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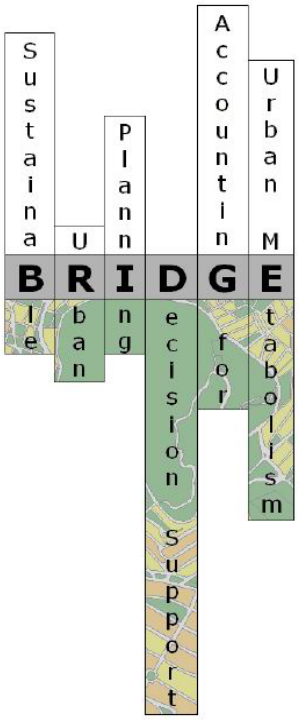
Issue 1

BRIDGE newsletter



Editorial

The FP7 project BRIDGE *(sustainaBle uRban plannIng Decision support accountinG for urban mEtabolism) is a joint effort of 14 European Organizations aiming at incorporating sustainability aspects in urban planning processes, accounting for some well recognised relations between* ***urban metabolism*** *and* ***urban structure****.* ***BRIDGE*** *was launched in 2008 in order to* ***assist urban planners to present and evaluate planning alternatives towards a sustainable city.***

This newsletter initiates an open dialogue between the partners of the BRIDGE consortium and all potential end-users and informs about activities, progress and achievements of the BRIDGE project. The newsletters will be published every 6 months and will be open to articles, news and opinions.

BRIDGE partners:

1. Foundation for Research and Technology - Hellas (FORTH), Greece
2. King's College London (KCL), United Kingdom
3. Consiglio Nazionale delle Ricerche (CNR), Italy
4. Instytut Ekologii Terenów Uprzemysłowionych (IETU), Poland
5. Technical University of Madrid (UPM), Spain
6. University of Aveiro (UAVR), Portugal
7. University of Basel (UBAS), Switzerland
8. Trinity College Dublin (TCD), Ireland
9. University of Helsinki (UHEL), Finland
10. National and Kapodistrian University of Athens (NKUA), Greece
11. Centro Euro-Mediterraneo per i Cambiamenti Climatici S.c.a.r.l. (CMCC), Italy
12. Météo France Centre National De Recherches Météorologiques (CNRM), France
13. Alterra B.V., The Netherlands
14. University of Southampton (SOTON), United Kingdom

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Primary articles

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What is a sustainable city?

'Sustainable city' is a city in which the population enjoys a high quality of life and which takes care not to transfer socio-economic and environmental or health problems to other places or future generations (WHO, 1999[1]).

The dynamics of a sustainable city is to an extent determined by 'urban metabolism', which is considered as the exchange and transformation of energy and matter between a city and its environment. BRIDGE focuses on the following components of urban metabolism:

Energy

-Optimise energy efficiency of the urban structure.
-Minimise energy demand of settlements.
-Maximise efficient use of energy through building services and energy supply.
-Maximise share of renewable energy sources.
-Maximise the use of eco-friendly and healthy building materials.

Water

-Minimise primary water consumption.
-Minimise impairment of the natural water cycle.

Carbon and pollutants

-Minimise the emissions to the atmosphere.
-Maximize pollutants sinks.
-Stabilize and manage contaminated land.

The BRIDGE objectives

Cities consume material and energy inputs, process them into usable forms, and eliminate the wastes from the internal processes. These processes comprise the "metabolism" of industry, commerce, municipal operations and households. Understanding the pattern of energy and material flows through a community's economy provides a systemic reading of the present situation for goal and objective setting and the development of indicators for sustainability.

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 food, water, energy, etc. from a city (Ngo and Pataki 2008[2]), or that compare the metabolic process of several cities (Kennedy et al. 2007[3]). 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 bio-physical sciences have led to new methods to estimate energy, water, carbon and pollutants fluxes. However, there is poor communication of new knowledge to end-users, such as planners, architects and engineers.

To this end, the BRIDGE project aims at bridging the gap between bio-physical sciences and urban planners and at introducing innovative planning strategies for urban panning.

The main objectives of the BRIDGE project are:

- Provide the means to:
  - define and quantitatively estimate energy, water, carbon and pollutants fluxes at local scale;
  - quantitatively estimate the environmental impacts of the above components;
  - translate the above environmental impacts to socio-economic benefits.
- Support the development of sustainable planning strategies.
- Involve local and regional stakeholders in the project from the begining.
- Support the implementation of EU policy on urban environment.
- Illustrate the economic advantages of accounting for environmental issues on a routine basis in urban planning decisions.

[1] World Health Organisation (1999), Towards a new planning process, A guide to reorienting urban planning towards Local Agenda 21, European Sustainable Development and Health Series: 3, url: http://www.euro.who.int/document/e77398.pdf, accessed 22/03/2009.
[2] Ngo, N. S. and Pataki, D. E., 2008: The energy and mass balance of Los Angeles County. Urban Ecosyst, 11, 21–139.
[3] Kennedy C., Cuddihy J., Engel-Yan J., 2007: The Changing Metabolism of Cities. J. Industrial Ecology, 22, 43-59.

The BRIDGE mission

BRIDGE will focus on the specific metabolism components (energy, water, carbon, pollutants) and will not perform a complete life cycle analysis or whole system urban metabolism.

A bottom-up approach based on quantitative estimates of urban metabolism components, at local and regional scales, can be obtained by considering the three-dimensional (3D) exchange and transformation of energy and matter between a city and its surroundings.

BRIDGE's main goal is to develop a Decision Support System (DSS) which has the potential to propose modifications on the metabolism of urban systems towards sustainability (Chrysoulakis et al. 2009[1]).

More specifically, BRIDGE is about to:

- define urban metabolism by means of energy, water, carbon and air pollution fluxes in local scale;
- examine how the change of land use and resources use affects the fluxes of energy, water, carbon, pollutants;
- develop indicators to quantify the environmental impacts of the above urban metabolism components;
- develop a DSS based on these indicators;
- use this DSS to evaluate planning alternatives in several case studies;
- devise sustainable planning strategies based on these evaluations.

The innovation of BRIDGE is the development of a DSS, which may assist urban planners in decision-making by providing a structured presentation of planning alternatives and the tools to evaluate them on the basis of environmental impacts and socio-economic implications of energy, water, carbon and pollutants fluxes.

[1] Chrysoulakis, N., Vogt, R., Young, D., Grimmond, C.S.B., Spano, D. and Marras, S., (2009): ICT for Urban Metabolism: The case of BRIDGE. In: Wohlgemuth, V. Page, B. and Voigt, K. (Eds): Proceedings of EnviroInfo2009: Environmental Informatics and Industrial Environmental Protection: Concepts, Methods and Tools. Hochschule für Technik und Wirtschaft Berlin, Vol. 2, pp. 183 – 193.

BRIDGE work-packages and responsibles

WP1: Project Management
(Dr. N. Chrysoulakis - FORTH)

WP2: Methodology Specification
(Prof. S. Grimmond - KCL)

WP3: Data Collection and Analysis
(Dr. E. Magliulo - CNR)

WP4: Physical Flows Modelling
(Prof. R. San Jose - UPM)

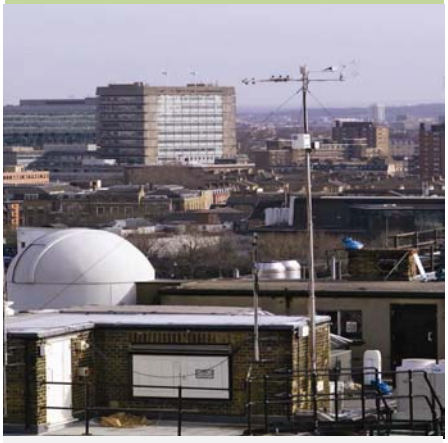
WP5: Environmental and Socio-economic Impact Assessment Methods
(Prof. M. Jones - TCD)

WP6: DSS Development
(Dr. N. Chrysoulakis - FORTH)

WP7: DSS Application
(Prof. C. Borrego - UAVR)

WP8: Demonstration
(Dr. J. Klostermann - ALTERRA)

WP9: Dissemination-Exploitation
(Prof. M. Santamouris - NKUA)



London

London, a metropolitan centre with the characteristics of a mega-city, faces modifications in its urban microclimate (increased temperature in the city centre, hotter summers, air quality problems) which need to be faced through a solid plan towards urban sustainability. In addition, London will host the Olympic Games 2012, a fact which further increases the potential for measures towards sustainability.

Lat/Lon: 51°30'00.55" N

00°07'34.45" W

Area: 1707km^2

Population: 7556900 inhabitants

End-user: The Greater London Authority

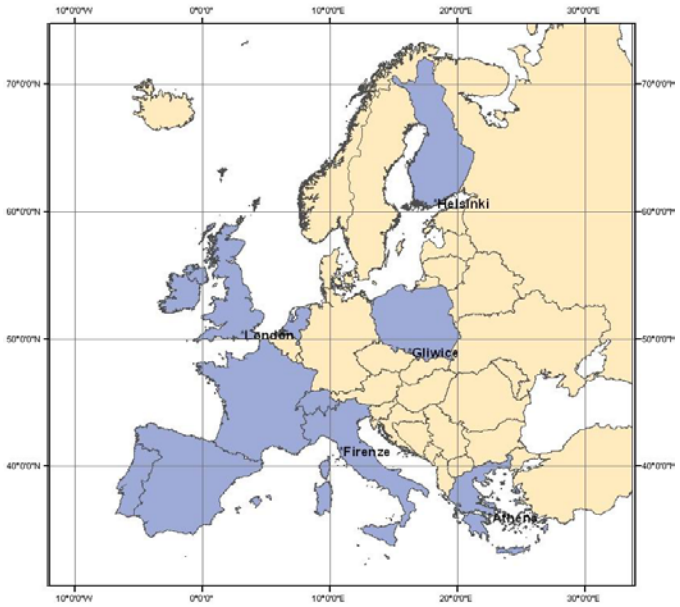
The BRIDGE approach

Multidisciplinary research will address urban metabolism and resource optimisation in the urban fabric. Recent advances in bio-physical sciences have led to new methods and models to estimate local scale energy, water, carbon and pollutants fluxes. Energy, water and carbon fluxes in urban areas are investigated in contemporary studies by three main approaches of science: micrometeorological site studies, remote sensing measurements and numerical modelling approaches. The energy and water fluxes are measured and modelled in order to define the spatio-temporal distribution of the energy and water balance at local scale (Offerle et al. 2006[1], Masson 2006[2], Mitchell et al. 2007[3]). The fluxes of carbon and pollutants are modelled and their spatio-temporal distributions are estimated (Borrego et al. 2006[4]). The uptake by trees and onward transport or storage of various pollutants in the urban environment are measured by a range of techniques (Freer-Smith and Taylor 2001[5]). These fluxes are simulated in a three dimensional 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 (San Jose et al. 2008[6]).

Models outputs lead to indicators which define the state of the urban environment. The end-users decide on the objectives that correspond to their needs and determine objectives' relative importance (weighting). The objectives weights reflect the central priorities of the project. Once the objectives have been determined, a set of associated criteria is developed to link the objectives with the indicators. BRIDGE integrates key environmental and socio-economic considerations into urban planning through Strategic Environmental Assessment (Donnelly et al. 2006[7]).

The BRIDGE DSS evaluates how planning alternatives can modify the physical flows of the above urban metabolism components. A Multi-criteria Decision Making approach has been adopted in BRIDGE DSS. To cope with the complexity of urban metabolism issues, the objectives 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 developed scales for each criterion to measure the performance of individual alternatives.

Five European cities have been selected as BRIDGE case studies: Helsinki, Finland; Athens, Greece; London, United Kingdom; Firenze, Italy and Gliwice, Poland.



The geographic distribution of the BRIDGE case studies and participating countries.

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 extreme 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 planning objectives. In this way, sustainable planning strategies will be proposed based on quantitative assessments of energy, water, carbon and pollutants fluxes.

[1] Offerle B., Grimmond, C. S. B., Fortuniak, K. and Pawlak, W. (2006): Intra-urban differences of surface energy fluxes in a central European city. J. Appl. Meteorol., 45: 125 - 136.
[2] Masson, V. (2006): Urban surface modelling and the meso-scale impact of cities. Theor. Appl. Climatol, 84: 35 - 45.
[3] Mitchell, V. G., Cleugh, H. A., Grimmond, C. S. B. and Xu, J. (2007): Linking urban water balance and energy balance models to analyse urban design options. Hydrol. Process., DOI: 10.1002/hyp.6868.
[4] Borrego, C., Martins, H., Tchepel, O., Salmim, L., Monteiro, A. and Miranda, A.I. (2006): How urban structure can affect city sustainability from an air quality perspective. Environ. Modell. Softw., 21, 461 - 467.
[5] Freer-Smith, P. H. and Taylor, G. (2001): Trees as Environmental Sinks. "Trees 2000 – Challenges for the Future" DETR Research for Amenity Trees Series).
[6] San Jose, R., Perez, J.L., Morant, J.L. and Gonzalez, R.M. (2008): CFD and Mesoscale Air Quality Modelling Integration: Web Application for Las Palmas (Canary Islands, Spain). In: Air Pollution Modeling and Its Application XIX, Springer Netherlands: 37-45.
[7] Donnelly, A., Jones, M., O'Mahony, T. and Byrne, G. (2006): Decision-support Framework for Establishing Objectives, Targets and Indicators for Use in Strategic Environmental Assessment. Impact Assessment and Project Appraisal, 24: 151- 157.

Athens

Athens has enjoyed a positive transformation due to the Olympic Games which took place in 2004. However the city still needs to improve air quality, to ameliorate the urban heat island and to increase free and green spaces. At the administrative level, the city needs to entrust science in its development plans so as to comply with local needs and demands.

Lat/Lon: 37°58'45.05" N

23°42'59.93" E

Area: 412km^2

Population: 3361806 inhabitants

Area of Interest: Municipality of Egaleo

End-user: Prefecture of Athens

Firenze

Firenze, a medium size city with strong historic character, needs to improve urban mobility as well as to limit emissions of air pollutants, to improve energy efficiency of public and private buildings, to decrease waste production and to raise awareness on environmental responsibility. Answers to local needs are to be defined with the use of recently installed micromet monitoring system capable to record urban mass and energy fluxes.

Lat/Lon: 43°46'07.44" N

11°15'24.84" E

Area: 102 km^2

Population: 366 488 inhabitants

End-user: The Direzione Urbanistica, Comune di Firenze

Project meetings

The kick-off meeting of BRIDGE was held in Heraklion, Greece, on January 22-23, 2009. During this meeting the imminent goals of the project were defined and the action list for the first 6 months was determined. The Management board (MB) and the Steering Committee (SC) held a session for the first time as well. The project's progress is reinforced by the constant communication among participants in various ways, eg. via email, via Skype or via the ftp web based server. Two additional committees were formed, the Intellectual Property Right Committee and the Advisory Committee, in order to secure deliverables and the results of the project in general.

Two technical meetings concerning WP5 and WP6 lead to the preparation of two technical reports named after "WP5 Indicators working paper" and "DSS Specification document".

The 2nd MB meeting was held on May 8, 2009 (Internet).

The 1st Progress Meeting was held in Helsinki on June 11-12, 2009 to review the first results of the project and to plan future activities. A WP5 technical meeting was also held in Helsinki to discuss the framework "Objectives-Criteria-Indicators" as the critical components of decision making.

The 3rd MB meeting and the 2nd SC meeting were organized on June 12 in Helsinki. In addition, Technical meetings have been organized via internet on May 29 and July 16, 2009.

The 4th MB meeting was held on September 21, 2009, whereas the 5th MB meeting was held on November 25 8, 2009 (both Internet meetings).

The minutes of each meeting are available on the BRIDGE ftp server: *http://www.iacm.forth.gr/egroupware*.

Participants of the kick-off meeting held at Heraklion on January 22-23, 2009.

Community of Practice meetings in BRIDGE case studies

The development of BRIDGE sustainability objectives, criteria and indicators for urban system assessment will be achieved during the Community of Practice (CoP) meetings. Critical issues of each case study-city, in the form of drivers and pressures, will be presented and the result will be the establishment of a core of objectives and indicators for each case study. To cope with the complexity of urban metabolism issues the objectives have to measure the intensity of the interactions among the different elements in the system and its environment. The criteria for the objectives will be related to the environmental and socio-economic indicators to be used in BRIDGE and will be based on international, European and local legislation (directives, regulations, conventions).

The 1st CoP meeting was held in Helsinki on June 15, 2009 to consolidate the users' needs and requirements. A questionnaire was prepared and it was distributed at the London CoP meeting on August 24, 2009, at the Athens CoP meeting on October 8, 2009, at the Firenze CoP meeting on October 16 and at the Gliwice CoP meeting on October 20 that followed.

A sample set of indicators, as they have been so far decided in the CoPs, is presented in the following table. The final set of indicators will be validated with datasets available and will be incorporated into the DSS to spatially assess the environmental impacts and the socio-economic implications of different urban planning alternatives on the basis of energy, water, carbon and pollutants fluxes.

First CoP meeting with local planning practitioners at Helsinki on June 15, 2009.

Gliwice

Gliwice is satellite city with an Old Town in the central part and residential districts around the centre. Its challenges towards sustainability include the definition of land use plans, the improvement of buildings through technical and energy efficiency measures, the management of the quantity and quality of water, the protection of the water resources and the improvement in the traffic patterns.

Lat/Lon: 50°17'40.17" N

18°40'16.97" E

Area: 134km^2

Population: 197 393 inhabitants

Area of Interest: Politechnika District

End-user: The Department of Architecture and Town-planning of Gliwice

Helsinki

Helsinki (and its Metropolitan Area) needs to considerably reduce greenhouse gas emissions, to increase the share of renewable energy sources in the production of district heating and electricity, to improve the energy-efficiency of the building stock, to extend the regional public rail transport network, to improve eco-efficiency in construction and service delivery and decrease waste production.

Lat/Lon: 60°10'11.56" N

24°56'18.27" E

Area: 716 km^2

Population: 582000 inhabitats

Area of Interest: Meri-Rastila

End-user: The Helsinki City Planning Office

A sample set of indicators that would allow monitoring of urban metabolism.

Urban metabolism component	Objective	Indicators
Energy	Optimise energy production and consumption	• Energy consumption per sector • Energy consumption from district heating per building type • Anthropogenic heat loss • Percentage of energy from renewable energy sources • Annual average temperature • Winter/summer temperatures • Heat island effect
Water	Protect the water balance	• Water consumption per capita and per sector • Precipitation (daily maximum & average, total annual) • Evapotranspiration (seasonal average, total amount) • Filtration • Surface runoff • Number of flooding/drought events
Carbon and Pollutants	Improve air quality	• GHG emissions per sector per hour • Carbon dioxide (CO_2) • Methane (CH_4) • Acidifying substances per sector per hour • Nitrogen dioxide (NO_2) • Sulphur dioxide (SO_2) • Particulate matter per sector per hour • Thoracic particle (PM_{10}) • Fine particle ($PM_{2.5}$) • Ozone (O_3)

Current status and upcoming events

The "BRIDGE conceptual framework" has been prepared as a contribution for the clarification of the methodology that will be adapted in the preparation of the DSS. The baselines for the methodology specification have been set to identify the current understanding that has to do with urban metabolism and the users' needs. The identification of the current understanding and modelling capability for energy, water and carbon flows and resources in urban environments is active, as well as the study of sustainable planning strategies and the status of their implementation. As far as the CoPs are concerned, the guidelines for the Protocol to develop CoP have been set, as well as a monitoring method for their implementation.

A list of measurements referring to the different case studies has been developed and measurement protocols for each of the five case studies have been produced. In situ measurements are undergoing regularly in all case studies. Remote sensing measurements have started in some case studies and measurements referring to socioeconomic data are in an advanced state of preparation. The specification of different modelling systems, their requirements and main definitions are also being examined.

The main outlines of the DSS have been set up. A mock-up version of the BRIDGE DSS has been developed, to comprise the keystone for the future implementation of the BRIDGE DSS. This mock-up was demonstrated in the 1st Progress Meeting and it was used in CoP meetings to help the users understand what BRIDGE can offer to them and how.

The most important upcoming event is the 2nd Progress meeting which will be held in Firenze, on December 2-3, 2009.

Publications

1. BRIDGE brochure (in English, Greek, Polish, Italian and Finish). Available on the BRIDGE web-site.

2. Järvi, L., Rannik, Ü., Mammarella, I., Sogachev, A., Aalto, P. P. , Keronen, P., Siivola, E., Kulmala, M., and Vesala, T., (2009). Annual particle flux observations over a heterogeneous urban area. Atmos. Chem. Phys. Discuss. 9, 13407- 13437.

3. Järvi, L., Mammarella, I., Eugster, W., Ibrom, A., Siivola, E., Dellwik, E., Keronen, P., Burba, G., and Vesala, T., (2009). Comparison of net CO2 fluxes measured with open and closed path infrared gas analyzers in urban complex environment. Accepted to Boreal Env. Res.

4. Chrysoulakis, N., Vogt, R., Young, D., Grimmond, C.S.B., Spano, D. and Marras, S., (2009). ICT for Urban Metabolism: The case of BRIDGE. In: Wohlgemuth, V. Page, B. and Voigt, K. (Eds): Proceedings of EnviroInfo2009: Environmental Informatics and Industrial Environmental Protection: Concepts, Methods and Tools. Hochschule für Technik und Wirtschaft Berlin, Vol. 2, pp. 183 – 193.

5. González, A., Donnelly, A., and Jones, M., (2009). BRIDGE: SustainaBle uRban plannIng Decision support accountinG for urban mEtabolism. National FP7 Environmental Information Day, 9 October 2009, Dublin, Ireland.

6. Chrysoulakis, N. (2008). Urban metabolism and resource optimisation in the urban fabric: The BRIDGE methodology. In: Proceedings of EnviroInfo2008: Environmental Informatics and Industrial Ecology. September 10-12, Leuphana University of Lüneburg, Germany, Vol. 1, pp. 301 - 309.

Deliverables

1. Project Management Plan, D.1.1 (delivered).

2. 1st Quarterly Progress Report, D.1.2.1 (delivered).

3. Dissemination and Use Plan, D.9.1 (delivered).

4. BRIDGE Web-Site, D.9.2 (operational).

5. 2nd Quarterly Progress Report, D.1.2.2 (delivered).

6. 3rd Quarterly Progress Report, D.1.2.3 (delivered).

7. Inventory of current state of empirical and modelling knowledge of energy, water and carbon sinks, sources and fluxes, D.2.1 (final draft).

8. Protocol to assess differences between knowledge supply and knowledge needs in the field, D.2.2 (final draft).

9. Protocol to Develop Communities of Practice in the Context of the BRIDGE Project, D.2.3 (final draft).

10. Datasets of air quality, energy, water, carbon and pollutants fluxes/concentrations, D.3.1.1 (final draft).

11. GIS data and maps of energy and water fluxes, pollution concentrations, land cover and vegetation, D.3.2.1 (final draft).

12. GIS data and maps on spatial, socio-economic development and impact indicators, D.3.3.1 (final draft).

13. Model Selection Report, D.4.1 (final draft).

14. DSS Design Report, D.6.1 (final draft).

15. BRIDGE Published Material, D.9.3.i (see Publications section).

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Further information can be found at: www.bridge-fp7.eu

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