

FertileCity II. Integrated rooftop greenhouses: symbiosis of energy, water and CO₂ emissions with the building – Towards urban food security in a circular economy

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1 FertileCity I: Unidirectional connection

Urban areas are increasingly larger and more numerous. They use nearly 70% of energy and are responsible for 75% of world greenhouse gas emissions. Urban areas are strongly dependent on food and water, and this makes them vulnerable and responsible for high environmental impacts. Within cities, most energy is required for housing, which is a major source of emissions. Besides, food production relies on energy (particularly for transportation) and water (in Southern Europe irrigation uses about 80% of deep groundwater).

FertileCity I project (CTM2013-47067-C2-1-R; 2014-2016) started research activities on a new horticultural production system based on multi-disciplinary tools (environmental analysis, economic and sustainability in life-cycle, energy efficiency). FertileCity I was also founded on agricultural methodologies to analyse crop response and development viability. Rooftop Greenhouses (RTG) are still in early stages of research and implementation. In Europe, such type of production is still beginning, and current pilot RTGs are always disconnected, in terms of water, energy and CO₂, from the building underneath.

2 FertileCity II: Towards a bidirectional connection

The objective of FertileCity II (2017-2019) project is deepening on research of urban agriculture in RTGs integrated with the building, providing information and tools that make integrated RTGs possible. During FertileCity I, a new facility started to operate on the ICTA-ICP building roof (UAB). Between January 2014-2016 different lettuce and tomato crops were grown. Such facility is currently connected to the building in terms of water, energy and CO₂, but only one-way, from the building to the greenhouse.

FertileCity II will focus on establishing a two-way greenhouse-building connection. The project will address subjects such as the recirculation of water for agricultural production; detailed energy modelling of the greenhouse-building system and its comparison with conventional greenhouses; the architectural and constructive study both on a building scale and on a neighborhood scale; the use of generated agricultural residues; the analysis of the system sustainability (environmental, economic and social viewpoints); the identification of business models; and the dissemination and transfer of the project and its results.

Such symbiosis greenhouse-building (energy, water, CO₂...) requires a multi-disciplinary approach which is covered by researchers from UAB (with expertise on environmental matters, water cycle in urban areas, waste and economy), UPC (expertise on energy, architecture, construction, and sustainability assessment) and IRTA (expertise on agronomy and greenhouse effect). FertileCity II is organised around ten tasks which are structured into five blocks: system (T1) with the adaptation of the experimental greenhouses to the project's requirements; technical and environmental system characterisation (T2-T6) focussed on the study of materials, energy, water, nutrients, food, greenhouse gases and wastes; analysis of environmental and socio-economic sustainability (T7-T8); urban system implementation (T9) and dissemination and exploitation of the project results (T10). The aim is to respond to the challenge of food safety and quality in cities through the production of sustainable food (reduction of products coming from far away, less environmental impact), quality (complete plant maturation) and contribution to the "Safe energy" and "Climate change" challenges by increasing the energy efficiency of buildings and CO₂ capture and storage, as well as reducing emissions and transporting food.

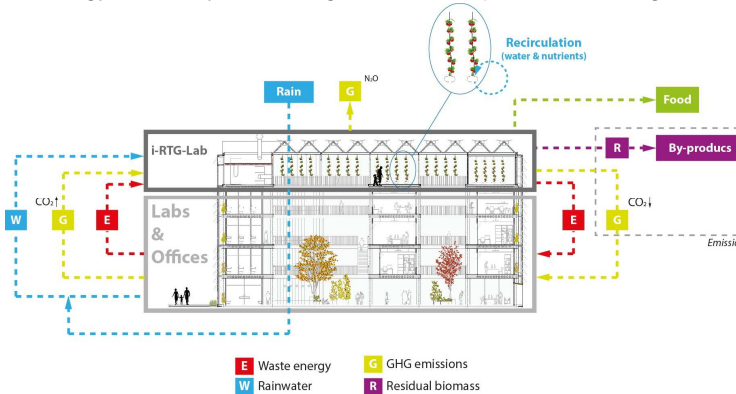


Figure 1. Exchange of flows between the ICTA-ICP building and its greenhouse on the roof.

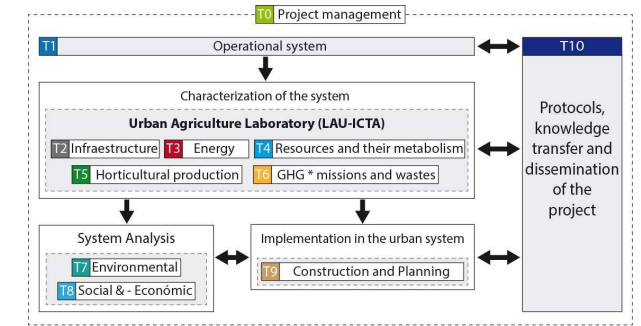


Figure 2. Tasks of the FertileCity II Project