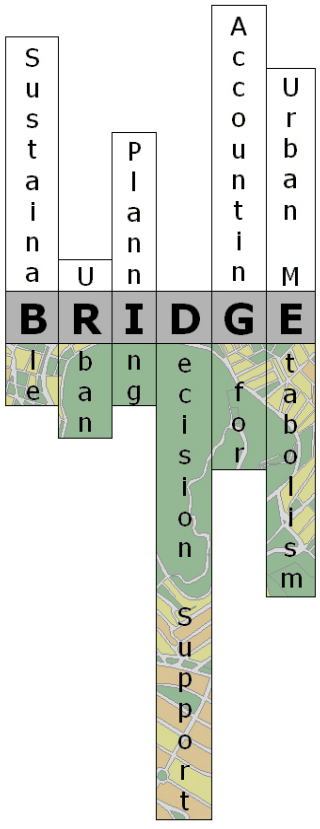
SEVENTH FRAMEWORK PROGRAMME

THEME 6: Environment (including climate change)

Contract for: **Collaborative Project**

D.8.1
DSS demonstration report[*]



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1 Introduction

1.1 Purpose of the document

This document is Deliverable 8.1 – *DSS demonstration report. Evaluation of the applicability of the first BRIDGE DSS prototype; Report of Umbrella Workshop I (5 May 2010)*, produced from Task 8.1 to organize an Umbrella Community of Practice (CoP) with representatives of the local CoP's. This report presents the results of ten CoP meetings in the five case study cities in 2009 and 2010, and of the Umbrella CoP workshop in 2010. The Umbrella CoP workshop was used to share experiences between cities, and to practice for the first time with a prototype version of the DSS. The **aim of this document** is to present a summary of the CoP meetings, the Umbrella CoP workshop results, and to formulate recommendations for the design of the DSS. We want to thank all participants of the CoP meetings and the Umbrella CoP workshop for their contributions.

1.2 Acronyms

3D	Three Dimensional
BRIDGE	sustainaBle uRban plannIng Decision support accountinG for urban mEtabolism
CAZ	Central Activity Zone (London)
CBA	Cost Benefit Analysis
CC	Climate Change
CMCC	Centro Euro-Mediterraneo per i Cambiamenti Climatici
CNR	Consiglio Nazionale delle Ricerche, National Research Council Italy
CO	Carbon monoxide
CO2	Carbon Dioxide
CoP	Community of Practice
DLO	DLO Foundation, part of Wageningen University and Research Centre
DSS	Decision Support System
EC	European Commission
EIA	Environmental Impact Assessment
EU	European Union
FORTH	Foundation of Research and Technology-Hellas
GHG	Greenhouse Gases
GIS	Geographical Information System
GLA	Greater London Authority
HIA	Health Impact Assessment
IETU	Institute for Ecology of Industrial Areas (Katowice)
KCL	Kings College London
LCA	Life Cycle Analysis
MCDM	Multi Criteria Decision Making
NKUA	National and Kapodistrian University of Athens
NOx	Nitrogen monoxide and nitrogen dioxide
O3	Ozone
PM	Particulate Matter (PM10: smaller than 10µm)
SEA	Strategic Environment Assessment
SOx	Sulphur monoxide and sulphur dioxide
TCD	Trinity College Dublin
UAVR	University of Aveiro
UBAS	University of Basel

UHEL	University of Helsinki
UHI	Urban Heat Island
UK	United Kingdom
UPM	University of Madrid
WP	Work Package
WUR	Wageningen University and Research Centre

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1.4 BRIDGE project overview

Urban metabolism considers a city as a system and distinguishes between energy and material flows. “Metabolic” studies are usually top-down approaches that assess the inputs and outputs of materials, water, energy, etc. from a city, or that compare the metabolic process of several cities. In contrast, bottom-up approaches are based on quantitative estimates of urban metabolism components at local scale, considering the urban metabolism as the 3D exchange and transformation of energy and matter between a city and its environment. Recent advances in biophysical sciences have led to new methods to estimate energy, water, carbon and pollutant fluxes. However, there is poor communication of new knowledge to end-users, such as planners, architects and engineers.

BRIDGE aims to illustrate the advantages of considering environmental issues in urban planning, with particular focus on specific metabolism components (energy, water, carbon, pollutants). BRIDGE’s main goal is to develop a Decision Support System (DSS) which has the potential to propose modifications to the metabolism of urban systems towards sustainability.

BRIDGE is a joint effort of 14 Organizations from 11 EU countries. Helsinki, Athens, London, Firenze and Gliwice have been selected as case study cities. The project uses a “Community of Practice” (CoP) approach, where local stakeholders and BRIDGE scientists meet on a regular basis to learn from each other. The end-users are therefore involved in the project from the start. These meetings are used to discuss and define the key sustainability issues for each city. These provide the basis to determine the sustainability objectives and associated indicators, as well as their relative importance, which would help assess planning alternatives with the overall goal of promoting sustainable development.

The BRIDGE project integrates key environmental and socio-economic considerations into urban planning through Strategic Environmental Assessment. The BRIDGE DSS evaluates how planning alternatives can modify the physical flows of the above urban metabolism components. A Multi-Criteria Decision Making (MCDM) approach has been adopted in the BRIDGE DSS. To cope with the complexity of urban metabolism issues, the indicators measure the intensity of the interactions among the different elements in the system and its environment. The objectives are related to the fluxes of energy, water, carbon and pollutants in the case studies. The evaluation of the performance of each alternative is done in accordance with the assigned weights for each criterion to measure the performance of individual alternatives.

The energy and water fluxes are measured and modelled at a local scale. The fluxes of carbon and pollutants are modelled and their spatial-temporal distributions are estimated. These fluxes are simulated in a 3D context and also dynamically by using state-of-the-art numerical models, which normally simulate the complexity of the urban dynamical process exploiting the power and capabilities of modern computer platforms. The output of these models leads to indicators which define the state of the urban environment.

Several studies have addressed urban metabolism issues, but few have integrated the development of numerical tools and methodologies for the analysis of fluxes between a city and its environment with its validation and application in terms of future development alternatives, based on environmental and socio-economic indicators for baseline and proposed situations. The innovation of BRIDGE lies in the development of a DSS integrating the bio-physical observations with socio-economic issues. It allows end-users to evaluate several urban planning alternatives based on their initial identification of sustainability objectives. In this way, sustainable planning strategies will be promoted, based on quantitative evidence in relation to energy, water, carbon and pollutant fluxes.

1.5 Communities of Practice (CoP's) in the BRIDGE project

'Communities of Practice' (CoP's) were used as a method to facilitate communication between BRIDGE scientists and potential end users of the BRIDGE DSS. The method was fully explained in D2.3 (Groot et al, 2009); we only provide a short summary here. Originally, a CoP is a 'natural' phenomenon of people with similar practices getting together on a regular basis to learn from each other (Wenger, 2002). This principle is used in BRIDGE to bring together practitioners from the cities with environmental researchers to discuss sustainable urban planning. Next to this, the participants are asked for input of ideas for the BRIDGE project. An effort has been made to establish a CoP in each of the five cities, and two rounds of meetings were organized in each city as well as an umbrella CoP workshop where representatives from each city came together. From each of these meetings a separate report is available on the website of the BRIDGE project (http://www.bridge-fp7.eu/). This report, Deliverable 8.1, presents the results of the umbrella workshop.

CoP II Florence, 16 October, 2009

CoP II London, 1 April, 2010

Table 1.1. CoP's and number of participants

	Date CoP1	Group size	Date CoP 2	Group size
Helsinki	15 June 2009	21	20 Jan 2010	17
London	24 Aug 2009	24	1 April 2010	10
Athens	8 Oct 2009	50	18 Feb 2010	29
Florence	16 Oct 2009	17	3 Dec 2009	14
Gliwice	20 Oct 2009	30	28 Jan 2010	26
Total		142		96

1.6 Umbrella CoP aims and program

The ten local CoP meetings were followed by an umbrella CoP on the 5th of May, 2010, in Athens (Metropolitan Hotel). In that Umbrella meeting the practitioners from the different European cities met each other. The aim of the meeting was, firstly, an exchange among urban planners and BRIDGE researchers on sustainability issues in the five case study cities of BRIDGE. The second aim was to reach an agreement on a list of indicators that were considered to be relevant for all five participating cities. Thirdly, the aim was to do a first exercise with a beta version of the BRIDGE Decision Support System (DSS).

For the programme of the meeting see table 1.2. A presentation was given on sustainable urban planning in each case study city (Athens, Florence, Gliwice, Helsinki, and London) by one of its representatives. Table 1.3 lists the presenters of each city. These presentations included planning concepts, challenges, assessment tools in use and real life case studies within each city. The case study leaders gave a short overview of BRIDGE activities in each city. This part of the workshop is described in Chapters 2 and 3.

Umbrella CoP workshop, May 5th, 2010, Athens

In a separate session all previous information and ideas on environmental and socio-economic indicators were summed up and a selection was made as input for the DSS as a core set of indicators applicable to all the case study cities. Next to this a list of indicators was made of indicators that were only relevant in some of the cities (considered a "discretionary" or case-specific set of indicators). This part of the workshop is briefly described in section 3.6, and fully in another deliverable of the BRIDGE project (D5.1).

During a final session detailed feedback was gathered on the usefulness and accessibility of the first version of the DSS. Outcomes are used to design the BRIDGE DSS according to needs and interests of its target groups. The DSS feedback session is reported on in section 3.7. How these end user comments are implemented in the DSS is reported in the deliverables of Work package 6.

Table 1.2: Umbrella CoP workshop program 5 May 2010, Athens

9:30 – 11:15	Morning session I – Shared issues	Presented by
	Introduction and presentation of shared issues	Judith Klostermann, (WUR-Alterra)
	Sustainable urban planning in five case study cities: 1. Local practices: Concepts, issues and assessment tools in use 2. Real life projects, including planning alternatives	Representatives from the case study cities (See table 3.1)
11:30-13:00	Morning session II –Sustainability indicators	
	1. Are the indicators chosen identical with generic sustainability aims in the local urban contexts, or specific to the planning case chosen? Can they be identified as "typical" issues encountered also in other urban areas? What are the methods of measuring them? 2. Which of these environmental and socio-economic indicators can be commonly applied to assess sustainability across Europe? 3. Which indicators are most relevant or need to be prioritized? Which ones can be measured by BRIDGE? What are the key gaps (i.e. if BRIDGE cannot measure them, can alternatives be efficiently assessed)?	Ainhoa Gonzales del Campo (TCD) and Margaretha Breil (CMCC)
14: 00 - 18:00	Afternoon session III – Prototype DSS	
	1. Introduction to the prototype DSS 2. Practicing sessions with the prototype DSS 3. Feedback: identification of points to improve DSS in content, structure and process	Nektarios Chrysoulakis and Zina Mitraka (FORTH)

Table 1.3: Overview of case study cities and persons presenting at the Umbrella CoP

Case study city	*Representative*	*Organization*
London	Louise Clancy	Greater London Authority
Helsinki	Olli Jokinen	City planning Department Helsinki
Gliwice	Marcin Czyż	Municipality of Gliwice
Athens	Vassilis Kostovassilis	Prefecture of Athens
Florence	Alberto Giuntoli	Urban Park City Council of Florence

1.7 Method of analysis of the CoP reports

From each of the ten Community of Practice meetings (Athens, Florence, Gliwice, Helsinki and London) meeting reports and minutes have become available; these documents have been analysed to find shared issues between the five case study cities. The CoP reports have been coded with "Atlas-ti", a text analysis software. The method used was open coding: the reports were read and codes attached to parts of the text, based on the interpretation of the researcher. Each code has to represent an important theme encountered in the text. After revision and merging of codes, the resulting list of codes was grouped in order to produce an orderly and consistent summary. The groups of codes are shown in Annex B. A summary was written for each group of codes.

The results were presented at the Umbrella CoP meeting on May 5, 2010. There, additional information was presented by the representatives of each case study city. Of the meeting, minutes were produced, and the contents were added to the information of the ten CoP reports. It must be noted that the CoP meetings did not have a strict format (because a CoP requires some freedom in the interaction process); the number and kind of attendants differed, and the CoP reports were made by different people. Because of this, the CoP reports varied in their content, and not all information is therefore available for every city.

The following two chapters present the summaries based on the content of the reports from the ten CoP meetings and the minutes of the Umbrella meeting. Chapter 2 is on environmental issues, chapter 3 on planning institutions, methods and tools.

1.8 Outline of the document

Chapter 2 summarizes the sustainability issues discussed during the ten local CoP meetings (two in each city) and the Umbrella CoP workshop held in Athens on May 5, 2010. It provides detailed information on the issues, challenges, solution strategies and open questions for realizing sustainable urban planning in the five case study cities. The results are categorized in a number of environmental themes.

Chapter 3 reports the results of the ten local CoP meetings and the Umbrella CoP meeting in the area of governance, social and economic issues and planning procedures and tools.

Chapter 4 presents the so-called 'real life case studies', or planning alternatives, for each case study city. These embedded case studies were formulated to create realistic planning questions to be answered by the DSS.

Chapter 5 presents the results of the discussions on sustainability objectives and indicators. Lists of potential indicators had been formulated in the various CoP workshops, and at the Umbrella CoP participants agreed on a final, combined set of environmental and socio-economic indicators (see also Deliverables 5.1, 5.2 and 5.3).

Chapter 6 reports the outcome of the DSS try out session during the Umbrella CoP workshop A beta version was installed on a number of laptops and potential end users could try some steps with it.

Finally, chapter 7 summarizes the main conclusions and translates those to recommendations and evaluation criteria for the BRIDGE DSS.

2 Urban metabolism issues in BRIDGE case study cities

2.1 Introduction

During the CoP meetings and the Umbrella CoP workshop the participants discussed what the issues and challenges in their city were for sustainable urban planning. Below the issues, and connections between issues, are reported, as they emerged from the CoP meeting reports and the minutes of the Umbrella CoP workshop.

2.2 Public health and air pollution

In this section topics are summarized that are related to public health. The main issue brought up by the participants is air pollution (NO_X, SO_2, CO, O_3, PM10 and PM2.5, Benzene) and its effects on human beings in the cities. Sometimes public safety issues (dealt with in the paragraph "Economic and social problems") are also related to public health by participants, as well as harmful substances that affect public health indirectly e.g. via their effects on climate change (like CO_2). Public health has been described during the Athens CoP as:

> *"Public health and safety issues include both car and pedestrian accidents, and the inhalation of the air pollutants. Lack of green areas make the situation worse." (Synnefa, 2010)*

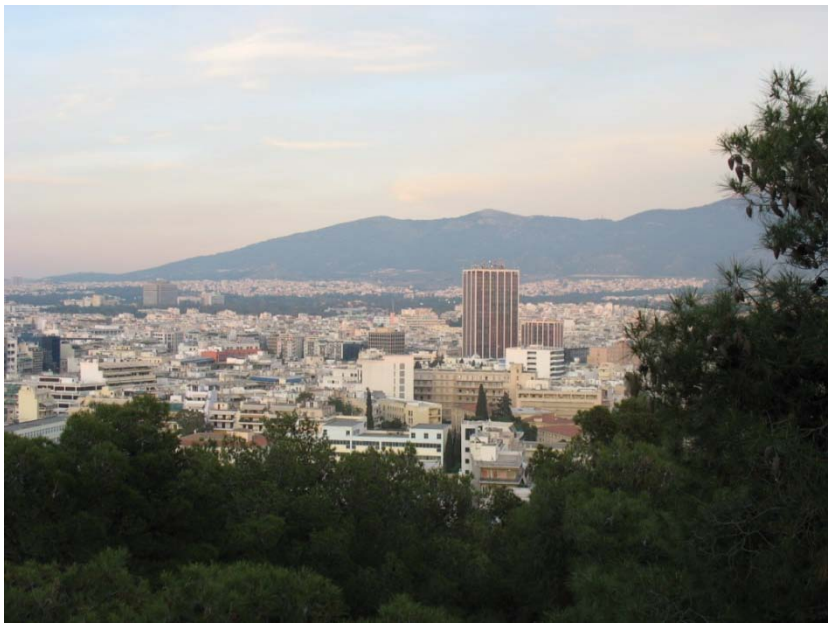
The summary in this section is restricted to air quality. Sources of harmful constituents of the air are mainly emissions by traffic, heating systems and industry. The effects of poor air quality on a city's population are the main reason why reducing air pollution is such an important planning objective in all five cities. Health risks due to poor air quality increase during heat waves (see paragraph "Thermal discomfort") and the large population of older citizens is especially vulnerable. Every city has air pollution monitoring networks and plans to deal with this problem.

According to the CoP in Athens, in their city centre, CO_2 and SO emissions have significantly decreased during the last decade, whereas NO_2 emissions remain stable. O_3 concentrations are quite high, they vary from year to year but overall remain stable too. Especially PM10 is increasing in Athens which leads to extra concern. Improving air quality by minimizing emissions is therefore perceived as a core sustainability objective for Athens (particularly CO_2, NO_X and PM). According to the CoP reports, air pollution seems a major challenge in the chosen case study in Athens (Egaleo). One of the national roads is passing through Egaleo. Heavy traffic leads to increased CO_2 emissions and air pollution. Individual traffic is also generated by the final station of the city's metro network where people park their cars. Retrofitting Thivon Avenue and creating more parking spaces in adequate areas is part of the plan to reduce air pollution. Specific objectives for Athens, Thivon Avenue, are improving air quality and reducing emissions.

The situation is comparable in Florence (PM10, CO_2, NO_X, SO_X, CO; reduce humidity). In this city, air quality is also a key planning priority. A factor that the DSS should be able to model seems to be the effect of vegetation in Florence on sequestering dust and PM. This shows that air quality issues are closely related to green space management in the cities (see also paragraph "Green and open spaces").

In Gliwice the main issues are PM and CO_2. The air protection programme for the Province of Silesia, relevant for Gliwice, focuses on elimination of waste and low-quality coal combustion in private stoves, reducing traffic related emissions, and elimination of emissions from industrial sources in the areas where air quality standards are exceeded. The goals of the programme are also to create an information system

concerning current air pollution and its health impact as well as raising public awareness about actions related to the pollutants, especially PM10 and benzo(a)pyrene resulting from low-quality coal emissions.



Athens (photo Klostermann, 2010)

In Helsinki CO_2 is the main issue.

Air quality is a persistent problem in London, especially for NO_2 and PM10 the air quality norms cannot be achieved. While air pollution seems to be perceived as a major issue in all cities, implemented actions to reduce it have only been mentioned for London. The city of London has realized several policies to improve air quality in the last few years. A congestion charge has been applied for the centre of the city which reduced emissions, accidents, and traffic (by 21%) and congestion (by 30%). However, congestion benefits have eroded after a few years due to removed road capacity (caused by a large number of sub ground road repairs). The overall effect is still positive:

> *"The gloomy predictions that the congestion charge would wreck the economy and create a ghost town did not happen, it is a workable policy, though unpopular. Future challenges are how to compete for road space, how to regulate street works, and how to manage demand: carrot or stick?" (Beevers 2009)*

A second effort is the London Low Emission Zone (since 2008) where goods and services vehicles have to comply with a low emission standard (nearly 100% compliance). Air quality is still a problem and meeting the EU standards is difficult in London. The new Mayor Boris Johnson who came into office in 2008 wrote a strategy for climate change adaptation in London. A lot of other interdependences are expected which make the DSS a valuable tool to address these issues:

> *"Another question is about the relation between energy use, green spaces, air quality and water use. That is why GLA is interested in the BRIDGE tool: can the DSS help us to quantify and weigh out different options? For example, is the extra cooling worth the extra air pollution? In July and September 2010, the Mayor's strategy will be inspected; can BRIDGE produce some valuable evidence? Maybe the tool can also spot and describe the problems better before solutions are implemented."(Grimmond 2010)*

The current London air quality strategy has a main thrust to improve combustion technology and to influence citizens' behaviour. Seven priority locations for reducing PM have been identified. Goals for NO_2 are considered to be set next. London has a heat wave plan but the criteria for putting the plan into operation probably need to be changed in the future. The strategy to adapt to climate change and reduce the urban heat island (UHI) effect is supported by the use of nested models of different scales to investigate e.g. the use of different surface materials to increase the albedo. The DSS should be able to answer questions like the one mentioned in the quotation above: how are energy use, green spaces, air quality and water use related?

2.3 Thermal discomfort

Temperatures in urban areas are known to be higher on average and especially during the night compared to temperatures in the rural surroundings – the so called urban heat island (UHI) effect. This and local characteristics like surface properties (albedo), housing insulation and ventilation as well as individual factors for each person influence the thermal comfort of people living in a city. Thermal discomfort was considered relevant in urban planning considerations in warm climate cities Athens and Florence. It also arises as a problem for megacities in moderate climates like London. In Gliwice and Helsinki cold extremes were a problem.

The air temperature in the case study area "Egaleo" in western Athens was found to be 5 °C higher in the afternoon compared to the city centre: so within cities, the UHI effect may be more extreme in some parts of a city. Bad insulation transfers the problem into the buildings; inside low income houses in Athens, 42 °C have been measured. Thermal comfort could be increased by better building infrastructure, but:

> *"…the people that are mainly affected by this problem cannot afford to rehabilitate their houses. According to statistical data older houses, with a smaller surface, poor environmental quality and increased energy consumption correspond to low income people." (Synnefa, 2009)*

Increased energy demand for air conditioning generates further problems. Poorly insulated houses in western Athens consume twice the amount of energy for cooling compared to northern Athens – if people living there can afford it. Power failures and increased CO2 emissions are secondary but not negligible problems. For Athens a specific objective is to reduce thermal discomfort.

Major environmental issues and challenges for London are caused by climate change: warmer winters, dryer summers causing overheating and droughts. Heat waves due to climate change make the problem even worse. During the extremely hot summer of 2003, 600 people in London died of summer heat. The UHI effect avoids that the city can cool off at night, so temperatures may be 10 °C higher for the centre of London than at the rural surroundings.

The main strategy to reduce thermal discomfort mentioned during the Cop's (Athens, Florence, London) is to mitigate the UHI effect by using appropriate surface materials and increase the amount of urban vegetation. For all CoP participants it was evident that trees and green areas have an effect on thermal comfort, but also that quantifying these effects is difficult (see paragraph "2.5 Urban green and open spaces"). Interesting research in this area has been presented: the GREEN project in Florence where surface/air temperatures are measured before and after actions were implemented; general investigations on the effects of urban surface (land use, albedo, vegetation etc.) on temperature (Athens, Florence, London); and the London strategy to adapt to climate change and reduce the urban heat island effect (see paragraph "2.1 Public health and air pollution").

Air conditioning devices in Athens
(photo: Klostermann, 2010)

Furthermore, increasing the energy efficiency of old buildings (Athens), reducing the likelihood of air conditioning by appropriate building types (London) and identifying vulnerable people in advance (London) have been brought up as ways to assess thermal discomfort impacts. However, the latter issue is not straightforward as a London participant explained:

> *"We struggle to map the vulnerability [but] it tends to be out-dated as soon as you have the data. There are civil rights against info collection, people move a lot, it also varies from day to day per person. How to simplify this information?"(Grimmond, 2010)*

2.4 Energy efficiency and CO_2 reduction

Energy
Energy use and energy efficiency have been perceived as key planning issues in all CoP meetings. A general decrease in energy use, improved efficiency and an increased use of renewable energy are throughout all cities mentioned as the main categories of problems. Optimizing energy use and efficiency includes many possible objectives as discussed in the CoP meetings. Objectives mentioned in one city are probably also generally valid for the other cities:

- improved efficiency for street lighting (Athens)
- Improve infrastructure, e.g. insulation of (old) buildings (Athens: insulation and air tightness Florence: especially windows; Gliwice: pipe-insulation of central heating system);
- Reduce anthropogenic heat production (Florence);
- Develop passive heating in new buildings (Florence);
- Reduce energy consumption of public buildings as a way to motivate citizens (Florence);
- Zero emission of new settlements (Florence, Helsinki);

- Decentralizing energy networks (London: idea to create small power stations, trigeneration of heat, power and cooling. Target: 25% of decentralized energy, replacing individual air conditioning systems in big buildings).

The following topics have been related to an increasing use of renewable energy:

- Promote use of solar energy (Athens)
- Increase hot water production by solar energy (Florence)
- Use organic waste for bioenergy (Florence, London)
- more innovative and energy-saving solutions (Gliwice)
- Increase use of wind energy (London, see quotation below)

"Production of 945GWh of energy from renewable sources by 2010 including at least six large wind turbines." (Beevers 2009)

Even if national or regional guidelines for improving energy efficiency exist, they may not always be easily adopted as an example of Florence shows: 90% of the old buildings are protected as a monument which cannot be retrofitted for energy efficiency, so the regional guidelines are only applicable to new buildings.

Solar energy in Egaleo, Athens (Photo Klostermann, 2010)

Carbon dioxide

According to the CoP reports, CO_2 reduction is also an objective in all cities. The influence of CO_2 as a greenhouse gas on global climate change and thus on the potential exposure of cities to more extreme temperature conditions seems to be the main driving force behind it. CO_2 emissions of a city are closely related to traffic and heating. Improving public transport efficiency, reducing private car use and improve energy efficiency of buildings as explicitly mentioned in the Athens CoP report are therefore probably the major challenges to address the CO_2 problem in all cities.

An objective for Florence is 20% reduction of CO_2 emissions by 2011. The effects of vegetation as a carbon sink (Florence, London) and by indirectly improving carbon emissions, as shading leads to less air condition (London), have also been mentioned. However, the ability of urban green to act as a (relevant) carbon sink has been doubted by a London participant.

For Gliwice and Helsinki the problem is the present use of coal and gas for heating and electricity. Helsinki's goal is to reach a zero carbon society. A concrete objective is to reduce CO_2 emissions by 20% in 2020 through changes in energy use and efficiency. Strategies to address it in Helsinki:

- Mobility management (metro line extension; bike lines)
- A-class houses (100 kWh/m^2)
- Promotion of central heating, heat pumps. District heating now already serves 93% of the heating need.

Existing concrete targets concerning the future reduction of CO_2 emissions have been mentioned as follows:

> *"Currently, cheap energy sources are commonly applied (55% gas, 25% coal). The Council made a decision to reduce 20% CO_2 emissions by 2020, which significantly affects energy sources. The energy department has signed an agreement to be carbon neutral by 2050." (Vesala, 2010)*
>
> *"Reduce CO_2 emissions to 23 per cent below 1990 levels by 2016 …[and]… 60% by 2025 [no reference level mentioned for the second goal]." (Beevers 2009)*

2.5 Mobility & traffic

Congestions, emissions, accidents and climate change on one side. Economic need and private interests on the other. Traffic and mobility are hot and difficult topics in urban planning. In general the problems and challenges that the BRIDGE case study cities seem to face today are more or less the same: Reducing private mobility and increasing public transport as well as non-motorized traffic use. From the CoP reports it becomes also clear that participants of the five cities prioritize the problems differently and with variable foci on sub-problems.

In Athens the number of metro lines will be increased from 3 to 9; a toll road is planned as well as development of new urban areas in the North East.

A major issue in urban planning for Gliwice is the transport system: it needs to be developed to improve mobility. Not the whole area is covered with accessible roads. Therefore, three new roads are planned including a ring and an inner city express road.

Objectives and needs for assessing problems generated by traffic and mobility that have been explicitly brought up during the different CoP meetings are:

- Enhance existing road capacity (Athens, Gliwice);
- Improve public transport (Athens, Florence, Gliwice, Helsinki, London);
    - Introduce different kinds of public transport (Florence)
    - Develop areas with focus on public transport (Helsinki, London)
- Reduce private mobility (Florence, Gliwice);
    - Minimize through traffic and transit (Athens, Florence, Gliwice)
    - Adequate parking provision (Athens, Florence, Gliwice, London)
- Improve and promote cycling and other alternatives (Florence, Gliwice, London);
- Promote a spatial balance of population and job growth (Helsinki, London);
- Ensure access to transport/connectivity (Helsinki, London);
- Improve quality of journey to work/ connectivity & safety (Helsinki, London).
- Reduce emissions and noise from traffic (London);
- Smooth traffic flows (London);

Parking space in Florence (photo Klostermann, 2009)

The citizens interest in private mobility can be an extremely difficult topic for urban planners as the example of Florence shows. In Florence, people sleep in suburbs, but work in the town centre. Traffic is on top of the list of environmental issues but seems to be politically too sensitive to be addressed. Emissions, accidents, congestions and a lack of coordination are making it a key priority, but on the other hand people react very emotional if, for example, plans are made to remove parking space:

> *"You cannot remove parking places, people will become angry! For another park to the public all kind of advantages have been communicated, for example, better temperature etc, but it did not interest people as long as they could park their car." (Breil, 2010)*

By defining possible objectives for the priority "Transport" CoP participants stated among other things that "cars are everywhere in Florence's city centre", even in formally car-free and pedestrian areas, due to too many exceptions. The traffic system in Florence suffers from 150'000 commuters and 30'000 tourists per day. The feeling arises, that comparatively strict regulations like London has (Congestion charge, Low Emission Zone, see paragraph "Public health and air pollution") would have no chance to be implemented in Florence. Even in London the Congestion plan has only been supported by a marginal majority of the population. A similar reason might underlie the hesitance of the Athens city council to apply economic instruments for traffic regulations as pointed out by local CoP participants.

2.6 Urban green and open spaces

Urban green areas and urban open spaces contain in this context mainly parks, trees and green roofs. According to the amount of quotations for each city it can be concluded that "urban green" is a very important issue in Florence and also in London; a less primary topic in Athens and Helsinki; and that it seems to be no planning priority in Gliwice.

Green areas in a city play an important role as recreational spots for the population. They increase the amenity of a place, sequester dust and particulate matter and have a cooling effect. When they become an important issue in urban planning considerations, it seems to be mostly because of a lack of green spaces,

e.g. because urban growth has not been going along with an adequate growth of green areas or that green areas are unevenly distributed (Florence).

The reasons for an insufficient quantity of green spaces may be different for each city. In Athens it was mentioned that laws restrict the municipality from buying public spaces and turn them into green and that environmental degradation is taking place due to increased urbanization without proper planning. Additionally, fires have reduced green space around Athens and the government was said to be unable to maintain large open spaces. Environmental degradation has also social implications in Athens as its impact is more serious on low income people (20% of the population). In the area of Egaleo, the Athens case study site, there are no adequate green spaces yet. In the CoP meeting this has been ascribed to bad or no planning at all. Increasing green spaces has been defined as a core sustainability objective for Athens, but in the area of Egaleo the buildings first need major and basic improvements before implementing green roofs could become an issue.

Planting trees is difficult in the heavily paved areas of Florence. This does not work in the city centre because economic objectives are hampered, it seems better to plant trees in less densely built up areas. Another challenge besides the lack of green can be the maintenance of existing areas. “The situation of green management in Florence is quite complicated” has been stated in a local CoP meeting in Florence. Problems here are missing resources, high maintenance costs (1.2 €/m2 and year), high touristic pressure, high bureaucracy and separation of responsibilities, high percentage of historical gardens, tight state regulations that require a lot of permissions for changing park management, high percentage of old trees along streets, bad communication with citizens and an old landscape ordinance. Public perception is again an issue that cannot be neglected. Felling old trees and replacing them with younger trees might offend sensibilities, even when young trees are probably better in sequestering dust and PM:

> *“Cutting trees is always controversial for citizens. The DSS output in terms of dust removal could help to explain the activity of replanting old trees.” (Miglietta, 2010)*

In Florence a GIS for green spaces is being prepared to assess spatial distribution of green compared to population density. Additionally, an interesting project (MOTO) here is to investigate how people utilize green areas by using mobile phone signals. A fact that is supporting the importance of green space management in Florence is that all collected ideas for potential case studies (tree replacement, San Donato Park, Castello Park, Cascine Park) were related to urban green.

The aims to conserve green and open spaces and the amenity of an area (Helsinki) have been brought up as reasons for people to oppose planning in such areas. For the Meri-Rastila case study site, planning “must maintain the nice forest area”.

Maintenance problems in London concern watering with drinking water (not sustainable, run-off from roofs could be an alternative), choice of species (diversity, climate change) and long term strategies (lifetime of a tree). The vegetation coverage in London is already comparatively high (20%). An ambitious plan to increase it by 5% in 2030 and another 5% in 2050 exists but is said to be difficult to achieve (other goals for London are: planting 10’000 street trees at UHI locations by 2012; improving 10 large parks around the city). Comparative benefits of different greening options (green roofs, more separate trees, big parks) have been brought up as a question here. In general, benefits of urban greening seem to be hard to quantify which is often a disadvantage when trying to justify costs:

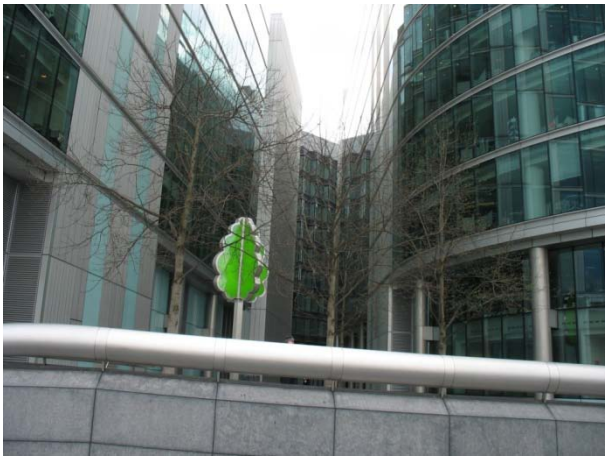
> *“We are still looking for ways to monetarize the benefits of green, how can we charge back the benefit of greening? Maintenance cost of green often blocks the creation of new areas; but it saves having to pay for sewage, air conditioning etc.” (Grimmond, 2010)*

Only a few planning instruments in use have been mentioned during the CoP's. London uses a database with a list of tree species for decisions. Improvements could be made by considering vegetation in the early stage of making plans to prevent from using easy, small species instead of more rewarding large species. A London CoP participant stated that evidence on the effect of green areas will encourage government to increase the amount of green spaces.

Possible greening objectives explicitly mentioned during the CoP meetings are:

- Increase and improve green and open spaces
  - Parks (Athens, Florence, London)
  - Street trees (Athens, Florence, London)
  - Green roofs (Florence, London)
  - More services in parks like concerts, sports (Florence)
  - Better access (public transport, parking) (Florence, Helsinki, London)
- Optimize benefits:
  - Shading (Florence, London)
  - Temperature (Florence, London)
  - Carbon sequestration (Florence, London) [1]
  - Air quality (Florence, London)
  - Slow down rain discharge, prevent peak flooding (London)
  - Maintain sufficient and continuous recreation (Helsinki)
  - Provide healthy landscape (London)
  - Biodiversity, maintain habitats (London, Helsinki)
- Optimize maintenance:
  - Water use (Florence, London)

Regent's Park, London (Photo Klostermann, 2009)



Trees dependent on drinking water, and even a fake tree in London (Photo Klostermann, 2010)

2.7 Water cycle

Water is one of the key BRIDGE aspects. Urban water management has been brought up at least as a topic in all CoP meetings. According to the quotations, it seems to be an important issue in London, Helsinki and Gliwice, a less important issue in Florence and only a minor issue in Athens. Water management in the BRIDGE case study cities seems to deal mainly with two fields: water use and flood management. The main

[1] As was already written in the paragraph "Energy efficiency and CO2 reduction" the ability of urban greening to act as a relevant carbon sink has been doubted during the London CoP meeting.

project objectives for the water aspect are to minimize primary water consumption and to minimize the impairment of the natural water cycle.

Water use is related to urban green. The water plants need to survive is supplied by different sources, primarily by rainfall. Irrigation, which is normally done with drinking water in the urban context, is the second source. Alternatively, surface run-off (e.g. from roofs) could be caught and used for irrigation but this seems not to be the case in any of the cities.

Optimizing water use in general was mentioned as an objective in every city. Surprisingly it was the only quotation for "water" in the Athens CoP reports (with the focus on volume of water used for irrigation).

Empty stream in Athens (Photo Klostermann, 2009)

River Thames in London (Photo Klostermann, 2010)

For Florence flooding is not an issue right now, the last flood happened in 1904. In Florence, neither parks nor street trees are irrigated.

Flood control through developing and preserving flooding areas is an issue in Gliwice. Sustainable water use, improved water quality, the connection of the houses to waste water treatment and the identification of projects with potential negative impact on water resources have been referred to as planning subjects in Gliwice.

The water balance in urban areas, as written in the Helsinki CoP report, takes into account precipitation, surface run-off, evapotranspiration, filtration and flooding events. Urban green areas can also have a positive effect in reducing flood risk as they can slow down discharge of rain to the sewage system. In Helsinki the following objectives were mentioned for protecting the water balance: storm water management to minimize flooding, and avoiding water pollution through untreated surface runoff.

Major environmental issues and challenges for London are caused by climate change: more intensive showers, possibly causing floods. A London participant said that there is more frequent flooding expected and that it would be good to know how reasonable an improvement of the London sewage system (> 100 years old, 1/7 households not connected to sewerage system) would be compared to improving the water retaining capacity of an area, for example, if it would be cheaper to plant trees. Mapping the ground elevation (for runoff modelling) and flood risk hotspots are two ways to assess the problem in London. In London street greenery is usually only watered when newly planted. An exception to that rule are trees and other vegetation planted on roofs (of basements), making them entirely dependent on irrigation. This seems

to be a trend in new developments in the London city centre. Pipeline leakage (loss of 20-30% of the drinking water) is a problem specifically brought up in London.

2.8 Urban infrastructure

Because of its general content, this section is somewhat overlapping with other sections such as "Thermal discomfort", "Energy efficiency and CO2 reduction" and "Water". The focus in this section lies on the lack of adequate building infrastructure which has implications for the first two topics. The quality of other infrastructure like a city's water system (London), road or energy infrastructure (Gliwice) has already been described in the previous sections.

Poor building quality is often related to houses of low income people. Of the low income population in Athens 90% lives in 'inappropriate' housing. More than 80% of the Athens building stock was constructed before the 1980's. Those buildings are poorly insulated, not airtight and outside environmental conditions are affecting the interior climate (high temperatures, air pollution). The quality of the building stock has been defined as a key planning priority by the participants of the CoP in Athens:

> *"We need to improve the urban environment and in parallel our buildings in order to be able to better adapt to outdoor conditions." (Synnefa, 2009)*

It has also been said during the meeting that the Prefect of Athens has decided to:

> *"…spend the Prefecture's funds for developing infrastructure and in works that aim to improve the quality of life of the citizens." (Synnefa, 2009)*

Thermo modernisation of buildings to save energy for cooling (Athens) or heating (Gliwice) can be supported by improving private and public infrastructure, e.g. by using eco-friendly, cool and photo catalytic materials.

Building quality may also be a trigger for social segregation within a city. The Meri-Rastila case study area in Helsinki consists of poor-quality social or rental dwellings from the 1990's and has become a suburb for immigrants (30% of the residents). Raising the quality of living is intended to help anticipating potential social problems.

Regions already facing social problems, so called "Areas of regeneration" have been mentioned in the London CoP's: social exclusion, economic deprivation, health, safety and employment are together with housing quality brought up as important factors to be improved in these areas. Concrete plans to supply more affordable houses in London exist (30'500 new homes a year 2007-2016, 50% as affordable homes).

2.9 Land use and urban sprawl

Minimizing urban sprawl by increasing densification is referred to as the main challenge for urban land use planning in the CoP reports. Next to this, the urban / green ratio is often discussed; this last issue is addressed in the paragraph 'Urban green and open spaces'.

Areas with a great potential of intensification and densification are urban brownfield areas. Eleonas in the Egaleo case study (Athens) is such a degraded area.

A problem of a different nature is how to deal with the master plans of neighbouring towns. Florence is trying to include regional cities in planning (e.g. for airport expansion).

Not only densification, also diversification of the functions of an area is mentioned as a way to cope with urban sprawl (Gliwice). Mixed land use and a controlled expansion of urban areas through local land use plans, a better access to the city centre and an improvement of local services have been brought up by the Gliwice CoP participants as planning priorities. New and enhanced public and open space is mentioned in Gliwice as well.

Urban sprawl is a big problem for sustainable urban planning in Helsinki, leading to more intense use of cars and traffic jams towards the city centre of Helsinki. The preferred solution is to improve connectivity by public rail transport. The traditional development was towards North-South corridors, but now the city is trying to develop a West-East corridor to connect other sub-canters. Helsinki also encourages the use of bikes. Copenhagen is considered a good example. In Helsinki it was said that the focus should lie on railway and metro stations (as planned in Meri-Rastila) which is in agreement with the new strategy for sustainability in Finland. Helsinki a mix of "places of work with housing" is also mentioned as a solution. Public opposition to high density planning may be expected as people are said to prefer low density areas:

"Personal preferences do not necessarily follow sustainability considerations" (Vesala 2010).

In London "Mixed land use development" is mentioned as a solution for urban sprawl. The so called "Opportunity areas" mentioned in the London CoP reports are also said to have the potential for an increase in density. Developments of such areas should be linked to public transport in order to be sustainable. The protection of existing public and open space seems to be important as well in London.

2.10 Summary

In the BRIDGE project 5 cities were chosen with the aim to represent the variety that exists among European urban agglomerations. Therefore, the sample includes the north (Helsinki) and the south (Florence and Athens); megacities (London and Athens) and a smaller city (Gliwice); Western Europe (London) and Eastern Europe (Gliwice). For the purpose of the DSS it is useful to assess both shared issues and differences between cities.

We conclude that the fact that issues are shared is more important than the existence of differences. Nearly all the issues raised are shared by two or more cities; and sometimes by all of them. When an issue is not seen as important, this can be due to current political agendas. Municipal governments tend to set priorities depending on, for example, national or European legislation, recent monitoring results or citizen initiatives. When the political agenda changes, the DSS should still be relevant; therefore the DSS design should cover a sufficiently broad range of potential issues. Since the most important added value of the DSS is to show linkages between policy fields, the DSS should also invite users to explore an issue more broadly by suggesting to look at planning alternatives from different perspectives.

The main issues that were raised during these ten Community of Practice meetings were:

- Air quality and its health effects; Urban Heat Island effect and relation with air quality; and mitigating potential of urban vegetation on both air quality and urban heat;
- Energy and CO2-emissions in relation to urban heat. In southern cities energy use is mostly related to cooling, in northern cities it traditionally is more related to heating; but due to climate change this focus is shifting, for example in London;
- Mobility and traffic. Although this has been on the agenda for decades, traffic problems and the related issue of urban sprawl are far from solved. The different efforts of cities can be compared for learning (for example, pricing in London and public transport in Helsinki). A question raised was how effects of policy responses can be monitored;

- Urban green: greening has benefits for urban heat, water management and air quality; however, the effects are hard to quantify and this makes it difficult to justify investments in green infrastructure;
- Water: like green infrastructure, water can offer solutions for urban heat. Water can also become a problem during weather extremes (flooding and droughts) so the question is how water can be managed optimally and what the relation is with urban vegetation.

In Figure 2.1, the areas of interest in different cities are presented in a simplified form. The picture has the main priorities in the centre in three green circles, in which most cities are interested:

- Sustainability priorities: air quality, energy and water;
- Transport, mobility, associated emissions and congestion;
- Green spaces and the services they offer such as leisure space, cooling, mitigation of air pollution and buffering/delaying of water runoff.

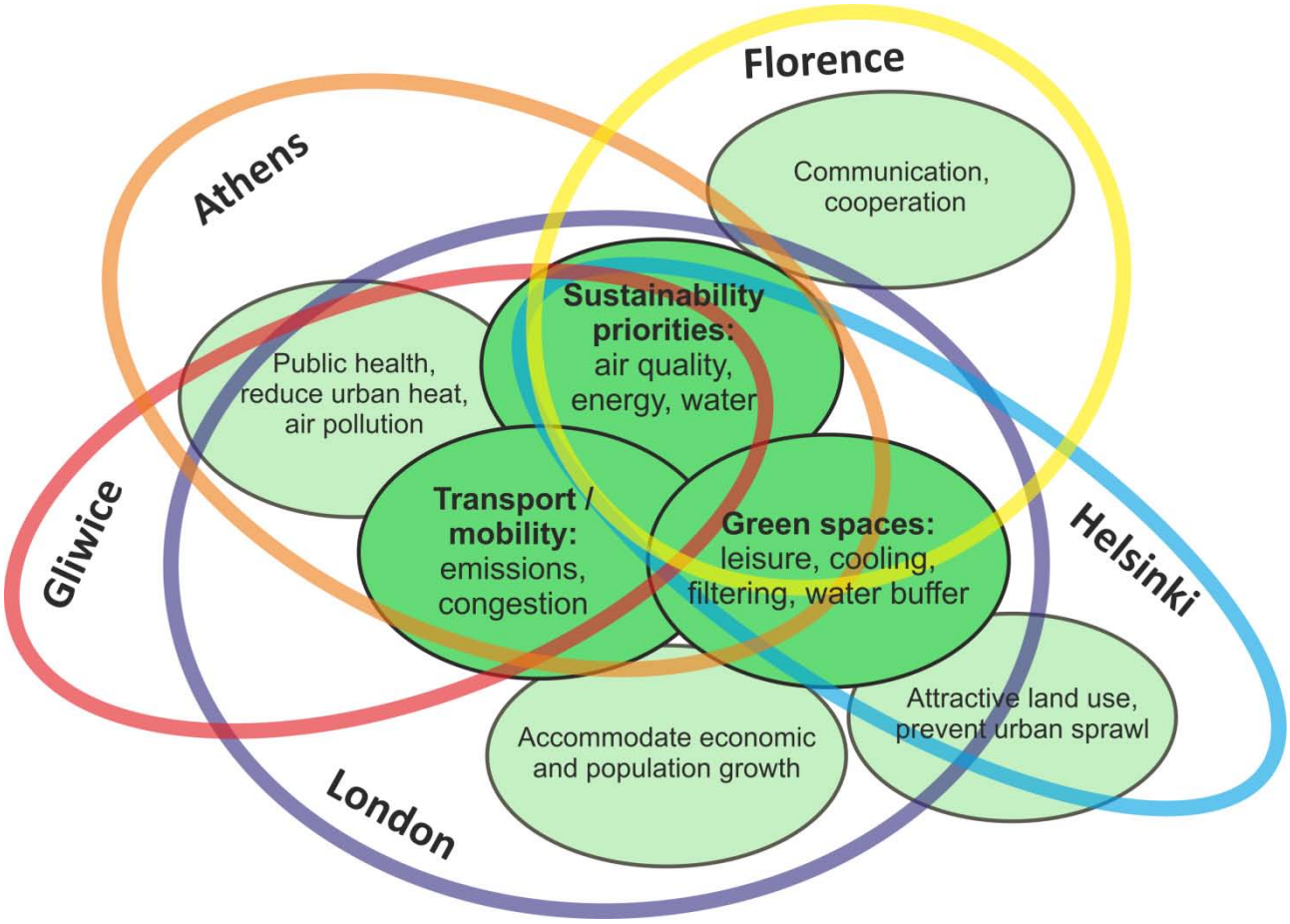


Figure 2.1: Overview of shared areas of interest in the five case study cities

Next to these shared issues, there are areas of interest in which only a selection of the cities has expressed interest. Athens is interested in the three green circles and relates this strongly to public health. Florence focuses on sustainability issues in relation to green spaces, and next to that they are interested in improving communication and cooperation (see the next chapter). Gliwice is focused on energy use, air quality and transport. In Gliwice green spaces are not seen as an important issue. Helsinki is mostly interested in sustainability related to green spaces, and next to that in efficient and attractive land use. The large, blue

circle shows that London is interested in all of these issues, with the exception of communication and cooperation.

3 Social, economic and governance issues in BRIDGE case study cities

3.1 Place identity

Place identity can be described as the character of an area or as the meaning and significance it has for people that are using it. It is about the image, the attractiveness and aesthetics of (public) places. The term "place identity" has been introduced by the participants of the second Athens CoP meeting, stating that the case study area of Egaleo has low aesthetic values and little "place identity" and that both could be improved by the intended planning interventions.

Improving place identity can be part of a city's planning objectives:

- Use novelty acceptance to prevent from vandalism (Egaleo, Athens).
- Improve existing green spaces with more services like concerts and sports (Florence);
- Improve the attractiveness of public spaces. Better quality, better architectural solutions (Gliwice);
- Preserve the character of forests/park areas (Meri-Rastila, Helsinki);
- Enhance human well-being by improving housing attractiveness (Helsinki);
- Provide a more positive image to areas (neighbourhood level), give a more urban than suburban character to a development (Meri-Rastila, Helsinki);

Cultural heritage contributes to the identity of a place or a city. Protection and conservation does not only happen because of its value as touristic attractions but also because of its value to the local people. Planning processes in areas with cultural heritage often have to take restrictions into account. Florence has a high percentage of historical green areas that are expensive to maintain and where interventions require a lot of permissions due to state level regulations. For the case study area of the Cascine Park it was mentioned:

> *"Considering the park's historic importance, operations on the Cascine must take into consideration its cultural heritage character and the legal bindings connected to them, leaving scarce room for modifying the present asset of plants." (Breil, 2010)*

In the Helsinki CoP report, amenity and recreation have been mentioned as planning indicators and have been used as synonym for physical and psychological health.

In London, one planning objective was mentioned to be the protection and improvement of London's heritage and public realm by a reduction in the proportion of buildings at risk as a percentage of the total buildings.

3.2 Economic and social problems

Economic problems
The functioning of the urban economy is a top priority in every city. Therefore, costs and benefits are important factors in assessing and selecting planning alternatives. During the CoP's, economic problems have sometimes been mentioned to be perceived as the most important (Athens).

In Florence, sustainability is said to play a minor role in decision making processes:

> *"There is a reactionary approach to planning: environmental problems are solved as they arise once the plan has been implemented. The municipality is always remediating errors. A new culture and awareness is needed in plan-making." (Miglietta 2010)*

The major problem why sustainability issues are hardly introduced in urban planning considerations seems to be the lack of ability to monetarize the benefits of e.g. green space, trees or rainwater drainage (flooding prevention). London has problems with the economy, transport, and housing. Partly it is caused by strong population growth: an increase is expected towards 1.1 million people in 2026. In London, a project tries to assess the economic effects of a flood on the longer term:

> *"A single flood has a huge impact on the economy; what are we willing to pay to reduce that risk?" (Grimmond, 2010)*

Economic development needs as derived from the London CoP reports are to:

- Promote sustainable planning
- Adapt to climate change
- Provide new and better employment
- Provide more affordable housing
- Perform integrated planning
- Provide for continuous investment
- Reduce carbon costs, and to
- Improve infrastructure efficiency.

Social problems

Social problems exist in every urban area. Social exclusion of marginalized groups came up as an issue in Athens. In Helsinki a problem is experienced with social and economic cohesion. Demographic polarization due to immigration seems to have the potential to become a problem in the Meri-Rastila area. Rising population and poverty were mentioned amongst others in an overview of problems for London.

Social inclusion objectives in the CoP reports include:

- Safe use of roads and sideways (Athens)
- Balanced local community composition (Athens, Helsinki)
- Better housing opportunities and access (Helsinki, London)
- Policies for neighbourhood renewal (London)
- Better health (London)
- Improving learning and skills (London)
- Greater safety (London)
- Better employment (London)
- Provision of services (London)
- Reduced social barriers (London)
- Tackling deprivation and discrimination (London)

3.3 Internal and external communication and coordination by local authorities

In the CoP's, the internal functioning of local governments was discussed. We present the discussions here because they may be relevant for the functioning of the DSS in a municipality context.

The main message in the quotations is that a lot of communication and cooperation is necessary to realize sustainable urban planning (see also Figure 1):

a) Between levels of authority;
b) Between different departments of a municipal administration;
c) Between municipal administration and politicians;
d) Between government and citizens;
e) Between municipal administration and science.

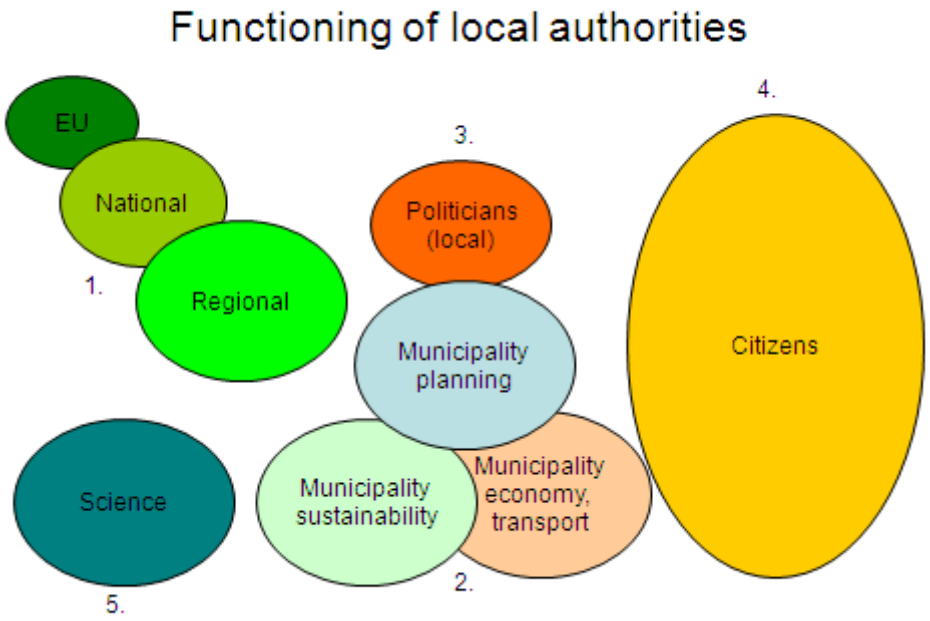


Figure 3.1: Functioning of local authorities as intermediary between different organizational groups.

a) Municipality and other levels of authority

Responsibilities for sustainable urban planning usually involve more than one administrative level.
Athens has the following levels:

- National;
- Attica Periphery;
- Prefecture of Athens;
- Municipality of Egaleo (and 38 other municipalities).

In Florence the following hierarchical levels are relevant for local development:

- Tuscany regulations and a regional plan;
- Florence municipality with Master plan (15 year) and Urban Code (5 year).

For Gliwice the levels are:

- EU;
- National;
- Province of Silezia;
- Gliwice municipality.

In Helsinki, the following levels are taken into account:

- National;
- Regional;

- Helsinki city.

In London, the following hierarchical levels are relevant:

- EU and other international obligations;
- National policies;
- Greater London Authority: strategic planning;
- Neighbouring district and county councils (GLA = county level);
- 33 boroughs (boroughs = districts level): local planning.

Table 3.1 shows that the BRIDGE project covers two types of cities: mega cities and medium size cities. In Florence, there is the level of Tuscany and the level of the municipality of Florence; a municipality of medium size (about 260.000 inhabitants). Similar hierarchical levels are found in Gliwice and Helsinki. In the larger cities Athens and London, however, the municipality itself is subdivided in two levels. In Athens the municipality level is defined as the lower level and Athens in its entirety has an authority called the Prefecture. London has 33 boroughs, and the Greater London Authority functions at a more strategic level. Other terms used are the county level (Greater London) and the district level (boroughs level). The Mayor is responsible for strategic planning and for relations beyond the boundary of London; the boroughs are responsible for local planning.

Table 3.1: Size of case study cities

Mega cities		Medium size cities	
Athens	Prefecture: 5 million inhabitants 54 municipalities Egaleo 120,000 inhabitants	Florence	Florence Commune: 400.000 inhabitants Florence Provincia 700,000 inhabitants Region Tuscany
London	Greater London 7 million inhabitants 33 boroughs CAZ: 10 boroughs	Gliwice	Municipality: 190,000 inhabitants
		Helsinki	Municipality: 500,000 inhabitants Helsinki area: 1,000,000 inhabitants

The levels of scale can have positive as well as negative effects on sustainability of planning. Examples of positive effects are:

- The Tuscany authority promotes learning between its nine municipalities;
- The Tuscany authority tries to enhance awareness of citizens and politicians for sustainability issues;
- The EU regulation on Strategic Environmental Assessment provides a framework of indicators that can help with sustainable urban planning.

Some negative effects are:

- In Athens, the municipal level knows what the urban problems are, however, to change the planning the municipality has to go through the prefecture and then central government level; if the prefecture fails to get the points across at the central level, nothing changes;

- It is difficult to create two-way communication with higher levels.

b) Different departments of a municipal administration
Cooperation between departments is important for integrated planning. Responsibilities for sustainable urban planning are generally divided over more than one municipal department. The intention is to do integrated planning. However, in Florence, urban planners tend to ignore environmental monitoring reports. For the CoP meetings, representatives from departments such as health, environment, energy, and/or water departments were invited, next to urban planners. Often it turned out that the participants from the municipality did not speak to other departments very often (Florence, Helsinki). As a result of the CoP meeting, they sometimes agreed to meet more frequently:

> *"[A participant] indicates that the Strategic Planning Division and the Energy Sector have met for the first time after the CoP. They plan to keep in touch and meet on a regular basis to address energy use and sustainable planning in the city." (Vesala, 2010)*

c) Municipal administration and politicians
Thirdly, there is communication needed between administrations and politicians. In Florence, politicians have made promises about sustainability, but not much was realized and now credibility is lost with the wider public. Still, politicians are needed to break through frozen bureaucratic rules.

d) Government and citizens
The fourth type of cooperation is with the citizens. A crucial topic in urban planning and decision making is how the citizens accept and approve planning interventions. Their perception of problems and solutions is often different from what planning authorities think.

Without good communication citizens are unaware of the health effects and citizen compliance with regulations deteriorates (Athens). In Athens, participants of the CoP meeting raised concern about:

> *"… the public perception of the 'ownership' (who should care to improve the living conditions) and lack of awareness about the direct and indirect health and other effects of current living conditions in the area." (Synnefa, 2010)*

Often, communication with citizens is not good enough (Florence). In Tuscany, citizens are informed through the internet and through schools. The idea is that public opinion will influence Florentine politicians, and politicians in turn influence administration. In Florence the experience sometimes is that private considerations are contrary to sustainability considerations, for example, when parking spaces are replaced with green spaces.

In Helsinki, there is opposition from citizens against urban planning in green areas (see paragraph "Urban land use"). Most citizens will prefer low density of buildings, even though high density is more sustainable. In such cases communication and cooperation with citizens is more difficult.

In London, forms of public participation can be informing the public, or a consultation process, or petitions. A bottom up approach is sometimes used in London: local communities can propose improvement plans, these will be evaluated and implemented when they are considered to be sound. Communication with citizens can be trial and error:

> *"There is a program where people can sign up to be informed on flood risk. (…) Only 19% has signed up; next month the program changes: you have to reject information on flooding instead of signing up." (Grimmond, 2010)*

e) Municipal administration and science.
The fifth and last kind of cooperation is between municipal administration and scientists. In Athens, there is cooperation at the level of the Prefecture of Athens with the University of Athens. Goals of the cooperation are:

- Evaluation of the current situation by performing measurements;
- Proposing solutions by a team of experts;
- Evaluate solutions using simulation tools.

Cooperation with science is meant to take advantage of available knowledge before planning, and to measure if intended improvements actually happen, for example in Florence:

> *"If the municipality wants to realize a new green area, we want to do measurements before and after the temperature changes" (Miglietta, 2010).*

In Florence cooperates with the municipality (Environmental Agency) by measuring urban mass and energy fluxes together with weather data in a dedicated monitoring station in the city centre.

In Helsinki, the Finnish Research Centre is working on a tool with sustainability indicators to measure the footprint of planning alternatives. It is based on eco-footprint, carbon footprint, ecology, and energy rating. Not all relevant aspects can be modelled yet, these aspects are evaluated qualitatively.

3.4 Planning procedures

Planning procedures tend to be different in every country; and maybe in every city. In thee CoP's we cover only a small sample of the possibilities, but they illustrate the diversity that can be expected.

In Florence a Master Plan is written: a strategic plan with a 15 year outlook, with numbers but no land use maps to avoid speculation. A draft is evaluated by:

- The Tuscany authority;
- Public forums (informally);
- The new mayor: revision because of political change.

Based on the Master Plan a Florence Urban Code is written: a detailed plan with a 5 year outlook, including land use maps; it is evaluated on impacts on the environment, economy and health.
Finally there is a third level of operational plans: Public works plans do not have to follow the procedures, they can be realized independently (e.g. schools, roads, parks).

Gliwice has a four year cycle in the planning process. Sustainable development rules are the basis for the creation and update of the local land development plans in Gliwice, for example:

- The guarantee of a proper balance of natural environment and rational resources management in the city;
- The determination of the structure of urban areas that allows for maintenance or recovery of proper life conditions and balance of nature;
- The determination of development methods for degenerated land;
- The inclusion of planning restrictions resulting from environmental protection programs;
- The diminution of influences and environmental disturbances, e.g. caused by transport routes.

In London the procedure for a spatial plan is as follows:

- Inputs in strategic process at GLA level:
  - International and national obligations;
  - Consultation of stakeholders and neighbouring district and county councils; Stakeholders are consulted to establish if they agree with the prioritization;
  - Cooperation with boroughs;
  - Also links and feedbacks are considered, for example sustainable drainage is connected to the planning strategies for cooling and water resource management.
- The Mayor of GLA writes a Spatial Development Strategy called the London Plan, which is a land use plan at the strategic level;
- The London plan is evaluated by:
  - A round of public consultation;
  - A sustainability appraisal;
- After revision the London Plan is formally published;
- The Secretary of State has to approve the final London Plan;
- Boroughs do local planning and implementation.

To promote sustainability in urban planning, the organization of competitions is another procedure in use in London. for example, the Great Spaces Initiative which brings together designers and architects. This competition was organized to come up with new and original ideas how to (re-) design the spaces between buildings. The competition was partly funded by businesses in the area.

Street plan of London inside City Hall, London (Photo Klostermann, 2010)

3.5 Strategies and plans

In the former paragraph we saw some examples of planning procedures. In this paragraph different types of plans and strategies are described.

In Athens, there are two specialized plans which influence urban planning: City Networks (for transport) and Green Buildings (for energy use). The City Networks model: The urban infrastructure networks, such as the existing metro and tram lines, the Attiki Odos (a highway across Attica), and the suburban railway, as well as the future expansion of these lines constitute a typical frame of a city networks model. Athens is spreading to suburban areas, but the city is also interconnected with other cities, for example Corinth, Kiato towards the

Peloponnesos and Chalkida towards the north. Although the transport networks help reducing the carbon emissions, on the other hand the same networks push the future expansion of the city along corridors and through the suburban residential areas, where the need of the car, and the great distances produce an opposite effect: higher carbon emission rates and air pollution, combined with the permanent loss of large open green spaces. The plan is to increase the metro lines from 3 to 9 and to build a toll road.

According to a new Greek Law (based on EU-legislation) every new building must comply with sustainable energy standards. New and old buildings in Athens will be inspected in order to be ranked according to energy standards. This law becomes a new planning assessment tool in use, which will produce Green Buildings, as for instance the new Opera House and the National Library designed by famous architect Renzo Piano in the middle of a new Green Park in Faliron (the Stavros Niarchos Park). The new Opera House is designed to be a self-sufficient building of renewable energy. The new National Library is going to house rare collections and state of the art technologies.

In Florence, the main plan is the Master Plan. Different documents are a part of this Master Plan:

- PAC – Piano d'Azione Comunale / Municipality Action Plan for air quality. This plan describes 88 foreseen actions such as:
    - Energy saving - energy efficiency
    - Renewable energy
    - Better and cleaner technologies for mobility (hybrid, Euro 5, electric and gas vehicles)
    - Heating efficiency
- PEAC - Piano Energetico Ambientale Comunale / Municipal Energetic Environmental Plan, a plan with 32 principal actions for mobility and energy efficiency;
- PGUT – Piano di Gestione Urbano del Traffic / Urban Traffic Management Plan (for metropolitan area).

According to a covenant of the mayor of Florence has to realize a Sustainable Energy Action Plan (SEAP) to reduce more than 20% CO2 emissions within 2011 (http://www.eumayors.eu/).

The municipality of Florence is going to lead urban forestry politics for climate mitigation. A prior target is to evaluate trees contributions to reduce summer temperatures in the urban area. The first foreseen step is to realize a green area in a western part of the town. Hopefully the municipality will begin to plant trees before the end of 2010 in a wide road (heavily paved area). Principal partners of the projects are: the Institute of Biometeorology of National Research Council (CNR Ibimet); the Interdepartmental Centre of Bioclimatology of the University of Florence (CIBIC); and CNR – IPP (Plants Care Institute) Istituto per la Protezione delle Piante. These partners will help to choose the best suitable trees to absorb CO2 and to have less output of natural PM. In Milano, the tree planting policy (1000 trees in city centre) has failed because of a negative financial balance; there were too many "side work" costs.

One of the underpinning planning concepts in Helsinki is "Suburban renaissance" with as strategic goals to improve housing quality, service quality, business opportunities, infill development, leisure & culture, social justice, safety and security, and nature.

In London, three strategies were presented that are strongly connected. Firstly, the "London Plan. Spatial development strategy for GLA "Where things can go"". Its primary goal is to enhance the quality of life. One of the objectives is to limit water use to no more 105 litre per day.
Secondly, there is a climate adaptation strategy consisting of 4 parts:

1. Context of adaption in London
2. Floods
3. Costs
4. Implementation

Thirdly, there is a strategy for air quality in London: NO2, PM10. European limits are the aim. Hotspots have been identified. There still is a large gap between the aim and the present state.

3.6 Frameworks and tools used for planning

International frameworks that are in use include:

- Athens / Egaleo signed with 100 other EU cities to reduce carbon.
- In Florence, Agenda 21 was adopted (and in 8 other cities in Tuscany). Strategic Environment Assessment (Directive 2001/42/CE) (EC, 2001) is also used
- In Gliwice a multi criteria decision support system is in use to support urban planning practices. This support system is based on the European SEA directive.
- Helsinki uses European directives to determine sustainability targets and indicators.
- London takes EU directives and the European Spatial Development Perspective on board.

In Florence, integrated and coordinated policies are developed for sustainable development through EU supported programs ENVIPLANS and CHAMP:

- ENVIPLANS: The Sixth Environment Action Programme of the European Community 2002-2012 has a thematic strategy on the urban environment VI (www.enviplans.net). They contain guidelines to realize a Sustainable Urban Management Plan(SUMP);
- CHAMP: This EU project will train and support local and sub-regional authorities in implementing an integrated management system to respond to climate change effects (see also http://www.localmanagement.eu/index.php/champ:home).

In Helsinki, for the master plan and strategic plan use is made of the Environmental Impact Assessment (EIA) tool (EC, 1985). It is applied, among others, for water construction, water supply and sewerage, forest industry, metal, chemical and mineral product industry, energy production, storage and transfer of energy, waste management and traffic. A project planning EIA is used to compare planning alternatives. This is compulsory by law. A strategic environmental assessment is carried out at the regional or the national scale.

National, regional and local plans and regulations to which objectives are related
In Athens, the Ministry of Environment measures several air pollutants.

In Florence, the following plans and regulations are in use:

- A Green Resources Plan which tackles climate change, temperature and urban water cycle;
- A Common Building Code for sustainable building and energy saving;
- Energy Plans and Energy politics to promote energy efficiency and use of renewable sources;
- Green public procurement, sustainable public accounting, sustainable public budgeting;
- Green guide lines;
    - Constructed wetland (to re-use rain water)
    - Green urban/street furniture (to cool town)
    - Trees to absorb CO2

In Gliwice, the main planning assessment tool used in land development planning is the prognosis of influence of a particular plan on the environment. It is created at the preparation stage of a draft of the plan. The main aim is to determine to which extent the idea of sustainability is included in the plan, taking the environmental protection into consideration as well. A prognosis document has 4 objectives:

1. Assessment of potential changes of the urban environment;
2. Identification of lands under the expected and significant influence;

3. Proposal of solutions that could preserve the natural environment from negative influences;
4. Presentation of alternative solutions.

In Helsinki, the following policies are influencing planning decisions:

- Aim to have carbon neutral developments in 2050;
- The Finnish sustainability strategy aims to minimize urban sprawl and to promote high density of new developments;
- Building regulations.

In London, to achieve the objectives of the different strategies hierarchies of solutions are used. For example for urban drainage the following planning hierarchy will be used:

- Storing water
- Infiltration
- Store at the surface in e.g. ponds
- Underground tanks
- Discharge water box
- Discharge to a sewer

Scientific tools used by planning offices

In Athens, a systematic structure for monitoring and measuring is lacking. An independent organization is necessary to assess the effectiveness of measures. An example may be available in the city of Komotini (North-east Greece).

In Florence, sustainability indicators are measured and monitored. The 'Master plan of Florence' is not informed by sustainability indicators yet. There is a lack of communication between the sustainability and planning departments. Until now, there was a reactive approach to problems. The Tuscany authority provides training in bio-architecture to promote that sustainability is taken into account.
Some other planning tools in use in Florence include:

- Sustainable Public Budgeting: A sophisticated LCA (a mix of LCA + CBA + HIA + EIA), to measure impacts and the costs of:
  - Town planning
  - Single building or infrastructure
- Ecological foot-print / carrying capacity

In Helsinki, several departments are using their own planning tools:

- The Planning and control department uses an evaluation matrix to assess planning alternatives with criteria on:
  - Cityscape and landscape
  - Nature, soils and rock
  - Traffic
  - health
  - City infrastructure
  - Services and commerce
  - Economic costs
- The Strategic division of the planning department uses standard planning tools, entailing the development and assessment of alternatives by checking them against key criteria:
  - Economic performance
  - Social inclusion
  - Connectivity

- Spatial cohesion
- The Energy department assesses energy demand and supply, costs and emissions;
- Eco-efficiency is another underpinning concept in Helsinki, translated into a Eco efficiency tool. To take planning to the right place and to avoid urban sprawl points are assigned for 12 topics to decide where to develop housing.

In London, a plan is made to better understand the urban heat island effect, including the development of four nested models addressing different scales:

- Regional
- Neighbourhood
- Street canyon
- Building

There is no model available yet to integrate different aspects such as energy, green, water and air quality. There are no criteria for city planning processes in London on how to include trees / green spaces. Green is integrated too late in the planning process which results into sub-optimal solutions like smaller tree species and irrigation-dependent trees that are decorative but cannot provide environmental services.

3.7 Summary

Cultural, social and economic issues play an important role in planning processes. For example, the goals of a new development can be to make an area more attractive to tourists, to improve living conditions and/or to promote social integration. In principle it is possible to integrate these issues into the DSS in a 'light' way, in the sense that they appear in a spider diagram at the end. However, the DSS cannot calculate the amount to which the cultural, social and economic targets are met. To include such objectives can, therefore, also lead to a false impression that they are calculated somehow.

Municipalities have a central role in urban planning, with a need to manage complex relationships within and outside of the municipal organization. When relationships within the municipality are already difficult, less time will be left for outside relations. Relationships outside the municipality may promote links to other organizations, for example, a science organization may provide a link to the EU level. The network within and around municipalities can be important both for the input and the output of the BRIDGE DSS. Concerning the input, other parts of the municipality and other organizations have to provide the necessary data to run the models (GIS data, environmental data, scenarios). They may also influence the criteria and weights applied in the DSS. Concerning the output of the DSS, this has to be in a form in which it can be communicated in a clear way to stakeholders inside and outside the municipality.

Different types of planning tools and concepts are in use: integrated plans; negotiated hierarchies of solutions; and assessment methods. An integrated plan (or strategy, or master plan) allows a municipality to identify problems and communicate solutions to the public. Negotiated hierarchies provide political guidance in the choice of solutions on a specific domain such as energy efficiency of buildings (Athens), green infrastructure (Florence) housing quality (Helsinki), or water management (London). The Strategic Environment Assessment method of the EU is used as a planning tool in several cities, but there also are other tools in use, both from international origin (LCA, Carbon Footprint) and self-made tools (Sustainable Urban Budgeting in Florence, Eco efficiency tool in Helsinki). The tool that BRIDGE is aiming for, to calculate which alternative is more sustainable from the viewpoint of urban metabolism, does not seem to be available in these five cities. The available tools focus on appealing 3D representation of development plans into the existing urban context and not on calculating environmental consequences. Our view on the rools in use is fragmented. Instead of organizing CoP meetings, is may have been better to visit planners in their offices and see how they work and what tools they use.

4 Planning alternatives

4.1 Introduction

In the ten Community of Practice meetings, possible real life case studies in each city were discussed. In the Umbrella meeting the final choices were presented. The resulting case descriptions can be found in this chapter. The same information can be found in Deliverable 5.1.

4.2 Athens

In Athens, the municipality of Egaleo is chosen as a case study. The municipality is passed by 5 main access roads into Athens which divide it into 4 quarters. The total area is 650 hectares with 120.000 inhabitants, who have medium/low education and there is a high unemployment rate. There are few green/open spaces, and building stocks are old with high energy consumption for cooling/heating. Pavements are in bad condition. A large part of the case study is a brownfield area, e.g., Eleonas with‘50-‘80’s old buildings which are not very energy efficient.

Thivon Avenue runs through 6 Municipalities of Athens, one of these being Egaleo where major improvements are proposed. The key problems in the avenue include: heavy traffic load; air pollution; environmental problems due to the neighbouring industrial area of Eleonas; lack of open and green spaces; lack of parking spaces; degraded urban infrastructure (e.g. destroyed pavements making very difficult the mobility of pedestrians, especially for disabled people); poor quality of buildings; “visual pollution” (e.g. large publicity panels, etc.); and high temperatures experienced in the city as a whole (thermal discomfort).

Thivon Avenue, Egaleo, Athens (Photo Klostermann, 2010)

The goal of this project is to create an oasis in this problematic area and present a pilot project that other municipalities will also follow. The objectives of the regeneration are to: a) create thermal comfort conditions; b) improve the microclimate; c) increase green spaces and improve ventilation/ air circulation conditions; d) appropriate choice of materials; and, e) respect the traditional architectural style of the area. Some of the proposed interventions include:

- Use of photo catalytic cool asphalt (with self cleaning, antipollution properties, antimicrobial properties);
- Use of ceramic tiles on pavements (cool materials that do not absorb sunlight, natural materials, easy to clean);
- PV, and PV lighting devices;
- Installation of Earth to air heat exchangers for cooling and ventilation;
- A bioclimatic solar tower that collects air pollution from near the road and transfers it at a height over the canopy. It also collects solar energy that can be used and is aesthetically pleasing;
- Use of pergolas for shading;
- Increasing green spaces by tree (already mature, appropriate, non allergenic) and bush planting for microclimate improvement and shading;
- Rehabilitation of the main squares around the avenue.

Three alternatives are proposed for assessment:
1. Use of photo catalytic technology and cool materials and asphalt, green spaces, earth to air heat exchangers, solar control chimneys;
2. Same as alternative ‘a’ but without the photo catalytic technology;
3. Same as alternative ‘a’ but without the earth to air heat exchangers or solar chimneys.

The assessment of alternatives with the DSS will focus on the economic implications of the different technologies and materials, the effects on air quality and thermal comfort and the effects on traffic circulation and associated impacts.

In addition, this case study will be used to validate the DSS outcomes (by contrasting the results provided by the University of Athens with those obtained by BRIDGE researchers and, consequently, evaluating the consistency and coherency of the DSS outcomes).

4.3 Florence

The planning alternatives for Florence comprise the future maintenance and development of Cascine Park. Considering the park’s historic importance, operations on the Cascine must take into consideration its cultural heritage character and the legal bindings connected to them, leaving scarce room for modifying the present asset of plants. Therefore, the following alternatives are proposed:

- Refurbishment and restoration of the park;
- Refurbishment and restoration of the park and planting of new trees along the city streets and on public places (and consequent effect on urban canopy layer and removal of areas for traffic and parking).

The park is multifunctional and supports a number of functions and activities, including: custody of a range of species; aesthetic and historical features; sport and leisure time activities (racecourse, tennis court, extended lawns, flea markets, luna park Cascine with respective parking areas); public functions (military school, public deposits; and activities which wish to escape from public control (prostitution, drug market). The project of the new tram in Florence affects the park as there will be a stop at the eastern end of the park. The different alternatives have different implications for these functions, or act in selective manner onto some of them, and have different implications for management and maintenance costs of the areas. The case study will be mainly assessed with regard to its potential impacts on air quality and thermal comfort generated by an increase of the number of trees.

Cascine Park along the river Arno, Florence (Photo Klostermann, 2009)

4.4 Gliwice

Challenges for sustainability in Gliwice include: a lack of development plans covering the entire city; difficulties connected with an optimal city management; and, the network of roads and mobility systems. The Politechnika District is chosen as a case study. Planning objectives and criteria that have influenced the design so far are accommodation of increasing mobility and availability of new and attractive services; attractive public space; and increase of income.

From the planning point of view, the focus is on the provision of new services in the area. There is a necessity to create a fully equipped campus at the Politechnika District. For the planning authority, this area represents a landmark for the proper development of the town. The challenge is the limited geographical extent of the district and the need to optimise space and solutions, as well as the environmental loads to the carrying capacity of the area.

A number of alternatives have been considered for the area:

- Scenario 1 – 'Minimum'. In this scenario the existing state of the buildings (academic and dwellings), built up spaces and the disposal of internal traffic will remain the same. The change will derive from the construction of the inner city express road (already ongoing) which will influence communication and accessibility to the district;
- Scenario 2 – 'Sports Hall The Podium'. This scenario assumes that the development plan zoning does not occur (i.e. the area remains the same) except for the construction of the sports hall, which will entail an additional load of people in the area;
- Scenario 3 – 'Centre of New Technologies'. This scenario entails the construction of a new centre, consisting of a 7-storey building with rooms for didactic and scientific purposes. The design of the buildings entails and intelligent approach incorporating sustainable energy use (e.g. heat energy from solar collectors, energy recovery, etc.). It includes the creation of public spaces and relays on the development and upgrading of local roads;
- Scenario 4 – 'Maximum'. This scenario would comprise the development of all the aspects considered in scenarios 1 to 3, plus to remove the traffic on Akademicka street and to create a pedestrian area (the contest of the Architecture Department).

Both positive and negative influences are expected to impact the environment of the Politechnika District and the entire city. The erection of the different buildings itself is not going to lead to environmental change but all the activities related to the development might do this. For example, the stadium will attract people from outside Gliwice. This will attract revenue but will also increase the environmental load, due to the increase in transport. Disadvantages of the alternatives are an increase of environmental load as result of new buildings (energy, water, and wastes), traffic load (increase of traffic, parking spaces, noise and garbage) and events in the Podium sports hall. Advantages are a higher quality of public space and architectonic solutions; new work places; increase of tax income for the municipality; development of innovative: and, energy-saving solutions.

Politechnika District, Gliwice (Photo Klostermann, 2011)

4.5 Helsinki

For Helsinki, the proposed case study area is Meri-Rastila. The city needs the development in this area to prevent development in other areas, where there is less good public transportation and people would use their private cars. The municipality has to deal with local opposition against Meri-Rastila's development because it is located in a forested area. The planning was restarted to incorporate the development of a metro station and a shopping mall. A new highlight of the existing recreational track is a seaside park. The plan should also include social cohesion as an objective.

The area identified for development is within 600m from the Metro station. The neighbourhood is a suburb, characterized by buildings built in the 1960s and 1980s (the population has increased from 16,000 inhabitants in the 60s to 30,000 today). The quality of the buildings is poor, most of them are social or rental dwellings. There is no real urban context in the area, there are lots of trees and no real urban services. The area is predominantly inhabited by immigrants. There are no social problems yet, but there are fears that problems might occur in future. The planning department wants to anticipate any potential problems and counteract by raising the quality of living in the area.

There is a regional recreation route along the coast in Meri-Rastila. The plan must maintain the forest areas as well as the geological formation (an ice-age rock outcrop in the middle of the plot) on the hill-top covering an area of 30mx60m which gives character to this forest part of Meri-Rastila.

The planning objectives for the area are:

- At the city level: to provide new housing for the growing metropolitan areas (by 2050 700 000 people are expected), build to address climate change (i.e., densification of urban structure, better use of the existing metro line), revitalization of neighbourhoods and creating places of work mixed with housing:
- At the neighbourhood level/Meri-Rastila level: to deal with demographic polarization (i.e. immigration issue), to move towards more housing ownership and bigger apartments for better social cohesion, to improve services and to provide a more positive image to the area (to attract new residents).
- With regard to green space/nature: to maintain sufficient and continuous recreation and habitats, and to improve accessibility to nature areas.

Three preliminary alternatives have been proposed during public consultation. These alternatives are not final; a new alternative will be developed after the public consultation process.

- Alternative 1: 5-storey apartments, 500 residents, minimal impact on green spaces and nature, little effect on the character of the area. This is a minimal impact alternative. It is expected that this alternative will have little impact on the planning objectives;
- Alternative 2: Two dense groups of apartments. 5-storey apartments and row of houses accommodating 1,500 residents. Hilltop built; slope not built. No connection to the sea and no real improvement of Meri-Rastila's character. Green environment but stand-alone buildings in the forest and no connection to exiting dwellings nearby. The area will not be self sufficient in terms of services. This alternative seems to lack character and it will not bring about much improvement to the area;
- Alternative 3: Residential building around the hilltop all the way down to the waterfront. Office space, maximum 1,000 work-spaces and 1,800 residents. More urban with sea views, various residential building types. Some public services planned for this alternative: primary school, day care centre. The sea views allow increasing profitability of buildings.

The alternatives must be assessed in terms of: cost (realization and profit); social cohesion; air quality and energy consumption.

Meri Rastila animation of development plan, Helsinki (Photo internet: http://omakaupunki.hs.fi/paakaupunkiseutu/uutiset/meri-rastilaan_kaavaillaan_asuntoja/

4.6 London

GLA participants proposed the Central Activity Zone (CAZ) as a case study for the application of the DSS. The CAZ covers the London central area, including the CBA and the commercial centre, with an overall area of approx. 3,300 ha – covering partly or entirely 10 boroughs with 280,000 inhabitants. The CAZ includes three major parks (Hyde Park, Regent's Park and Green Park) and some minor urban green areas. It is targeted and delimited by the London planning strategies and it is object of specific objectives and goals which are also related to urban metabolism issues. The primary planning goals for the area are to: (a) increase green-space;(b) improve air quality; (c) reduce the UHI effect (heat-island): and, (d) prevent flash-floods. The policy objective related to climate change was described as a crosscutting argument triggering mitigation and adaptation needs.

The area being consolidated as a planning unit (although not corresponding exactly to the delimitation of boroughs) should facilitate data retrieval. Policy scenarios including quantitative goals can be derived from the objectives of the London plan.

KCL has its main measurement activities in the CAZ:

- Ceilometers to measure air pollution;
- Plane flight 2008: building heights, trees/vegetation presence (sky view factor, including green), mean radiant temperature;
- Modelling anthropogenic heat flux (LUCY);
- SOLWEIG: model to estimate influence of vegetation on thermal comfort.

The London case study became much more specific during the Foresight Exercise of March 2011. The main objective for the purpose of BRIDGE and the application of the DSS became the greening of the city with tree planting and green roofs.

City Hall, Greater London Authority (Photo Klostermann, 2010)

4.7 Summary

The chosen case studies are very different in size and aim; this hopefully reflects some real life practices of planners, as the case studies will be a test case for the functioning of the DSS.

There are differences in the routines of urban planners, who use assessments at a quite coarse scale, and the routines of sustainability researchers, who use a detailed scale. If planning is done roughly at a regional scale, it will be hard to relate this to detailed environmental models. It is also a question how to scale up sustainability outcomes to the level of an entire city.

5 Discussion on sustainability objectives and indicators

5.1 Introduction

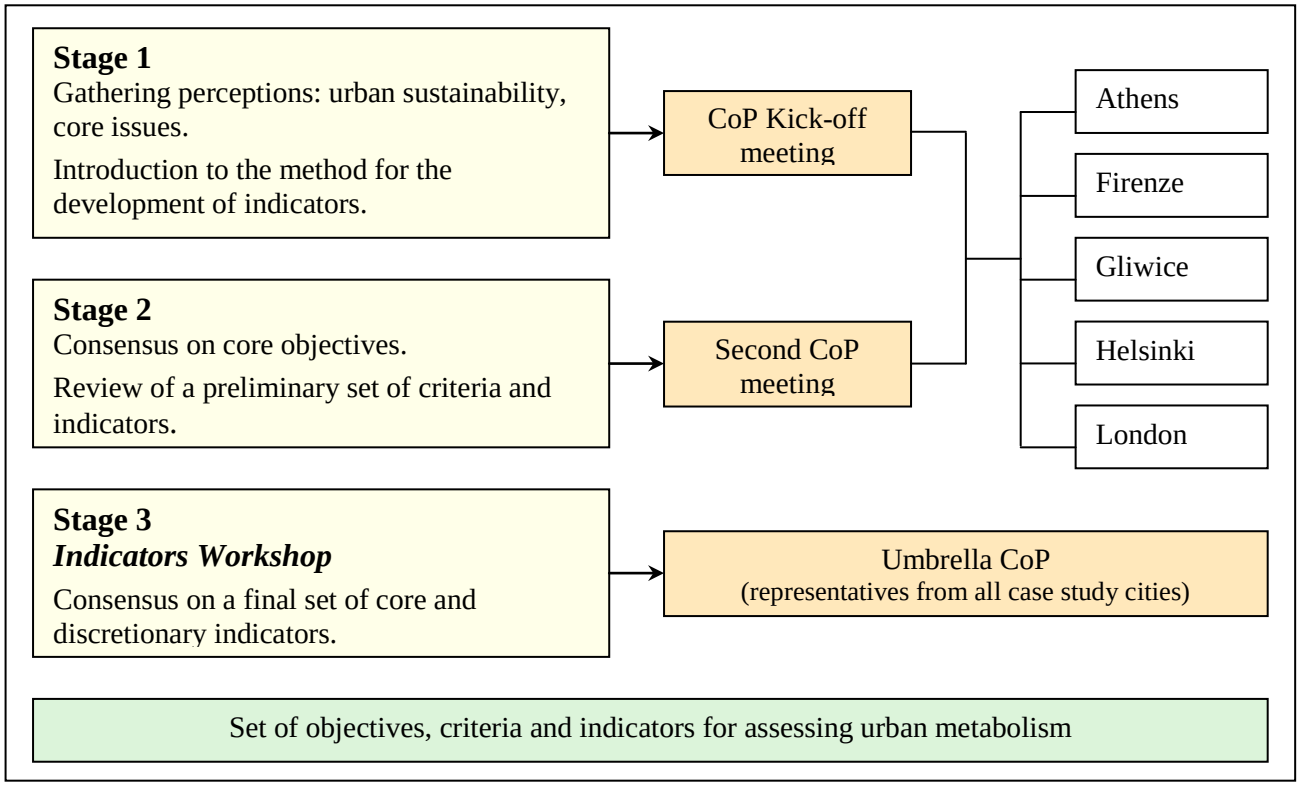
A major part of the Community of Practice meetings was devoted to developing objectives, criteria and indicators for the BRIDGE DSS. In this chapter we report briefly on the method and the results. Thorough reporting on this can be found in Deliverables 5.1, 5.2 and 5.3.

5.2 Procedure to create a list of indicators for BRIDGE

For an overview of the method for participative development of objectives, criteria and indicators, see Figure 5.1. The *kick-off CoP meetings* varied in scope, but all included an indicators session that addressed the following aspects:

- The scope of BRIDGE: what questions should be and can be answered by the DSS;
- The conceptual approach used for the development of objectives and indicators;
- Discussing planning priorities: pressures, opportunities and challenges for sustainable urban planning and perceptions in relation to sustainability objectives and indicators.

Figure 5.1. Participative approach to the development of objectives, criteria and indicators.



A draft questionnaire was prepared to aid the gathering of stakeholders' perceptions at the CoP kick-off meetings. The questionnaire addressed some of the issues highlighted by Groot et al. (2009) and also tackled some specific aspects relating to the development of indicators. Regrettably, responses to the questionnaire were limited (i.e. about 2-3 respondents per CoP). The questions were also used to guide the discussion in the second CoP meeting.

During the kick-off CoP meetings, the core planning issues to be addressed in each of the cities were discussed in the form of drivers and pressures. All gathered perceptions were subsequently used to determine the sustainability objectives for each case study. Consequently, a preliminary set of indicators was discussed by answering the following question: 'What indicators are required to demonstrate achievement of each sustainability objective?'

During the *second round of CoP* meetings the objectives and indicators proposed for the sustainability of the city were revisited to fit them to the scope and requirements of the specific planning alternatives to be analysed by BRIDGE. Therefore, the second CoP meetings were based on the following questions:

- Are the sustainability objectives and related indicators as identified during the first CoP meeting also relevant to the case study? Do they address the key issues in the area?
- What additional environmental, social and economic indicators are needed to evaluate the sustainability of the proposed planning alternatives?
- Which of these indicators are already available? Which are already measured?

The specific characteristics of the case studies largely shaped the revised set of sustainability objectives and indicators. In all cases, the proposed indicators targeted key considerations to be assessed and monitored in order to ascertain the success/failure of those planning interventions. The various objectives and indicators were compiled for each case study city, the selection criteria applied and, finally, they were validated to establish a preliminary set of indicators.

The preliminary set of indicators was further discussed at *the Umbrella CoP*, where the final sets of core and discretionary indicators were established for inclusion in the DSS. The Umbrella CoP addressed the following aspects:

- How can we measure urban sustainability across Europe? How can the DSS be effectively applied?
- Which sustainability objectives and indicators are applicable to all cities?
- Which objectives and indicators reflect local planning issues, and environmental, social and economic characteristics?

A consensus was sought for the final set of indicators. Thus, the final indicators set was contextualised to each city, and grouped in: a) core – urban sustainability indicators that are common to all cases; and b) discretionary – indicators that are singular to one or several urban systems.

From the results, it can be concluded that certain environmental and socio-economic considerations remain common to all the cities. These include improving air quality (and the associated concentration and distribution of pollutants as indicators), improving energy efficiency (with energy demand/consumption and percentage of renewable energy sources as indicators) and ensuring social inclusion/comfort (with use/appreciation of services and social composition as key indicators.

5.3 Result: list of indicators

The objectives and indicators agreed at the Umbrella CoP meeting are shown in table 5.1.

Table 5.1: Sustainability objectives and indicators for BRIDGE

ENVIRONMENTAL	
Objectives	**Indicators**
Common Aspects (Core)	
Improve Air Quality	• Concentration of pollutants (PM_{10} and $PM_{2.5}$, O_3, NOx) • GHG and CO_2 emissions • Number of days above established air quality threshold
Improve Energy Efficiency	• Energy demand (kw per hour per m^2) • Potential for renewable energy • Additional heat generated • % of energy created (renewables)
Anticipate CC (Flooding)	• Flooding zones (m^2) & hot spots
Optimize Water Use & Mgmt	• Surface runoff evapotranspiration and filtration • Water consumption per capita
City-Specific Aspects (Discretionary)	
Increase Green Space Areas	• Density of green areas (m^2 per habitant) • Canopy/green surface or area newly created • Accessibility to green areas
Thermal comfort	• Ambient & surface air temperature (^oC) • Number of days above established threshold
Optimize Materials Used	• Volume of material re-used
SOCIO-ECONOMIC	
Objectives	**Indicators**
Common Aspects (Core)	
Urban land use	• New urbanized areas (land use changes) • Number of brownfields re-used • Density of development
Ensure Economic Viability	• Cost of intervention • Effects on local economy
Improve Mobility & accessibility	• Quality of pedestrian sideways • Length of cycle ways provided • Length of new roads provided • Use of public transport • Number of persons close to public transport
City-Specific Aspects (Discretionary)	
Promote Social Inclusion	• Access to housing and services
Maintain Public Health/Safety Enhance Human Well-being	• Number of persons affected by flash flooding • Number of persons affected by heat waves & air pollution

6 Decision Support System try out session

6.1 Introduction

A Decision Support System is an interactive knowledge-based information system. The DSS that will be developed in BRIDGE is for assessment of planning alternatives as described in Deliverable 6.1 (Mitraka et al., 2010). A first prototype (beta version) was tried during the Umbrella CoP session of May, 5th, 2010 in Athens. Three small groups consisting of one or two potential end users and a BRIDGE researcher tried to go through the system and afterwards they were interviewed by a BRIDGE researcher. The reflections from the end users are presented below.

6.2 Interview results

Due to the fact that the beta version of the DSS was in its very first stage, the testing possibilities were limited and even within this limited operational space proper functioning was not always guaranteed. Still participants had a few positive comments, that reflected an appreciation of the possibility to work with specific models that project an output as a map of the area of interest.

"It is helpful to work with detailed models like the CO model."
"Specific maps are great, because now no one knows how fluxes go."

One category of negative comments was on the functionality of the DSS: the usability of the DSS was questioned and the user interface was seen as faulted. These comments were partly caused by the embryonic stage in which the beta version was at the time of the umbrella CoP. There were very few options available for running models and the software did not run smoothly yet. A recommendation made by one of the participants is to provide an easy to understand instruction manual, guiding the user through the DSS step by step. Within the context of BRIDGE the researchers have brought all available data of the five case study cities into the DSS tool. When the tool is used for other cities, it should also be clear to the user what these inputs are.

"The DSS prototype is difficult to use, has low usability."
"Simplicity on the screen would be appreciated. Try to show only necessary information on screen."

Another category of negative comments is more fundamental. It shows that participants were sceptic concerning aggregation of results as a function of the DSS. They questioned both the method by which this aggregation was performed and the usefulness of such an outcome. It was not clear to the respondents what assumptions were behind the process of aggregation, and how they could influence it. Therefore they could not trust such an outcome and could not learn from it. Aggregation meant loss of information. A way to solve this would be to aggregate, but then to unwrap it into an explanation what factors have led to the aggregated outcome.

"Use of the indicators and the weights is unclear and a clear explanation is really needed."
"How are the qualitative indicators in combination with the quantitative indicators taken into account?"
"Sceptical about aggregation (outcome: this alternative is better than that one)."

Then there were questions on how to adapt the tool to the needs of the user. The BRIDGE tool offers a set of indicators; is it possible to select only the indicators of interest to the user? Is it also possible to add indicators that are not in the tool yet? A participant also wondered who decided on the weight of an indicator. Selecting indicators and weighting are two options the BRIDGE tool already intends to provide to

tailor the DSS to user needs. The answer to the question on *adding* indicators is not clear yet within the BRIDGE team. A final, important question is how sensitive the DSS models will be for using at a low scale and how flexible the tool will be in adapting to different scales.

"Is there a possibility to leave out an indicator if it is not needed?"
"Who judges which indicators are more important? Can I do it myself as a planner?"

An important category of comments is that the tool would probably not be used to *choose* between alternatives (a tacit assumption of the BRIDGE team), or to *decide* on anything, but to *learn* about the sustainability status of a city and about the measures that could improve it. DSS means decision support system, but apparently this should not be taken too literally. When the DSS becomes a tool for learning, this has implications for its design:

- It should be easy to change scenario's and alternatives and rerun a model.
- The DSS output should not just be a map but also a good explanation of what the visualized problems are (e.g., red means that an EU threshold has been crossed) and what caused these problems (e.g. the difference between picture 1 and 2 is a decrease in cooling by urban green).

While the two design principles mentioned above are likely to be possible in the BRIDGE DSS, there also is a number of ideas for which it may be too late in this stage of the BRIDGE project. Still, it would be useful to consider these possibilities:

- Can the DSS also do a problem analysis for a city? By providing a baseline map indicating problem hotspots for air quality, urban heat, CO_2 emission and flood risk?
- Can the DSS suggest improvements to the alternative that scores the best?
- Can the DSS also indicate what needs to be done to reach an ideal value for an indicator?

"What are the simplified rules for better design? Can I learn from it how to manipulate the outcome?"
"Maybe a problem based approach would be better than starting with alternatives?"
"If alternative 2 is best, how can I make it even better?"

Participants wondered if the tool could also be used in communication about urban planning with politicians and citizens. For such a use, the tool would have to work quickly (no 24 hour model runs), and the output would have to be instantly clear for interpretation by non-experts. The level of uncertainty, or the validity of the DSS output also needs to be clear.

"Does it support an interactive session with politicians or citizens?"
"The quality of the model outcome must be clear."

6.3 Summary

In general we conclude that the development of the BRIDGE DSS is on a good way. The outputs promised by the DSS tool, namely model calculations of the effects of planning on urban sustainability, are welcomed. The tested beta version of the system and its handling has been basically understood by the participants of the Umbrella CoP workshop and it seems to be realistic that the DSS will become an applicable instrument in urban planning and decision making in the BRIDGE case study cities and other cities as well.

During the try out sessions, participants were very interested in the functioning of the DSS. Nevertheless, improvements of the beta version of the BRIDGE DSS will be necessary to enhance its usability and make its use and output better understandable. The usefulness of the tool mainly depends on its procedural flexibility and the clarity of explanations both on how to use the tool and how to interpret the results. The

main recommendations made by the workshop participants are listed in paragraph 7.2. The feedback will be useful in the further development of the BRIDGE DSS.

7 Conclusions and recommendations

7.1 Conclusions on shared issues in urban metabolism

Shared environmental issues
In the BRIDGE project five cities were chosen with the aim to represent the variety that exists among European urban agglomerations. Therefore, the sample includes the north (Helsinki) and the south (Florence and Athens); megacities (London and Athens) and a smaller city (Gliwice); Western Europe (London) and Eastern Europe (Gliwice). For the purpose of the DSS it is useful to assess both shared issues and differences between cities.

The main issues that were raised during ten Community of Practice meetings and the Umbrella CoP workshop were:

- Air quality and its health effects; Urban Heat Island effect and relation with air quality; and mitigating potential of urban vegetation on both air quality and urban heat;
- Energy and CO2-emissions in relation to urban heat. In southern cities energy use is mostly related to cooling, in northern cities it traditionally is more related to heating; but due to climate change this focus is shifting, for example in London;
- Mobility and traffic. Although this has been on the agenda for decades, traffic problems and the related issue of urban sprawl are far from solved. The different efforts of cities can be compared for learning (for example, pricing in London and public transport in Helsinki). A question raised was how effects of policy responses can be monitored;
- Urban green. Adding more urban green areas or even street trees has benefits for urban heat, water management and air quality; however, the effects are hard to quantify and this makes it difficult to justify investments in green infrastructure;
- Water management. Like green infrastructure, water can offer solutions for urban heat. Water can also become a problem during weather extremes (floods and droughts) so the question is how water can be managed optimally and what the relation is with urban vegetation.

We conclude that the fact that issues are shared is more important than the existence of differences. Nearly all the issues raised are shared by two or more cities; and sometimes by all of them. When an issue is not considered to be important, this might be due to current political agendas. Municipal governments tend to set priorities depending on, for example, national or European legislation, recent monitoring results or citizen initiatives. When the political agenda changes, the DSS should still be of use; therefore the DSS design should cover a sufficiently broad range of potential issues. Since the most important added value of the DSS is to show linkages between policy fields, the DSS should also invite users to explore an issue more broadly by suggesting to look at planning alternatives from different perspectives.

Shared cultural, social and economic issues
Cultural, social and economic issues play an important role in urban planning processes. For example, the goals of a new development can be to make an area more attractive to tourists, to improve living conditions and/or to promote social integration. In principle it is possible to enter such issues into the DSS in a ‘light’ way, in the sense that they appear in a spider diagram at the end. However, the DSS cannot calculate the amount to which the cultural, social and economic targets are met with different alternatives. To include such objectives might, therefore, also lead the user to the false impression that they have been somehow calculated within the system.

7.2 Conclusions on the planning process

Context of urban planning
Municipalities have a central role in urban planning, with a need to manage complex relationships within and outside of the municipal organization. When relationships within the municipality are already difficult, less time will be left for outside relations. Relationships outside the municipality may promote links to other organizations, for example, a science organization may provide a link to the EU level. The network within and around municipalities can be important both for the input and the output of the BRIDGE DSS. Other parts of the municipality and other organizations will have to provide data to run the models (GIS data, environmental data, scenarios). They may also influence the criteria and weights applied in the DSS. The output of the DSS has to be in a form in which it can be communicated in a clear way to stakeholders inside and outside the municipality.

Different types of planning tools and concepts are in use in the five municipalities: integrated plans; negotiated hierarchies of solutions; and assessment methods. An integrated plan (or strategy, or master plan) allows a municipality to identify problems and communicate solutions to the public. Negotiated hierarchies provide political guidance in the choice of solutions on a specific domain such as energy efficiency of buildings (Athens), green infrastructure (Florence), housing quality (Helsinki), or water management (London). The Strategic Environment Assessment method of the EU is used as a planning tool in several cities, but there also are other tools in use, both from international origin (LCA, Carbon Footprint) and self-made tools (Sustainable Urban Budgeting in Florence, Eco efficiency tool in Helsinki). The tool that BRIDGE is aiming for, to calculate which alternative is more sustainable from the viewpoint of urban metabolism, does not seem to be available yet in these five cities.

7.3 Conclusions on DSS development

Choice of indicators
During the Umbrella CoP workshop consensus was sought for the final set of indicators. Thus, the final indicators set was contextualised to each city, and grouped in: a) core – urban sustainability indicators that are common to all cases; and b) discretionary – indicators that are singular to one or several urban systems.

From the results, it can be concluded that certain environmental and socio-economic considerations remain common to all the cities. These include improving air quality (and the associated concentration and distribution of pollutants as indicators), improving energy efficiency (with energy demand/consumption and percentage of renewable energy sources as indicators) and ensuring social inclusion/comfort (with use/appreciation of services and social composition as key indicators).

Although the SEA directive (2001/42/EC) was implemented in European countries, and also in the national legislation of the countries that participated in the BRIDGE project, the requirements related to environmental reporting described in article 5 and annex I of the directive are only partially reflected in the DSS. The BRIDGE DSS focused on factors which change urban metabolism (energy, water, carbon, pollutants), and on expected climate changes at the local scale.

Case studies
The chosen real life case studies within each city are very different in size and aim. This hopefully reflects some real life practices of planners, as the case studies will be a test case for the functioning of the DSS.

There is a fundamental difference between the routine of urban planners, who use assessments at a quite coarse scale, and the routines of sustainability researchers, who use a detailed scale. If planning is done

roughly at a regional scale, it will be hard to relate this to detailed environmental models. It is also a question how to scale up sustainability outcomes to the level of an entire city.

Try out session
In general we conclude that the development of the BRIDGE DSS is on a good way. During the try out sessions, participants were very interested in the functioning of the DSS. The outputs promised by the DSS tool, namely model calculations of the effects of planning on urban sustainability, are welcomed. The tested beta version of the system and its handling has been basically understood by the participants of the Umbrella CoP workshop and it seems to be realistic that the DSS will become an applicable instrument in urban planning and decision making in the BRIDGE case study cities and other cities as well.

Nevertheless, improvements of the beta version of the BRIDGE DSS will be necessary to enhance its usability and make its use and output better understandable. The usefulness of the tool mainly depends on its procedural flexibility and the clarity of explanations both on how to use the tool and how to interpret the results. The main recommendations made by the workshop participants are listed in paragraph 7.2. The feedback will be useful in the further development of the BRIDGE DSS.

7.4 Recommendations for the DSS

1. Provide an easy to understand instruction manual, guiding the user through the DSS step by step. Within the context of BRIDGE the researchers have brought all available data of the five case study cities into the DSS tool. When the tool is used for other cities, it should also be clear to the user what these inputs are. Just as an example:
- Minimum input:
  - Hardware minimum specifications
  - GIS shapefile
  - Weights
  - Alternatives
- Additional input depending on analysis:
  - Extra indicators
  - Weather data
  - …

2. Explain how the tool can be adapted to the needs of the user:
- By selecting the indicators of interest to the user;
- By adding new indicators to the tool (if this possibility exists);
- By deciding on the weight of an indicator.

3. To make it useful for medium sized cities as well as mega cities, it should be adaptable to use at different scales. Offer something for strategic as well as implementation levels of government;

4. Provide the assumptions of the aggregation method as explicitly as possible. Also explain clearly how users can influence the aggregation method (by changing the weights). Prevent that aggregation leads to a loss of information; aggregate to a spider diagram, but then to unwrap it into an explanation what factors have led to the aggregated outcome. Show single indicator outcomes too (in both spatial and numerical form).

5. Provide information on the validity and reliability of the DSS output. Make clear what the consequences are of using the model at different scales and what the uncertainties are for the different indicators.

6. Build a DSS that supports learning. The tool will probably not be used to *choose* between alternatives, but to *learn* about the sustainability status of a city and about the measures that could improve it. DSS means decision support system, but apparently this should not be taken too literally. When the DSS becomes a tool for learning, this has implications for its design:

- It should be easy to change scenarios and alternatives and rerun a model.
- The DSS output should not just be a map but also a good explanation of what the visualized problems are (e.g., red means that an EU threshold has been crossed) and what caused these problems (e.g. the difference between picture 1 and 2 is a decrease in cooling by urban green).

While the two design principles mentioned above are likely to be possible in the BRIDGE DSS, there also is a number of ideas for which it may be too late in this stage of the BRIDGE project. Still, it would be useful to consider these possibilities:

- Can the DSS also do a problem analysis for a city? By providing a baseline map indicating problem hotspots for air quality, urban heat, CO_2 emission and flood risk?
- Can the DSS suggest improvements to the alternative that scores the best?
- Can the DSS also indicate what needs to be done to reach an ideal value for an indicator?

7. Consider how the tool and its outputs could also be used in communications about urban planning with politicians and citizens. For such a use, the tool would have to work quickly (no 24 hour model runs), and the output would have to be instantly clear for interpretation by non-experts. Printing options should also be available for the output.

7.5 Recommendations for the BRIDGE project

The Umbrella CoP meeting was organized to help making the DSS user friendly. The feedback obtained during the DSS demonstration event from CoP participants was reported in this deliverable as well as the deliverables 5.1, 5.2 and 5.3. The recommendations should therefore be used to improve the DSS.

Looking forward to Demonstration event 8.2 more learning experiences can be obtained. The following evaluative questions should be asked before and during the event:

- How can we ensure that end user feedback from the CoP's and Demonstration event 8.1 is going to be incorporated into the DSS? What barriers (work package structure of the BRIDGE project, one way flow of information) can be expected and how can we avoid them?
- Which steps are needed to make a prototype DSS and prepare for the end user demonstration session? A timely pre-testing program of the DSS by as many BRDIGE members as possible is absolutely necessary to gather experience with the system and to ensure informed guiding of the users at Demonstration event 8.2.
- How comprehensive is the set of objectives/indicators?
- What follow up is needed after the BRIDGE project to create a marketable, user friendly product out of the BRIDGE prototype DSS?

What we have learned so far is that sustainable urban planning, based on real knowledge and data on the urban environment, is far from easy. Even so, it is necessary to make progress in this area. The interconnections between water, urban green, urban heat, energy and air pollution are important to explore

and consider before plans are implemented. Scientists and urban planners have to do this together to ensure that ideas on urban developments are both grounded in the physical reality and socially and economically achievable.

8 ANNEX A – List of participants of the umbrella CoP meeting

Name	Affiliation and role	Email address
Athens, Greece		
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Roberto San José	UPM / Technical University of Madrid, WP4	roberto@fi.upm.es

9 ANNEX B – Groups of codes used in Atlas-ti.

The number of quotations in the right column reflects the amount of text dealing with a theme.

CODES	Number of quotations
Totals	427
Public health / air quality	
Public Health – Problem	29
Public Health – Indicators	14
Thermal discomfort	
Thermal discomfort – Indicators	7
Thermal discomfort - Problem	16
Energy efficiency and CO2 reduction	
Energy use and efficiency - Indicators	13
Energy use and efficiency - Problem	19
CO2 reduction - Indicators	8
CO2 reduction - Problem	10
Mobility & traffic	
Mobility & Traffic - Indicators	7
Mobility & Traffic - Problem	26
Green spaces	
Urban green & open spaces - Indicators	9
Urban green & open spaces - Problem	28
Water	
Water management - Indicators	11
Water management - Problem	21
Infrastructure	
Lack of adequate urban infrastructure - Indicator	1
Lack of adequate urban infrastructure - Problem	17
Housing Demand - Indicators	3
Land use	
Urban land use - Indicators	4
Urban land use - Problem	12
Place identity	
Place identity - Indicators	3
Place identity - Problem	9
Heritage protection	4
Economic and social problems	
Economic criteria - Indicators	6
Economic criteria - Problem	10
Social problems - Indicators	4

Social problems - Problem	9
Public perception - Problem	4
Authorities - internal functioning	
Authorities: hierarchical / internal cooperation, partnership	14
Authorities: Level of scale issues	3
Authorities: public participation in planning	4
Need: cooperation / communication	7
Political, cultural and psychological factors	7
Authorities: methods in use	
Authorities: key planning & sustainability objectives	14
Authorities: environmental/sustainability issues	13
Authorities: Mentioned application of European directives	4
Authorities: indicators in use	6
Authorities: planning instruments & procedures	3
Authorities: planning: quality control / monitoring / tools in use	13
Authorities: Existing collaborations between urban planners & scientists	4
Totals	427