

## ESTIMUM

Quantifying and assessing the value of urban ecosystem services associated with scenarios of nature-based solutions' implementation



### Inspiration

Cities are complex and dynamic systems in continuous evolution, whose metabolism can generate massive impacts on the environment and human health. Nowadays assessing the sustainability of urban metabolism (UM), disclosing sources of impact, reducing their negative effects, and ultimately supporting a sustainable management and design of urban spaces represent great challenges. While no consensus exists on best practices for UM sustainability assessment, urban designers, planners and policy makers need more and more understanding and decision support systems to predict changes in cities and implement the most effective and sustainable solutions to improve the welfare of citizens.

### Innovation

ESTIMUM aims to develop an integrated spatially-explicit operational instrument for simulating the value change (both monetary and physical) of ecosystem services over time at multiple urban scales, which run different scenarios of urban metabolism and implementation of nature-based solutions in cities. Because the proposed simulation framework evaluates changes in urban ecosystem service trends over time and different uses of land, a special focus is on improving the urban biodiversity and management of green spaces, while at the same time fostering the implementation of nature-based solutions in the cities.

A toolbox, called MIMES-TUM (Multiscale Integrated Model of Ecosystem Services Tailored for Urban Metabolism), will be created to evaluate ecosystem service trade-offs (e.g. air purification, noise reduction, urban cooling, runoff mitigation, food provision) in urban regions. A scenario analysis interface will be incorporated in MIMES-TUM to allow forecasting the environmental, physical and socio-economic benefits (and costs) of solutions designed to enhance the supply of ecosystem services in cities. Such a toolbox is built using a System Dynamics rationale, and is suited to characterise the complex relationships between biosphere and technosphere components in urban regions (assumed to represent dynamic UM patterns). This is innovative in the way that components of urban ecosystems are stocks and flows of infrastructure and commodities (goods and services produced, transformed and consumed in the city), mainly associated with life cycle product and input-output economic sectorial datasets.

### Impact

An integrated structure will be produced to display the intra- and inter-linkages among the components of a city (both man-made and natural ones), informing on its metabolic pathways and allowing to trace the inputs and outputs of the urban system in relation with the surrounding environment, at multiple scales (city > region > country > Earth).

ESTIMUM thus offers an unprecedented monitoring, simulation and prospective decision support system for sustainable urban planning and policy development. Accordingly, MIMES-TUM will undergo an iterative validation process in test-bed conditions of urban decision-making, both in Luxembourg and outside. In particular, the toolbox will be handled to describe the UM of three cities: Esch-sur-Alzette (located in the South of Luxembourg), taken as a principal demonstrator, and then Lisbon (Portugal) and Siena (Italy), implemented for comparison and robustness testing. In this regard, different stakeholders among which internationally renowned key-players in UM, ecosystem services and sustainable urban planning will feed the modelling development with expert inputs.

On the long term, this project can contribute to meeting national research and policy targets oriented towards a conceptual construction, organisation and practical use of urban space, fostering the transition of the socio-economic and environmental development in Luxembourg towards the use of green urban space and infrastructure, and improving the future quality of life within the country.

### Partenaires

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