travel surveys) Local governments

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
Pedestrian infrastructure	Total length of pedestrian, car free and calming streets divided by the city surface area	km/km2	SUT: Walking infrastructure supply		Increase the length of the footpath network (AC annex)	5-years City Core Sub-city District	CORE 1: high feasibility Local governments
Bicycle infrastructure	Total length of cycle paths divided by the city surface area	km/km2	SUT: Cycling infrastructure supply		Increase the length of the bicycle network (AC annex)	5-years City Core Sub-city District	CORE 1: high feasibility Local governments
Traffic safety	Number of fatal injuries per million vehicle kilometres	Deaths/millions car kilometres	SUT: increasing transport safety	Urban Audit: Road accidents (deaths or serious injuries) per 1000 inhabitants The TISSUE indicator is more precise, because the number of accidents is more strictly related to the number of kms travelled than to the	Reduce the number of transport fatalities and persons injured in transport accidents (AC annex)	Yearly Larger Urban Zone Core City	CORE1: high feasibility Local governments National/regional governments (insofar as they have road management responsibilities)

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
				number of inhabitants EU Transport White Paper: Halving the number of road accidents by the year 2010			
Freight transport demand	Tonnes-kilometres moved per year divided by the regional GDP	Ratio	SUT: increasing freight traffic			Yearly Larger Urban Zone	CORE2: low feasibility Regional governments
Modal split based on kilometres	Distribution of trip kilometres made among the transport modes	%	SUT: split of private vs alternative transport modes		Increase the share of journeys made by public transport, on foot and by bicycle	Yearly City Core + commuting trips from/to the Larger Urban Zone	CORE2: low feasibility Local governments
Quality of public transport	Ratio of the journey speeds for private car and public transport within the urban area	Ratio of average kms by PT per 1 km by car	SUT: relative quality of public transport		Promote attractive alternatives to the use of private motor vehicles	At planned years City Core + commuting trips from/to the Larger Urban Zone	CORE2: low feasibility Local governments

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
SUSTAINABLE URBAN DESIGN							
Resident population density	Total resident population per km2 of built-up area	Inhabitants/Km 2 of urbanised area	SUD: Urbanisation trends	Total resident populaton per Km2 The TISSUE indicator considers the density in the urbanised area (rural surface is excluded)	Avoid urban sprawl by achieving appropriate urban densities	5-years Larger Urban Zone City Core Sub-city Districts	CORE1: high feasibility Local governments
Brownfields vs. greenfields development	Ratio of new developments on brownfields to new development on greenfields	Ratio	SUD: Balanced development of greenfields and brownfields		Prioritise brownfield site over greenfield site development	10-years Larger Urban Zone City Core	CORE1: medium feasibility Local governments National/regional governments (holding housing programmes)
Accessibility to open areas	Inhabitants living within 300 metres from open areas (of certain minimum size) divided by the total number of inhabitants	%	SUD: increasing demand for accessible green space	Proportion of population within 15 minutes walking distance of urban green space The TISSUE indicator is the same as the Urban Audit (with the	Increased percentage of people living within 300 metres of a public green space (AC annex)	5-years City Core Sub-city Districts	CORE1: medium feasibility (GIS might be needed to compile this indicator, therefore small cities might not have data available) Local governments

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
				equivalence ”300 metres = 15 minutes” and ”open areas = green areas”). We suggest to use the Urban Audit formulation			
Accessibility to public transport	Inhabitants living within 300 metres from PT accesses divided by the total number of inhabitants	%	SUD: demand for public transport oriented development SUT: demand for accessibility and transport quality		Decrease the average distance to the nearest bus stop (AC annex)	5-years City Core Sub-city Districts	CORE1: medium feasibility (GIS might be needed to compile this indicator, therefore small cities might not have data available) Local governments
Consumption of land	Surface of urbanised area divided by the total municipal area	%	SUD: total consumption of land	Proportions of the area in various uses (15 different uses) The Urban Audit indicators detailed by use are more complete and useful, but data are difficult to gather (on average only 20% of	Prioritise brownfield site over greenfield site development Ensure the conservation of the greenfield sites (AC annex)	10-years City Core	CORE2: medium feasibility (”urbanised area” is not easy to measure) and poor relevance (the share of urbanised area does not tell how the land is used)

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
				the UA cities responded)			Local governments
Accessibility to basic services	Inhabitants living within 300 metres from basic services divided by the total number of inhabitants	%	SUD: demand for attractiveness of city centres and neighbourhoods		Ensure equitable access to public services	5-years Larger Urban Zone City Core Sub-city districts	CORE2: low feasibility (there are problems of comparability of ”basic” services across countries and cities) Local governments
Population and jobs density	Inhabitants + jobs per Km2 of built-up area	Inhabitants +jobs/ km2 of urbanised area	SUD: mixed land use		Ensure the mixed use of buildings and developments with a good balance of jobs, housing and services	Yearly Sub-city districts	CORE2: medium feasibility Local governments
Jobs/housing ratio	Total number of jobs divided by the total number of population living in houses within the boundary of the city/ neighbourhood	Ratio	SUD: mixed land use; demand for attractiveness of city centres and neighbourhoods	Ratio of day-time to night-time population Insofar as the day-time population in the Urban Audit indicator includes not only jobs, but also other potential visitors, the UA indicator is	Avoid urban sprawl by achieving appropriate urban densities Ensure the mixed use of buildings and developments with a good balance of jobs, housing and	5-years Sub-city Districts	CORE2: medium feasibility (the Urban Audit indicator is available in 60% of the UA cities)

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
				preferable	services		
SUSTAINABLE URBAN CONSTRUCTION							
Energy consumption of buildings	The average total energy consumption of buildings (based on the energy-certificates of buildings)	kWh/m^2	SUC: increased environmental and energy efficiency of buildings	Urban Audit: Share of electricity use in domestic sector The TISSUE indicator covers all energy aspects of buildings, not only electricity. The energy efficiency of buildings will be regulated on basis of the European Directive on Energy Performance of Buildings (2002/91/EC)	Avoid unnecessary energy consumption, and improve end-use energy efficiency Increased proportion of buildings with an energy consumption of less than 70 kWh/sqm (single family buildings) and less than 55 kWh/sqm (multi-family buildings) (AC annex)	Yearly City Core	CORE1: medium feasibility (data on energy use other than electricity can be difficult to gather) Local governments
Share of sustainability-classified buildings	Share of sustainability-classified buildings of all new and renovated	%	SUC: increasing demand for new building methods and efficient	Communication "Towards a TSUE", 11.2.2004: The Commission will develop a common	Apply requirements for sustainable design and construction and promote high quality	5-years City Core Sub-city Districts	CORE1: medium feasibility. There is the need to define a common standard

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
	buildings		maintenance of buildings	methodology for evaluating the overall sustainability of buildings.	architecture and building technologies		for ”sustainable buildings”. National methods are in use in a number of EU countries. Local governments
Construction and demolition waste	Total volume of construction and demolition waste	kg per person	SUC: increasing demand of environmental efficiency in the building sector		Manage and treat waste in accordance with best practice standards	Yearly City Core	CORE 1: good feasibility Local governments
Poor quality housing	Share of total population/ households living in substandard/ unfit housing	%	SUC: increasing demand for good-quality housing and indoor comfort	Urban Audit: Proportion of dwellings lacking basic amenities The TISSUE indicator applies a wider concept of ”poor housing”, but more difficult to measure. The UA indicator is therefore preferable for the present.	Secure good quality and socially integrated housing and living conditions	5- years City Core Sub-city Districts	CORE2: low feasibility (there is no common definition of poor housing conditions across Europe) Local governments

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
Soil sealing	Area covered by low or non permeable layers because of buildings, yards, roads, vehicle parks and other constructive assets	m2 per person	SUD: consumption of land		Improve soil quality, preserve ecologically productive land Reduced proportion of eroded soil and/or newly sealed surfaces (AC annex)	5-years Larger Urban Zone City Core Sub-city Districts	CORE2: medium feasibility (Satellite Earth Observation sources can be required) Local governments National/regional governments
SUSTAINABLE URBAN MANAGEMENT							
Adoption of Environmental Management Systems	Presence of an EMS (e.g. EMAS) in the city National and EU statistics on the number of cities adopting an EMS	Yes/No answer at the city level Number and proportion of cities adopting an EMS at country/EU levels	SUM: adoption of environmental management practices by European cities		Deliver integrated management towards sustainability Adopt for the local authority sustainability management systems and/or sustainability related cyclic reporting (AC annex)	Yearly City Core	CORE1: medium feasibility (information on the municipalities adopting an EMS is needed) Local governments
Share of certified enterprises and public agencies	Number and proportion of local firms and organisations with	Number and % of certified firms and organisations	SUM: adoption of certified		Increased share of public and private organisations adopting an	Yearly Core City	CORE1: high feasibility National

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
	certified systems	on the total number of firms and organisations in the city	environmental systems in the local public and private organisations		environmental management system and/or sustainability related cyclic reporting mechanisms (AC annex)		governments (e.g. agencies issuing the certificates)
Citizens' satisfaction with the state of the urban environment	Citizens satisfaction measured through ad hoc surveys	Number and share of citizens (distribution of citizens answers)	SUM: citizens perceptions and attitudes towards the urban environment		Governance; all tasks under commitment 1	At planned years City Core Sub-city Districts	CORE2: low feasibility (the indicator requires expensive surveys and deliver very context dependent results, which can be hardly comparable across cities) Local governments
Citizens' engagement in environmental and sustainability oriented activities	Number and proportion of citizens engaged in environmental and sustainability-oriented activities	Number and share of citizens (distribution of citizens by activities)	SUM: increasing citizens involvement		Build participation and sustainable development capacity in the local community Increased effectiveness of	At planned years City Core Sub-city Districts	CORE2: low feasibility (a common definition of "environmental and sustainability oriented initiatives" is needed. Local governments

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
					participation in local consultation processes (AC annex)		
Adoption of integrated urban plans (environment, transport, land use)	Presence of an integrated plan in the city National and EU statistics on the number of cities adopting integrated plans	Yes/No answer at the city level Number and proportion of cities adopting integrate plans at country/EU levels	SUM: increasing need and adoption of integrated plans	SEA Directive 2001/42/EC: Environmental assessment and report for the preparation and adoption of plans and programmes	Develop, adopt and implement a sustainable urban mobility plan in consultation with the other local plans such as the urban master plan and in cooperation with the surrounding areas Cooperate effectively and in partnership with adjoining municipalities, other cities and towns and other spheres of government	At planned years Larger Urban Zone City Core	CORE2: medium feasibility (it requires the definition and classification of the various types of integrated plans) Regional governments Local governments
Legal framework for active public participation	Presence of statutory planning involving stakeholders before draft in the	Yes/No answer at the city level Number and proportion of cities adopting	SUM: increasing need and adoption of participatory planning	SEA Directive 2001/42/EC: Environmental assessment and report for the	Build participation and sustainable development capacity in the local community	At planned years City Core Sub-city Districts	CORE2: medium feasibility (an European wide definition of participatory

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
	city National and EU statistics on the number of cities adopting statutory planning processes involving stakeholders before draft	participatory planning processes at country/EU levels	approaches	preparation and adoption of plans and programmes			planning processes is needed)
SUSTAINABLE URBAN ENVIRONMENT							
Water consumption	Water consumption in total and by sectors Domestic water consumption per capita	Million litres, m3 per year per person	SUE: Water consumption	Consumption of water (m3 per annum) per capita The TISSUE indicator coincides with that of the Urban Audit set	Save water and use water more efficiently Decreased water consumption per inhabitant (AC annex)	Yearly Core City Sub-city Districts	CORE1: high feasibility Local governments Water authorities
Compliance with drinking water standards	Index of compliance with standards relating to water quality parameters for drinking water	% of compliance/ non compliance of sample tests by proportion of population affected Days of non	SUE: drinking water quality	Urban Audit: Total number of annual tests on drinking water quality Number of annual determinations which exceed the threshold	Improve water quality	Yearly Core City Sub-city Districts	CORE1: medium feasibility (both the measurements are feasible at the local level, but there are difficulties to get the data in the new member states)

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
		compliance by proportion of population affected		values The TISSUE indicators are more, because they take into account the proportion of population affected. EU Drinking Water Directive (98/83/EC)			Local governments Water authorities
Compliance with urban wastewater standards	Annual compliance with standards relating to the level of Biological Oxygen Demand (BOD), Chemical Oxygen (COD) and Total Suspended Solids (SS) for towns and cities discharging into ”normal” waters. Annual compliance with standards relating to levels of nitrogen (N),	% of compliance by proportion of total wastewater treated	SUE: wastewater quality and treatment	EU Urban Wastewater Treatment Directive (2000/60/EC)	Decreased BOD / N load in surface and ground water (AC annex) Decreased N and P load from municipal wastewater plants (AC annex)	Yearly Core City	CORE1: medium feasibility (both the measurements are feasible at the local level, but there are difficulties to get the data in the new member states) Local governments Water authorities

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
	phosphorus (P) and microbiological parameters for cities discharging into ”sensitive” waters.	% of compliance by proportion of total wastewater treated					
Air quality; Number of days with exceeding PM10 and O3	Number of days in a year in which the limit/target value of PM10 and O3 is exceeded (in each urban area)	Number of days above the threshold	SUE: Urban air quality	Urban Audit: Number of days O3 exceeds 120 μg/m3 (8hr averaging time) Number of days PM10 concentrations exceed 50 μg/m3 The Urban Audit and the TISSUE indicators are the same EU Air Quality Framework Directive 96/62/EC and Daughter Directives	Improve air quality	Yearly City Core Sub-city Districts	CORE1: high feasibility (in larger cities) Local governments Regional governments (for background concentrations)

Indicator	**Definition**	**Units**	**Trends measured**	**Urban Audit indicators** **EU legislation** **EU policy goals**	**Aalborg Commitments**	**Time scale and spatial units**	**Feasibility and responsibilities**
Air quality; Annual average concentration of NO2	Annual average concentration for NO2	μg/m3	SUE: Urban air quality	EU Air Quality Framework Directive 96/62/EC and Daughter Directives	Improve air quality	Yearly City Core Sub-city Districts	CORE1: high feasibility (in larger cities) Local governments Regional governments (for background concentrations)
Share of population exposed to excessive noise	Annoyance caused by exposure to noise during day, evening and night periods (L_{den}) Sleep disturbance caused by exposure to noise during night period (L_{night})	Share of population % exposed to values of L_{den} above 55 dB(A) and L_{night} above 45 dB(A)	SUE: acoustic environment quality	Urban Audit: Share of residents exposed to day noise > 55 dB(A) Share of residents exposed to night noise > 45 dB(A) The Urban Audit and TISSUE indicators are the same EU Environmental Noise Directive (2002/49/EC)	Local action for health Reduce the impact of transport on the environmental and public health	Yearly City Core Sub-city Districts	CORE1: medium feasibility Local governments
Municipal solid	Total municipal solid waste produced in the	Annual kg per capita	SUE Waste production, collection and	Urban Audit: Collected solid waste per capita per year	Avoid and reduce waste	Yearly	CORE1: high feasibility

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
waste generation	urban area		treatment	The TISSUE indicator of waste production coincides in practice with the collected solid waste of the Urban Audit set. EU Waste Framework Directive (1999/31/EC) Comm. Dec. 2000/ 532/ EC and amendments		City Core	Local governments
Municipal waste separately collected	Proportion of total produced waste collected through a separate collection service which may lead to recovery operation	%	SUE Waste production, collection and treatment	Thematic Strategy on the prevention and recycling of waste (COM(2003) 301 final)	Avoid and reduce waste and increase reuse and recycling	Yearly City Core	CORE1: high feasibility Local governments
Municipal solid waste treatment	Proportion of total waste by type of waste	%	SUE Waste production, collection and	Urban Audit: Proportion of solid waste processed by:	Decreased amount of non-recycled/ landfilled waste from:	Yearly	CORE1: high feasibility

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
	management: thermal treatment (with and without energy recovery), biological treatment and landfill disposal		treatment	– landfill – incinerator – recycling – other methods The TISSUE indicator is similar to that of the Urban Audit set. The only difference is that it doesn't include recycling cause this data is not easily available at local level. The information is anyway available in terms of "separate collected waste" (see previous indicator)	households; industry and commerce; local government operations	City Core	Local governments
Greenhouse gases emissions	Total CO2 equivalent emissions released by residential, tertiary and	Tonnes of CO2 equivalent emissions per capita per year	SUE: release of GHG emissions	Urban Audit: CO2 emissions per capita. The TISSUE indicator refers to all	Mainstream climate protection policy into our policies in the areas of energy, transport,	5-years City Core	CORE2: low feasibility (data are not easily available, local authorities should

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
	transport sectors per capita			GHGs. However, CO2 represents more than 90% of greenhouse gases, so the Urban Audit indicators may be preferable if data on GHG other than CO2 are not available.	procurement, waste, agriculture and forestry Reduced CO2 emissions caused by energy consumption in municipal buildings and operations (AC annex)		be supported by regional or national data collection campaigns) Local governments National/regional governments
Air quality; Population weighted exposure to PM10 and O3	Population weighted exposure to PM10 and O3	Annual weighted average of PM10/ O3 concentrations	SUE: healthy living environment	The population exposure indicators would replace the earlier indicators on exposure above the limit value which are laid down in Directive 1999/30/EC for PM10 and other pollutants, and in the Directive 2003/3/EC relating to ozone	Promote health impact assessment	Yearly City Core	CORE2: medium feasibility (but this will be enhanced if and when the indicators will be adopted as structural air pollution indicators by Eurostat) Local governments
Renewable energy consumption	Renewable energy consumption as a % of total energy	%	SUE: energy availability and consumption		Reduce primary energy consumption, and increase the	Yearly	CORE2: low feasibility (it is very difficult to get local

Indicator	Definition	Units	Trends measured	Urban Audit indicators EU legislation EU policy goals	Aalborg Commitments	Time scale and spatial units	Feasibility and responsibilities
	consumption of the urban area				share of renewable and clean energies	Larger Urban Zone	data)
Intensity of energy use in transport	Energy consumption for transport per passenger-km Energy consumption for transport per tonne-km	MJ/pkm MJ/tonne-vkm	SUE: energy consumption and efficiency		Reduce the impact of transport on the environment and public health	Yearly Larger Urban Zone	CORE 2: low feasibility (at the moment it is not feasible at the local level, due to the lack of the necessary data) Local governments
Urban biodiversity	Types and numbers of threatened/ protected species Types and numbers of birds species	Number of threatened species (classification) Numbers of birds (classification)	SUE: biodiversity quality	EU Habitat Directive (92/43/EEC) EU Birds Directive (79/409/EEC)	Promote and increase biodiversity	At planned years Larger Urban Zone Core City	CORE 2: still low feasibility, but there are city best practices of urban biodiversity indicators (e.g. London) that could be disseminated elsewhere

3 Definitions, policy relevance and feasibility of TISSUE indicators

This section introduces the **TISSUE** indicators in terms of their definitions, policy relevance and feasibility.

Definitions show suggested metrics of the indicator, data from which it is compiled and compilation methodology.

Policy relevance of the indicator point out the relevance of the indicator in particular with the Thematic Strategy of Urban Environment.

Consensus and feasibility illustrate to what extent there is a general consensus about the adoption of the indicator and how feasible is the implementation of the indicator.

The **TISSUE** CORE 1 and CORE 2 indicators are listed in Tables 11 and 12. The following pages introduce the individual indicators each on one page.

*Table 11. **TISSUE** CORE 1 indicators.*

Sustainable Urban Transport	Passenger transport demand
	Modal split (share of trips)
	Pedestrian infrastructure and Bicycle infrastructure
	Traffic safety
Sustainable Urban Design	Resident population density
	Brownfields vs. greenfield development
	Accessibility to open areas
	Accessibility to PT stops
Sustainable Urban Construction	Energy consumption of buildings
	Share of sustainability-classified buildings
	Construction and demolition waste
Sustainable Urban Management	Adoption of environmental management systems
	Share of certified enterprises and public agencies
	Citizen satisfaction with the state of the environment

Sustainable Urban Environment	Water consumption Compliance with drinking water standards Compliance with urban waste water standards Air quality; Number of days with exceeding PM10 and O3 Air quality; Annual average concentration of NO2 Share of population exposed to excessive noise Municipal solid waste generation, Municipal waste separately collected, Municipal solid waste treatment Green house gases emissions

Table 12. ***TISSUE*** *CORE 2 indicators.*

Sustainable Urban Transport	Freight transport demand Modal split (share of kms) Quality of public transport
Sustainable Urban Design	Consumption of land Accessibility to basic services Population and jobs density Jobs / housing ratio
Sustainable Urban Construction	Poor quality housing Soil sealing
Sustainable Urban Management	Citizens' engagement with environmental and sustainability oriented activities Adoption of integrated urban plans (environment, transport, land use) Legal framework for active public participation
Sustainable Urban Environment	Air quality; Population weighted exposure to PM10 and O3 Renewable energy consumption Intensity of energy use in transport Urban biodiversity

CORE 1 – Passenger transport demand

Definition and measurement

Average distance travelled per person per day (km/person/day).

Usually this data is derived from household surveys. Surveys can differ to a certain extent. In France and Britain five day data is collected while in the other countries seven days data is commonly used. Other differences are found in the age groups and trips considered. A lot of work has been done in the recent years on the harmonisation of definitions among surveys used across Europe. To obtain maximum comparability all surveys should contain 7 day 24 hour data. All age groups and both short and long distance trips should be included. Surveys should record the origin and destination of trips in order to make it possible to exclude trips outside the urban area (see SESAME-project). Often, surveys are carried out depending on the needs for local transport policy. Due to the high costs of surveys, they are not carried out each year and the dates of surveys vary between cities. To limit the bias due to variations in year of survey, the gap between surveys should not be larger than three years. If surveys are not in conformance to these regulations, small adaptations can be made by making use of other, often more aggregated, data sources.

Policy relevance

This indicator directly measures the *desired reduction of traffic volumes* as stated in the Thematic Strategy on the Urban Environment. It also directly relates to Aalborg commitment 6.5, reducing the impact of transport on the environment and public health. By multiplying the distance travelled per person per day with the total number of inhabitants within a city one obtains an estimation of the environmental burden of transport. This is due to the close relationship of this indicator with the total number of vehicle kilometres which on its turn has a direct (negative) impact on sustainability issues as traffic safety, carbon dioxide emissions, energy consumption, noise and pollution.

Consensus and feasibility

Sources of data are local transport surveys. The transport surveys are conducted either by public organisations (for example in the Netherlands, Switzerland and France) or by private research institutes, commissioned by public bodies (for

example Germany, UK and Spain). Some of them are national surveys, covering the whole country and being carried out regularly (The Netherlands, Switzerland), others are limited to single cities or regions (Germany, France, Spain, UK) and are more irregular. Despite of these differences, the used methodologies are more or less comparable: all surveys are household-based and employ travel diaries.

There is however still a considerable amount of different definitions used but recent developments in Europe are aiming to harmonise transport survey designs and definitions. Moreover, if surveys are not in conformance, small adaptations can be made by making use of other, often more aggregated, data sources.

The indicator is included, in the above described or a closely related way, in many indicator sets used across Europe . Around 40 of the 57 assessed indicator sets include at least one indicator which measures transport demand. Among these sets are the Urban Audit and ECI sets. These sets use the distance travelled per capita per year respectively per day[19]. Another frequently used definition is the number of trips made per person per day. For both ways of measuring transport demand some indicator sets use a subdivision in different purposes and/or modalities. It can be concluded that there is great consensus in Europe on including transport demand as an indicator for measuring the sustainability of the urban environment. Moreover, the availability and harmonisation of data is sufficient.

CORE 1 – Modal split (share of trips)

Definition and measurement

Share of each transport mode in the total number of trips made (%).

Transport modes should include at least all public transport (metro, tram bus, train), car as a driver; car as a passenger, motor-bike, bicycle, walking and other (incl. taxi, boat, airplane). Trips should be assigned on basis of the main mode

[19] However, the Urban Audit 2, due to limited availability of data on distance travelled by private car users, considers only public transport.

only. Usually this data is derived from household surveys. For a review of methodological differences between surveys see the indicator "transport demand". Like transport volume, modal split data is very sensible for differences in definitions. If for example one city collects data starting at trips of al least 1 km and another city collects data starting at 500 m, the outcomes with regard to modal split will differ. Nevertheless, if documented well, small adaptations can be made by making use of other, often more aggregated, data sources if surveys are not in conformance.

Policy relevance

This indicator directly measures the desired change in modal split in favour of more efficient transport modes such as public transport, cycling and walking as stated in the Thematic Strategy on the Urban Environment. It also directly relates to commitment 6.2 of the Aalborg+10 commitments. This commitment aims at increasing the share of journeys made by public transport, on foot and by bicycle.

Public transport and the slow modes produce less negative side effects than car traffic and are therefore preferable. Moreover, the high level of motorised urban transport also contributes to the increasingly sedentary lifestyles with a range of negative effects on health and life-expectancy, notably in relation to cardio-vascular disease. Cycling for 30 minutes per day can reduce the risk of cardiovascular disease by as much as half, yet more than half the trips of less than 5 km are made by car. A recent study calculated that a 10% shift from cars to cycling and walking in London might save 100 early deaths and 1,000 hospital admissions each year.

Consensus and feasibility

Modal split based on trips is measured in so many cities across Europe that there will be no problem in acquiring enough data for monitoring modal split all over Europe. Nevertheless, often it will be needed to make adaptations to correct for methodological differences in the data. For example, when a particular city does not include walking in their transport survey the resulting modal split data needs to be adapted by using national data which does include walking in the modal split.

CORE 1 – Pedestrian infrastructure and Bicycle infrastructure

Definition and measurement

A. The total length of pedestrian, car free and traffic calming streets divided by the city surface area (km/km2).

This indicator shows the importance accorded to pedestrian streets. Pedestrian streets are defined as streets entirely used for pedestrians from which all vehicular traffic is banned. This definition is also used in the Healthy Cities set. Traffic calming streets are urban streets with some measure of motorized traffic moderation. Examples are pedestrian, inverted priority and 30km/h zones.

B. The total length of cycle paths divided by the city surface area (km/km2).

Cycle paths should be defined as infrastructure that is dedicated to only bicyclist. However, in Europe many other definitions are being used. For example, in some cities every street accessible for bicyclists is considered a bicycle infrastructure, Unfortunately there are no conversion factors which can compensate for the existing wide variety of definitions used for cycle paths. Therefore as it is now it is not possible to compare bicycle infrastructure between European cities.

Policy relevance

The existence of a (high quality) extended network of pedestrian and bicycle infrastructure helps to reduce the negative impacts of transport, to tackle the rising volumes of traffic and congestion and to change the modal split in favour of more efficient transport modes such as cycling and walking as stated in the thematic strategy. It also contributes to attain three of the five transport related Aalborg 10+ commitments. It concerns commitments 6.1, 6.2 and 6.5 which respectively are: reducing the necessity for private motorised transport and promoting attractive alternatives accessible to all, increasing the share of journeys made by public transport, on foot and by bicycle and reducing the impact of transport on the environment and public health.

A recent cost-benefit analysis of walking and cycling track networks in Norway estimated the benefits of investments in cycle networks to be at least 4–5 times the costs.

Consensus and feasibility

Bicycle and especially pedestrian infrastructure is monitored in many indicator sets. The broadest of these sets is the Healthy cities project set. This set covers a wide range of northern and eastern European cities. Besides the Healthy cities set there are quite a lot of local sets which include this indicator. Also many local authorities have data on this indicator at their disposal.

There are however considerable methodological differences between cities and therefore collecting the data needs to include a process of data mining and harmonisation.

CORE 1 – Traffic safety

Definition and measurement

Number of fatal injuries per million vehicle kilometres (deaths/1.000.000 car kilometres).

Traffic safety is best comparable between different cities when the definition is on the one hand restricted to fatal injuries and on the other hand divided by the total number of car kilometres. The reason for the restriction to fatal injuries is that terms commonly used in accident statistics such as injured, slightly injured and seriously injured, refer to differing national definitions. For example, a seriously injured person in Austria is hospitalised and is not able to work for at least 24 days whereas some countries do not even require hospitalisation in their definition of a serious injury. Today the only reliable category for international comparisons of traffic safety is fatal injury, as most countries use the standard definition given. This definition names a fatal injury as any person who was killed outright or who died within 30 days as a consequence of the accident. The argumentation for dividing the number of fatal injuries by the total number of vehicle kilometres is that this measures the risk of participating in traffic and this also makes traffic safety comparable between cities.

Data on this indicator can in most countries be obtained from local government or police statistics and hospital records.

Policy relevance

Although transport is considered an essential for the well-being of society and of each individual, is it also a potential danger. Every year in Europe (EU 15) there are 41,000 deaths on the roads, equivalent to wiping a medium sized-town off the map. Every day the total number of people killed on Europe's roads is practically equivalent to a medium-haul plane crash. Road accident victims, the death or injured, cost society tens of billions of euro but the human costs are incalculable. Road accidents are estimated to cost 2% of the Community GNP. Two thirds of the 1.3 million traffic accidents in the EU in 2000 that led to injuries took place in urban areas and one fatal accident in two. Therefore injuries and deaths are an impact category which the thematic strategy seeks to reduce. The Aalborg 10+ commitments are less clear than the TSUE by only stating that the impact of transport on the environment and public health should be reduced.

Consensus and feasibility

The indicator traffic safety is included in so many indicator sets, including the sets EEA – Dobris Assessment and Urban Audit (184 reporting cities), and measured in so many cities that there is no problem in collecting enough data for monitoring traffic safety all over Europe. Differences in measurement method and definition can be compensated for by using conversion factors. This is for example done in the OECD's IRTAD database. Because a few countries have a different standard than the "30 day's" definition of a fatal injury for each of these countries a correction factor has been developed to adapt these data to the common definition. It should nevertheless be borne in mind that, while the correction factor used for each country gives a more or less accurate figure for the total killed, for complete accuracy a correction factor would be needed for each type of road user.

CORE 1 – Resident population density

Definition and measurement

The indicator measures the intensity of land consumption. By comparing its value for a frequency fixed at 10 years, it allows to measure the way consumption of land is avoided by increasing density.

$$\frac{\text{total resident population}}{\text{urbanised area of the municipality}} \quad \text{[inhabitants/ (urbanised) km²].}$$

The density is a key issue which is related to the urban sprawl and depends on the history of the city and also on the localization of the city in the conurbation. The density depends on the definition used for the considered area, that's why the indicator takes into account the urbanised area under the administration of the municipality excluding rural areas.

The density value is directly available from the city planning service or can be easily computed by using the census data available in each country. The measurement frequency for this indicator corresponds to the census frequency (generally 10 years). A problem that may be encountered by using this indicator is the updating of the data. The censuses are performed at different moments in the different European countries (for example, last update has been done, in France, in 1999 and in Italy in 2003). Data on the surface of urbanised areas are gathered also for the measurement of the indicator 'Consumption of land'.

Policy relevance

Density is a measure of the efficient use of the land (i.e. use enabling a reduction of the consumption of land point of view). This indicator is clearly related to the **TISSUE** trends Consumption of land and space, Urban sprawl and urbanisation, and Car dependency.

It measures the improving of the cities density and the urban sprawl reduction as stated in the Thematic Strategy on the Urban Environment. It also directly relates to commitment 5.2, of the Aalborg+10 commitments ("avoid urban sprawl by achieving appropriate urban densities and prioritising Brownfield site over Greenfield site development").

Consensus and feasibility

According to the **TISSUE** assessment there are several indicators sets that include this indicator, like ISDIS system, Environment Explorer Amsterdam, Adriatic Common Indicators, Urban audit. As far as the latter set, which gives a good coverage of all of the EU 25 countries, is concerned, the response rate on this indicator is 84% of the cities. This indicator seems feasible and there is no need of harmonisation.

CORE 1 – Brownfields vs. Greenfield development

Definition and measurement

The ratio of new developments on brownfields to the new developments on greenfields.

This indicator considers the avoided consumption of green land thanks to the reuse of brownfields for new urban development. By comparing its value for a frequency fixed at 10 years, it allows measuring whether the reuse of brownfields is preferred to the use of virgin land.

According to ECI[20] methodological sheet of the indicator n°9 ("Sustainable Land Use"):

- a greenfield represents a land "uncovered" by artificial surfaces, corresponding to any of Corine land cover classes, except for "artificial surface";
- a brownfield is defined as part of the developed/urbanised land (artificial surfaces) no longer in use (for housing, industry or services) and/or a land affected by levels of pollution of the soil or subsoil that are high enough to require remediation before safe reuse is possible.

This indicator should be measured by steps:

1. Measurement of the amount of brownfields and greenfields within the municipal area.

[20] http://sustainable-cities.org/indicators.

Data concerning the contaminated sites can be found in national databases (like BASOL[21] for contaminated sites and BASIAS[22] for industrial sites no more in use) in France) or require specific surveys. The computing of contaminated sites is mandatory in several European countries. Data concerning sites no longer in use might also require specific surveys.

2. Measurement of new urban developments on brownfields and greenfields.

   The data concerning the new developments should be found in local land registers, in plans and specific programmes of the local authority.

3. Measurement of the ratio of new urban developments on brownfields and greenfields.

   When the new urban developments are planned in a sustainable way, the value of the indicator is above 1 (provided that there are some brownfields available).

Some problems may be encountered in the short term in the measurement of the amount of brownfields, because of the lack of a clear definition of this term and because of the lack of data in some countries.

Policy relevance

This indicator is directly related to the TISSUE trends Balanced development of greenfields and brownfields, Consumption of land and space, Attractiveness of cities centres and amenity of streets and neighbourhoods, and Soil Pollution. It measures the improving of the reuse of brownfields over the use of greenfields as stated in the Thematic Strategy on the Urban Environment. It also directly relates to commitment 5.2 ("avoid urban sprawl by achieving appropriate urban densities and prioritising Brownfield site over Greenfield site development") and 5.1 ("reuse and regenerate derelict or disadvantaged areas") of the Aalborg+10 commitments.

[21] http://basol.environnement.gouv.fr/
[22] http://basias.brgm.fr/

Consensus and feasibility

A majority of systems, instead of this indicator use "Amount/Extension of brownfield (mc; ha; num.)" and "Brownfield renewal (% of tot; absolute value)", that obviously represents a mean to obtain data useful to define the local relevancy of the above indicator (see first step of the measurement of the indicator). The European systems use different definitions of "brownfield" but similar in the meaning: 'previously developed land', 'derelict', or 'contaminated'. Thus there is a need of harmonisation. The soil contamination[23] represents an expected report[24] to the European Environment Agency (annual reporting frequency).

CORE 1 – Accessibility to open areas

Definition and measurement

The share (%) of inhabitants living within 300 m from open areas (> 5000 m^2) and the share (%) of inhabitants living within 300 m from open areas of any size.

This indicator measures the state of presence and vicinity of open areas. By comparing its value for a frequency fixed at 5 years, it allows to measure the way the creation of open spaces and their accessibility have taken into account in the urban design.

According to the definitions provided by ECI methodological sheet of the indicator n°4[25], open areas are:

- public parks, gardens or open spaces, for the exclusive use of pedestrian and cyclists, except green traffic islands or dividers, graveyards (unless the local authority recognizes their recreational function or natural, historical or cultural importance)
- open-air sport facilities, accessible to the public free of charge
- private areas (agricultural areas, private parks), accessible to the public free of charge.

[23] See http://rod.eionet.eu.int/index.html for the list of the countries and detailed information.
[24] See http://rod.eionet.eu.int/index.html for the list of the countries and detailed information.
[25] http://sustainable-cities.org/indicators.

This indicator doesn't take into account in its definition the quality of the green and open spaces. The satisfaction of the inhabitants could be monitored in a specific representative citizen survey suggested for the measurement of a SUM-indicator "Citizen's satisfaction with the state of urban environment in their cities/urban areas".

The indicator should be measured by steps:

1. Identification of open areas (greater than 5,000 m² and of any size), e.g. measure of the availability in terms of total amount of open areas and their geographical distribution.
2. For each open area, measurement of population living in the vicinity.
3. Measurement of population living in the vicinity of open areas.

The indicator can be measured thanks to GIS, if the cities have them to their disposal; otherwise the necessary data should be verified through the use of maps and on-the-spot inspection. Data concerning geographical distribution of open spaces and their size are available from the plans of the municipality (city Master Plan) and data about population are available from the municipality or from national statistical institutions (ex: INSEE for France, ISTAT for Italy, etc.).

Policy relevance

This indicator is related to the TISSUE trends Availability and accessibility of green and open spaces, Attractiveness of cities centres and amenity of streets and neighbourhoods, Urban sprawl and sub-urbanisation, Availability of green and open spaces, Accessibility of green and open spaces, Biodiversity and Car dependency. It measures the improving in creation, protection of green spaces as stated in the Thematic Strategy on the Urban Environment. It also directly relates to commitment 6.1, 6.2, 9.2 of the Aalborg commitments.

Consensus and feasibility

This indicator has been adopted – even if under different names, but with methods and metrics that could be easily harmonised, by relevant existing sets at EU and national/regional level: ECI, ISDIS, EEA, Urban Audit, RESPECT, Denmark's National Strategy for SD, Ecosistema urbano, Zukunftsfähige Kommune, CERCLE, ACI, Nordic Larger Cities XARXA.

Many systems indicators in addition or instead of this indicator use “Availability (tot. amount; m²/capita, % of total area) of green areas” representing, in some sense, a proxy or a complementary data respect to the “Accessibility” indicator (see first step of the measurement of the indicator). The feasibility is good but there is a need of clear common definition of open areas (see ECI suggested checklist) and of “accessibility”. According to TISSUE assessment, different interpretations of “accessibility” exist: 15 minutes walking, 500m, 300m.

CORE 1 – Accessibility to PT stops

Definition and measurement

The share (%) of inhabitants living within 300 m from PT accesses.

The indicator measures the state of presence and vicinity of public transport accesses. By comparing its value for a frequency fixed at 5 years, it allows to measure the way the creation of public transport accesses and their accessibility have been taken into account in the urban design.

The public transports (local and regional) that should be taken into consideration are bus stops, underground, tramway and railway connections. This indicator doesn’t take into account either the quality of the transports (frequency of the service, etc. …), or the satisfaction of the inhabitants. The latter could be monitored in a specific representative citizen survey suggested for the measurement of a SUM-indicator ”Citizen's satisfaction with the state of urban environment in their cities/urban areas“.

The indicator should be measured by steps:

1. Identification of the local and regional public transport accesses, e.g. measure of the availability in terms of total amount of public transport accesses and their geographical distribution.
2. For each public transport access, measurement of population living in the vicinity, e.g. measure of their accessibility.
3. Measurement of population living in the vicinity of PT accesses

The indicator can be measured thanks to GIS, if the cities have them to their disposal; otherwise the necessary data should be verified through the use of

maps and on-the-spot inspection. Data concerning geographical distribution of public transports stops are available from the municipality (Mobility Plan) and data about population are available from the municipality or from national statistical institutions (ex: INSEE for France, ISTAT for Italy, etc.).

The suggested measurement frequency for this indicator may be every 5 years.

Policy relevance

Accessibility of public transports reduces the needs of mobility by private cars.

This indicator is related to the TISSUE trends Accessibility, transport quality, Public Transport System Quality, Short distance and public transport oriented development, Car dependency and Accessibility of basic services and facilities.

It measures the improving of location of infrastructures as stated in the Thematic Strategy on the Urban Environment. It also directly relates to commitment 6.1, 6.2 and 9.2 of the Aalborg+10 commitments.

Consensus and feasibility

This indicator has been adopted – even if under different names, but with methods and metrics that could be easily harmonised, – by relevant existing sets at EU and national/regional level: ECI, ISDIS, TERM, Zukunftsfähige Kommune, MONET.

There is a need of clear common definition of "accessibility". According to TISSUE assessment, different interpretations of "accessibility" exist: 15 minutes walking, 500m, 300m.

CORE 1 – Energy consumption of buildings

Definition and measurement

The average total energy consumption of buildings per square meter.

The result should be given in two classes: residential buildings and office, retail and public buildings.

The result should be calculated yearly on the bases of the energy certificates of buildings.

Policy relevance

Energy consumption of buildings belongs to the most important aspects of sustainable construction. On the basis of life cycle assessments of buildings, the biggest part of environmental loadings of buildings comes from the use stage of buildings. The energy required for heating and ventilation of buildings in order to maintain the intended indoor air climate is responsible for the most significant part of total consumption of energy and release of harmful emissions to air with regard to the whole life cycle of buildings. The construction stage is much less important in this respect.

The management of energy performance of buildings is an important target for the European Union in order to reach the objectives stated in the Kyoto Agreement, because building sector is responsible for about 40 % of Europe's total primary energy consumption. Thus there is a strong policy relevance.

The energy efficiency of buildings will be regulated on basis of the European Directive on Energy Performance of Buildings (2002/91/EC). The efficiency in resource consumption in sustainable urban construction is also emphasised in the Communication ”Towards a TSUE“ (11.2.2004).

The indicator is consistent with the following Aalborg commitments:
- reduce primary energy consumption, and increase the share of renewable and clean energies,
- avoid unnecessary energy consumption, and improve end-use energy efficiency.

Consensus and feasibility

All the relevant sustainable construction assessment systems include indicators that express energy consumption during use of buildings. There is a wide consensus and knowledge about the significance of the building sector with regard to the Europe's total primary energy consumption. In addition, many cities – especially in the Nordic Europe – collect information about the energy consumption of buildings.

However, the true measurement of the results requires that there is transparency in the energy data. If this is not the case one has to base the estimation on the modelling and assessment. There are good-quality tool, which have been developed in order to support this kind of estimation.

CORE 1 – Share of sustainability-classified buildings

Definition and measurement

Share of new buildings and building renovations which have been assessed and classified in terms of sustainability (considering the volumes of the projects).

Sustainability classification according to a national or the European method for the assessment and classification of new and existing buildings.

The assessment of the indicator requires that there is a national or a European method for the assessment and classification of building and renovation projects. The European method will be developed within the 6th FP in the near future.

For example in Finland the indicator would be measured on the basis of the number of projects classified on the basis of the PromisE-system before there is a European method. The PromisE system classifies new and existing buildings into five classes from E to A the last one representing excellent results).

After the development of the European system, the reference method should be the assessment and classification of construction and renovations projects with help of the common system.

Policy relevance

Sustainable building methods have a high policy relevance because of the significance of building with regard to energy consumption and release of greenhouse gases and because of the effect of building on the well-being of users. This has also been acknowledged in the Communication ”Towards a TSUE“, 11.2.2004. The Communication states that among the sustainable construction related actions and priority themes the following issues are included:

The Commission will develop a common methodology for evaluating the overall sustainability of buildings and the built environment, including life-cycle cost indicators. This will be applicable for both new building as well as for significant renovations. All Member states are encouraged to adopt this methodology. The Commission will propose further non-energy-related environmental performance requirements to complement the Energy Performance Directive.

– All Member States are encouraged to
  - develop a national sustainable construction programme
  - introduce sustainability requirements in the tendering procedures.

The indicator is consistent with the following targets stated in the Aalborg commitment:

– undertake sustainable procurement
– apply requirements for sustainable design and construction and promote high quality architecture and building technologies.

Consensus and feasibility

There is a wide consensus about the need of sustainable construction assessment and classification methods. Sustainable construction should bring about the required performance with the least unfavourable ecological impacts, while encouraging economic, social and cultural improvement at a local, regional and global level.

Instead of assessing the sustainability of buildings on the basis of quality of building stock and on the basis of induced economic and environmental effects, we can alternatively use process related indicators. In that case the assessment is based on the concept that if construction and renovation process uses certain methods, this probably promotes and improves the sustainability of buildings.

Building sector has developed assessment and classification methods for construction and renovation processes in a number of European countries. For the time being there is no common European method. However, it is probable that the European countries will develop common methods for the assessment during coming years.

CORE 1 – Construction and demolition waste

Definition and measurement

The volume of construction and demolition waste in kg per year.

The amount of waste should be related to the yearly volume of construction.

The assessment of the indicator should be based on the information of the amounts of waste deposited at refuse tips.

Policy relevance

Waste produced from building materials during the construction and demolition stages are the source of 22 % of all waste generated in Europe.

The relevance of the indicator is also acknowledged in the in the Communication ”Towards a TSUE“, 11.2.2004. The Communication states that the Commission will consider measures to tackle the growing levels of construction and demolition waste.

The Communication from the Commission ”Towards a thematic strategy on the prevention and recycling of waste“ points out that construction and demolition waste belongs to the major waste streams in Europe.

The indicator is consistent with the following targets stated in the Aalborg commitment:

– avoid and reduce waste, and increase re-use and recycling.

Consensus and feasibility

There is a wide consensus about the significance of the indicator. The feasibility of the results is good.

CORE 1 – Adoption of environmental management systems

Definition and measurement

EMP and EMS are specific instruments developed in the context of TSUE and described in section 5.2 above. In case of a voluntary implementation of both instruments by the cities and urban areas, the indicator will measure the national adoption rates of EMP and EMS and will be defined as ”the proportion of cities with EMP and EMS from all larger cities with more than 100.000 inhabitants“. Two indicator values will be calculated, one for EMP and one for EMS. If the EMP- and EMS-implementation will be declared mandatory for all EU cities with more than 100.000 inhabitants, adoption rates will be replaced by two qualitative indicators assessing the relevance and impact of these two instruments. The "relevance" will be defined and measured in terms of the legal status and binding character of these instruments and their relation to other plans, the ”impact“ in terms of their effects upon the quality of urban environment. The exact way and formula for the calculation or estimation of such indicators can not be defined here, but will have to be specified later by the responsible policy makers and institutions in case of mandatory implementation of both instruments.

Policy relevance

In the Communication of February 2004, the Commission identifies ”management as the key issue for the improvement of the overall quality of urban areas in Europe. Together with sustainable transport plans, EMP and EMS are main implementation tools and measures of the TSUE. The EMP should aim towards environmental sustainability by supporting a more comprehensive and holistic approach to public policy, so tackling the contradictions arising from policy compartmentalisation. The EMS is a way to ensure that the EMP is implemented by affecting decisions on a day to day basis.”[26]

[26] Interim Report of the Working Group on Urban Environmental Plans and Systems, p. 21

Consensus and feasibility

There is not much experience with the utilisation of EMP adoption numbers and rates as indicators for the quality and sustainability of urban management, but the collection of necessary data and information for this purpose should be easy. It will/would be much more difficult to collect harmonised data on EMP-relevance and impact. Some hints of how this could be done can be found in CITIES 21 and Local evaluation 21. If cities themselves are expected to provide the necessary information about the existence and quality of such local plans, the reported data could be positively biased. The data situation and feasibility is much better with regard to the second indicator measuring the adoption rates or relevance and impact of EMS. This indicator has been adopted – under different names, and with methods and metrics that needs to be harmonised – by many relevant systems at EU and national or regional level. Good examples are ECI, CEROI, Nordic larger cities, Local evaluation 21, Cities 21, and Quality of life counts.

CORE 1 – Share of certified enterprises and public agencies

Definition and measurement

Number and proportion of (i) large firms, (ii) SME and (iii) other organisations with certified environmental and/or social management system.

Policy relevance

The policy relevance of the suggested indicator is very high, because of the importance of public-private partnership and of the role which large firms and organisations play today as advocates and promoters of environmental concerns.

Consensus and feasibility

There are several certification systems (EMAS, ISO 14001, eco-budget, CLEAR, eco-Procurement or eco-label with a focus on environmental certification, SA 8000 with focus on social certification), and the problem seems to be which should be taken into consideration and which not. Data about the number of certified firms and organisations can be gained from the official databases of the certifiers themselves, data about the total number of firms and

organisations can be gained from pertinent national statistics, with the help of expert estimates or by the means of a special survey.

CORE 1 – Citizen satisfaction with the state of the environment

Definition and measurement

Number and proportion of citizens satisfied with the state of the urban environment in their cities. Data and information necessary for the calculation of values of this indicator can be collected with a special representative TSUE survey among citizens of EU cities and urban areas (this same survey can be used to collect data for the other citizens related indicator, i.e. the citizens engagement in environmental and sustainability-oriented activities).

Policy relevance

The policy relevance of the suggested indicator is very high, even though it is rather difficult to interpret pertinent positive or negative statement as being addressed solely to the state of urban environment. In surveys, which are the only way how to obtain representative satisfaction data, respondents tend to express generalised feelings and neglect the specific objects and themes which should be addressed. In other words: in cities with high general level of dissatisfaction, people will automatically express more dissatisfaction with the state of urban environment as well.

Consensus and feasibility

The satisfaction indicator has been used in the framework of ECI. With exception of ECI, no good and comparable data exists. In order to prevent the above mentioned undesirable ”general satisfaction or/dissatisfaction“ effect, the respondents should not be asked to express their satisfaction with the state of local environment in general, but with the state of specific environmental media (local air-quality, noise, water, etc.).

CORE 1 – Water consumption

Definition and measurement

a) Water consumption in total and by sectors
   The indicator of water consumption/ intensity has been used all around the Europe already for decades, but its definition undergoes some changes. Recently, this indicator relates to sustainable management of water resources (Directive 2000/60/EC).

b) Domestic water consumption per capita

c) Other sectors water consumption per GDP
   This indicator is influenced not only by the water intensity of industry (paper and pulp, textile, chemical, etc.), but also by the IPPC Directive 96/61/EC fostering the concept of "the best available technology", which requires water operators/main users to decrease their water consumption, e.g. by closing water cycles, recycling, etc.

Measurement is based on mandatory monitoring of water withdrawal from available water sources (Surface and ground water). Industrial operators and water companies keep their water balance and compare it with measurements at end user points (installations, dwellings, enterprises, hospitals, schools, etc.). Individual consumption and annual total consumption are known with relatively small inaccuracy (less than 1%).

Data obtained from any of the above mentioned sources should provide a fairly comprehensive list of geographic and hydrologic information for public water suppliers, and in some cases, data on the rate or volume withdrawal from each source. Data also may be available on the amount of water supply into the distribution system, deliveries to groups of users, and unaccounted water use.

Frequently, these data are not developed from uniform criteria and will need to be analyzed carefully before being incorporated into the project data base. The data need to be checked for consistency and completeness (e.g. requesting a breakdown of deliveries to the public water supplier's largest users may help resolve data inconsistencies). Public use and unaccounted use are frequently estimated as the difference between water release into the distribution network and deliveries to billed customers. When this occurs, the two groups cannot be

separated and they are referred as public use and losses. Public use and losses varies from 10 to 40 percent.

Policy relevance

The indicator is related to the following TSUE related trends and Aalborg+10 commitments:

- Trend 22: Water consumption by sector
- Trend 23: Water intensity related to relevant units
- Aalborg: Commitment 3.2. Using water more efficiently/ improving water quality.

Consensus and feasibility

Indicators are measured and reported at national level, e.g. as a part of environmental indicators. Mandatory reports are related to extraction permits/ water companies, industrial operators) and extraction charges. The values at national/municipal level are aggregates of water accounts, which exist at consumer and supplier level. Availability of the indicators at urban area is reasonable (Urban Audit, available for 40 from 56 European cities), however time series are not often presented. When data are presented on regional level and regional zoning change (regions vs. districts), available data do not necessary need to be comparable with long time data series, due to different geographical zoning. When data on water consumption come from water companies, the area covered might not always coincide with the city/WTU boundaries. This is the case of Madrid WTU, Strasburg WTU and Birmingham for example (see Urban Audit, 2004).

CORE 1 – Compliance with drinking water standards

Definition and measurement

Index of Compliance with standards relating to water quality parameters for drinking water as per Drinking Water Directive 98/83/EC (including nitrates, pesticides and microbiological).

According to Directive 98/83/EC (DWD), water intended for human consumption shall be wholesome and clean if it:

- is free from any micro-organisms and parasites and from any substances which, in numbers or concentrations, constitute a potential danger to human health, and
- meets minimum requirements set out in Annex I, Parts A and B of the Directive.

The quality of potable water for mass consumption is affected by numerous factors, quality of raw ground or surface water (resources management), technology of raw water treatment (design and management) and distribution system (design and management). Treated high-quality potable water is stored and delivered for consumption via a distribution network, where certain chemical, physical and biological processes may take place under specific circumstances. The effects of such processes on the quality of the transported water are negative in most cases. They manifest usually in the form of deterioration of sensorial parameters of water, increased concentrations of heavy metals, occurrence of side effects of disinfection, bacterial recontamination, etc.

Limit values for nitrates, pesticides and microbiological parameters in drinking water should be related to DWD to obtain comparable values of the indicator. Laboratories involve in monitoring should be accredited (EN ISO/IEC 17 025:2000) and participate in inter-laboratory comparisons/proficiency testing. Sampling frequencies are also set by the DWD. The uncertainty of the chemical analysis allowed by DWD is 10%. This uncertainty may relate to number of samples not complying with microbiological and chemical parameters. Sampling techniques also vary and may lead to anomalous data. In addition, sampling boundaries might be larger than city boundaries (Athens, Thessaloniki and Bradford).

Policy relevance

Quality of drinking water is a great concern: in Europe almost 50% of analyzed samples on average do not comply with quality standards, and most of the time limit values of nitrates and pesticides are exceeded. The trend is related to TSUE action due to the fact that SUD and SUM could play and important role in monitoring and preventing pollution and health risks. It has some relevance in Aalborg Commitments (3-Natural goods, 7-Health).

The indicator is relevant for the following Aalborg+10 commitments:

- Commitment 3.2. Improve water quality, save water, and use water more efficiently,
- Commitment 7.1. Raise awareness and take action on the wider determinants of health, most of which lie outside the health sector,
- Commitment 9.1. Secure good quality and socially integrated housing and living conditions.

Consensus and feasibility

Similar indicators of drinking water quality are adopted in some important indicator sets assessed by the TISSUE team:

- Cities 21: Volume of distributed water processed to drinking water quality standards (Mlitres – city)
- Healthy Cities: Water quality (% exceed WHO guidelines and number of times standards exceeded)
- Urban audit: Drinking water quality is defined as: Percentage of determinations (total number of annual tests on all parameters on drinking water quality) which exceed the prescribe concentration values, as specified in the Directive 80/778/EEC.

The indicator is based on obligatory monitoring required by the DWD for the EU members. DWD presents a set of minimum quality requirements (Art. 4. Annex I) and defines point of compliance. In case of non-EU countries, the same monitoring conditions should be used to obtain comparable values.

CORE 1 – Compliance with urban waste water standards

Definition and measurement

Art.2 Directive 91/271/EEC define urban waste water as domestic waste water or mixture of domestic waste water with industrial waste water and /or run-off rain water. Domestic waste water includes waste water from residential settlements and services which originate predominantly from human metabolism and from households. Industrial waste water includes any waste water which is discharged from premises carrying on any trade or industry, other than domestic waste water and run off rain water.

The EC Urban Waste Water Treatment Directive sets down minimum standards for discharge of treated effluent from waste water treatment works. According to this Directive, there are two possible ways of measuring compliance with urban wastewater standards:

- Annual compliance with standards relating to the level of Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Total Suspended Solids (SS) for towns and cities discharging into "normal" waters, as defined by the Urban Wastewater Treatment Directive (UWWT).
- Annual compliance with standards relating to levels of nitrogen (N), Phosphorus (P) and microbiological parameters for cities discharging into "sensitive" waters as defined by UWWT.

Limit values for BOD, COD and SS parameters and in case of sensitive area, concentrations of nitrogen, phosphorus and microbiological indicators, in wastewater should be related to UWWT parameters to obtain comparable values of the indicator). Laboratories involved in monitoring should be accredited (EN ISO/IEC 17 025:2000) and participate in inter-laboratory comparisons/proficiency testing. The Directive identifies the number of samples which can fail and also defines that extreme values obtained during heavy rain should not be taken into account. Sampling frequencies are also set by the UWWT.

Policy relevance

Sustainable development is dependent on suitable water availability for a variety of uses ranging from domestic to industrial supplies. Strict water quality standards have been established to protect users from health and other adverse consequences of poor water quality. For instance, the presence of high BOD may indicate faecal contamination, or increases in particulate and dissolved organic carbon from non-human and animal sources can restrict water use and development, necessitate expensive treatment and impair ecosystem health. Human ill health due to water quality problems can reduce work capability and affect children's growth and education. Increased oxygen consumption poses a potential threat to a variety of aquatic organisms, including fish.

Consensus and feasibility

The indicator is based on mandatory monitoring required by UWWT for the EU members (Annex 1). UWWT presents set of minimum quality requirements. In case of non-EU countries, the same monitoring conditions should be used to obtain comparable values. The suggested "water indicators" are closely related to main problems connected to urbanization, but their definitions do not cover all water-management related problems. For example the indicator "Index of Compliance with Urban Waste Standards" takes into account the chemical impact of discharging waste water on recipient, but does not take in account hydraulic and hydrological impact on the recipient. The urban drainage affects the water bodies and changes mutual interactions among hydraulic, morphological, chemical and biological condition in watercourse. The indicator would deserve to be extended also to cover hydraulic issues to fulfill requirement of the Water framework, for complex assessment and especially to reach a good ecological status of the watercourses.

Useful indicators can be for example the annual amount of water discharged to watercourse and the number of overflows from sewer system. However, there are still missing standards identifying acceptable amount of water which can be discharged to the watercourse from the hydraulic point of view, to keep or reach good ecological status, and not to cause hydraulic stress for aquatic community.

CORE 1 – Air quality indicators: 1) Number of days with exceeding PM10 and O3 and 2) Annual average concentration of NO2

Definition and measurement

Air pollution – Short term exposure: Unit of measurement: – Number of days in a year in which the limit/target value for PM10 and for O3 is exceeded (in each urban area)

Air pollution – Long term exposure: Unit of measurement: – Annual mean concentration for NO2 (in each urban area)

The indicators are calculated based upon data from all street stations and background in the urban area. Limit/target value: as defined by Ambient Air Quality Dir. 1999/30/EC (for PM10 and for NO_2) and Dir. 2002/3/EC (for O_3)

for the protection of human health. Number of exceedences (days): it is calculated as a single exceeding day in case the value is exceeded during a day one or more than one time (for O3), in one or more than one station[27], for one or both pollutants (as an index, but for a better information is possible to maintain 2 single indicators, one for each pollutant). The number of days limit/target value is exceeded during a year must be report distinguishing the different types of stations, that is number of exceedings for PM10 and/or for O_3 for each station group: traffic station, industrial station and background station[28].

Pollutant	Average time mean	TSUE Indicator Metrics	Daughter directive limit / target value defined by
PM10 - stage 1	24 hours	number of exceedings (days) of PM10 limit value for the protection of human health plus MOT	1999/30/EC
PM10 - stage 2	24 hours	number of exceeding days of PM10 limit value for the protection of human health plus MOT	1999/30/EC
O3	8 hours	number of exceeding days of the target value for the protection of human health	2002/3/EC

MOT - Margin of tolerance defined for the specific pollutant by the relative daughter directive

[27] It is important to consider only the stations that fulfil the minimum data capture requested by the Dir. 1999/30/EC Annex VIII and by the Dir 2002/3/EC. Annex VII.

[28] Guidance on the Annexes to decision 97/1001/EC on Exchange of Information (EoI Decision) as revised by Decision 2001/752/EC: Traffic station (T) – Located such that its pollution level is determined predominantly by the emissions from nearby traffic (roads, motorways, highways). Industrial station (I) – Located such that its pollution level is influenced predominantly by emissions from nearby single industrial sources or industrial areas with many sources. Industry source is here taken in its wide meaning including sources like power generation, incinerators and waste treatment plants. Background station (B) – Located such that its pollution level is not influenced significantly by any single source or street, but rather by the integrated contribution from all sources upwind of the station.

Annual mean: could be compiled as absolute value and/or as % upper/above the limit value + Margin of Tolerance (MOT). The indicator could be assessed considering the minimum and the maximum average annual mean registered by all type of stations; that is the % of the annual average upper/above the limit value + MOT for the station that registers the lower concentration level and the % of the annual average upper/above the limit value + MOT for the station that registers the higher concentration level.

Pollutant	Average time mean	TSUE Indicator Metrics	Daughter directive limit value defined by
NO2	calendar year	% of the annual average upper/above the limit value for the protection of human health plus MOT	1999/30/EC

MOT - Margin of tolerance defined for the specific pollutant by the relative daughter directive

For agglomerations where concentration levels are below the lower assessment thresholds, probably no fixed measurement will be available; in that case the agglomeration must report the maximum concentration level estimated (for each one of the pollutants which concentration level is below the lower assessment threshold) with the use of modelling or objective estimation techniques: the daily maximum concentration level for PM10 and/or the 8 hours maximum concentration level for O_3 and/or the annual maximum concentration level for NO_2. Note that in the near future it is expected a possible revision of air quality directives and limit value as a result of the WHO project "*Systematic Review the Health aspects of air pollution in Europe"* and of the work in progress for the Thematic Strategy on Air Quality/Pollution – CAFE Programme[29].

[29] Notes for the CAFE Steering Group, May 2004: "Possible measures to be analysed, the need to set new standards for PM (either PM 2,5 or PM10 or both) and the view of the indicative limit value for 2010".

Policy relevance

The main reasons for these indicators selection are:

- the present legislative framework represented by the Council Directive 96/62/EC of 27 September 1996 (on ambient air quality assessment and management) and the following daughter directives
- the on going Thematic Strategy for Air Quality Pollution (Clean Air for European programme – CAFE), launched in March 2001 and expected to be ready on 2005
- the 2003 EEA Report on Air Pollution in Europe 1990–2000 and the 2004 WHO Europe Report on Health effects of Air quality pollution.

Consensus and feasibility

The 2 Indicators are coherent with the above legislative and policy framework and the reporting procedures presented in Appendix 3. They are used by the EEA Air Pollution regular reporting action and indicated as key indicators (even if with some slight differences that could be discussed, harmonised and finalised with EEA and DGENV[30]). Urban Audit[31] and European Common Indicators[32]

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[30] European Environment Agency (2003), *Air Pollution in Europe 1990–2000:* Exposure of the European urban population to ozone, to PM10 and to NO2 (three single indicators, one for each pollutant):

- O3: an average number of exceedance days with 8 hours mean above 120 µg/m3 and the indicator is the frequency of exposure class (0 days; 0–25 days; 25–50 days; > 50 days);
- PM10: an average number of exceedance days with daily mean above 50 µg/m3 and the indicator is the frequency of exposure class (0 days; 0–35 days; 35–45 days; > 45 days);
- NO2: indicator is the frequency of exposure class in respect of the annual mean (< 40 µg/m3; 40–60 µg/m3; 60–80 µg/m3; > 80 µg/m3);

For NO2 and Ozone only the background stations are included, while for PM10 also streets stations are included to increase the limited coverage of its monitoring.

[31] Urban Audit, if there is more than one station within the specified spatial unit, the most representative of local conditions is to be selected (no average of values from different station to be used but rather the value from a ”typical" station”):

- Winter smog: Days per year SO2 exceeds125 µg/m3 (24hr averaging time);
- Summer smog: Days per year Ozone exceeds120 µg/m3 (8hr averaging time);
- Days per year that NO2 concentrations exceed 200 µg/m3 (1hr averaging time).
- *Days per year that PM10 concentrations exceed 50 µg/m3*
- *Concentration of lead Pb in ambient air in µg/m3.*

have adopted almost similar specific indicators for air quality too. Many other existing indicators sets at national and local level, individuated and assessed by TISSUE have adopted the indicators proposed (upon different names, and by means of methods and metrics that could be harmonised)[33].

CORE 1 – Noise indicators; share of population exposed to excessive noise

Definition and measurement

1 Annoyance caused by exposure to noise during day, evening and night periods
Unit of measure: Share of population exposed to L_{den}[34] > 55 dB(A)

2 Sleep disturbance caused by exposure to noise during night period
Unit of measure: Share of population exposed to L_{night}[35] > 45 dB(A)

The values suggested (55 dB(A) and 45 dB(A)) are not to be considered as limit values, they must be considered just as a noise bands useful to evaluate the proposed TSUE indicators. At the moment, the Environmental Noise Directive (END – Directive 2002/49/EC) does not indicate any limit value (that are to be defined by the Member States). The indicators require the following data, as defined by Directive 2002/49/EC Annex I (Noise Indicators) and Annex VI (Data to be sent to the Commission)):

– The estimated number of people (in hundreds) living in dwellings exposed to each of the following bands of values of L_{den} in dB 4 m above the ground on

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[32] ECI, if more than one fixed sampling point is available for a single pollutant in the same zone or agglomeration, the one that observes, during the year, the highest number of exceedances must be used:
- Number of times EC limit values exceeded (City). PM10 is the headline indicator.

[33] Healthy Cities, RESPECT, ACI, Cities 21, Eco-budget Nature Balance (Netherlands), Ecosistema Urbano (Italy), Local Quality of Life Indicator (UK).

[34] Lden (day-evening-night noise indicator) shall mean the noise indicator for overall annoyance as defined in the Directive 2002/49/EC Annex I reporting the Noise Indicators definitions.

[35] Lnight (night time noise indicator) shall mean the noise indicator for sleep disturbance as defined in the Directive 2002/49/EC Annex I reporting the Noise Indicators definitions.

the most exposed façade: 45–49; 50–54[36]; 55–59, 60–64, 65–69, 70–74, > 75, separately for road, rail and air traffic noise and noise from industrial sources.

– The estimated total number of people (in hundreds) living in dwellings exposed to each of the following bands of values of L_{night} in dB 4 m above the ground on the most exposed façade: 40–44; 45–49[37]; 50–54, 55–59, 60–64, 65–69, > 70, separately for road, rail and air traffic and for industrial sources.

The above data must be calculated through the use of strategic noise maps as it is defined by END Annex IV (Minimum requirements for strategic noise mapping), considering the Commission recommendation 2003/613/EC concerning the guidelines on the revised interim computation methods for industrial noise, aircraft noise, road traffic noise and railway noise, and related emission data[38] and the recommendations given by the European Commission Working group "Assessment of exposure to noise" (WG AEN)[39].

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[36] The first two L_{den} bands are suggested by the current TSUE methodology (they are not included in the END Annex VI; the value bands indicated by the END Annex V start from 55–59), considering the % annoyed people at those levels for aircraft, road and rail (curves dose-effects presented on the *Position paper on dose response relationships between transportation noise and annoyance* (European Commission, 2002).

[37] The first two L_{night} bands are proposed by the current TSUE methodology (the first one is not included in the END Annex VI; the value bands indicated by the END Annex VI start from 50–54; the band 45–49 is suggested by END Annex VI if data are available), considering the % sleep disturbance at those levels for road and rail (curves dose-effects presented on Miedema et al. report *Elements for a position paper on night-time transportation noise and sleep disturbance* (2002)).

[38] "Harmonise", project co-funded by the European Commission, as been developed by a consortium consists of 19 partners from 8 different Member States and 1 Associated State (Poland), with the objective of developing methods to predict community noise level from roads and railways. The methods are expected to be available at the end of 2004.

[39] The first version (not yet an official statement of the position of the European Commission) (December 2003) of the *Good practice guide for strategic noise mapping and the production of associated data on noise exposure,* is available on: http://europa.eu.int/comm/environment/noise/best_practice_guide.pdf.

The two CORE 1 indicators, relative to L_{den} and L_{night} – in accordance with the Noise Directive (END) – are computed for each one of the noise bands and separately for each one of the sources (road traffic, rail traffic, air traffic and industrial), as estimated number of people exposed to each source. The formulation of the indicators is as follows:

- Share of population exposed to Lden above 55 dB(A) (considering Lday of 55 dB(A); a Levening of 50 dB(A) and a Lnight of 45 dB(A))40.
- Share of the population exposed to Lnight above 45 dB(A).

The choice of these noise bands is coherent with WHO Guidelines[41].

Policy Relevance

The policy relevance of the noise indicators stems in particular from:

- The sixth Environmental Action Programme which sets the objective of "substantially reducing the number of people regularly affected by long-term average levels of noise, in particular from traffic…".
- The present legislative framework represented by the European Parliament and the Council Directive 2002/49/EC (Environmental Noise Directive, END), main Annexes and the following working documents presented by the EU Noise Expert Network and relatives Working Groups.

[40] The Lden band value suggested in current TSUE methodology was defined considering the END - Annex I Lden indicator definition, that signs a penalty of 5 dB(A) for the Levening average sound level and a penalty of 10 dB(A) for the Lnight average sound level.

[41] "*To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB(A) LAeq for steady, continuos noise. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB(A) LAeq. (...) At night, sound pressure levels at the outside façades of the living spaces should not exceed 45 dB(A) LAeq and 60 dB(A) LAmax, so that people may sleep with bedroom windows open."* , Berglund, B., Lindvall, T., Shewela, D. (ed.), (1999), WHO *Guidelines for Community Noise*.

Consensus and feasibility

The WHO programme on noise and health[42], on its meeting report (April 2003) identified and presented a set of 17 noise indicators based on DPSEEA model (Driving forces-Pressures-State-Exposure-Effects-Action). Based on a review of an initial set of 17 indicators, the expert group proposed a first core set of indicators to be integrated into EH set (EHIS project); the core set will then cover:

- annoyance (as described in the European Directive 2002/49/EC and considering the relationship dose-effects proposed by the European Commission - EU's Future Noise Policy, Working Group 2 (2002));
- sleep disturbance (as described in the European Directive 2002/49/EC and considering the relationship dose-effects proposed by Miedema et al (2002));
- cardio vascular morbidity and mortality (to be described by WHO working group);
- effects on cognitive performance development (to be described by WHO working group after further development work).

The WHO ECOEHIS project proposed as noise indicator: Population exposed to noise by sources[43]. Urban Audit[44] and European Common Indicators[45] have adopted almost similar specific indicators for environmental noise. Many other existing indicators sets at national and local level, individuated and assessed by **TISSUE**, have adopted the indicators proposed (upon different names, and by means of methods and metrics that could be easily harmonised).

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[42] WHO Europe (Bonn Office) (2003), *WHO technical meeting on noise and health indicators – Meeting report,* 7–9 April 2003 - Brussels; available on:

[43] http://www.euro.who.int/EHindicators/Indicators/20030528_1

[44] Urban Audit:

-Proportion of residents exposed to day noise, Lday (as defined by 2002/49/EC) > 55 dB(A)

-Proportion of residents exposed to night noise, Lnight (as defined by 2002/49/EC) > 45 dB(A).

[45] ECI:

-% of population exposed, broken down into different value bands of Lden and Lnight;

-% of measurements corresponding to different value bands of indicators Lden and Lnight;

-headline indicator: Percentage of population exposed to Lnight >55 dB(A).

CORE 1 – Municipal waste indicators: 1) Municipal solid waste generation and 2) Municipal waste separately collected *3) Municipal solid waste treatment*

1 Municipal solid waste generation: Total municipal solid waste produced in the urban area, kg/person/year

2 Municipal waste separately collected: Proportion of total produced waste collected through a separate collection service which may lead to recovery operation (%)

3 Municipal solid waste treatment: Proportion of total waste by type of waste management (thermal treatment (with and without energy recovery), biological treatment, landfill disposal)(%)

The indicators proposed are concerned with the generation and management system of "Municipal waste", that is the waste originated by households, commerce and trade, small business, office buildings and institutions[46]. The indicators refer to all waste that are collected through a traditional collection service (usually a door-to-door service that collects mixed household waste) or through a separate collection service (door-to-door collection service of separate waste fraction such as glass wastes, paper and cardboard wastes, or through voluntary deposits of separate fractions[47]), which may lead to recovery operation[48]. The indicators definition (Municipal solid waste) includes (as in the

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[46] Municipal waste, as defined on Directive 1999/31/EC (article 2.b), shall mean "*waste from households, as well as other waste which, because of its nature or composition, is similar to waste from household*".

[47] Separately collected fraction of waste, as defined on Regulation (EC) n. 2150/2002 (article 2.b), shall mean "*household and similar waste, selectively collected in homogeneous fractions by public services, non profit organisations and private enterprises acting in the field of organises waste collection*".

[48] Recovery, as defined on Directive 75/442/EEC (article 1.f), shall mean "*any operation provided for in Annex II, B*". Some examples: Recycling/reclamation of organic substances which are not used as solvents (including composting and other biological transformation process); Land treatment resulting in benefit to agriculture or ecological improvement. According with a recent jurisprudence the European Court of Justice developed a criterion for distinguishing between waste recovery and waste disposal: Waste treatment operation is to be classified as recovery when the fundamental objective of the operation is that the waste substitutes the use of primary resources. (COM(2003) 301 final, pp. 21).

Waste Directive) also bulky waste and waste from municipal services (street cleaning wastes, parks and garden maintenance wastes, including cemetery wastes, market wastes, septic tank sludge), but do not include waste from municipal sewage network and treatment and the construction and demolition waste (a different waste stream, not included by the Waste Directive in the Municipal definition). The indicators require the following data.

The indicator is based on data collected at city level and related to the annual municipal waste collected under the responsibility of the local authority (including waste collected on behalf the local authority by private companies). This includes the categories indicated on the Commission Decision 2000/532/EC[49] and following amendments[50], that are indicated in its List of waste (LoW) Annex Chapter 15 01 Packaging (including separately collected municipal packaging waste) and in Chapter 20 Municipal waste (household waste and similar commercial, industrial and institutional waste) including separately collected fractions (except 15 01)[51]. The indicator is the total amount of municipal waste generated in a year (including separately collected fraction, bulky waste and municipal services waste) divided by the number of inhabitants of the city (or agglomeration). Its unit of measurement is kg / person / year.

This indicator concerns the municipal waste treatment operations for the residual fraction of municipal waste not separately collected. The indicator is based on data collected at city (or urban agglomeration) level regarding the amount of municipal waste:

– thermal treated with or without energy recovery[52];

[49] Commission Decision of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste (notified under document number C(2000) 1147).

[50] Commission Decision 2001/118/EC of 16 January 2001; Commission Decision 2001/119/EC of 22 January 2001; Council Decision 2001/573/EC of 23 July 2001.

[51] Member states shall take the measures necessary to comply with the Commission Decision 2000/532/EC not later than 1 January 2002 (article 4, 2000/532/EC).

[52] Thermal treatment shall mean treatment of waste in a incineration plant or in a co-incineration plant, respectively, defined in Directive 2000/76/EC, as "*any stationary or mobile technical unit and equipment dedicated to the thermal treatment of wastes with or without recovery of the combustion heat generated. This includes the incineration by oxidation of waste as well as other thermal treatment processes such as pyrolysis, gasification or plasma processes in so far as the substances resulting from the treatment are subsequently incinerated.* (...) (article 3.4)" and as

– submitted to a biological treatment [53];
– deposited in landfill[54].

The municipal waste treatment indicator corresponds to the percentage of each specific type of treatment (1 to 3) on the total municipal waste generated. Their unit of measurement is: % by type of treatment: thermal, biological, landfill.

Policy relevance

The policy relevance of the waste indicators stems in particular from:

– The updating process of the Community's waste strategy by means of the on going Thematic Strategy on the prevention and recycling of waste (a final Strategy is expected to be ready on 2005).

– The European legislation on waste management, in particular the Waste framework Directive, on waste treatment operation and on specific waste streams.

– The European Parliament and Council Regulation (EEC) n. 2150/2002 on waste statistics (Waste Statistics Regulation, WSR).

Consensus and feasibility

The indicators are coherent with the above legislative and policy framework and the below reporting procedures (see at Feasibility). The Eurostat's Structural

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"*any stationary or mobile plant whose main purpose is the generation of energy or production of material products and which uses wastes as a regular or additional fuel; or in which waste is thermally treated for the purpose of disposal.* (...) (article 3.5)"

[53] Biological treatment includes composting, anaerobic digestion and mechanical/biological treatment (a European common definition is attended though the publication of a proposal for a directive on the Biological treatment of biodegradable).

[54] Landfill, as defined on Directive 1999/31/EC (article 2.g), shall mean "*a waste disposal site for the deposit of the waste onto or into land (i.e. underground), including internal waste disposal sites (i.e. landfill where a producer of waste is carrying out its own waste disposal at the place of production), and a permanent site (i.e. more than one year) which is used for temporary storage of waste, but excluding facilities where waste is unloaded in order to permit its preparation for further transport for recovery, treatment or disposal elsewhere, and storage of waste prior to recovery or treatment for a period less than three years as a general rule, or storage of waste prior to disposal for a period less than one year*."

indicators include three indicators for municipal waste, one related to waste generation - amount of waste collected by or on behalf of the municipal authorities, and two related with the municipal waste treatment system - amount which are land-filled and amount which are incinerated. Data are collected by mean of an Eurostat / OECD (Organisation for Economic Co-operation and Development) Joint Questionnaire, that, from 2006, will be replaced by the mandatory data collection under the Waste Statistics Regulation (Regulation (EC) n. 2150/2002). Urban Audit (2004) adopted the following indicators for waste generation and treatment and disposal system:

- Collected solid waste per capita per year (same waste definition as the one proposed by this sheet);
- Proportion of solid waste processed by landfill;
- Proportion of solid waste processed by incinerator;
- Proportion of solid waste processed by recycling;
- Proportion of solid waste processed by other methods;
- Annual amount of toxic waste per capita.

See more about the feasibility of the waste indicators in Appendix 3.

CORE 1 – Green house gases emissions

Definition and measurement

The indicator measures total CO_2 equivalent emissions released by residential and tertiary sectors within the FUR against total resident population. The unit of measurement is tonnes of CO_2 equivalent emissions per capita per year.

The starting point to analyse the contribution of the household sector in conditioning climate change is data on energy consumption. Energy consumption information of buildings should primarily be based on factual data based on sales of fuels and information from power plants about electricity and district heat. If the factual data is not possible to receive, the energy consumption information of buildings should be assessed on the basis of models, which can assess the total energy consumption of buildings based on information about the building types, volumes, facilities etc. The process should start with careful assessment of the effect of building stock on energy use. After this the assessment of the energy use should take place every 5 years with help of an

assessment tool, which enables the assessment of the effects of changes. These kinds of models and tools have been developed in different countries. For example the KULE [55] programme support the assessment of total energy consumption of buildings in such a way that the needed background covers statistical information of buildings. The SUNTOOL project within the 6th FP will develop an assessment tool for the assessment of the impact of technical changes on the total energy consumption. Fuel, electricity and heat consumption values should be translated to values that represent the consumption of primary energy resources and GHG emissions with using the IPCC Guidelines and other relevant information.

Policy relevance

As shown by EEA, for the year 1998 household and commercial sectors contributed for the 20% of the total CO_2 emissions generated in Europe. Current national and local data on energy consumption are often related to civil sector without distinguishing between residential and commercial/institutional activities. For both the sectors the major contributors in releasing CO_2 emissions are related to buildings heating and the growing electricity consumption for appliances. Compare also the indicators "Energy consumption of buildings". The indicator shows the contribution of households activities to climate change. It represents an important tool for urban planning aimed to reduce energy consumption related to those household activities that cause a high level of CO_2 emissions. In this sense, ICLEI's Cities for Climate Protection (CCP) campaign provides examples from municipalities from around the world that are successfully reducing CO_2 emissions.

Consensus and feasibility

The indicator is feasible, but due to the difficulty in recording the quantity of each type of fuel in each activity, big efforts should be made to obtain estimates of emissions in each end-uses activity as precise as possible. A particular attention should be given to the electricity supply distribution per activity sector distinguishing between those part deriving from local production and those

[55] KULE (assessment of energy consumption). VTT, Finland.

coming from import. Each country, that is Party of the Convention (COP), have to compile annually the national GHG emission inventory through the compilation of the Common Reporting Format (CRF), in agreement with the guidelines provided by the United Nations Framework Convention on Climate Change and European Union's Greenhouse gas Monitoring Mechanism (IPCC, 1997; IPCC, 2000; EMEP/CORINAIR, 1999). This confirms the importance of the matter and the necessity to expand the range of action not only at national level but more in depth at regional and local level. This indicator has been implemented in many European activities and project and TISSUE indicator sets: Urban Audit[56], Ceroi and ECI (Sectoral per capita emissions).

CORE 2 – Freight transport demand

Definition and measurement

Ton kilometres moved per year divided by the regional GDP (ratio).

Ton kilometres are chosen because the definition is relative simple and therefore the data is relatively good comparable. The number of truck movements is an alternative but data is less easily available and comparable. The amount of ton kilometres moved within an area is a clear measure of how much the burden of freight transport is on the environment. This is due to the direct (negative) impact on sustainability issues as traffic safety, carbon dioxide emissions, energy consumption, noise and pollution of kilometres made for transportation of freight by heavy vehicles such as trucks. A relatively high ratio of ton kilometres moved divided by the regional GDP is an indication for a relatively high pressure on the urban environment. This ratio is amongst others affected by the structure of the local economy (industry, services) and the extent to which a city experiences transit traffic.

[56] "Total quantity of CO_2 emitted from sources within the defined area including fossil fuelled electricity supply, industry, road transport, domestic sources and other" – The Urban Audit Yearbook, Volume III.

Policy relevance

Transport demand is twofold: passengers and freight. While most transport demand indicators are directed at persons, it is also needed to monitor the demand for freight transport. Freight movements and in particular road haulage, are an important source of congestion and other traffic problems, particular within the urban environment. The noise and nuisance generated by heavy lorries, the problems created by on-street loading and unloading of goods, and the usual complaint about lorries taking up a good deal of the capacity of roads are only some of the problems associated with this type of traffic. This indicator directly measures the desired reduction of traffic volumes and congestion as stated in the Thematic Strategy on the Urban Environment. It also directly relates to commitment 6.5, reducing the impact of transport on the environment and public health, of the "Aalborg+10 commitments".

Consensus and feasibility

No indicator sets which monitor freight traffic demand on the urban level have been found. But there are two indicator sets (Indicators for Sustainable Development in Scotland and IFEN) which monitor freight demand and relate it to the growth of the GDP. Monitoring freight demand on the national level is actually very common in Europe. Also Eurostat has the demand of freight transport related to GDP incorporated in its structural indicators. Unfortunately it is not possible to scale down freight demand data on the national level to the level of cities. However, local authorities are expected to increasingly monitor freight demand in the near future.

CORE 2 – Modal split (share of kms)

Definition and measurement

Distribution of trip kilometres made among the transport modes.

This indicator is in essence the same as the modal split indicator, but it describes the share of each transport mode based on trip kilometres (%). Data could be obtained from household surveys. It must be noted that precise information on distances per trip are sometimes lacking and are often imprecise because respondents have to estimate distances. However, since the same error is made

for car as for public transport, household surveys are a suitable source to determine the kilometre modal split.

Policy relevance

This indicator measures more directly the competition between car and public transport with regard to middle and long distance trips. Trip kilometres are the source of most negative transport side effects, not trips. Hence, to achieve a reduction of the number of car kilometres as stated in the Thematic Strategy on the Urban Environment, it is needed to monitor the trip kilometres. The trip modal split is not sufficient because when all long trips are made with the car and only short trips with non-motorised modes the desired impact of a modal shift is limited.

Consensus and feasibility

Although modal split based on trips is measured in many cities across Europe this is not yet the case for modal split based on trip kilometres. However, many indicator sets such as the EEA-Dobris assessment and Urban Audit 1 and also the Adriatic Common Indicators already have this indicator incorporated. Therefore availability of this indicator is expected to be sufficient in the near future.

CORE 2 – Quality of public transport

Definition and measurement

Ratio of the journey speeds (km/hour) for private car and public transport within an urban area. By dividing both journey speeds and thus calculating the ratio between the average journey speeds the indicator is well comparable between different cities. Data can be obtained from household surveys. In these surveys trip distances and times and therefore speeds are usually estimated by the respondent and this may introduce an error. A second way of measuring is to record actual journey times manually or automatically with GPS for a representative sized sample of public transport vehicles in a selected number of corridors within cities. This second approach is difficult and does not always deliver good comparable data. The first approach does give better results but asks for a relatively large survey sample.

Policy relevance

This indicator is of importance for the thematic strategy's objective of reducing the negative impacts of transport by amongst others changing the modal split in favour of more efficient transport modes such as public transport. Because for increasing the modal share of public transport compared to the share of the private car, the relative quality of public transport should be comparable as much as possible. This indicator thereby also directly relates to commitments 6.1 and 6.2 of the Aalborg 10+ commitments. These commitments respectively aim at reducing the necessity for private motorised transport and promoting attractive alternatives accessible to all, and increasing the share of journeys made by public transport, on foot and by bicycle.

Consensus and feasibility

This indicator may incidentally be measured in some cities, but there is no consensus yet on a larger European scale on the need for monitoring this indicator. Therefore this indicator is proposed for use in the future.

CORE 2 – Consumption of land

Definition and measurement

The ratio (%) of the surface of urbanised areas to the total municipal area.

This indicator measures the state of urbanisation. By comparing its value for a frequency fixed at 10 years, it allows to measure the way urbanisation has developed during this period of time. According to ECI[57] methodological sheet of the indicator n°9 ("Sustainable Land Use") the municipal area is the area under the administration of the Municipality (including rural areas; Metropolitan areas should include the whole territory under administration) and urbanised areas are lands occupied by buildings, in a continuous or discontinuous manner, corresponding to the Corine Land Cover [58] "artificial surfaces" categories land use which include the continuous and discontinuous urban fabric, the industrial

[57] http://sustainable-cities.org/indicators
[58] http://dataservice.eea.eu.int/dataservice/metadetails.asp?id=188

and commercial zones, the road and the rail networks and the areas related to them, the harbour areas, the airports areas, the mine, dump and construction sites, the urban green areas, the equipments for sport and leisure.

The Corine Land Cover is a subprogram of the CORINE program monitoring land use. The database contains 44 land use categories divided into groups: artificial surfaces, agricultural areas, forests and semi-natural areas, wetlands and water bodies. The indicator can be computed by using the CORINE EU sources. Thus the frequency of measurement of the indicator has been chosen corresponding to that of the Corine Land Use update (10 years).

In order to gather more complete and specific information it would be interesting to measure the urbanised surface consumed by category. The indicator to be used could be: Land uses [surface/total municipal area]. The different land uses that should be taken into account are[59]: unused (contaminated or derelict land) area, urban area subject to special physical planning conservation measures, land area in housing/residential use, land area in shop/retail use, proportion of urban area subject to special physical/planning conservation measures, proportion of urban area in housing/ residential use, proportion of urban area in shop/retail use, proportion of urban area in commercial/industrial use, proportion of urban area in road/rail networks use, proportion of urban area in ports/airports use, proportion of urban area in mineral extraction, dump and construction sites use, proportion of urban area in sports and leisure use, proportion of urban area that are green spaces.

Policy relevance

This indicator is a measure of the degree of land consumption and urbanisation. Urban expansion and the increase of urbanised areas reduce virgin land and green areas. Thus, this indicator supplies information on the protection of ecologically sensitive sites (Habitats Directive 92/43/EEC). It measures the urban sprawl reduction as stated in the Thematic Strategy on the Urban Environment and it is directly related to the **TISSUE** trends Consumption of land and space, Urban sprawl and urbanisation and Car dependency. The

[59] Land use categories used by URBAN AUDIT set (www.urbanaudit.org).

indicator also directly relates to commitment 5.2 of the Aalborg commitments: "avoid urban sprawl by achieving appropriate urban densities and prioritising Brownfield site over Greenfield site development".

Consensus and feasibility

The indicator has been adopted (even if under different names, but with methods and metrics that could be easily harmonised) by relevant existing sets at EU and national level: Urban Audit, Monet, Local quality of life counts, Zukunftsfähige Kommune, Xarxa, Cercle, Baden-Württemberg Indikatoren NRW, Catania – State of the Environment Report. The feasibility is good, but there is a need to harmonise the definition of 'artificial', 'used', developed', 'anthropised', 'sealed' or 'settled' area. The progress on updating the Corine Land Cover and data about land use and land use change represent expected reports[60] to the EEA.

CORE 2 – Accessibility to basic services

Definition and measurement

The ratio (%) of inhabitants within 300 m from basic services to all inhabitants.

This indicator measures the state of presence and vicinity of basic services. By comparing its value for a frequency fixed at 5 years, it allows to measure the way the creation of basic services and their accessibility have taken into account in the urban design.

This indicator measures the number of inhabitants divided by the total number of inhabitants of the municipal area who live within 300m (as the crow flies) from basic services [%].

The basic services are defined as:

– Primary public health services (general practitioner, hospitals, first-aid posts, family advice bureaux or other public centres supplying medical services, such as diagnosis or specialist examinations) (Basic services 1),

[60] See http://rod.eionet.eu.int/index.html for the list of the countries and detailed information.

- Public schools (compulsory and kindergarten) (Basic services 2),
- Food shops (bakeries and greengroceries) (Basic services 3),
- Spaces and structures for cultural and leisure activities (theatres, movie theatres, civic centres, libraries, sport complex (Basic services 4).

The indicator should be calculated for each of the 4 services separately, and computed through the following steps:

1. Identification of services, e.g. measure of the availability in terms of total amount and their geographical distribution.
2. For each service and them for each service category, measurement of population living in the vicinity, e.g. measure of their accessibility.
3. Measurement of population living in the vicinity of each basic service category.

Data concerning the geographical distribution of basic services require the use (and the setting-up) of special database that may be available from the local authority, from public bodies (Chamber of Commerce), etc. This indicator can also be measured thanks to specific surveys or interviews even if this method is expensive. The suggested measurement frequency for this indicator could be 5 years.

Policy relevance

This indicator helps discover how accessible services are to local people and whether their needs are likely to be met in the vicinity. This indicator is related to the TISSUE trends Accessibility of basic services and facilities, Densification and clustering of settlements, mixed land use, Short distance and public transport oriented development, Urban sprawl and sub-urbanisation and Car dependency.

It measures the improving of mixed land use and the reduction of mobility needs as stated in the Thematic Strategy on the Urban Environment. It also directly relates to commitment 5.3, 6.1, 6.2 and 9.2 of the Aalborg+10 commitments.

Consensus and feasibility

This indicator has been adopted – even if under different names, but with methods and metrics that could be easily harmonised, - by relevant existing sets

at EU and national/regional level: ECI, ISDIS, Zukunftsfähige Kommune, MONET, Quality of life indicators-UK, XARXA. Many systems, in addition or instead of this indicator use "Availability (tot. amount or amount/pro capita) of basic services" (see first step of the measurement of the indicator).

The existing systems consider generally different categories within basic services, thus this indicator require specific harmonisation. Normally the systems consider within the basic services the public transports. As we suggest a specific indicator on the accessibility of public transport, this indicator doesn't take into account this kind of service.

CORE 2 – Population and jobs density

Definition and measurement

Inhabitants + jobs / surface of the urbanised area (present people / urbanised km²).

This is a more sophisticated indicator of density. It measures the total density of "day" (employees) and "night" (residents) population in the urban area, i.e. the intensity of land use for living and for working. The notion of human activity density, obtained by adding up population and employment provides a more faithful description of the use of urban space than the simple population density in which only the number of residents is considered. This indicator can be measured thanks to statistical data about population and about employment. The suggested frequency of measurement is 10 years.

Policy relevance

This indicator is related to the **TISSUE** trends Consumption of land and space, Urban sprawl and urbanisation, and Car dependency.

It also directly relates to commitment 5.2 ("avoid urban sprawl by achieving appropriate urban densities and prioritising Brownfield site over Greenfield site development") and 5.3 ("ensure the mixed land use of buildings and developments with a good balance of jobs, housings and services"), of the Aalborg commitments.

Consensus and feasibility

According to **TISSUE** assessment there are no systems containing this indicator.

CORE 2 – Jobs / housing ration (Attractiveness)

Definition and measurement

The indicator is the total number of workplaces (industry and tertiary jobs or "day time" population) divided by the total number of population living in houses within the boundary of the city/neighbourhood (resident or "night time" population). The indicator makes sense when applied to analyse the distribution of the workplaces and the resident population between the core city and the suburbs, including satellite towns. When the distribution is balanced the indicator is near 1 meaning that mixed-uses are evenly distributed on the entire metropolitan area. On the contrary, when the distribution of workplaces is polarised, we have dormitory towns/neighbourhoods including a majority of housing and few services – which show therefore values of the indicator below 1 – and office or industry poles with a higher density of workplaces compared to housing, and values of the indicator well above 1.

Regardless of how balanced a community is with values of the jobs-to-housing ratio near to 1, the same community can be more or less self-sufficient in terms of employment catchments areas. Their business may use local labour force or we may have a balanced community whose business import every day the majority of workers from elsewhere. A measure used by urban geographers to gauge the degree of self-containment is the independence index that is the number of internal trips (within the community) divided by the number of external trips. The index depends on the dimension of the geographical area, the larger being the community area the higher the self-containment. The "independence index" is meaningful when comparing communities of similar dimension. A low degree of self-containment of work trips in otherwise jobs-to-housing-balanced communities encompasses balanced two-way traffic flows between the satellite towns, i.e. with peak traffic in both directions in the morning and in the evening. This may facilitate public transport, especially if the satellite towns/neighbourhood are interconnected by efficient rail services. Tidal patterns of rail commuting – full trains in one direction and half-empty ones in the other – have been an Achilles heel in many parts of the world. Unidirectional

flows are typical on radial networks where the only significant concentration of jobs is downtown. On the contrary, cities as Stockholm where regional planning has channelled the population and employment growth into compact, mixed-use communities sited along rail-served suburban corridors, have been successful in achieving and maintaining a high share of public transport. The indicator is strongly related with the "modal split" indicator.

The indicator can be easily computed for the generality of municipalities at Census years, using census data on employment and resident population. Data from Census surveys on mobility and commuting flows may also be used to compute the independence index. The indicators built upon Census data are useful to analyse structural changes in the territorial distribution of workplaces and housing over an entire census period. The frequency of measurement corresponds to the frequency of census (generally 10 years). However, it is also possible to collect data from the administrative records of population and business registers available at city level, in order to update the indicator at years between two censuses.

Policy relevance

The indicator is relevant in relation to polycentric development and the reduction of travel needs and private car traffic this may enable, thanks to a potentially higher number of short journeys within the mixed-use communities (due to the availability of workplaces or services in walking or cycling distances) or a higher number of public transport trips facilitated by the bi-directional commuter flows between the communities. The indicator is related to the TISSUE trends Densification and clustering of settlements, mixed land use, Attractiveness of cities centres and amenity of streets and neighbourhoods, Urban sprawl and sub-urbanisation, Consumption of land and space, and Car dependency. It measures the ensuring of the mixed land use as stated in the TSUE. It also directly relates to commitment 5.3.

Consensus and feasibility

The indicator is included in the list of Urban Audit indicators, and it is used in 59% of the cities of the Urban Audit sample (157 European cities).

CORE 2 – Poor quality housing

Definition and measurement

The suggested content of the indicator is as follows: Percentage of total population/households living in substandard/unfit housing.

Substandard conditions should be defined with reference to three elements:
- the floor area per person,
- the level of building services and
- the building performance of houses in terms of indoor climate and safety.

This indicator should not be for the monitoring and comparing of European cities but for the monitoring the development of the quality of building stock within a city. The use of this indicator requires that the city would formulate the suggested three sub-indicators in such a way that it would be possible to collect information. The suggested three sub-indicators are as follows:

- The limit of cramped living conditions is defined as more than one person per room including kitchen.
- The required services include the connection with sewerage treatment system and the availability of safe drinking water (connection with water supply network). Other specific city services should also be included, as for example central heating.
- The assessment of building performance should be a rough estimation of the share of houses the structural safety and building physical conditions of which are so low that the building would need immediate renovation.

Policy relevance

Housing is one of basic needs of people in order to get shelter from surrounding outdoor environment and in order to ensure possibilities for rest and recover. The Communication ”Towards a TSUE“ (11.2.2004) states that with regard to sustainable urban construction key issues of the visions include the ability to produce good-quality built environment (attractive, durable, functional, accessible, comfortable and healthy). The indicator is consistent with the Aalborg commitment "secure good housing and living conditions”.

The quality of housing conditions depends on the availability and affordability of housing. Availability and affordability of housing can be indicated on the basis of the share of homeless people, availability of different kinds of houses and flats with regard to ownership, the prices and rents compared to income level etc. However, these indicators are not dealt with as construction related indicators. With reference to urban construction, the quality of housing is dealt with on the basis of technical quality of buildings and available technical services.

The quality of housing depends on a number of factors including the following:

- adequate floor area per person,
- the standard of equipment and the level of services: connection with sewerage treatment system, availability of safe drinking water, connection to water supply network, warm water, central heating, adequate heating, adequate ventilation to provide adequate indoor air quality, waste collection and waste sorting systems
- adequate building physical state (with regard to moisture damages) of buildings in order to provide adequate indoor quality

For example the city of Helsinki defines that the living conditions are cramped in the case of more than one person per room. The needed level of building services varies for example according to the climate conditions.

Consensus and feasibility

There is a wide consensus about the significance of quality of housing on the sustainable development and welfare of citizens. It is clear that the building sector and the construction technologies have a significant effect on the quality of housing. However, there is no relevant information and methods available in order to monitor and compare the quality of housing in different European cities. This kind of indicators should be taken into account as cities collect information about the sustainable development and welfare of citizens, but the results should not be compared on the European level. The comparisons would be possible only after the development of a common methodology.

CORE 2 – Soil sealing

Definition and measurement

The suggested content of the indicator is as follows: Soil sealing (m^2 per citizen) and the changes in five years periods. Soil sealing happens because of covering earth with non-permeable or low-permeable layers because of constructive assets (roads, buildings etc). Soil sealing expresses impacts of construction on bio-diversity, quality of soil and water table.

Measurement

The area of soil sealing within the whole area of the city should be mapped considering buildings and yards, roads, vehicle parks and other covered areas. The changes taken place during five years periods should be taken into account on the basis of statistics considering all construction projects.

Policy relevance

The value of earth and soil is based on its ability to offer a living environment, natural resources and protect cultural heritage. The protection of soil means maintaining its ecological, cultural and economic capacity. The ecological functions of soil include the production of biomass, percolation, buffering and conversion of materials and energy, offering of a living environment, genetic reserves and spreading routs. Construction causes irreversible changes and consequently the bio-diversity will be reduced. The damage of soil can be classified as physical damage, biological damage, radio activity, chemical damage, irreversible changes of land use and damages with regard to cultural heritage and natural historic values. The use of land means consumption of resources both in terms of changing the end use and consumption of soil materials. Land areas can be classified according to their value. Different European countries have classified and mapped valuable areas from the view point of nature protection. The value in terms of nature protection can be taken into account when assessing the environmental impacts of land use. The reduction of different kinds of living environment results from the purpose of use of land especially because of agriculture and forestry and urban construction.

Covering of earth by buildings and other constructive assets including roads and ways can be expressed with the term sealing. Sealing earth with non- or low-

permeable layers may express impacts of a building or other constructive assets on bio-diversity, quality of soil and water table. The widening of urban areas affects significantly the ecological capacity of earth. For example changes in the quality of groundwater and the lowering of water table may indicate the changes in water-economy. Soil sealing together with fragmentation effect are among the most important land use related environmental effects of building. Fragmentation isolates areas from others, increases the border effect and has influence on bio-diversity. There is a certain relation between the size of a population and the land area. The fragmentation may affect in such a way that the size of the population decreases more than in the case of continuous areas.

The European Environmental Agency (EEA) lists the following issues as the biggest land use related problems [61]: sealing, erosion, hillside stability, pollution, acidification and impairing quality of soil in Eastern Europe. The significance of sealing may still increase considering the threats with regard to climate change and increasing risks of strong weather changes (including floods and dry periods).

Consensus and feasibility

There is a wide consensus about the significance of building with regard to land use and soil sealing. The effect of construction on land use and biodiversity is typically included in the sustainable constructions methods. However, the availability of relevant information with reference to city level management of data may be difficult. On the other hand, after once mapping the degree of soil sealing, it should be possible to monitor the development of the situation, if this information was required within supervision of building.

[61] Down to earth. Soil degradation and sustainable development in Europe. A challenge for the 21st century. European environmental agency., EEA. UNEP Regional office for Europe international environment house. Copenhagen 2000. Environmental issues series. No 16.

CORE 2 – Citizens' engagement with environmental and sustainability oriented activities

Definition and measurement

Number and proportion of citizens (i) engaged in environmental and sustainability oriented activities and/or (ii) average time in hours spent per year and inhabitant in such activities. Data and information required for both indicators can be collected in a special representative TSUE survey among citizens of EU cities and urban areas.

Policy relevance

Clear policy relevance.

Consensus and feasibility

The number and proportion of engaged citizens can be measured in activity surveys like European Social Survey (ESS), the average time pro year and inhabitant in time use surveys (TUS). The big problem and unsolved question of this approach is the choice of which civic engagement activities should be counted as a contribution to sustainability and sustainable management of local environment.

CORE 2 – Adoption of integrated urban plans (environment, transport, land use)

Definition and measurement

This indicator will be used only in case of voluntary implementation of EMP and EMS and for cities which do not apply these instruments. Integrated land-use, transport and environment plans are similar as EMP in their content, form and objectives. Some of them fulfil or would fulfil all EMP criteria – or even go beyond – and will be used instead or as them. The indicator will measure the number and proportion of cities and urban areas which have integrated - as opposed to sectoral - land use, transport and environment plans.

Policy relevance

Cities with good integrated land-use, transport and environment plans fulfil the most objectives of SUM, regardless whether they let their plans being registered and formally approved as EMP. The difference between EMP and local integrated plan (LIP) lies in the fact of decentralised (national, regional or sometimes even local) registration, validation and/or approval of the latter. If a city has a LIP and not an EMP, it does not necessarily mean that it does less for the sustainable development of urban environment; the cities could have other reasons for their LIPs not being registered and approved as EMPs.

Consensus and feasibility

It is very important that only officially approved ("statutory") LIPs are counted for the calculation of the pertinent indicator value; regardless of the fact, by whom they have been approved and whether they contribute and do more or less for the urban environments than EMPs. For the purposes of the calculation of this indicator all cities and urban areas in EU-member states must be divided into two groups:

- cities and urban areas with integrated land-use, transport and environment plan
- cities and urban areas with sectoral land-use, transport and environment plans.

The existence of a third group of cities and urban areas without any land-use, transport and environment plans is very unlikely. The exact way, criteria and "thresholds" for the above mentioned division cannot be described here, but could be subject of a future study or research project. Some hints for this classification can also be derived from the Commission's Guidance on the Implementation of the 2001/42 Directive on the Assessment of the Effects of Certain Plans and Programmes on the Environment and from Commission's publications and communications on Strategic Environmental Assessment (SEA). Another methodological approach could be a survey: all cities without EMP and EMS could be asked to deliver a report on their local land-use, transport and environment plans, containing information and data necessary for the calculation of this indicator's values.

CORE 2 – Legal framework for active public participation

Definition and measurement

Existence of legal framework: Number and proportion of cities in which public participation local environmental planning and public consultation of relevant local plans is required and regulated by national, regional or local legislation.

Implementation of specific measures and strategies: Number and proportion of cities which have specific strategies and implement specific measures aiming to enhance public participation in environmental planning.

Policy relevance

This indicator refers to the first legalistic as well as the second investment and prerequisite-oriented approach to public participation elaborated in the section 5.3. Most European cities acknowledge the participation of the public in the local environment planning as an important objective, even though the understanding of this concept, it's appropriate forms, and promotional activities, etc. vary widely among European countries and cities. The relevance of public participation and this indicator is therefore high, in spite of the above mentioned differences and of the complex and unclear impact of public participation on urban environments.

Consensus and feasibility

The existing experience with public participation indicators (see the concluding table in section 5.7) is not a very positive one. Self-reporting and self-evaluation on pertinent participation possibilities and measures lead often to glossy favourably biased pictures. The reality is much more complex and public participation can be also an obstacle to sustainable solutions and cause of problems in local environment. Nevertheless and as already suggested in other TISSUE WP2 and WP3 reports, we consider it as important to establish an overview, what larger European cities undertake in order to inform the public and to enhance the citizen participation in local environmental planning. Since we doubt on the explanatory power and significance of the self-reporting and self-evaluation in this respect, and since all top-down controlling approaches are not feasible as well, an analysis of legal situation, and a classification system of relevant public participation forms and measures/strategies combined with the

collection of pertinent data could be established in a pertinent 6th or 7th FWP research project.

CORE 2 – Air quality; Population weighted exposure to PM10 and O3

Definition and measurement

Unit of measurement: – substitute, if confirmed as new Eurostat's Structural indicators

Urban population exposure to PM10 and Ozone (annual average)

Compare CORE 1 Air quality indicators

Fore the CORE 2 Indicator the method under definition by the Eurostat's Structural indicators should be considered (and for this reason here considered as a possible perspective as CORE 2, but not as a standard reference). The indicator is expressed as *Urban Population exposure to PM10 and Ozone (annual average)*[62]. The data source indicated, in the revised methodology proposed on Sept 2004, will be the AirBase air quality data system. In this case warning data (reported at national scale) should be expressed at city level.

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[62] The Indicators, calculated on national scale, are:
Population weighted exposure of urban population to Particulate matter (PM10) (considering the annual average PM10 concentration);
Population weighted exposure of urban population to Ozone (considering the average of 8 hourly maximum concentration (less a cut-off concentration that still needs to be evaluated) for each station for all days in a year for which data is available);
As indicated in the revised methodology proposed on September 2004, "both indicators are calculated as population weighted concentrations, measured in the stable set of urban and suburban background stations and subject to QA/QC (quality assurance / quality control) procedures, aggregated for a particular country. Population attributed to each measurement/station is defined by the area of representativity around the station. At present this area is defined by a circle with a radius of 3 km, uniform for all measurement stations. Where areas of representativeness intersect, a procedure is applied to attribute population to the closer station, preventing it to be counted twice."

Policy relevance

The main reasons for these indicators selection are:

- the present legislative framework represented by the Council Directive 96/62/EC of 27 September 1996 (on ambient air quality assessment and management) and the following daughter directives
- the on going Thematic Strategy for Air Quality Pollution (Clean Air for European programme – CAFE), launched in March 2001 and expected to be ready on 2005
- the 2003 EEA Report on Air Pollution in Europe 1990–2000 and the 2004 WHO Europe Report on Health effects of Air quality pollution.

Consensus and feasibility

The Eurostat's Structural indicators, presently submitted on revised process (and for this reason here considered as a possible perspective for CORE 2, but not as a standard reference), include two indicators for air quality related to Urban Population exposure to PM10 and Ozone (annual average). The data source indicated, in the revised methodology proposed on Sept 2004, will be the AirBase air quality data system.

CORE 2 – Renewable energy consumption

Definition and measurement

The indicator shows the percentages of total energy consumption supplied from renewable energy sources over total energy consumption of the FUR calculated for a year (in %). Renewable energy sources refer to energy collected from current ambient energy flows or from substances derived from them. This definition includes energy derived from geothermal, hydro, solar, tide, wind and wave power, and bio-fuels, such as fuel-wood, bagasse, charcoal, animal and vegetal wastes, and other (industrial and municipal) wastes.

A wider concept may include also the energy produced from heat recovery, and in this case we would adopt the indicator “share of consumption of renewable energy sources and heat recovery”. Difference in definitions sometimes can give rise to comparability problems.

At urban level gathering information on renewable energy consumption is often harder to do than collecting data on the other forms of energy consumption. Therefore, a complementary indicator to be analysed may be the ratio between total fossil fuel consumption on total final energy consumption; where final energy consumption corresponds to energy supplied available to the final consumer to be converted into useful energy, in other words is the consumption of primary and derived energy by the end-use sectors. Fossil fuel are taken from natural resources (coal, crude oil, natural gas, oil shale) which were formed from biomass in the geological past; by extension, the term fossil is also applied to any secondary fuel manufactured from a fossil fuel (petroleum products, manufactured solid fuels and gases).

Policy relevance

The importance of renewable energy sources is due to the absence of GHGs emissions during their generation (except for biomass which is neutral over its life cycle in GHG terms). In the White Paper on the Security of Energy Supply the European Commission sets the goal of increasing the share of renewable energy sources to 12% of total amount of energy consumption by 2010 and in 1999 it launched the Campaign for Take-Off[63]. The aim of this campaign is the promotion over the period 1999–2003 of the three key renewable energy sectors identified: solar energy, wind and biomass. Finally, Chapter 4 of Agenda 21 calls for an improvement of efficiency in the use of energy sources and for a transition towards the environmentally friendly use of renewable resources.

The indicator is related to the **TISSUE** trends: “Local production of renewable and non-renewable energy sources and dependency on external sources”, “Making use of renewable energy sources”, “Energy intensity related to relevant units”, “Energy consumption by sector”, ”GHGs and CO_2 emissions by sector”.

[63] The objective has been confirmed by the adoption of the Directive of the European Parliament and of the Council on the promotion of electricity from renewable energy sources in the internal electricity market (2001/77/EC).

Consensus and feasibility

National data and estimates on renewable and non-renewable resources are available from national statistical offices and country publications in many countries. A combination of a "top-down approach" – exploiting the availability of national data on renewable resource availability and standard energy conversion factors – with a "bottom-up" approach exploiting local data to compute the share of urban energy consumption on the total energy consumption of the country and/or the presence of local sources of renewable energy, seems the best strategy to obtain reliable indicators at the city level. Looking at the TISSUE assessment, there are several indicators sets which include similar or look-alike indicators: EcoBudget, Urban Audit, Respect, Ianus, and other local sets.

CORE 2 – Intensity of energy use in transport

Definition and measurement

Two different indicators are recommended, respectively for energy intensity of passenger and freight travel:

- energy consumption for transport per tonne-km (freight transport) – (MJ/tonne-vkm)
- energy consumption for transport per passenger-km (passenger transport) – (MJ/pkm).

These indicators express the measure of the energy effectiveness of the provision service better than the per capita indicator. The indicators consider final energy consumption since it is very difficult to estimate the allocation of primary energy consumption used in the various final sectors. Electricity consumption for subway, trams rails and electric vehicles should be indeed converted into primary energy consumption, but in the various city contexts different conversion factors are often applied, which makes any attempt to compare primary energy computations very difficult and unreliable.

These indicators are primarily a measure of the energy efficiency, they represents a performance index suitable for comparison between different transport modes. Separating freight and passenger travel is needed and generally not difficult, but separating the related energy consumption is often complicated.

Energy use per passenger-km or tonne-km within the Functional Urban Area should be disaggregated by vehicle type, i.e. two-wheeler, car/van, bus, local rail, metro, tram for passengers; and light and heavy lorries for freight. Aggregate energy intensity for passenger travel or freight transport is a meaningful summary indicator, the value of which depends on both the mix of vehicles and the energy intensities of particular types of vehicles. The energy intensity for a vehicle type depends on both capacity and capacity utilisation. A large vehicle that is fully loaded generally has a lower energy intensity per tonne-km than a fully-loaded smaller vehicle, but a small vehicle fully loaded will have a lower energy intensity than a large vehicle with the same load. Typical load factors for private cars are 1,5 people per car. Typical load factors for rail and bus vary from well below 10 percent to over 100 percent of nominal capacity at peak times. Typical load factors for trucking might be 60 to 80 percent of weight capacity when loaded, but trucks commonly run 20 to 45 percent of their kilometres empty, yielding a relatively low overall load factor. Fuel consumption per vehicle-km also depends on traffic conditions as well as vehicle characteristics.

Final energy consumption for transport deals with all energy used for passenger and freight transport. For the various modes of transport it can be based on information from the supplying companies, for example oil companies can provide data on related sales for different purpose of use. As far as possible local final energy consumption for transport should be directly recorded.

Policy relevance

Transport is a major consumer of energy, mostly in the form of fossil fuels, and the share of transport in energy consumption is generally increasing. Urban transport is a major and growing share of total transport activity, too. The indicator is clearly related to Sustainable Urban Transport (SUT) trends. In order to reduce total amount of transportation energy consumption and to decrease the related level of GHGs emissions, improvements should be get not only in terms of technologies implemented but also through a better organisation of traffic plans.

Consensus and feasibility

The indicator is in use in many countries, and it is included in the European Environment Agency (EEA) TERM reporting mechanism. Problems of data availability may limit the dis-aggregation of the indicator to the desired level, and considerable work is often required even at the national level to disaggregate energy balances into various modes of transportation. Ecosistema Urbano investigated in 103 Italian cities the indicator "Fuel consumption (gasoline and diesel) per capita in a reference year"; data were collected at provincial level (NUTS 3), and included only urban fuel sales (sales made in both highways and extra-urban network are excluded).

CORE 2 – Urban biodiversity

Definition and measurement

Types and numbers of threatened/protected species.
Types and numbers of bird species and/or other relevant species.

The proposed indicators have high relevance across all areas of Europe. With regard to the indicator concerning biodiversity of threatened/protected species these types of species are readily defined at a national, EU and international level. Although the indicator concerning general urban biodiversity is mainly concerned with bird species, specific towns and cities may also wish to monitor trends in other species according to their local urban circumstances. Rather than use such indicators to compare absolute levels of urban biodiversity it is only feasible to use them to compare the relative status of urban biodiversity between towns/cities in terms of its maintenance, improvement or degradation. The actual species monitored will vary according to a range of factors, and particularly the geography of the city/town.

Policy relevance

An integrated approach to the sustainable urban management of nature and biodiversity, as well as its protection through more sustainable urban design are key elements of TSUE. They provide an important contribution to the quality of urban areas and the provision of a healthy living environment. In addition, TSUE highlights the fact that green space, parks, gardens and woodland should

be enhanced since they offer great potential to maintain and develop urban biodiversity.

The first biodiversity indicator relates to specific species defined as being acutely at risk at the European level or beyond. It concerns the existing presence of rare/protected species and whether trends indicate increasing or decreasing populations. In addition this type of indicator could identify rare/protected species previously not present suggesting improvements in at least some aspects of urban biodiversity.

The second biodiversity indicator relates to a need for a more general indication of the level of urban biodiversity. This requirement is often fulfilled by indicators, which are a proxy indicator for the general level of biodiversity such as the numbers of different types of bird species or tree species present. However, this type of indicator may not in itself be a sufficiently useful indicator to identify undesirable pressures on specific urban species until that species is no longer present to any great extent. It would therefore be of more use to also monitor the trend in population of identified species.

Consensus and feasibility

These indicators are not a reporting obligation in themselves at a city level. There are however national reporting requirements concerning the Habitats Directive and Birds Directive. In addition there are responsibilities relating to the adopted Communication on a European Biodiversity Strategy, together with the associated requirements for Biodiversity Action Plans operating within the wider framework of the UN Convention on Biological Diversity. All of the aforementioned may have implications at the local level of towns and cities. The extensive geographical coverage of the relevant **TISSUE** indicators suggests good feasibility.

The relevance is based on the following. TSUE: Habitat and species presence, Aalborg Commitment 3.3: Promote/increase biodiversity, TSUE: Green/Open space quality, Aalborg Commitment 3.3: Care for Nature Areas, Aalborg

Commitment 3.4: Soil quality improvement and preserve ecologically productive, TSUE Themes: Sustainable urban management, construction and design, Habitat Directive[64] and Birds Directive[65]. The consensus is based on the following: RESPECT: Biodiversity – number of rare/protected species, EEA Dobris: Number of bird species.

[64] Directive 92/43/EEC
[65] Directive 79/409/EEC

PART 5:
RECOMMENDATIONS

1 Introduction

The overall goal of the **TISSUE** project was to analyse trends of sustainable development of urban environment, to collect and assess existing sets of urban sustainable development indicators and to define a harmonised set of indicators for monitoring the sustainable development of urban environment.

The project developed a set of indicators based on the analyses of sustainable urban development trends and concerns and on the assessment of existing sets of indicators. The proposal was dealt with in workshops organised by CEMR and together with the representatives of ICLEI Europe, REC, EUROCITIES and UBC.

The proposed set of indicators includes 42 indicators divided into two groups: CORE 1 indicators, which are feasible in short-term and CORE 2 indicators which are considered as important indicators but not yet feasible.

The project developed recommendations for the necessary measures in order to enable proceeding towards a harmonised ser of urban sustainability indicators. **TISSUE** presents recommendations with using the following outline:

TISSUE RECOMMENDATIONS

1) Development of a more comprehensive approach by
   - deepening the role and importance of socio-economic and cultural indicators,
   - responding to the needs of different tasks of local authorities
   - responding to the needs of target setting and responsive way of working.
2) Development of the feasibility of the **TISSUE** CORE 2 indicators by
   - improving the availability of the necessary information
   - developing common methods for surveys, measurements and assessments.
3) Improving the comparability of the measured results and proceeding towards a weighted set of **TISSUE** indicators
4) Development of appropriate tools and methods for monitoring and target setting.
5) Development of urban sustainability indicators for the needs of risk management.

The **TISSUE** recommendations are based on the premise that the importance and usefulness of indicators is based on their ability to support monitoring and target setting. Mere monitoring of sustainable development does not benefit cities, if the process does not indicate reasons for changes taken place but only shows the direction and strength of change. Indicators aid target setting if the results can be allocated to the issues that are the causes of changes.

ISO AWI 21929 [66] divides environmental indicators into two groups: direct indicators which show the environmental performance of buildings in terms of environmental loadings and use of resources and consequential indicators, which express environmental impacts in terms of building performance or location either quantitatively or qualitatively. The advantage of environmental loadings and resources consumption as environmental indicators is that those show the very phenomena that are wanted to monitor. The advantage of consequential indicators is their ability to show the causes of changes. Local authorities need both kinds of indicators. The most useful indicators show - not only the total release of emissions and use of resources – but also the essential causes, and therefore they can support decision making for more sustainable urban environment.

When further developing the individual indicators, the objective should be the feasibility of indicators not only in terms of availability of data, measurability and comparability etc but also in terms of their ability to show the factors of change in order to support decision making with help of indicators.

TISSUE recommendations are also based on the premise that local authorities need separate indicators for their different tasks from strategic planning to technical and social services. Depending on the member state, the authorities have different competences and their tasks vary. This project has concentrated on indicators from the strategic point of view. The purpose of the **TISSUE** indicators is to monitor the sustainable development of urban environment. However, in the next stages local authorities should also pay attention to the

[66] Building Construction – Sustainability in Building Construction – Sustainability Indicators Part 1 - Framework for the development of indicators for buildings, ballot version for TS.

development of indicators that aid the different technical services in their efforts towards sustainable development.

The aim of the harmonised set of indicators may be of different kind. The most ambitious option is that the thematic strategy and the achievement of its goals are monitored with help of a harmonised set of indicators in chosen cities according to a designed timetable. The much less ambitious alternative is that the set of indicators is recommended as a common indicators set and also the assessment and reporting of sustainable urban development is recommended.

2 Development of a comprehensive approach

Challenge

The project developed a set of urban indicators focusing on the environmental aspects of sustainable urban development. In long term the harmonised set of urban sustainability indicators should be completed with indicators which are able to measure and support target setting of cultural and socio-economic sustainable development.

TISSUE analysed and developed indicators from the five view points including sustainable urban management, urban traffic, urban construction, urban design and urban environment. The focus was on the ability of indicators to support monitoring of sustainable urban development though the developed indicators may also be used in order to support target setting for urban management, design, traffic and construction.

Recommendation

Based on the Aalborg Commitment and on the results of the trend analysis, **TISSUE** recommends that **supplementary indicators** should be developed in the first place for the following categories:

- the maintenance of cultural heritage of built environment
- affordability of housing
- barrier free use of built environment
- access to information
- equal access to public services
- safety of urban environment
- social exclusion
- health of citizens
- sustainable stewardship.

TISSUE recommends that in the future, the systems of sustainable indicators of cities should be developed more comprehensive in such a way that the indicators serve for – except monitoring – in particular also **target setting and responsive way of working** in different levels of local authorities' activities.

3 Mobilisation of common indicators and development of the feasibility of indicators

Challenge

TISSUE based its work on the earlier studies on urban sustainable development indicators. On the basis of the trend analysis and the assessment of existing sets of indicators, the **TISSUE** project developed a harmonised set of indicators. The suggested indicators were widely discussed within the project together with the organisations representing local governments. The common conclusion of the project is that the essential future challenge concerns the development of the feasibility of CORE 2 indicators. The content of indicators is analysed and relatively widely agreed upon. However, big differences exist in the possibilities and abilities to collect basic information in order to calculate and express the results with help of indicators. The CORE 1 indicators were assessed as feasible indicators. However, it should be noted that the situation varies also with regard to these indicators in different cities with regard to the availability of information and methods.

Some of the essential sustainability indicators of urban environment concern issues, about which there is no easily available information. For example, even such basic indicators like the total energy consumption may be complicated to monitor because of difficulties in data collection. In addition, the situation varies a lot in cities. In some places the collection and compiling statistics in public is much more traditional than in others. Since all data necessary for the monitoring of sustainable development of urban environment is not available in the cities, one should start by analysing, which data is available and which is missing, how the missing data could be collected and what would be the costs of collecting it. The **TISSUE** project dealt with the problems of local data availability only slightly.

Although the feasibility of CORE 1 indicators is good, the European level comparability is still incomplete. The statistics and the data collection methods and surveys methods still vary with at least in some degree.

The feasibility of indicators depend on the availability of information and relevant methods such as

- analysing and measuring methods;
  for example in order to monitor air quality in cities one needs methods with help of which the measurements can take place.
- statistical data;
  for example in order to monitor traffic safety, one needs statistical data about traffic accidents.
- data basis and background information;
  for example in order to interpret the total energy consumption of buildings and traffic in terms of induced greenhouse gases, one needs information about the eco-profiles of energy and transportation.
- common procedures;
  for example in order to monitor modal split or citizen's satisfaction, one needs common survey methods.
- common definitions and calculation rules;
  for example in order to monitor brownfield versus greenfield and availability and accessibility of open areas, one needs common definitions and calculation rules for these concepts.

The feasibility of individual indicators included in the **TISSUE** set should be further developed ensuring that all individual indicators are usable and the results are comparable.

Recommendation

TISSUE recommends the mobilisation of the CORE 1 indicators. The project also recommends that the feasibility of indicators should be further improved continuing the development of the individual indicators proposed by **TISSUE** and especially the feasibility of the so-called CORE 2 indicators. Although the feasibility of the CORE 1 indicators is good, big differences in knowledge and abilities to carry out data collection exist in different cities. The further development of individual indicators should result in

- improved availability of information, common methods for surveys, common measurement and assessment methods,

– improved comparability of the measured results and
– the mobilisation of the common indicators.

The recommendations about the measuring methods and frequencies of the surveys and responsibilities are presented in Part 4 of this report (Table 10).

TISSUE also recommends proceeding towards weighted set of indicators. The development of classified set of indicators would support local governments to set targets with help of indicators.

In the following table (Table 13) the **TISSUE** indicators are summarised from the point of view of feasibility. The feasibility is assessed with regard to
– the availability of background information and statistics
– the availability of measurement methods
– the availability of assessment methodologies and calculation rules
– knowledge about harmful concentrations, threshold values etc.

*Table 13. Summary of the development needs in order to ensure the feasibility of **TISSUE** indicators.*

CORE 1
Sustainable Urban Transport
Passenger transport demand
Sources of data are local transport surveys. Surveys can differ to a certain extent. Due to the high costs of surveys, those are not carried out each year and the dates of surveys vary between cities. There are different definitions about the indicator but recent developments in Europe are aiming to harmonise transport survey designs and definitions.
Harmonisation of survey methodologies.
Modal split
Data is usually derived from household surveys. Methodological differences exist. Modal split data is sensible for differences in definitions. Modal split based on trips is measured in so many cities across Europe that there should be no problem in acquiring enough data for monitoring modal split all over Europe.

Detailed definition and harmonisation of survey methodologies.
Pedestrian and bicycle infrastructure
Bicycle and especially pedestrian infrastructure is monitored in many indicator sets. The broadest of these sets is the Healthy cities project set, which covers a wide range of Northern and Eastern European cities. Also many local authorities have data on this indicator. However, there are considerable methodological differences between cities and big differences in the availability of information.
Harmonised rules for data collection and assessment of results.
Traffic safety
Traffic safety is best comparable between different cities when the definition is restricted to fatal injuries and divided by the total number of car kilometres. The indicator traffic safety is included in so many indicator sets. No problems in collecting enough data for monitoring traffic safety all over Europe. Differences in measurement method and definition can be compensated for by using conversion factors.
-
Sustainable urban design
Resident population density
There are several indicators sets that include this indicator. The indicator is quite feasible.
Harmonisation of the definition of urbanised area.
Brownfield versus greenfield development
The indicator is included in some existing indicator sets. however, there is a need for harmonising definitions. In addition, there are needs to develop and establish methods of data collection.
Harmonisation of definitions. Detailed methods for data collection.
Accessibility to open areas
The indicator has been adopted – even if under different names, but with methods and metrics that could be easily harmonised, by relevant existing sets of indicators. The indicator is feasible but there is a need for harmonisation of

definitions. The collection of information for the indicator is time consuming. There are big differences in the availability of data.
Harmonisation of definitions. Detailed rules for data collection.
Accessibility to PT stops
This indicator has been adopted – even if under different names, but with methods and metrics that could be easily harmonised, - by relevant existing indicator sets at EU and national/regional level. There is a need to develop common definitions. The collection of information for the indicator is time consuming and there are big differences in the availability of data.
Harmonisation of definitions. Detailed rules for data collection.
Urban construction
Energy consumption of buildings
The Energy Performance directive requires the energy certificates of buildings. The use of the indicator requires the collection of data of all energy-certificated buildings in order to calculate the average values.
Normalising the data collection of energy-certificates based information of buildings.
Share of sustainability-classified buildings
Building sector has developed assessment and classification methods for construction and renovation processes in a number of European countries. For the time being there is no common European method. However, it is probable that the European countries will develop common methods for the assessment during coming years. After this the feasibility of the indicator is good and the collection of information should be rather easy. In the mean time, the national methods should be referred to.
Development of a common European assessment and classification method about the sustainability of buildings.

Construction and demolition waste
There is a wide consensus about the significance of the indicator. The feasibility of the results is good.
-
Sustainable urban management
Adoption of environmental management systems
The collection of necessary data and information for this purpose should be easy (from the point of the view of a city it is yes/no information).
-
Citizen satisfaction with the state of urban environment
Data and information necessary for the calculation of values of this indicator could be collected in a special representative TSUE survey among citizens of EU cities and urban areas. In order to prevent the above mentioned undesirable "general satisfaction or/dissatisfaction" effect, the respondents should not be asked to express their satisfaction with the state of local environment in general, but with the state of specific environmental media (local air-quality, noise, water, etc.).
Specifying of the survey method.
Share of certified enterprises and public agencies
The indicator is feasible and information should be easily available.
-
Sustainable urban environment
Compliance with Drinking Water Standards
The indicator is based on obligatory monitoring required by the DWD for the EU members. DWD presents a set of minimum quality requirements and defines point of compliance. In case of non-EU countries, the same monitoring conditions should be used to obtain comparable values.
-

Compliance with urban waste water standards
The indicator is based on mandatory monitoring required by UWWT for the EU members. UWWT presents set of minimum quality requirements. In case of non-EU countries, the same monitoring conditions should be used to obtain comparable values.
The suggested “water indicators” are closely related to main problems connected to urbanization, but their definitions do not cover all serious problems caused by urbanization to sound water management. So the above “water indicators” are to be taken as a very minimum.
Air Quality; Number of days with exceeding PM10 and O3, Annual average concentration of NO2
Indicators should be already measurable by DGENV and by the assisting organisations. Measurement techniques still require development and harmonisation. The measurement and collection of information is rather time-consuming.
-
Share of population exposed to excessive noise
Requested data should be available in the next years, if adequate investments supporting local monitoring will be provided. According to the Noise Directive strategic noise maps must be done and reported information must be sent to the European Commission. However, the needed information is rather resource consuming.
-
Municipal waste indicators
The indicators are feasible but the data collection is rather time-consuming.
-
Green house gases emissions
The indicator is feasible, but due to the difficulty in recording the quantity of each type of fuel in each activity, big efforts should be made to obtain estimates of emissions in each end-uses activity as precise as possible.

Development and harmonisation of the methods of assessment of total energy consumption.
CORE 2
Sustainable urban transport
Freight transport demand
No indicator sets which monitor freight traffic demand on the urban level have been found. However, monitoring freight demand on the national level is quite common in Europe. It is not possible to scale down freight demand data on the national level to the level of cities.
Defining detailed rules for data collection and calculation of results.
Modal split (share of kms)
Data can be obtained from household surveys. Modal split based on trip kilometers is not typically measured in cities across Europe. However, many indicator sets include this indicator. Therefore availability of this indicator is expected to be sufficient in the near future.
Harmonisation of survey methodology.
Quality of public transport
Needed data for this indicator can be obtained from household surveys. This indicator is sometimes measured in some cities, but there is no consensus yet on a larger European scale on the need for monitoring this indicator.
Harmonisation of survey methodology.
Sustainable urban design
Consumption of land
The indicator has been adopted – even if under different names, but with methods and metrics that can harmonised - by relevant existing indicator sets at EU and national/regional level. Therefore, this indicator is feasible, but there is a need to harmonise the definitions. There are also differences in the availability of information.
Harmonisation of definitions. Detailed rules for data collection and handling.

Accessibility to basic services
This indicator has been adopted – even if under different names, but with methods and metrics that could be easily harmonised, – by many existing indicator sets at EU and national/regional level. There is a need to develop common definitions. The collection of information for the indicator is time consuming and there are big differences in the availability of data.
Harmonisation of definitions. Detailed rules for data collection.
Population and jobs density
The indicator is not in use and thus there are no established methods for collection of information .
Harmonisation of definitions. Detailed rules for data collection and handling.
Jobs/housing ratio
The indicator is included in widely used indicator sets. The indicator is feasible and the data is available but the collection of data is rather time consuming.
Detailed rules and improved methods for data collection
Sustainable urban construction
Soil sealing
The indicator is not included in widely used sets of indicators. There are no established methods for data collection and the availability of relevant information is rather low. However, after mapping the degree of soil sealing once, it should be possible to monitor the development of the situation.
Harmonisation of definitions. Detailed rules for data collection.
Poor quality housing
There is a wide consensus about the significance of quality of housing on the sustainable development and welfare of citizens. However, there are no relevant information and methods available in order to monitor and compare the quality of housing in different European cities. In addition, harmonisation of definitions would be necessary.
Harmonisation of definitions and assessment methods.

Sustainable urban management
Citizen's engagement in environmental and sustainability-oriented activities
Data and information required for both indicators can be collected in a special representative TSUE survey among citizens of EU cities and urban areas.
Detailed method and rules for surveys.
Adoption of other integrated urban plans (environment, land-use, transport)
The collection of necessary data and information for this purpose should be easy (from the point of the view of a city it is yes/no information). From the point of view of a city this is YES/NO information.
The indicator becomes relevant only when cities widely develop integrated urban plans.
Legal framework for active public participation
The level of participation would be difficult to measure. At least it would require harmonisation of definitions and establishment of methods in order to measure the results. However, in the form of the suggested indicator, this is yes/no information from the point of the view of a city and the collection of necessary data should be easy.
The indicator becomes relevant only when cities widely develop specific strategies and implement specific measures aiming to enhance public participation in environmental planning. Development of detailed definitions for the required quality of the legal framework and public participation.
Sustainable urban environment
Air quality; population weighted exposure to PM10 and O3
The Eurostat's Structural indicators, presently submitted on revised process include two indicators for air quality which are related to urban population exposure to PM10 and Ozone (annual average).
Substitute indicator, if confirmed as new Eurostat's Structural indicators

Renewable energy consumption
National data and estimates on renewable and non-renewable resources are available from national statistical offices and country publications in many countries. A combination of a “top-down approach” – exploiting the availability of national data on renewable resource availability and standard energy conversion factors – with a “bottom-up” approach exploiting local data to compute the share of urban energy consumption on the total energy consumption of the country and/or the presence of local sources of renewable energy, seems the best strategy to obtain reliable indicators at the city level.
Development of a harmonised assessment method. Improvement of data availability.
Intensity of energy use in transport
The indicator is in use in many countries, and it is included in the European Environment Agency (EEA) TERM reporting mechanism. Problems of data availability may limit the disaggregation of the indicator to the desired level, and considerable work is often required even at the national level to disaggregate energy balances into various modes of transportation.
Development of data availability.
Urban biodiversity
The indicators are not a reporting obligation in themselves at a city level. There are however national reporting requirements concerning the Habitats Directive and Birds Directive.
Development and harmonisation of the assessment and reporting methods.

4 Towards effective processes

4.1 Information tools

Challenge

Simple access to appropriate data is often a problem.

Information on sustainability indicators is still after **TISSUE** dispersed and widely scattered in different locations and in different format. For some part of the needed information it would be helpful, if common information was available through internet. This concerns for example information about

- environmental impact of energy sources,
- environmental impact of transportation,
- harmful concentrations and threshold values of emissions,
- analysing and measurement methods for the concentrations of harmful substances in air and water,
- recommended survey methods,
- recommended assessment and calculations methods for concepts like particular areas (urban, green, open, brownfield ..), densities, accessibility and availability,
- definitions for issues and concepts dealt with in the common set of indicators.

A unified help desk for the harmonised set of indicators accessible through internet would be useful for practitioners of indicators. An information tool, like the browser developed in the project, accessing to supporting information about indicators also outside **TISSUE** would serve the needs of different actors involved in indicator work in cities.

Recommendation

A general help desk on sustainability indicators should be developed and maintained for local authorities with a simple viewer to access to relevant supporting information about indicators included in the harmonised set of indicators.

4.2 Design tools

Challenge

Design tools exploiting urban sustainability indicators and case studies are needed.

TISSUE project focused on sustainability indicators needed in monitoring the sustainable development of urban environment. Although the focus was on indicators for monitoring, these indicators can also be used in design for sustainable urban areas.

When using indicators in design for sustainable urban areas, the essential thing is the suitability of indicators for target-setting.

Primarily, in sustainable urban design, it is important to understand the wide picture of influencing factors and causalities. In the second place, it is essential to be able to set targets. And finally, it is important to be able to monitor the development and perform improving actions.

In order to support target setting, indicators should be understandable also in terms of target values. An indicator itself is a parameter, but in order to aid target setting, one should be able to understand, which levels of results are poor, average or good. The issue comes even more complicated when considering that these levels depend on geographical and cultural dimensions.

When developing and designing new solutions the experts need – not only information on indicators, but also information about the earlier use of indicators in real cases. Tools that can assist in designing city environments benefiting from earlier experiences are needed. Visual aids interconnected with indicators add value for the client and for citizens. Interoperability with other design tools is of vital importance.

Recommendation

Design tools for town planners that support sustainable target setting and finding sustainable solutions for urban construction, transport and design should be

developed. These tools should support town planners to find effective ways of working for sustainable urban environments. Thus these tools should support target setting of town planning in the first place.

4.3 Implementation barriers

Challenge

Despite of many potential benefits there seem to be implementation barriers that need to be overcome.

There are many reasons why new working methods are not taken into practice. In addition to natural human and organisational resistance towards change in some cases, there may be important barriers for implementation that are not sufficiently understood and acknowledged. They may relate with cultural patterns, man-machine interfaces, personal incentives, lack of information on value creation etc. Studying these bottlenecks would help in promoting and exploiting these important matters properly.

Recommendation

Research on implementation barriers is recommended..

4.4 Support for local governments

Challenge

Successful TSUE implementation demands pre-requisites which the existing city infrastructures don’t always support.

Local governments will need support from the Commission to be able to implement TSUE and to monitor the sustainable development of urban environment. The needed support includes guidelines about data collection and reporting, common reporting formats, training, etc. The degree of support needed probably varies depending on the country and the size of the local

authority. One part of these challenges should be possible to solve with help of an informative tool (compare recommendation 4.1). However, a study that aims at finding out and specifying the support needs of implementing TSUE and monitoring the sustainable development would be necessary in order to ensure the efficient start of the procedure. The study should also try to identify, who would be responsible for providing support.

It should also be studied how the monitoring requirements of directives implemented at local level and TSUE overlap. It would be important to develop and establish a monitoring framework, which is easy to fulfil for the local authorities, but which gives comprehensive information to the EC.

Recommendation

Support mechanisms needed for implementing TSUE should be studied.

4.5 Setting objectives

Challenge

The use of indicators should have an impact in local policy making and decision making

The urban sustainability indicators should support the monitoring of sustainable development of urban environment at the EU level. On the other hand, the sustainability indicators should also be able to provide the information needed to monitor developments at local level. The sustainability indicators should be able to support cities in their own target setting and in efforts to change the negative trends. A study should be carried out, how the selected indicators and possibly additional indicators will support local governments to set specific targets and especially how these indicators support the target setting with reference to the Aalborg commitment. Indicators should support local governments both in monitoring as well as in setting measurable targets.

Recommendation

Indicators influence on policy making and decision making at local level should be studied.

4.6 New participation models

Challenge

New participation models can act as catalyst for spreading the use of indicators.

The TSUE will formulate a strategic definition for the sustainable development of urban environments. Sustainable development of urban environments is not only the matter of local governments but it will require and benefit from the participation of urban citizens. Public participation and citizen interaction is one dimension in urban sustainable development.

Enabling end users to communicate with the plans that they are concerned requires common language. Indicators should be used and interpreted so that citizens could participate the urban design processes with help of those. Various participatory procedures may exploit indicators. Thus, taking advantage of different participation modes the use of indicators may be encouraged and concurrently the citizens' participation reinforce the sustainable urban development.

Recommendation

Research on new modes for participation is recommended with indicators as means for communication.

4.7 Local development

Challenge

New concepts for local development exploit indicators.

In local development, the traditional prescriptive planning procedures and traditional delivery limits may be complemented or replaced by new means of development. When responsibilities and contractual boundaries change earlier control mechanisms may not be appropriate. Then sustainable construction, transport and design indicators can be used as parts of means for managing the development processes.

Recommendation

Research on new local development concepts is recommended with indicators as means for communication.

4.8 Systematic risk management

Challenge

Risk management indicators are needed.

Systematic risk assessment has become an important activity of decision making in many activities. Risks of investments, functional disorders or natural catastrophes can be risk mapped. A set of risk management indicators would be useful for different actors and for different purposes.

Recommendation

Research and development on systematic risk management indicators is recommended.

5 Summary

Table 14 summarises the TISSUE recommendations concerning process improvements.

*Table 14. **TISSUE** recommendations.*

	Recommendation	Description
1	Development of comprehensive approach	Supplementary indicators for the following categories: – the maintenance of cultural heritage of built environment – affordability of housing – barrier free use of built environment – access to information and education – equal access to public services – safety of urban environment – social exclusion – health of citizens – sustainable stewardship.
2	Support for target setting and local development	Supplementary indicators and tools for target setting and responsive way of working in different levels of local authorities' activities. Development of new concepts for local planning with indicators as means of communication in order to improve the traditional prescriptive planning process.
3	Mobilisation of TISSUE CORE 1 indicators	Improvement of the knowledge and recognition of common indicators. Identification of implementation barriers which may vary in different European countries. Support and information for cities which have less experience in the use and development of indicators.

		Development of detailed guidelines and reporting formats, translation of guidelines to national languages, offering training courses.
4	Development of the feasibility of TISSUE CORE 2 indicators	Improvement and harmonisation of – availability of needed background information and statistics, – measurement, calculation, survey and reporting methods
5	Development of information tools	Development of an internet-based help desk with a viewer to access to relevant supporting information about common indicators.
6	Development of design tools	Development of internet-based design tools that assist in designing sustainable city environments. should add value for the client and for citizens. Design tools interconnected with indicators should support sustainable target setting, getting acquainted with exemplary cases and finding sustainable solutions for urban construction, transport and design.
7	Development of indicators as means of communication and participation	The use and interpretation of indicators so that citizens could participate the urban design processes with help of those. Enabling the end users to communicate with plans that they are concerned with help of sustainable urban indicators.
8	Development of risk management indicators	Identification and development of indicators for systematic risk assessment with regard to risks of investments, functional disorders and natural catastrophes.

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Appendix 1: Description of the TISSUE trends

Sustainable Urban Design related PRESSURE concerns and trends

Concern: Land use

Land use trends – urban sprawl and sub-urbanisation, growing car dependency, consumption of land and space, decreasing accessibility to basic services and facilities – may be considered as fundamental negative pressures on the environment. They are briefly described below.

Trends

Urban sprawl and suburbanisation Urban growth is accompanied by urban sprawl – a relative shift in the location of activities (housing, industries, retail and other services) towards the peripheries of the urban agglomeration. This was and currently is an established trend that affects the growth of modern cities, which is time after time associated with a gradual decrease in density at the centre, and a decrease in the rate of density reduction depending on distance from the centre. Similarly, sub-urbanisation trends are likely to continue. In some cases suburbanisation will cause more urban sprawl as well as higher travel distances, as most of the working places are still in the city while, on the other hand, suburbanisation of working places, shops and leisure time facilities might possibly cause increasing suburbs-to-suburbs traffic.

Consumption of land and space European cities are experiencing continuous growth in the land consumption because of urban expansion, which is increasingly affecting the surrounding landscape (forests, wilderness areas, etc.). Transport network and corridors are still the major consumers of space: the densification of the transport network and the length per capita has increased steadily over the last few decades and is likely to follow a similar trend over the coming years. The increasing length of roads, particularly motorways, and the development of additional roads shows that more and more land is being used for transport in the ACC as well as in the EU15.

Car dependency The coming of widespread car usage after World War II substantially changed the accessibility to urban centres. Increased mobility begot ever more serious effects, in that the total number of trips taken has steadily increased, and widespread car ownership transformed the city centres in the least accessible locations. Congestion and decreased accessibility in the city centre has, therefore, spurred development in suburban areas. This unfavourable trend is likely to continue, considering that EU15 car population is projected to grow in the next 50 years by 25%.

Accessibility of basic services and facilities Access to basic services is becoming more and more dependent on cars, due to increasing urban sprawl, while a large fraction of the population has difficulty in accessing even basic services. It is, however, generally recognised that providing access for everyone, with the least impact on the environment, should be achieved, at the urban planning level, through a better spatial mix of economic activities backed by improvements in public transport, cycling and walking facilities, and by restrictions on parking.

Concern: Urban design

Sustainable urban design includes a series of strategies which are the main responses to the unsatisfactory land use trends. They can help to create more accessible land use patterns, improve transport options, create more liveable communities, reduce public service costs and achieve other land use objectives, mitigating the impacts of the current urban sprawl and sub-urbanisation trends.

Trends

Densification and clustering of settlements, mixed land use ("compact city strategies") Effective land use and transport integration is increasingly being achieved by interlocking policies and planning methodologies like the monocentric and polycentric strategies of spatial development, proving quite successful for larger towns as to stem urban sprawl, and, on a smaller spatial scale, "clustering" or "compact development" strategies that improve accessibility by reducing travel distances and improving transportation options. On the other side, the "mixing homes and jobs" strategy is succeeding in reducing travel, while the "mixed land use" strategy is constantly featured in different historical urban fabrics where dealing with urban renovation is the

primary concern. The use of zoning policies is increasingly common to many EU15 cities also to support small and medium enterprises and the vitality of city centres.

Short-distance and public transport oriented development Implementation of measures achievable in the context of a "short distance structure development" – creating a pedestrian and cycling friendly approach to site development, and facilitate "door-to-door" travel without using the car, encouraging the use of alternative transport modes at the same time – are more and more widespread across European cities. Similarly, strategies of public transport-oriented development aiming at creating residential and commercial areas designed to maximize access by transport and non-motorised transportation featuring additional facilities, are one of the currently most successful strategies to implement integrated land use planning and transport.

Balanced development of greenfields and brownfields Urban sustainability strategies are increasingly starting to tackle the issue of a balanced greenfield and brownfield development. The review of national approaches for the redevelopment of brownfields in Europe made quite clear that the problem has been recognised particularly in industrialised countries and specific actions have been taken. At the same time, however, current local and national planning practices still involve a significant level of development on greenfield sites, especially because of insufficient information concerning the number of brownfields and vacant sites in cities, and about the economic, social and environmental outcomes of redevelopment, as well as the inflexibility of policy and legislation which inhibits the redevelopment of brownfield sites.

Attractiveness of city centres and amenity of streets and neighbourhoods All over Europe, strategies to promote and enhance the attractiveness of city centres (and other town districts) are continuously and successfully being promoted, often featuring integrated land use and transport measures, in order to promote vital and viable centres, offering a mix of uses, which are accessible to the greatest number of people, and provided with an ample range of transport option. A current trend in developing such practices has seen the increasing involvement of neighbourhood associations, business associations and developers, often as result of a community's strategic plan.

Availability and accessibility of green and open space Access to green space varies considerably all over the EU 15, while more and more existing green spaces within the urban areas are built up, threatening biodiversity, as well as the quality of life and health of city dwellers. Urban green space amounts to an average of only 1.4% in the EU. However, there is a great variability around this average: the proportion of land taken by green areas ranges from 70% in Turku, Oslo and Gothenburg to only 2% in Seville and Bratislava.

ICT-contribution to sustainable design of cities and communities Within the development of sustainable cities, planning and design related matters have emerged to promoting the use of ICT to bring about sustainable cities. There is an increasing pressure on cities to be endowed with constant communication, business and entertainment whilst providing a high quality physical environment. ICT is increasingly particularly important for urban planning at present (provision of information and the enactment of information systems, creation of scenarios and simulations of planning outcomes, dissemination of information / planning participation via the Internet, promotion of transparency of activities and public awareness of planning and sustainability issues). Studies have shown that ICT will only be able to support a sustainable urban development if accessibility of ICT is guaranteed by low cost of equipment, ICT knowledge and awareness is encouraged for city administrations and the public, as well as if ICT is promoted by the legislative framework.

Sustainable urban design related PRESSURE concerns	*Sustainable urban design related PRESSURE trends*
Land use (+++)	Urban sprawl and suburbanisation (+++)
	Consumption of land and space (++)
	Car dependency (++)
	Accessibility of basic services and facilities (++)
Urban design (+++)	Densification and clustering of settlements, mixed land use ("compact city strategies") (+++)
	Short distance and public transport oriented development (++)
	Development of greenfield and brownfield areas (++)
	Attractiveness of city centres and amenity of streets and neighbourhoods (++)
	Availability and accessibility of green and open space (+)
	ICT-contribution to sustainable design of cities and communities (+)

Overview of selected SUD-concerns and trends and their relevance for TSUE and it's monitoring.

Sustainable Urban Transport related PRESSURE concerns and trends

Concern: Development of transport demand in relation to activity patterns

Trends

Transport demand Individual activity patterns and production processes tend to disperse over ever growing areas. In general, this causes a rapid increase in the total demand for passenger and freight transport, especially in terms of distances covered.

Accessibility, transport quality Generally, accessibility, in terms of travel times from origin to destination, tends to improve as a result of general system improvement. However, due to growing transport demand on a limited space, accessibility deteriorates at certain places and times, especially in urban areas. Due to growing car dependency and decreasing public transport quality, accessibility deteriorates for non-car users.

Affordability Generally, travel costs for private and public transport, as well as freight transport costs are increasing. However, increased user costs can be compensated by a higher income level.

Concern: Supply, quality and use of transport means and services

Trends

Modal split Due to growing travel distances and dispersion of activity patterns, the use of the private car increases, in the disadvantage of public transport, bicycle and walking. This process is intensified by growing car dependency and decreasing public transport quality.

Transport safety Due to growing transport demand, transport safety (in terms of accidents, injuries and casualties) will deteriorate, unless an effective safety policy is carried out.

Vehicle park Generally, car ownership tends to grow (Post-communist countries show a rapid growth). This leads to increased car use (with all kinds of positive and negative impacts), and growing car dependency. Fleet age is important as well, as it shows a relationship with noise, emissions and safety. Bicycle ownership is a precondition for the bicycle being an alternative for car use.

Public Transport System Quality Investing in the density, speed, frequency, interconnection and reliability of urban public transport networks of all modes, leads to decreasing car dependency and a better accessibility of inner cities, with positive impacts on economic development. Offering good bicycle sheds and P+R facilities enlarges the accessibility area of stations and stops.

New Transport Technologies Introducing new transport technologies, like developing sustainable propulsion systems, putting intelligence into vehicles and infrastructure and offering effective travel information services, leads to positive impacts on system quality, efficiency and environment.

Concern: Infrastructure supply and traffic circulation

Trends

Traffic Volume Due to growing transport demand, the traffic volume (the amount of vehicles in circulation) increases, causing negative impacts on the urban environment.

Traffic circulation, congestion Rising traffic volumes lead to growing pressure on the infrastructure capacity available. When congestion occurs, this leads to delays with all its negative impacts. Congestion tends to shift from urban roads to main roads leading to the city.

Infrastructure supply Transport infrastructure consists of different categories of roads, as well as rail tracks, water ways, bus lanes and bicycle paths. Generally, building large-scale infrastructure in urban areas is very expensive and in many cases it is not favourable from environmental point of view. However, there should be a balance between traffic volume and infrastructure supply.

Traffic restriction zones Liveability of inner cities can be improved by creating zones with restricted traffic and pedestrian areas. Special care has to be taken of the accessibility of those areas by public transport and bicycle, and of an effective policy for parking and (un)loading facilities.

Sustainable urban transport related PRESSURE concerns and trends	
Development of transport demand in relation to activity patterns (+++)	Transport demand (+++) Accessibility, transport quality (+++) Affordability (+)
Supply, quality and use of transport means and services (+++)	Modal split (+++) Transport safety (+++) Vehicle park (++) Public Transport System Quality (+++) New Transport Technologies (++)
Infrastructure supply and traffic circulation (+++)	Traffic Volume (++) Traffic circulation, congestion (+++) Infrastructure supply (+++) Traffic restriction zones (+++)

Overview of selected SUT-concerns and trends and their relevance for TSUE and it's monitoring.

In spite of the fact that all above listed concerns and trends are important for the sustainable development of urban environment, some of them are clearly more relevant with regard to the TSUE and will be marked with a top priority for the monitoring. TISSUE project considered a trend as very relevant when it is able to represent

- others (others are consequences of it),
- European common phenomena and Thematic Strategy specific phenomena that differentiate cities,
- phenomena with great dynamics (bad/good environmental performance) and
- phenomena which are critical for sustainable development of urban environment at the local level and less relevant when it fulfils not all, but only some of these relevance criteria.

Sustainable Urban Construction related PRESSURE concerns and trends

Concern: Environmental pollution and consumption of resources

The changes in the environment and the increasing threats especially in relation to climate change, pollution and decreasing bio-diversity causes growing high requirements for building and all industrial sectors. The quality of life suffers

increasingly from the changes in the environment and from the related threats. Following trends are important in connection with this concern:

Trends

Energy efficiency of buildings Because of the use of buildings significantly affects the total energy consumption and the related CO_2 emissions and because – on the other hand – of the threats about the increasing prices of energy, there is an increasing pressure towards more energy-efficient buildings. The new energy directive already is one step towards improving energy efficiency.

Making use of renewable energy sources Because of the use of buildings significantly affects the total energy consumption and the related CO_2 emissions there is an increasing need to develop and make use of renewable energy sources for heat energy of buildings.

Water consumption of buildings Because the activities in buildings significantly affect the consumption of water, there is a pressure to ensure an efficient water management by using special equipments, which reduce consumptions, or by making use of non-drinkable water like rainwater.

Sustainable products, environmental declarations of building products, sustainable construction Because the building sector essentially affects the total consumption of natural raw materials and because the production of building materials and products also significantly affects the totals of harmful emissions, there is an increasing pressure towards the development of environmentally sound products and environmental declarations of building products. Correspondingly, there is also a growing demand for service life design of buildings and design for adaptability of buildings. Both of these significantly affect the building-related environmental impacts.

Minimising, sorting out and recycling the household wastes and wastes from building sites Because the building sector significantly affects the amount of wastes that ends up to dumping places there is still an increasing pressure towards efficient sorting out and recycling of building and demolition wastes and developing other procedures which help to minimise wastes. There is also a pressure towards efficient sorting out and recycling of household wastes and

optimising the design of the collection premises and the organisation of indoor collection.

Efficient maintenance and management of buildings Because some important changes in the buildings perfomance concern, for example, the energy efficiency and water consumption may occur during their life, there is an increasing pressure towards efficient maintenance management procedures and modes.

Concern: Health and comfort

Growing number of people suffer from allergic reactions and discomfort because of particles and harmful emissions in outdoor and indoor conditions. Increasing share of people in urban environments suffer from disturbing noise. Following trends are important in connection with this concern:

Trends

Indoor climate, micro climate in built environment Because of an increasing number of people suffers from allergic reactions, because of a high number of indoor-air related problems and because of the water-quality related risks, which have turn out in existing buildings and also because of the increasing awareness about the importance of good indoor climate with regard to health and comfort, there is an strengthening pressure to ensure that the indoor conditions of buildings offer healthy living and working conditions for occupants and users of buildings. Indoor conditions is an important factor that affects the health and comfort of people, and people in cities spend the most of the time in buildings. In addition, there is also a strengthening pressure to ensure that the micro climate in built environment offers adequate conditions for the users of built environment.

Noise Because there is an increasing share of people in urban environments that live and work in the neighbourhoods of busy roads and motor-traffic ways and suffer from disturbing noise, there is an increasing need to develop methods of planning, building and renovation, which ensure acoustically tolerable conditions for occupants and users of built environment. Because of the nuisances that the construction or renovation building sites may cause, there is

an increasing need to develop construction methods and procedures and to optimize the works organisation in order to ensure noise pollution reduction.

Other risks An environmental and/or health risk may occur because of the use of construction and maintenance materials and products, which potentially contaminate environment when released into air or water and/or in the case of fire or other specific condition possible with regard to a building. A health risk may also be related to building process. For example certain working methods may be risky with regard to damp damage, indoor air quality and durability and service life. A high number of indoor-air related problems and risks, especially concerning damp problems and the use of harmfully emitting products, have turn out in existing buildings. This is why there is a strengthening pressure towards risk management and possibilities to ensure the use of safe building products and design solutions.

Concern: Ageing/Disabled and other special groups of users of buildings

The average age of people in Europe is increasing and the share of the elderly is growing. A willingness to take into account the needs of disabled and other special groups can be distinguished. A following trend is important in connection with this concern:

Trend Barrier-free use, accessibility Because the average age of European people is increasing and the share of the elderly is rapidly growing, there is a strengthening pressure to develop design processes and buildings to improve the possibilities of the elderly to manage at homes. This includes that there is an increasing need to develop barrier-free housing and built environment and to ensure the effortless access to needed services. This concerns also other special groups with restricted possibilities to move.

Concern: Mobility/Changes in the living standard

The mobility of people in Europe is still increasing. There will probably be a rapid increase in the standard of living in the new member countries of the EU. A following trend is important in connection with this concern:

Trend Availability of housing and buildings Because of the still increasing mobility of people in Europe, the need of housing and buildings increases in growing centres. There is a need to ensure the availability of buildings and housing and the advantageous location of buildings with regard to services, public facilities and other activities. The rapid increase in the standard of living in the new member countries causes increase in building in those areas.

Concern: Business environment, productivity

The real estates can be seen as part of an investor's portfolio. More and more, the driving force for all activities is the return on capital and the attractiveness of investment. A following trend is important in connection with this concern:

Trend New services Because increasingly, the driving force for all activities is the productivity and the return on the invested capital, one has to be able to develop new services in the real estate sector. This is necessary in order to ensure the high utilisation rate of real estates and the increasing value. The increasing pressure to develop new real estate related services also means the better possibilities to satisfy the needs of different kinds of users.

Concern: Individuality and client-orientation

The development is towards increasing emphasis on individual solutions, products and services. An increasing willing for client-oriented products and services can be distinguished. A following trend is important in connection with this concern:

Trend Fulfilment of individual client needs Because of the growing valuation of individuality, there is an increasing pressure towards houses and buildings, which fulfil the individual needs of the owners and users of buildings. This means that there is an increasing need to be able to ensure that the buildings can offer high-quality performance, which fulfils the individual requirements of the users of buildings both with regard to building performance (indoor conditions, safety, accessibility, adaptability, usability and comfort) and with regard to environmental impacts and life-cycle costs. Also an improving ability and willing in the building sector to carry out client-orientated business can be distinguished.

Concern: Age of building stock

The average age of housing and building stock in the European cities is growing. A following trend is important in connection with this concern:

Trend Renovation The average age of housing stock and building stock in many European cities is growing. Because of the high average age of the building stock in the European cities, there is a growing need to refurbish and renovate buildings, to ensure the adaptability of new buildings and to develop methods of efficient maintenance management of buildings.

Concern: Technological and information and communication technological development

There is a rapid development going on in technology and information and communication technology. A following trend is important in connection with this concern:

Trend Technological and IC technological challenges The rapid development in technology and IC technology offers improving possibilities to improve the efficiency of building process and improve the quality of buildings. The technological and IC technological development offers increasing potentials for efficient development of design methods and for the efficient control and management of building performance. For example, the new kind of sensors may help to avoid building related problems and help to ensure the good safety and indoor conditions.

Sustainable urban construction related P-concerns and P-trends	
Environmental pollution and consumption of resources (+++)	Energy efficiency of buildings (+++) Making use of renewable energy sources (++) Water consumption of buildings (++) Sustainable products, environmental declarations of building products, sustainable construction (++) Minimising, sorting out and recycling the household wastes and wastes from building sites (+) Efficient maintenance and management of buildings (++)
Health and comfort (+++)	Indoor climate, micro climate in built environment (+++) Noise (+++) Other risks (+)
Ageing/Disabled and other special groups of users of buildings (++)	Barrier-free use, accessibility (++)
Mobility/Changes in the living standard (++)	Availability of housing and buildings (++)
Business environment, productivity (++)	New services (++)
Individuality and client-orientation (+++)	Fulfilment of individual client needs (+++)
Age of building stock (++)	Renovation (++)
Technological and information and communication technological development (+)	Technological and IC technological challenges (+)

Overview of selected SUC-concerns and trends and their relevance for TSUE and it's monitoring.

STATE concerns and trends with regard to the state of sectors of urban environment

The overall aim of the Urban Environment Thematic Strategy is "to improve the environmental performance and quality of urban areas and to secure a healthy living environment for Europe's urban citizens, reinforcing the environmental contribution to sustainable urban development while taking into account the

related economic and social issues"[67]. TISSUE considered the three main areas that are highlighted in this declaration and classified S-concerns and trends in terms of their relevance for the quality and the healthy living aspects of the urban environment as well as for the environmental performance of processes and products. The three main areas considered are the following.

Quality of urban environment, that is intended as availability of resources needed to sustain current lifestyles and characterisation of elements affecting the overall quality, and therefore considers:
- availability of resources: energy and water;
- urban environment quality: built environment and biodiversity.

Healthy living environment, that refers to all those elements of the urban areas that contribute to or have effects on human being health, and therefore considers:
- environment media quality: air, water, acoustic, soil, green and open spaces;

Environmental performance, that refers to the processes that use resources, and therefore considers:
- resource consumption and efficiency: energy, water, food and wood;
- processes outputs: residuals and emissions;
- resources recovery: waste and wastewater.

STATE concerns and trends with regard to Quality of the Urban Environment

Resources Availability

Concern: Energy Availability

Trends

Local production of renewable and not-renewable energy sources and dependency on external sources: Cities need energy for their services and

[67] COM(2004)60 final, Communication From The Commission To The Council, The European Parliament, The European Economic And Social Committee And The Committee Of The Regions, Towards a thematic strategy on the urban environment.

activities and the chance of relying on renewable or "clean" sources (better if locally produced) is a way to ensure a sustainable and constant supply, thus decreasing dependency on external/non renewable sources. The trend could be the result of direct TSUE actions for SUC and SUD and has high relevance in Aalborg Commitments (4-Resp. Consumption; 5-Planning and design).

Concern: Water Availability

Trends

Scarcity of and access to drinking water: The quantity of drinking water is currently adequate in most European countries, but it is important to take into consideration the lost of water due to leaks in the distribution system (that accounts from 25% to 60% in European countries)[68]. Seasonal water shortages are observed only in some southern European cities but demands will generally not to be met in the next century if renewable water-resources pollution and abstraction continues to increase at current levels[69]. The trend could be the result of direct TSUE actions for SUM and has high relevance in Aalborg Commitments (8- Health; 9-Social equity), considering the principle of "assuring equitable access to public services".

Scarcity of groundwater: Some European countries are overexploiting their groundwater resources and this results in consequent water table depletion and, into coastal aquifer, into salt-water intrusion[70]. The trend is less relevant and already "captured" by the previous, Trend 1.

Scarcity of surface water: Some European countries are overexploiting their surface water (e.g. for energy uses) and this results in consequent ecosystem damages. In some cases the urban structure affects and is affected by changes

[68] Sustainable development and health: concepts, principles and framework for action for European cities and towns, European Sustainable Cities and Towns Campaign, 1997.
[69] Environment in the European Union at the turn of the century, EEA, 1999.
[70] Europe's Environment: The Third Assessment, EEA, 2003.

(e.g. due to climate changes) in surface water (for example Amsterdam and Venice)[71].

Concern: Built Environment Quality

Trends

Housing and building quality: As people spend about 80% of their time indoors, the quality of housing is an important environmental factors; the amenity value of housing (both internal and external) are affected by design, layout and building materials[72]. Also conservation/renovation and effective and correct use of buildings and cultural heritage could really influence the attractiveness of urban areas (peripheries in particular). Trends in housing and consequently, living condition, is a relevant factor for TSUE (SUD and SUC) and improvement of social sustainability (see Aalborg Commitments, 9-Social).

Concern: Biodiversity Quality

Trends

Habitat and species presence: In Europe the human influence on natural environment is pervasive and has lead to a decline of biological diversity; the Convention on Biological Diversity has been conceived so as to lead to a sustainable use of biological diversity[73]. This trend, less relevant in urban areas then in natural areas, could be anyway a result of actions related to TSUE/SUD strategies and is pointed out by Aalborg Commitments (3-Natural goods).

[71] Sustainable development and health: concepts, principles and framework for action for European cities and towns, European Sustainable Cities and Towns Campaign, 1997.
[72] Sustainable development and health: concepts, principles and framework for action for European cities and towns, European Sustainable Cities and Towns Campaign, 1997.
[73] Sustainable development and health: concepts, principles and framework for action for European cities and towns, European Sustainable Cities and Towns Campaign, 1997.

STATE concerns and trends with regard to Healthy Living Environment

Environment Media Quality

Concern: Air Quality

Trend: PM_{10}, SO_2, NO_X, NMVOC, CO and O_3 atmospheric concentrations: Despite success in reducing certain pollutants, air quality continues to represent a main problem in most European cities[74]. An estimated 70–80% of European cities with more than 500,000 and some of those with 200,000 inhabitants exceed WHO air quality guidelines at least once a year[75]. The trend would be the result of direct TSUE actions for SUT and SUD and has high relevance in Aalborg Commitments (5-Planning and design; 6-Better mobility; 7-Health).

Concern: Water Quality

Trends

Concentration of nitrates, pesticides and microbiological parameters in drinking water: Quality of drinking water is of great concern in Europe as almost 50% of samples analysed do not comply with quality standards, and most of the times exceed limit values of nitrate and pesticides[76]. The trend is related to TSUE actions due to the fact that SUD and SUM could play an important role in monitoring and preventing pollution and health risks. It has some relevance in Aalborg Commitments (3-Natural goods; 7-Health).

Concentration of nitrates, pesticides and chloride, value of pH and electrical conductivity in groundwater: The state of groundwater quality is of vital importance because all over Europe it is the main sources of drinking water[77];

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[74] Europe's Environment: The Second Assessment, EEA, 1998.
[75] Sustainable development and health: concepts, principles and framework for action for European cities and towns, European Sustainable Cities and Towns Campaign, 1997; European Common Indicators, Ambiente Italia/EC, 2003.
[76] Sustainable development and health: concepts, principles and framework for action for European cities and towns, European Sustainable Cities and Towns Campaign, 1997.
[77] Europe's Environment: The Third Assessment, EEA, 2003.

the parameters considered are those revealing pollution due to agriculture (nitrates and pesticides) and evaluating other relevant water characteristics. The trend is slightly related to TSUE actions (even if in some terms SUD and SUM could play an important role in monitoring and preventing pollution) It has some relevance in Aalborg Commitments (3-Natural goods).

Value of BOD and COD, concentration of nitrate and Extended Biotic Index (EBI) in surface water: Despite the introduction of water quality targets in the European Union (EU), there has been no overall improvement of river quality since the beginning of the 1990s. An estimated 20 % of all surface water in the European Union is seriously threatened with pollution[78]. The trend is slightly related to TSUE actions (even if in some terms SUD and SUM could play an important role in preventing pollution) It has some relevance in Aalborg Commitments (3-Natural goods).

Value of BOD and COD, concentration of suspended matter in wastewater: Biological and Chemical Oxygen Demand and the concentration of suspended matters are the parameters fixed by the relevant European Directive[79] to be considered in analysing wastewater coming from treatment plants that is discharged to receiving waters. The trend is related to TSUE actions due to the fact that SUM could play an important role in monitoring and preventing pollution. It has some relevance in Aalborg Commitments (3-Natural goods).

Concern: Acoustic Environment Quality

Trends

Acoustic zonation: Effects of noise on human health have been recognised and data shows that noise levels in our cities are very high and often exceed the values considered safe. The trend is related to TSUE actions due to the fact that SUT and SUM could play an important role in monitoring and preventing noise pollution and health risks for population. It has some relevance in Aalborg Commitments (6-Mobility; 7-Health).

[78] EU Focus on Clean Water, European Commission DG Environment, Nuclear Safety and Civil Protection, 1999.
[79] Urban waste water treatment, Directive 91/271/EEC.

People exposed to different noise levels or to different source-generated (road, railway, aircrafts, industries, …) noise levels: The proportion of people exposed to unacceptable levels of noise (higher than 65 dB(A)) in large urban areas can be two to three times higher than national average[80]. The trend is related to TSUE actions due to the fact that SUD and SUM could play an important role in monitoring and preventing pollution and health risks for population. It has some relevance in Aalborg Commitments (3-Natural goods; 7-Health).

Concern: Soil Quality

Trends

Soil pollution: Areas with high density of urban agglomeration and with long tradition of heavy industry are those mainly affected by soil contamination[81]. The trend is related to TSUE actions due to the fact that SUD and SUM could play an important role in monitoring and preventing pollution and health risks for population. It has medium relevance in Aalborg Commitments (3-Natural goods; 7-Health).

Soil losses and erosion: Irreversible losses due to increasing soil sealing and soil erosion is considered a main problem in EU and this losses are expected to increase as a result of, between the others, land use changes and human activities; urbanisation, infrastructure development and erosion are considered the main causes of this degradation, even though there is a lack of data on the amount of soil loss through surface sealing at the EU[82]. The trend is related to TSUE actions due to the fact that SUD and SUM could play an important role in monitoring and preventing soil losses. It has medium relevance in Aalborg Commitments (3-Natural goods; 5-Planning).

Vulnerability to hazardous natural events: Natural hazards, such as earthquakes, flooding and landslides are often very devastating in terms of loss of life and

[80] Sustainable development and health: concepts, principles and framework for action for European cities and towns, European Sustainable Cities and Towns Campaign, 1997; European Common Indicators, Ambiente Italia/EC, 2003.
[81] Environment in the European Union at the turn of the century, EEA, 1999.
[82] Environment in the European Union at the turn of the century, EEA, 1999.

environmental damage; human impacts can to some extent be prevented by integrated land-use planning, although in general the spreading of settlements has seen a progression into higher risk areas[83]. The trend is related to TSUE actions due to the fact that SUD and SUM could play an important role in monitoring and preventing hazards. It has high relevance in Aalborg Commitments (3-Natural goods; 5-Planning).

Concern: Green and Open Spaces Quality

Trends

Availability of green and open spaces: It is widely recognised that natural features and amenities have important environmental and social functions in urban areas[84]. Urban green space amounts to an average of only 1.4% in the EU[85]. The trend is related to TSUE actions due to the fact that SUD and SUM could play an important role in conserve, extend, cure green areas and open spaces. It has high relevance in Aalborg Commitments (3-Natural goods; 5-Planning).

Accessibility of green and open spaces: Accessibility, both measured as distance or time needed to reach them, is widely used to evaluate the real functionality that green urban areas may have. Surveys show that access to green areas vary considerably in European cities[86]. The trend is related to TSUE actions due to the fact that SUD and SUM could play an important role in conserve, extend, cure green areas and open spaces. It has high relevance in Aalborg Commitments (3-Natural goods; 5-Planning).

Fragmentation of green and open spaces: The impacts of urbanisations around cities concern areas of recreational and ecological value, through, between the others, habitats fragmentation[87]. The trend is related to TSUE actions due to the

[83] Environment in the European Union at the turn of the century, EEA, 1999.
[84] Sustainable development and health: concepts, principles and framework for action for European cities and towns, European Sustainable Cities and Towns Campaign, 1997.
[85] Environment in the European Union at the turn of the century, EEA, 1999.
[86] Environment in the European Union at the turn of the century, EEA, 1999; European Common Indicators, Ambiente Italia/EC, 2003.
[87] Environment in the European Union at the turn of the century, EEA, 1999.

fact that SUD and SUM could play an important role in conserve, extend, cure green areas and open spaces. It has high relevance in Aalborg Commitments (3-Natural goods; 5-Planning).

STATE concerns and trends with regard to Environmental Performance

Resources Consumption and Efficiency

Concern: Energy Consumption

Trends

Energy consumption by sector: In most countries, cities account for the largest share of total energy consumption: in fact the main part (three quarters) of total energy is consumed for heating and transportation in urban agglomerations[88]. In the past two decades energy consumption has risen and further increases can be anticipated unless energy pricing measures provide a sufficient deterrent.[89] The trend is related to TSUE actions due to the fact that SUD, SUC, SUT and SUM could play an important role in reducing energy use. It has high relevance in Aalborg Commitments (4-Resp. Consumption; 5-Planning; 6-Mobility).

Energy intensity related to relevant units: A way to reduce the environmental pressure of energy use is to deliver the same services/products by consuming less energy: therefore it is very important to use energy efficiently (as recognised by the Energy Charter Treaty on Energy Efficiency and Related Environment Aspects). The trend is related to TSUE actions due to the fact that SUD, SUC, SUT and SUM could play an important role in improving energy efficiency. It has high relevance in Aalborg Commitments (4-Resp. Consumption; 5-Planning; 6-Mobility; 8-Economy).

[88] Europe's Environment: The Second Assessment, EEA, 1998.
[89] Environment in the European Union at the turn of the century, EEA, 1999.

Concern: Water Consumption

Trends

Water consumption by sector: The EEA has recognised that more than 50% of European urban areas are over-exploiting their groundwater resources and that this fact may become a constraint for future urban development in some countries[90]. The trend is related to TSUE actions due to the fact that SUD, SUC and SUM could play an important role in reducing water consumption. It has high relevance in Aalborg Commitments (3-Natural goods; 4-Resp. Consumption; 5-Planning; 6-Economy).

Water intensity related to relevant units: The minimization of water consumption is considered the way to reduce the pressure exerted on the environment and to avoid future shortage due to over-exploitation; this can be obtained through a reduction of the water intensity in some processes and activities. The trend is related to TSUE actions due to the fact that SUD, SUC and SUM could play an important role in improving water efficiency. It has high relevance in Aalborg Commitments (3-Natural goods; 4-Resp. Consumption; 5-Planning; 6-Economy).

Concern: Food Consumption

Trends

Food consumption by sector: The consumption of food is one of the items considered in estimating the ecological footprint of an urban area and it is related to the equity and the even distribution of the planet earth resources[91]. The trend is related to TSUE actions due to the fact that SUM could play an important role in promoting the footprint calculation and use for firms/citizens sensitisation. It has high relevance in Aalborg Commitments (4-Resp. Consumption; 10- Local to global).

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[90] Europe's Environment: The Second Assessment, EEA, 1998.
[91] European Common Indicators, Ambiente Italia/EC, 2003.

Food intensity related to relevant units: The minimization of food consumption is considered the way to reduce the pressure exerted on the global resources; the increase of efficiency, and thus the decrease of the intensity is the aim that has to be pursued. The trend is related to TSUE actions due to the fact that SUM could play an important role in promoting the footprint calculation and use for firms/citizens sensitisation. It has high relevance in Aalborg Commitments (4-Resp. Consumption; 10- Local to global).

Concern: Wood Consumption

Trends

Wood consumption by sector: The consumption of wood is another item considered in estimating the ecological footprint of an urban area and it is related to the exploitation of natural resources and to the deforestation trend. The trend is related to TSUE actions due to the fact that SUM could play an important role in promoting the footprint calculation and use for firms/citizens sensitisation. It has high relevance in Aalborg Commitments (4-Resp. Consumption; 10- Local to global).

Wood intensity related to relevant units: The minimization of wood consumption is considered the way to reduce the pressure exerted on the global resources; the increase of efficiency, and thus the decrease of the intensity is the aim that has to be pursued in order to avoid over-exploitation. The trend is related to TSUE actions due to the fact that SUM could play an important role in promoting the footprint calculation and use for firms/citizens sensitisation. It has high relevance in Aalborg Commitments (4-Resp. Consumption; 10- Local to global).

Concern: Waste generation

Trends

Waste production (municipal and hazardous): The increase in quantity of municipal and industrial waste represents an impact on natural resources

availability and could create severe problems in waste disposal and processing[92]. The trend is related to TSUE actions due to the fact that SUM could play an important role in waste management and firms/citizens sensitisation. It has high relevance in Aalborg Commitments (4-Resp. Consumption; 5-Planning).

Waste intensity related to relevant units: The minimization of waste generation is considered crucial to move towards sustainable patterns of production and consumption[93] and a way to do it is surely to reduce the waste generation intensity. The trend is related to TSUE actions due to the fact that SUM could play an important role in waste management and firms/citizens sensitisation. It has high relevance in Aalborg Commitments (4-Resp. Consumption; 5-Planning).

Concern: GHGs and CO_2 emissions

Trends

GHGs and CO_2 emissions by sector: GHGs and CO_2 emissions are to be considered because they are the responsible of climate change that is one of the main global environmental concern; main responsibility of the emission of these pollutants can be attributed to urban areas, because emissions generated by energy, transport and industry sectors[94] are most of the times devote to satisfy 'urban' needs. The trend is related to TSUE actions due to the fact that SUT, SUC, SUD and SUM could play an important role in reducing energy consumption and firms/citizens sensitisation. It has high relevance in Aalborg Commitments (4-Resp. Consumption; 10- Local to global).

GHGs and CO_2 emissions by relevant units: The minimization of GHGs and CO_2 emissions in urban areas is considered crucial for reducing the global climate change and a way to do it is surely to reduce the emission intensity. The trend is related to TSUE actions due to the fact that SUT, SUC, SUD and SUM

[92] Sustainable development and health: concepts, principles and framework for action for European cities and towns, European Sustainable Cities and Towns Campaign, 1997.
[93] Sustainable development and health: concepts, principles and framework for action for European cities and towns, European Sustainable Cities and Towns Campaign, 1997.
[94] Environment in the European Union at the turn of the century, EEA, 1999.

could play an important role in reducing energy consumption and firms/citizens sensitisation. It has high relevance in Aalborg Commitments (4-Resp. Consumption; 10- Local to global).

Concern: Waste collection and disposal

Trends

Waste collection by typology (paper, glass, aluminium, …): To close materials cycles, and thus reduce the pressure on the stock of natural resources and reduce the impacts of their final disposal, is fundamental to collect each fraction separated by the others. Selective collection is a trend very sensitive to yearly changes and geographical differences. The trend is related to TSUE actions due to the fact that SUC and SUM could play an important role in improving selective collection and firms/citizens sensibilisation. It has high relevance in Aalborg Commitments (4-Resp. Consumption; 8-Economy).

Waste treatment, landfill disposal, energy recovering, transport: Over the last decade difficulties in urban waste final disposal have increased along with the increasing of waste volume and with the lack of suitable disposal methods and/or sites[95]. The trend is related to TSUE actions due to the fact that SUM could play an important role in improving waste management. It has medium relevance in Aalborg Commitments (4-Resp. Consumption).

Concern: Wastewater disposal

Trends

Households connected to the sewage system: The percentage of the population connected to the sewage system and to wastewater treatment is variable across cities of different countries in Europe[96]. The trend is related to TSUE actions due to the fact that SUM could play an important role in improving sewage systems. It has medium relevance in Aalborg Commitments (3-Nat. goods).

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[95] Sustainable development and health: concepts, principles and framework for action for European cities and towns, European Sustainable Cities and Towns Campaign, 1997.
[96] Europe's Environment: The Third Assessment, EEA, 2003.

Wastewater treatment plants: Municipal wastewater plants are responsible for releasing much of the phosphorus that is found in surface water in Europe; although treatment has improved in many countries, variation across cities is still very large[97]. The trend is related to TSUE actions due to the fact that SUM could play an important role in improving wastewater management. It has medium relevance in Aalborg Commitments (3-Nat. goods).

The following table classifies the State concerns and trends from the point of view of the 3 areas (quality of life, healthy living and environmental performance) and main aspects cited above. It also indicates the relevance of the concerns and trends assessed with the help of criteria listed at the end of the section 7.2.1.

STATE concerns and trends with regard to Quality of the Urban Environment	
Energy availability (+++)	Local production of renewable and not-renewable energy sources and dependency by external local sources (++)
Water availability (Drinking water, groundwater, surface water) (+++)	Scarcity of and access to drinking water (+++) Scarcity of groundwater (++) Scarcity of surface water (+)
Built environment quality (+++)	Housing and building quality (++)
Biodiversity quality (+)	Habitat and species presence (+)
STATE concerns and trends with regard to Healthy Living Environment	
Air quality (+++)	PM_{10}, SO_2, NO_X, NMVOC, CO and O_3 atmospheric concentrations (+++)
Water quality (+++)	Concentration of nitrate, pesticides and microbiological parameters in drinking water (+++) Concentration of nitrate, pesticides and chloride, value of pH and electrical conductivity in groundwater (+) Value of BOD and COD, concentration of nitrate and EBI index in surface water (+) Value of BOD and COD, concentration of suspended particulate matter in wastewater (+++)

[97] Europe's Environment: The Second Assessment, EEA, 1998.

Acoustic environment quality (+++)	Acoustic zonation (++) People exposed to different noise levels or to different source-generated (road, railway, aircrafts, industries, …) noise levels (+++)
Soil quality (+)	Soil pollution (++) Soil losses and erosion (+) Vulnerability to hazardous natural events (+)
Green and open spaces quality (+++)	Availability (++) Accessibility (+++) Fragmentation (+)
STATE concerns and trends with regard to Environmental Performance	
Energy consumption (+++)	Energy consumption by sector (++) Energy intensity related to relevant units (+++)
Water consumption (+++)	Water consumption by sector (++) Water intensity related to relevant units (+++)
Food consumption (+)	Food consumption by sector (+) Food intensity related to relevant units (+)
Wood consumption (+)	Wood consumption by sector (+) Wood intensity related to relevant units (+)
Waste generation (+++)	Waste production (municipal + hazardous) (+++) Waste intensity related to relevant units (+++)
GHGs and CO_2 emissions (++)	GHGs and CO_2-emissions by sector (++) GHGs and CO_2-emissions by relevant units (++)
Waste collection and disposal (+++)	Waste collection by typology (paper, glass, plastic) (+++) Waste treatment, landfill disposal, recycling, energy recovering, transport (++)
Wastewater disposal (+++)	Households connected to the sewage system (+) Wastewater treatment plants (+++)

Overview of selected S-concerns and trends and their relevance for TSUE and it's monitoring.

RESPONSE related concerns and trends with regard to urban management and policy responses at different levels of (state) activity

Concern: Capacity and resources for TSUE and management (steering) of urban environment

Trends

Availability of financial resources Are financial means for management (steering) of urban environment sufficient or not? Availability of sufficient financial resources is one of the basic preconditions for the successful implementation of the TSUE. A very relevant trend.

Sufficient personnel resources Sufficient personnel resources are also crucial for the implementation and success of the TSUE. They can be substituted by financial means and vice versa. Presently, in most European cities financial shortages and budget cuts force cities to save money and reduce the number of employees and this could cause problems with the implementation and monitoring of TSUE.

Autonomy of cities and pertinent changes In connection with this trend we refer to different situation in different European countries with regard to the autonomy of cities to decide on matters, which are relevant for the urban environment. This trend is less important but also relevant for TSUE and its monitoring.

Concern: Co-operation between cities and suburban communities

The quality of co-operation between core cities and suburban communities or the number and intensity of pertinent conflicts and the way or easiness how cities and suburban can solve such conflicts are another important prerequisite of TSUE-successful implementation.

Trends

Institutional set-up, co-operation platforms and institutions In relation to this trend we are interested in institutional arrangements for co-operation between cities and suburban communities and pertinent changes. There are multiple

linkages and functional dependencies between core cities and suburban communities – and in most European countries agglomeration does not exist as an administrative level. Good co-operation arrangements can compensate the administrative anachronism and can be of relevance for a successful implementation of TSUE.

Frequency and intensity of conflicts, conflict resolution Even though both cities and suburban communities have good reasons to co-operate since they complement each other in many respects, the reality is often different and stamped by differences in the social composition of population, divergent interests, differences in political preferences and – as a result of it – by many conflicts which have to be negotiated and resolved.

Concern: Co-operation, exchange of experience with other cities

Trend Participation in national and international city networks TSUE is a European initiative and it's success depends also – even though we consider it less important than above mentioned concerns and trends – on the intensity and quality of co-operation with other cities. This quality can be expressed for example through exchange of experience, which is also mentioned as an intended measure in official documents describing the TSUE. At least the quantitative aspect of this co-operation can be measured with the help of the indicator ”Participation in national and international city networks“.

Concern: Development of urban focus and integration of urban environment in key national policies

Another important policy concern is the development of urban focus and integration of urban environment in key national – and European?! – policies. This concern takes into account the modern way of "outsourced" or ”main-streamed“ policy making and is also mentioned explicitly in documents describing the 6. EAP (see the second policy making principle mentioned in section 2.2) and TSUE.

Trend: Political differences and distribution conflicts between representatives of cities on one and regional as well as federal state levels on the other side Even

though it will not be easy to find good indicators for measurement, we consider this trend as highly relevant for the TSUE and it's monitoring.

Concern: Co-operation and co-ordination of different policies at local level

Trend Adoption of integrated environmental management plans (EMAP) and Implementation of integrated environment management systems (EMAS)

Since many policies are of relevance and exercise strong impact upon the urban environment, co-operation between different departments and actors as well formal and material co-ordination of these policies is of great importance for TSUE. The two most important foreseen tools and instruments of this co-operation and co-ordination are environmental management plans and integrated environmental management systems. For the monitoring of TSUE and its impact upon urban environment it is absolutely essential to gather information and measure the progress of introduction of these two instruments in different European cities.

Concern: Acceptance and implementation of other relevant constituent TSUE-measures

Trends

Information campaigns and other ”soft“ measures Since it is difficult to assess the effects of soft policy measures like information campaigns, we suggest to concentrate the monitoring on the implementation – and not on the efficiency and effectiveness of these measures. Information campaigns and other ”soft“ measures of environment policy – which are foreseen to have a prominent role in TSUE – can achieve their intended objectives, but ideally they should not be implemented alone, but in combination with other measures.

Public procurement, introduction of sustainability requirements into tendering procedures Public procurement is now an important element of many sectoral EU-policies, and some member states oppose the attempt for regulation in domains, which up to now were perceived as purely in national – and very often even regional and local – responsibility. On the other hand, the idea is correct and important the administration and policy makers must first introduce and

follow the policy principles in their own sphere of influence, before they can expect others – households and firms – to change their behaviour.

Eco-labels, product declaration Again a very important and constitutive TSUE-measure aiming to improve the transparency, environmental awareness and knowledge of the consumers. It is believed to have the desired effects, even though the empirical evidence is not completely clear.

Measures, which will be selected and decided upon in future In addition to integrated environmental management plans and systems, other measure are foreseen to play an important role in the implementation of the TSUE. The first three trends relates to measures which are known already and mentioned in the pertinent documents and reports. The last trend is for measures which are unknown yet and will be decided upon in future.

Concern: Public debate and policy discourse on urban environment issues

Trend Degree of consensus and polarisation in the public debate and policy discourse on urban environment issues In many European countries the public discourse on urban environment issues is very intensive and polarises the society into different factions. In spite of such per se undesirable fragmentation and polarisation effects this very often leads to situations, in which it is difficult or even impossible to implement any policy measures.

Concern: Citizens perceptions and attitudes

The first 6 following trends describe TSUE-relevant perceptions and attitudes, the last four the factual TSUE- and UE-relevant behaviour of the citizen. It is a well known fact that the relationship between environmental perceptions and attitudes on one and behaviour on the other side is rather complicated – environmentally friendly attitudes do not necessarily imply environmentally friendly behaviour and vice versa. The data on the first 9 trends should be gathered by the means of a harmonised international survey.

Trends

Environmental awareness and interest for sustainability issues Very important and explicitly mentioned in official TSUE documents. A motivating communication with the citizen is a key element of any policy making strategy and information and data about citizen's environmental awareness and interest for sustainability issues will be important for the work of persons and institutions responsible for the TSUE.

Importance attributed to environmental problems This trend is less relevant and correlates with the previous one. We recommend it here since the pertinent question has been asked for a long time in most representative surveys dealing with the environment and offers therefore good possibilities for longitudinal comparisons in the area of environmental attitudes.

Satisfaction with the state of urban environment This trend was already covered by one of the 10 ECI-key indicators and is clearly very important for the monitoring of the TSUE. Interpretation of answers to pertinent questions is sometimes not easy, since some people express general or unspecific dissatisfaction and blame for it the scapegoat ”urban environment“. Quite frequent are also discrepancies between the objective state of the urban environment and subjective perceptions of the citizen.

Satisfaction with the work of local government and authorities This trend was also already covered by one of the 10 ECI-key indicators and is also very important for the monitoring of the TSUE. What has been said about the citizen's satisfaction with the urban environment is even more valid for their satisfaction with the work of (local) government and authorities – as a matter most people in Europe are rather or even very unsatisfied with their governments and authorities and it is not very clear, how much of this dissatisfaction is caused by their bad work and how much has some other causes. In spite of these methodological and interpretation problems, this trend must be monitored in the framework of TSUE.

Readiness for relevant and necessary behavioural changes: Even though a smaller part of environmental problems could be solved or reduced by other – e.g. technical – means, significant improvements in the state of urban

environments will be possible only with different behaviour of people in the key areas of consumption of natural goods and environmental resources. Again we would like to stress methodological difficulties related to the measurement of the readiness for behavioural changes: Questions of the kind ”Would you be ready to change your behaviour, if ..?” and ”Under what conditions would you be ready to change your behaviour?” have not proved as being very informative and significant for the real later factual behaviour of the people.

Knowledge about the urban environment and sustainable behaviour: Is in many relations and behavioural areas a prerequisite of sustainable behaviour and lifestyles. People have to know how to heat and cool their houses, when and how to drive cars, how to let fresh air into their houses in winter, etc. Some people acquire this knowledge in simpler form of mechanical guidelines for the right behaviour, others want also to understand, how is their behaviour linked to the state of urban environment.

Concern: Citizens behaviour

Trends

Participation in planning at the city and local level This trend is very important and explicitly mentioned in official TSUE documents. Whereas in the past ”grass-root“ and ”basic democracy“ was a model for public participation, presently there is a discussion going on about more efficient participation forms and formalised and selective participation platforms like public fora and ICT play an important role in this discussions.

Adoption and diffusion of UE-friendly life styles Lifestyles are of essential importance not only because of their direct relation to the consumption of natural goods and resources, but also because of their diffusion and multiplicative character.

Purchase of UE-friendly products Purchase of products and goods with attested (labelled) environmental friendliness helps to improve the state of the urban environment. On the other hand it is also a symbolic sign and expression that people do matter about environment and sustainability.

Average household consumption key figures: energy, housing, mobility, waste For many or even most areas of the environmental behaviour there exists official measured consumption data. The most relevant aspects in this relation are traffic and mobility, energy consumption for different purposes, water consumption as well as the production, recycling and disposal of waste.

Concern: Perceptions and attitudes of firms and enterprises

Even though the households and citizens are the most important target group of TSUE, in many relations firms and enterprises are also foreseen to play a key role within the strategy. The below listed trends refer to aspects and characteristics of firms/enterprises, which are mentioned explicitly in official documents describing the strategy (see section 7.1) The first two trends relate to both perceptions and attitudes on one and behaviour of the firms and enterprises on the other side, the last one only to UE-relevant aspects of behaviour (practice) of firms and enterprises. Similar to the above mentioned trends concerning the attitudes and behaviour of citizens, the data on attitudes and behaviour of firms and enterprises will have to be gathered with the help of an international harmonised survey.

Trends

Professional know-how of firms which offer products and services relevant for urban environment Many firms and enterprises offer products and services which are relevant for urban environment – examples are here firms which built or renovate houses, produce and maintain cars, but also firms producing tertiary products like plans and consultancy. Their professional expertise is needed in order to make the right decisions, choose and realise good products and improve the state of urban environment.

Corporate environmental responsibility, sustainability audits and certificates Corporate environmental responsibility (CER) and corporate social responsibility (CSR) are aggregate constructs describing firms and enterprises behaviour in relation to overarching environmental and social goal of the society. Since the assessment of such constructs is methodologically very demanding, it might be simpler to quantify this trend with the help of formalised

and institutionalised quality criteria expressed in form of environmental certificates and audits.

Concern: Behaviour of firms and enterprises

Trends

Average consumption key-figures of firms and branches of economy: energy, waste, mobility Aspects which are relevant in this last connection are energy consumption, production and recycling of waste and the mobility behaviour of the employees, which can be influenced by different measures. Larger firms and enterprises sometimes even develop specific mobility plans.

RESPONSE concerns and trends with regard to the resources, measures and policy integration (SUM)	
Capacity and resources for TSUE and management (steering) of urban environment (+++)	Financial resources (+++) Personnel resources (++) Autonomy of cities (++)
Co-operation between cities and suburban communities (++)	nstitutional set-up, co-operation platforms and institutions (++) Frequency and intensity of conflicts, conflict resolution (++)
Co-operation, exchange of experience with other cities (+)	Participation in national and international city networks (+)
Development of urban focus and integration of urban environment in key national policies (+++)	Political differences and distribution conflicts between representatives of cities on one and regional and federal state levels on the other side (+++)
Co-operation and co-ordination of different policies at local level (++)	Adoption of integrated environmental management plans (EMAP) (+++) Implementation of integrated environmental management (EMAS) (+++)
Acceptance and implementation of other relevant constituent TSUE-measures (++)	Information campaigns and other "soft" measures (++) Public procurement, introduction of sustainability requirements into tendering procedures (++) Eco-labels, product declaration (++)
Public debate and policy discourse on	Degree of consensus/polarisation in the public debate

urban environment issues (+)	and policy discourse on urban environment issues (+)
RESPONSE concerns and trends with regard to the perceptions, attitudes and behaviour of citizen	
Perceptions and attitudes (++)	Environmental awareness, interest for sustainability issues (++) Importance attributed to environmental problems (++) Satisfaction with the state of urban environment (+++) Satisfaction with the work of local government (+++) Readiness for necessary behavioural changes (+++) Knowledge about sustainable behaviour (++)
Behaviour (+++)	Participation in planning at the city and local level (++) Adoption + diffusion of UE-friendly values and life styles (+++) Purchase of UE-friendly products (+++) Average household consumption key figures: energy, housing space, mobility, waste, … (+++)
RESPONSE concerns and trends with regard to perceptions, attitudes and behaviour of firms and enterprises	
Perception and attitudes (++)	Professional know-how of firms which offer goods and services relevant for urban environment (+++)
Behaviour (++)	Corporate environmental responsibility, sustainability audits and certificates (+++) Average consumption key-figures of firms and branches of economy: energy, waste, mobility, … (+++)

Overview of selected R-concerns and trends and their relevance for TSUE and it's monitoring.

Appendix 2: Coverage of the indicators sets studied, gaps indentified

TISSUE analysed the existing gaps by comparing the relevant trends POINTED OUT BY tissue with the indicators existing in the indicators sets studied. The identified weaknesses are listed and commented in the following tables.

Sustainable Urban Transport

TRENDS	*COMMENTS*	*GAPS*
Transport demand	Good coverage	Lack of indicators which monitor freight demand
Accessibility, transport quality	Moderate coverage	• No indicators on the local level • Journey speed (car, public transport) indicators
Affordability	Low coverage	Fixed and variable user costs per mode
Modal split	Good coverage	Modal split based on vehicle kilometres
Transport safety	Good coverage	
Vehicle park	Moderate coverage	Segmentation of car fleet (age, fuel type)
Public transport system quality	Moderate coverage	• Vehicle density • Public transport speed
New transport technologies	Low coverage	Pecuniary investments in New transport technologies
Traffic volume	Moderate coverage	Lack of indicators on the international and national levels
Traffic circulation, congestion	No indicators	• Deviation of travel time per car • Total queue length

TRENDS	*COMMENTS*	*GAPS*
Infrastructure supply	Good coverage	Data available but fragmented
Traffic restriction zones	Low coverage	Data available but fragmented

Sustainable Urban Construction

CONCERNS	*COMMENTS*	*GAPS*
Environmental pollution and consumption of resources	Good coverage. These indicators measure especially the energy use, materials resource use and land use by buildings and the CO2-emissions because of building-related energy use. Many indicators also refer to sustainable construction classification systems.	-
Health and comfort	Low coverage	Monitored only by a couple of indicators Difficult to formulate an indicator on European scale.
Ageing/Disabled and other special groups of users of buildings	Low coverage	Monitored only by some indicators No common systems which classify barrier-free use of built environment and buildings

CONCERNS	*COMMENTS*	*GAPS*
Mobility/Changes in the living standard	Good coverage Accessibility and affordability of housing monitored by many indicators.	Indicators often deal with the issue on the basis of average living space. Aspect of equity should be taken into account.
Business environment, productivity	Low coverage	No specific indicators. Only indicators on parking place
Individuality and client-orientation	Low coverage	No specific indicators.
Age of building stock	Some indicators refer to sustainable renovation classification systems.	Some indicators (refurbishments) Correlation with sustainable construction should be improved.
Technological and information and communication technological development	Low coverage	No specific indicators

Sustainable Urban Design

TRENDS	*COMMENTS*	*GAPS*
Urban sprawl and suburbanisation	Lots of look-alike indicators Well covered by regional sets	Not well covered by European sets.
Consumption of land and space	Indicators of good quality and Well covered Lots of look-alikes	-
Car dependency	-	No appropriate indicator Not taken into account explicitly neither by European/National, nor by Regional sets
Accessibility of basic services and facilities	Lots of look-alikes	-
Densification and clustering of settlements, mixed land use	-	No indicators specifically and directly related to mixed land use but to a part of this concern
Short-distance and public transport oriented development	Existing indicators deal with 3 main issues: access to transports, short distance to facilities and services and pedestrian and cycling friendly approach.	No indicator can summarize all the issues of this trend.

TRENDS	*COMMENTS*	*GAPS*
Balanced development of greenfields and brownfields	Existing indicators deal with 3 main issues: brownfields, greenfields and derelict areas.	Only one indicator takes into account both greenfields and brownfields.
Attractiveness of city centres and amenity of streets and neighbourhoods	Existing indicators deal with 4 main issues: Quality & living environment, Pedestrian and Cycling areas, Urban renewal, Services and facilities.	No headline indicator
Availability and accessibility of green and open space	Existing indicators deal with 2 main issues: Accessibility and Accessibility and availability Lots of look-alikes.	Most part of the existing indicators take into account only green areas and not also open spaces.
ICT contribution to sustainable design of cities and communities	-	No indicators.

Sustainable Urban Management

TRENDS	*COMMENTS*	*GAPS*
Availability of financial resources	well covered by international and regional sets.	Investments should regard more items
Sufficient personnel resources	Not monitored at local level.	No indicators of personnel resources in the reviewed sets.
Autonomy of cities and pertinent changes	Not monitored at national and local levels	Need for more direct indicators of local autonomy and empowerment (e.g. local tax share or decentralisation of responsibilities)
Frequency and intensity of conflicts, conflict resolution	Not monitored at national and local levels	No indicator highlights directly the frequency and intensity of conflicts between core city and suburban communities.
Political differences and distribution conflicts between representatives of cities on one and regional as well as federal state levels on the other side	The indicator monitoring this trend is part of a international set.	Only one indicator monitors this trend.

TRENDS	*COMMENTS*	*GAPS*
Adoption of integrated environmental management plans (EMAP) and Implementation of integrated environment management systems (EMAS)	Lots of duplicates.	Not all indicators are equally representative of integrated environmental practices.
Information campaigns and other "soft" measures	Not monitored at national and local levels.	The two indicators belong to a set (RESPECT) that contains cities in the EU15 countries.
Public procurement, introduction of sustainability requirements into tendering procedures	-	Not well monitored: there is a need for a more comprehensive indicator covering the different public procurement processes and purchase categories. Monitored only at local level
Eco-labels, product declaration		Monitored only at national and local levels.
Degree of consensus and polarisation in the public debate and policy discourse on urban environment issues	Monitored by an international set	-

Appendix 3: Feasibility of Air Quality and Waste indicators

Number of days with exceeding PM10 and O3

Annual average concentration of NO2

Feasibility

The TISSUE CORE 1 Air Quality indicators should be already measurable by DGENV and by the assisting organisations (EEA and ETC/ACC) upon data reported by Member States according with EC Decisions related to on going Reporting obligations (Decision 2004/461/EC) and with EC procedures for the exchange of information (Eol, Decision 2001/752/EC)[98]. Recently the European commission (DG ENV), by means of Commission Decision 2004/461/EC of 29 April 2004, set out a questionnaire to be used for annual reporting on air quality assessment under the framework directive (96/62/EC) and its daughter directives (1999/30/EC, 2000/69/EC and 2002/3/EC)[99]. The DG ENV prepare than a guidance document and a predefined excel sheets to the questionnaire[100]. Yearly reporting is compulsory for the 25 EU countries[101].

Directive 96/62/EC defined different options for assessing the air quality depending on population concentration and/or density and the existing levels of each pollutant. Briefly, the options are:

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[98] According with the procedure Eol, member-states can either report raw data (corresponding to the recommended averaging time) and quality objectives or send both data and statistics. In the first case, the statistics will be computed by the Commission itself.

[99] This Directive up dates the Decision 2001/839/EC laying down a questionnaire to be used for annual reporting on ambient air quality assessment under Directives 96/62/EC and 1999/30/EC44 provided a model on the basis of which Member States were to provide the information on air quality required under those Directives.

[100] Member states must codify each zone where data have been collected indicating whether the zone is an agglomeration or not. Member-States must declare if they use Standard Methods or use any other method which it can demonstrate gives results equivalent to the Standard Method.

[101] The reporting to European Commission (DG ENV) is compulsory for the 25 European countries (Cyprus, Czech Republic, Denmark, Estonia, Finland, Austria, Belgium, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, United Kingdom).

- the assessment of ambient air quality based on measurement is mandatory:
  - in the agglomerations (zone with a population > 250.000 inhabitants or, where the population is 250.000 inhabitants or less, a population density per km² which for the Member States "justifies the need for ambient air quality to be assessed and managed"),
  - in zones in which levels are between the limit values and the upper assessment threshold, and other zones where levels exceed the limit values.
- a combination of measurements and modelling techniques may be used to assess ambient air quality where the levels over a representative period are below the upper assessment threshold.
- the sole use of modelling or objective estimation techniques for assessing levels shall be possible where for a representative period the levels are below the lower assessment threshold.

Considering these alternatives, requested data should be available in the next years, if adequate investments supporting local monitoring will be provided. In particular it is expected to have data for the agglomerations with more than 250.000 inhabitants (even if limit/target values are not exceeded) and for the agglomeration with less inhabitants but where the concentration levels are at least above the upper assessment thresholds (evaluated for each single pollutant). As already mentioned above while presenting the selected air quality indicators, for agglomeration where concentration levels are below the lower assessment thresholds probably no fixed measurement will be available (for one or more pollutant); in that case the agglomeration must report the maximum concentration level estimated (for each one of the pollutants which concentration level is below the lower assessment threshold) with the use of modelling or objective estimation techniques.

Measurement techniques, even for the well-established PM10 metric, are still intensely debated, so the city data comparability is still rather limited and must be developed with some caution. The reference method (gravimetric: conditioning and weighing filters on a precision balance before and after sampling on a filter in the field) essentially defines what PM10 is, by specifying the device that separates (with a finite cut-off range) particles up to 10 μm from larger particles. This method is labour-intensive and does not provide up-to-date information to the public. There are also other methods widely in use, in

particular the beta-absorption and TEOM® methods. Discrepancies between these automatic methods and the reference method are significant (typically 10 to 30%, sometimes as much as 50%). An EU working group has provided guidance on how to determine a correction factor to achieve the equivalence required by the First Daughter (EC Working Group on Particulate Matter. Guidance to Member States on PM10 monitoring and intercomparisons with the reference method, Directive, European Commission 2002). Some correction factors have been applied for PM10 from 2001 onwards (leading for instance BE to revise PM10 concentrations by 37%). Although the application of such factors seems unavoidable, they have not been applied retro-actively in all countries before 2001. Therefore, the comparability over time and across countries is limited for PM10 data before 2002.

In the recent years data have been collected by means of the following initiatives:

- The EEA Report on Air Pollution 1990–2000 (2003) has used air quality data from AirBase, the European air quality database[102], collected by the European Topic Center on Air and Climate Change (ETC/ACC). From 1996 to 2000, the EEA considered (around Europe): 827 SO2 stations; 794 NO2 stations; 666 Ozone stations; 146 PM10 stations.
- The WHO review project on health aspects of air quality (2004), was based on a meta-analysis of time-series and panel studies of particulate matter and ozone[103].
- The ECI review (2002) collected the data needed to calculate the European Common Indicators directly from the signatories to the voluntary agreement ”Development, refinement, management and evaluation of the European Common Indicators initiative“; the Indicator 5 – Quality of Local Outdoor Air received data from 23 participants local authorities[104.]

[102] The AirBase information system is developed and maintained by the European Topic Centre on Air Quality on behalf of the European Environment Agency (EEA). It contents air quality data for a selection of stations and a number of components, and meta information on air quality monitoring networks and stations. The current database contains information transmitted by EIONET partner states in the framework of "Exchange of Information" (EoI) Decisions, or as part of EuroAirnet.

[103] WHO Europe (2004), *Meta-analysis of time-series studies and panel studies of particulate matter (PM) and Ozone (O_3),* Report of a WHO task group.

[104] Ambiente Italia et al. (2002), *ECIP Interim Report – April 2002.*

- The Urban Audit review (2004) has collected data from 189 Cities in the EU, plus 69 Candidate Countries; with the following response rate: 54% to winter smog; 52% to summer smog; 53% NO2 exceedings; 44% PM10 exceedings; and 25% Pb concentration[105].
- Ecosistema Urbano benchmark 103 cities in Italy from 1994, collecting data on air quality directly from the cities that participate on the initiative. To the last review (2004), 94 cities gave data on its monitoring system; 79 gave CO monitoring data; 77 gave NO2 monitoring data; 71 gave O3 monitoring data; 62 gave benzene monitoring data; 68 gave SO2 monitoring data; and 72 gave PM10 monitoring data[106].
- The City of Linz (Austria) began to benchmark itself, collecting data on air quality in a number of EU cities from 1992. In the latest Air Quality Survey (www.linz.at/Umwelt_28269.asp) data are available for 46 cities.

Municipal solid waste generation

Municipal solid waste treatment

Feasibility

The indicators are coherent with the above legislative and policy framework and the below reporting procedures (see at Feasibility). The Eurostat's Structural indicators include three indicators for municipal waste, one related to waste generation – amount of waste collected by or on behalf of the municipal authorities, and two related with the municipal waste treatment system – amount which are land-filled and amount which are incinerated. Data are collected by mean of an Eurostat / OECD (Organisation for Economic Co-operation and Development) Joint Questionnaire, that, from 2006, will be replaced by the mandatory data collection under the Waste Statistics Regulation (Regulation (EC) n. 2150/2002). Urban Audit (2004) adopted the following indicators for waste generation and treatment and disposal system:

[105] European Commission, Eurostat – Theme 1 General statistics (2004), *Urban Audit - Methodological Handbook*.
[106] Ambiente Italia (2004), Data base Ecosistema Urbano.

- Collected solid waste per capita per year (same waste definition as the one proposed by this sheet);
- Proportion of solid waste processed by landfill;
- Proportion of solid waste processed by incinerator;
- Proportion of solid waste processed by recycling;
- Proportion of solid waste processed by other methods;
- Annual amount of toxic waste per capita.

Many other existing indicators sets at national and local level, individuated and assessed by **TISSUE**, have adopted the indicators proposed (upon different names, and by means of methods and metrics that could be easily harmonised)[107].

The European Parliament and Council Regulation (EEC) n. 2150/2002 on waste statistics (Waste Statistics Regulation, WSR), establishes a framework for the production of Community statistics on the generation, recovery and disposal of waste (considering hazardous and non-hazardous waste generated by economic activities; waste generated by households; waste arising from recovery and/or disposal operations), in order to ensure comparability of the results in waste statistics supplied by Member States. The WSR, amended by the Commission regulation (EC) n. 574/2004 to incorporate the European List of Waste (LoW) established by Commission Decision 2000/532/EC[108], comprises three technical annexes (Annex I on generation of waste, Annex II on recovery and disposal of waste and Annex III that reports a table of equivalence between the LoW and the Statistical waste classification request on the WSR (EWC-Stat Rev. 3)) describing the data to be transmitted, by the Member States to Eurostat. Data collection will take place every second year starting from 2004; the first set of statistics will be available to the Commission in 2006.

[107] Municipal waste generation: CEROI, Ecobudget, Cities21, Nordic Larger cities, Ecosistema Urbano, Local Quality of Life Counts; Municipal waste separately collected: CEROI, EEA Dobris, ISDIS, Healthy cities, ACI, Cercle, Ecosistema urbano; Waste treatment: EEA Dobris, Healthy cities, RESPECT, ACI.

[108] Amended by the Commission Decision 2001/118/EC, the Commission Decision 2001/119/EC and Council Decision 2001/573/EC.

The WSR, referred to national level, asks Member-States to report the total quantity of waste generated as indicated on its Annex I, that (differently from the Directive) categorises waste per typology and not per source. As a consequence, the WSR municipal waste streams are included in several voices that consider also other types of non municipal waste. However, considering that WSR procedures asks to Member States to collect and record data at different level of aggregation (all waste categories, all sources and territorial scale) the national data base could be required to collect the useful municipal data.

In any case, due to the fact that data at municipal level are produced and available at city level, a collection at European level could be feasible if an efficient reporting mechanism is in place, and if definition and level of aggregation of data are respected by the municipalities and validated by who is charged for data processing.

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Title

Trends and Indicators for Monitoring the EU Thematic Strategy on Sustainable Development of Urban Environment

Final report. Summary and recommendations

Abstract

Trends and Indicators for Monitoring the EU Thematic Strategy on Sustainable Development of Urban Environment (TISSUE) belonged to the 6th framework programme area "Integrating and Strengthening the European Research Area". The overall goal of the project was the following:

1. to analyse demand and define appropriate trends which should be measured to properly determine progress towards sustainable development of the urban environment at local level;
2. to carry out comparative research on existing sets of indicators;
3. to define the set-up needed for a harmonised set or subset of indicators;
4. to collect indicators and structure the indicators into a database.

TISSUE outlined the urban indicators considering the following main areas: sustainable urban transport, sustainable urban design, sustainable urban construction, sustainable urban management and sustainable urban environment (energy, emissions, air quality, noise, wastes, biodiversity).

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Häkkinen, Tarja

Nimeke

EU:n temaattisen strategian linjauksien mukaiset kaupunkiympäristön kestävän kehityksen seurannan indikaattorit

Tiivistelmä

Tässä julkaisussa esitetään yhteenveto EU:n komission kuudennessa puiteohjelmassa toteutetun TISSUE- (*Trends and indicators for monitoring the EU thematic strategy on sustainable development of urban environment*) hankkeen tuloksista.

TISSUE-hankkeen tavoitteena oli

1) analysoida kaupunkien kestävän kehityksen huolenaiheet ja trendit
2) kerätä ja vertailla kaupunkien kestävän kehityksen indikaattorisysteemeitä ja indikaattoreita
3) analysoida eri indikaattoreiden soveltuvuutta kaupunkien kestävän kehityksen seurantaan sekä laatia ehdotus harmonisoitavaksi indikaattorisysteemiksi. Ehdotettujen indikaattoreiden avulla tulisi voida seurata kaupunkialueiden temaattisen strategian toteutumista ja kestävää kehitystä paikallisella tasolla.
4) laatia verkkoon TISSUE-selain, jonka avulla voidaan etsiä indikaattoreita eri tarpeisiin.

TISSUE-hanke analysoi ja vertaili kaupunkien kestävän kehityksen trendejä ja indikaattoreita neljän pääteeman suhteen. Pääteemoja olivat:

1) kaupunkialueiden kestävä hallinto (*Sustainable urban management*)
2) kaupunkialueiden kestävä liikenne (*Sustainable urban transport*)
3) kaupunkialueiden kestävä rakentaminen (*Sustainable urban construction*)
4) kaupunkialueiden kestävä aluesuunnittelu *(Sustainable urban design)*.

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