The problem addressed

Today, with the majority of the global population living in urban areas, cities are a key contributor to climate change. City activities are the main source for carbon dioxide (CO_2) emissions. If global efforts to address climate change are to be successful, they will need to integrate city requirements and environmental management capacities (UNEP/UN Habitat 2009).

The way urban areas are built – in spatial and technological terms – has a great influence on the present and future demand for resources, energy and land.
The SUME – Sustainable Urban Metabolism for Europe – project, supported by the European Union 7th Framework Programme, attempts to show how urban resource use is being influenced by the spatial form in which cities are being built. It explores new ways to design cities – and to change existing cities.

What is Urban Metabolism

The metabolism concept investigates the biophysical interaction between a society and its environment, by accounting for resource use (energy, materials, land…) and outputs to the environment, and linking these with social, economic and technical parameters. Socio-metabolic patterns change throughout history and exhibit large scale and geographic variations.

In an increasingly urbanized world, understanding urban metabolism, i.e. the socio-metabolic specificities of different urban areas, and their development trajectories may bring key insights for sustainability at the global scale. From the perspective of urban metabolism, cities are seen as part of the solution as well as part of the problem, through resource-efficient buildings, infrastructure, and urban form.

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Join us at the SUME Dialogue Conference 3 May 2011 in Vienna

Expected results

Urban development includes processes of growth in new areas, decay, abandonment and also restructuring in others, varying strongly between different cities and countries. The SUME project will explicitly deal with these differences when analyzing the potential for the transformation of existing urban built environments in order to reduce resource and energy consumption.

Based on an urban form and urban development survey of European cities, a number will be selected for scenarios, model applications and case studies. The expected project outcomes include
– spatial development scenarios for selected cities (until 2050), such as Vienna, Munich, Newcastle, Stockholm, Porto and Athens, comparing a trend and a SUME-policy scenario as the ground to analyse policy options further
– develop and apply a spatially-explicit urban resource flow (metabolism) model, to be tested and applied in case study cities, accompanied by an agent-based model component to allow the simulation of urban planning decision-making
– an investigation of actors and planning policies and institutions relevant to influence the spatial dimension of urban development, designing appropriate policies and policy tools
– an urban planning and evaluation method to analyse the impact of large scale urban development projects on the overall resource performance of a city

The results will provide essential insights for environmental and spatial policy making, for urban development policies and for transportation policies at both national and local levels. It will be useful for scientific and practical applications. One of the potentially most fruitful outcomes will be the improved communication between research communities which have worked independently to date, giving a strong impulse for future research and development activities. Dissemination and communication is a crucial component of the project, involving policy makers, stakeholders, urban planners and social networks. It is important for ensuring high quality outcomes and will improve the tools for future dissemination to a wider public.

Project facts

Title: SUME – Sustainable Urban Metabolism for Europe

EU-funding: Seventh Research Framework Programme – CP FP7 (Collaborative Research Project, Area 6.2.1.5 Urban development, ENV.2007.2.1.5.1 Urban metabolism and resource optimisation)

Project budget: 3,629,965.00 €

Duration: 36 months, 01/11/2008 – 30/10/2011

Consortium: 10 partners from 9 countries and 2 continents (Europe and Asia)

Key words: urban form, urban development, urban metabolism, built environment, energy consumption, material flow, urbanization, urban transport, urban modelling

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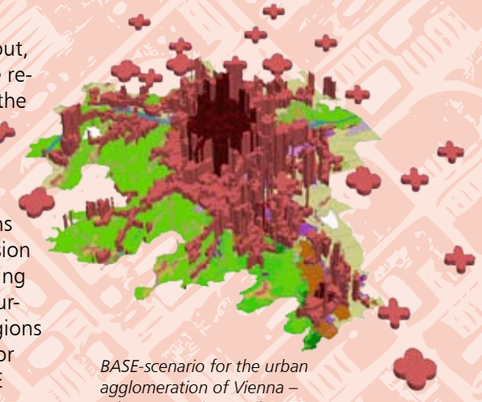
SUME
Sustainable Urban Metabolism For Europe

Future urban dynamics

Austrian Institute for Regional Studies and Spatial Planning (ÖIR), Christof Schremmer

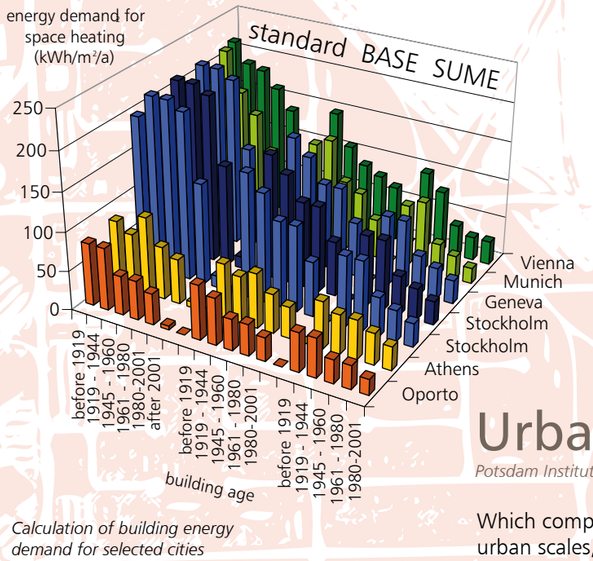
The spatial form of cities – the densities used, the spatial and functional layout, the transportation infrastructure – has a significant long-term impact on the resources needed for the daily operations within an urban systems over time: the amount of energy needed for heating, cooling and transportation and also the land required for urban expansion.

In SUME, current trends and driving forces of future urban development are analyzed and applied to a typology of urban forms (densities, spatial patterns etc.) and a typology of transformation patterns (fast or slow growth, expansion or inner-city development). Based on a set of quantitative input data, including population projections and long-term economic development, scenarios of urban transformation are being elaborated for a number of selected urban regions in Europe. The scenario approach is intended to provide realistic estimates for the future action space for policy makers and planners by comparing a BASE and a SUME scenario which includes resource-relevant densification measures.

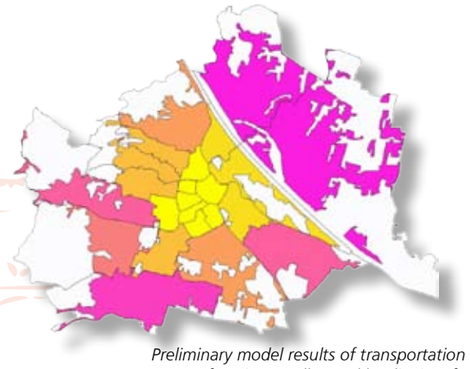


BASE-scenario for the urban agglomeration of Vienna – urban expansion until 2050

Three SUME-scenario densification steps for the urban agglomeration of Vienna until 2050



Calculation of building energy demand for selected cities



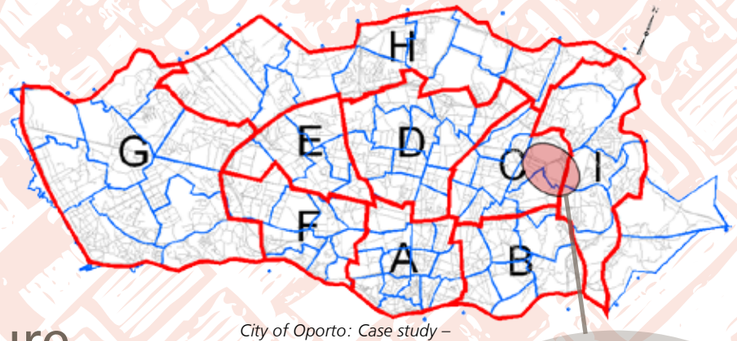
Preliminary model results of transportation energy for Vienna, allocated by district of origin

Urban Metabolism

Potsdam Institute for Climate Impact Research (PIK), Helga Weisz

Which components of the material and energy system are specific to urban scales, what are the determining factors of urban metabolism and how can they be influenced by urban planning? SUME is developing a formal spatially explicit model of urban metabolism, focusing on the two aspects of urban metabolism most strongly connected to urban form and urban planning: buildings and transportation.

The model can be applied to existing cities, scenarios of their future evolution, or used to model hypothetical cities. It takes into account both stocks (the existing infrastructure of the urban built environment) and the flows required to construct, maintain use, and demolish this infrastructure. The modelling goal is the simulation of the long term stocks and flows dynamic and how it can be influenced by urban planning decisions.



City of Oporto: Case study – application of transport model

Urban Structure

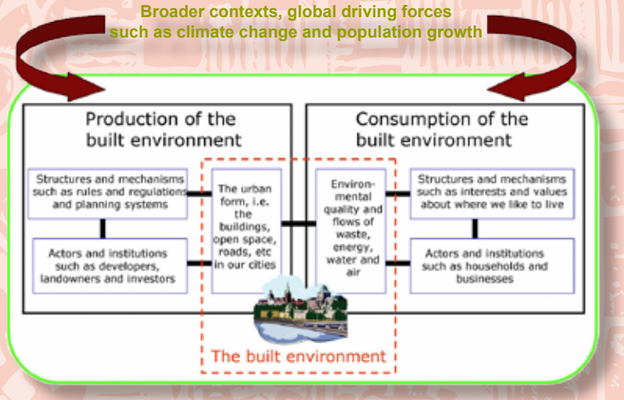
Faculty of Engineering of the University of Oporto (CITTA), Paulo Pinho

Urban areas are dynamic systems. The way these systems are being built – in spatial and technological terms – has a great influence on the quantities and qualities of resources used to maintain urban life, especially land use, materials and energy consumption.

The intent of this SUME component is to relate urban structures to the concept of urban metabolism, by designing an innovative methodology, the Metabolic Impact Analysis (MIA), to evaluate the urban development process. It provides an operational method to assess the overall impact of a particular development proposal on the existing urban metabolism performance of a given city.

This research aims to optimize either existing or planned urban structures in order to demonstrate potential metabolic improvements or impacts. MIA will be applied and tested on different cities for validation.

Urban development project (Antas zoning map)



The SUME model of the urban development process

Policies and strategies

University of Newcastle upon Tyne (GURU), Simin Davoudi

There are multiple stakeholders who, in interaction with each other, contribute to the development of our cities. They include governments, landowners, developers, investors, and, most importantly, the end-users (households, businesses, etc.). Developing a deeper understanding of how different policies and strategies may influence their behaviour in the production and consumption of the built environment is central to SUME.

New strategies incorporating policy packages designed to achieve metabolically more acceptable urban form are being produced. Alongside these strategies, methods of implementing them and transferring them between different countries and different contexts are being developed. These strategies aim to move beyond targeting one or two groups of actors (developers and landowners), and focus on motivating a wider range of stakeholders to make our cities more sustainable.