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Science for Environment Policy

New planning tool to improve flows of energy and materials in cities

A new tool to help planners choose urban designs that positively influence flows of energy, carbon, water and pollutants in cities is presented in a recent study. It is designed to integrate scientific knowledge into the planning process and support cities in achieving sustainability objectives.

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A city can be conceived of as a system with energy and materials that flow between the city itself and the wider environment - comparable to a natural ecosystem. Unlike ecosystems, however, the flow of energy and materials through cities is usually one-way and not self-sustainable.

Analysing the environmental and human activities that define the 'urban metabolism' of cities allows these systems to be manipulated through strategic urban development. Urban metabolism considers and quantifies the inputs, outputs and storage of energy, water, nutrients, materials and wastes in urban regions.

The study, conducted under the EU BRIDGE project[1], considered the metabolism of five European cities to develop and evaluate a Decision Support System (DSS) tool that could assess planning options for sustainable urban development.

The five cities used as case studies had very different profiles. Helsinki, Finland, has a large energy expenditure for heating; Athens, Greece, has a large energy expenditure for cooling; London, UK, is an example of a megacity; Florence, Italy, is an example of a historic city; and Gliwice, Poland, is a city that has seen recent and rapid economic, social and political change.

Local planners and urban developers in each city identified distinct sustainability objectives, such as improved air quality or a reduced heat island effect. Using the tool, they could assess the impact of different planning options designed to achieve these objectives on various environmental elements, i.e. the relationships between energy, water, carbon and pollutants, and socioeconomic factors, such as investment costs, housing and employment.

Each committee decided on the relative importance of each objective and also agreed suitable measures of success. They then identified a part of the city that needed to be redesigned and proposed three alternative practical solutions.

The DSS analysed data on local energy patterns and human activity and assessed the impact of each of the three design solutions on energy, water, carbon and pollutant fluxes in each city.

In each of the five case studies, green spaces were found to have a positive effect in meeting sustainability objectives, through cooling, sequestering CO_2, buffering water and improving air quality. Adding buildings and roads had a negative effect. While these results were not unexpected, the DSS was able to quantify the findings and relate them to sustainability targets. Diagrams are provided by the tool, which illustrate each planning option's effects on environmental flows.

The researchers say one of the DSS's key strengths is that the objectives can be selected and weighted to suit different priorities that may change over time. They highlight that the DSS tool is unlikely to ever provide a definitive planning solution for a city that meets all its sustainability objectives; therefore, the tool will not simplify the urban planning process. However, the DSS can help urban planners better understand the trade-offs between competing objectives and how urban design features influence urban metabolism.

1. BRIDGE (sustainaBle uRban planning Decision support accountinG for urban mEtabolism) is supported by the European Commission under the Seventh Framework Programme. See: www.bridge-fp7.eu