Rooftop greenhouse connected to water, heat and CO2 flows of the building

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CityZen digital workshop on urban farming, April 2021
1. Fertilecity. ICTA-UAB

2. FoodE. Food System in European Cities

3. Tectum Garden, spin off

4. Groof. Greenhouses to Reduce CO2 on Roofs

The presentation reflects the author’s views. The Research Executive Agency (REA) is not liable for any use that may be made of the information contained therein.
Urban rooftop farming. ICTA-UAB

The Rooftop Greenhouse Lab (i-RTG-Lab):
New building ICTA-ICP (UAB) May 2014 - Bellaterra, Barcelona

Our case study

Our crop study

Fertilecity. ICTA-UAB

Food System in European Cities. FoodE
Spin off: Tectum
Greenhouses to Reduce CO2 on Roofs
The Rooftop Greenhouse Lab (i-RTG-Lab):
Soilless system: perlite
Fertilecity. ICTA-UAB

Food System in European Cities. FoodE

Spin off: Tectum

Greenhouses to Reduce CO2 on Roofs

Fertilecity. ICTA-UAB

Linear conventional agriculture

Linear UA

Circular Urban Metabolism

Circular UA

Synergies within UA and between UA and other urban systems

Minimized external resources for UA

Minimized Waste + Wastewater

Minimized Nutrient depletion and eutrophication

Urban Agriculture

External resources for UA

Nutrient depletion + Eutrophication

Waste + Wastewater

Cities

Horticultural products

GHG and Fossil, Mineral and Water depletion

Linear

Circular
i-RTG-LAB: Towards a bidirectional connection

In contrast to conventional RTG projects, the RTG-Lab is an Integrated RTG (i-RTG) that exchanges the residual flows (energy, water and gas) with the ICTA-ICP building. Different crops have been cultivated: tomato, lettuce... and bean

2 i-RTGs (122.8m² each one, with 84.34m² for the crop)
Food System in European Cities. FoodE
Spin off: Tectum
Greenhouses to Reduce CO2 on Roofs
## Energy saving

### Building-Greenhouse Interconnection

### Daytime

**Conventional production**

- Desert temperatures for crop production (35°C), particularly in summer

**i-RTG-Lab**

- Building ➔ Cold air ➔ Greenhouse

### Night

**Conventional production**

- Desert temperatures for crop production (<15°C), particularly in winter

**i-RTG-Lab**

- Building ➔ Waste heat ➔ Greenhouse

### Day

**i-RTG-Lab**

- CO₂ is injected to supply crop demand to enhance photosynthesis and crop yield

- Building ➔ CO₂ ➔ Greenhouse

Also... natural ventilation of the greenhouse!
Energy saving

Building-greenhouse integration

- iRTG 420 kWh/m²
- ICTA 152 kWh/m²

Recovered by the greenhouse:
- 342 kWh/m²

Insulation effect:
- 32 kWh/m²
- 13 kWh/m²

Gained to the greenhouse:
- 62 kWh/m²
- 16 kWh/m²

Gained to the building:
- 110 kWh/m²

Natural energy flows:
- 512 m²
- 8,600 €

Forced energy flows:

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Food System in European Cities. FoodE

Spin off: Tectum

Greenhouses to Reduce CO2 on Roofs
Water parameters of the crop cycles. **DAT**: Days After Transplanting; **WUE**: Water Use Efficiency, in L/kg; **RWU**: Rainwater used, in %; 
T: Tomato; L: Lettuce; G: Green Bean; S: Spinach; C: Chard; R: Arugula; P: Green Pepper.
Social analysis. Citizen participation

Methodological: multiple scales (municipality, building and household), is multi-dimensional (environmental and socio-economic, structural and functional), and is informed by different data sources.

The scenarios were designed based on the concerns of residents, which were gathered in a participatory workshop.
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History class. A college, somewhere in Europe. Year 2050
Aquaponic Design

AQUAPONIC DESIGN –
#3 of 178 in Bologna, Italy
Workshops, Aquaponics, Training
18 reviews
1652 m

BOOK ONLINE
Visit their website
Foode Hero 2022

Today: open 9 am – 6 pm

Search tool

What are you looking for?

Fresh Food

Crops
- Herbs, spices, aromatic and medicinal plants
- Cereals
- Fruits
- Vegetables
- Pulses
- Edible flowers
- Mushrooms
- Oil crops

Fisheries
- Fish
- Algae
- Shellfish

Livestock & poultry
- Ruminants
- Pig
- Chicken

Management type
- Mostly free range
- Mostly not-free range

System Type
- Salt water
- Sweet water
- Bioreactor
- Aquaponics

Cultivation type
- Biodynamic
- Organic
- Integrated
- Conventional

Fertilecity. ICTA-UAB
Food System in European Cities.
FoodE
Spin off: Tectum
Greenhouses to Reduce CO2 on Roofs
Multi-user online survey tool

Target groups
- users of CRFS (e.g. consumers)
- owners/members of CRFS
- stakeholder groups (HEIs, PAs and NGOs)

Kind of information
- reviewing provided value proposition
- enter business data
- enter additional case studies
- administrative/policy support for political decisions (e.g. city planning, food councils)

FoodE App
- receive a sustainability assessment
- enter business data
- receive a sustainability assessment
- enter additional case studies
- administrative/policy support for political decisions (e.g. city planning, food councils)

Spin off:
- Tectum
- Greenhouses to Reduce CO2 on Roofs
Simplified assessment of CRFS

Scorable part:

Social
- Job
- Community
- Food Quality & Safety

Economic
- Organisation Outlook
- Local Economic Development
- Customer & Users

Environmental
- Food Production/Supply
- Resource Use
- Waste Management
- Transport

5 KPIs
4 KPIs
5 KPIs
3 KPIs
3 KPIs
4 KPIs (+ optional)
5 KPIs
3 KPIs
4 KPIs
3 KPIs
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Tectum Garden

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Greenhouses to Reduce CO₂ on Roofs
An innovative and multidisciplinary approach to reduce CO2 in the building and agricultural sectors by combining energy exchange and local food production.

Partners:
France, Belgium, Germany, Spain, Luxembourg

4,9 Millions euros of budget

Fertilecity. ICTA-UAB
Food System in European Cities. FoodE
Spin off: Tectum
Greenhouses to Reduce CO2 on Roofs
By implement greenhouse on the rooftop of building

Rooftop greenhouses as useful equipment for:

- **Reuse resources not consumed by the building** => recovered heat-loss
- **Collect CO₂ produced by people and building activities for the benefit of plants**
- **Increasing food resilience in urban areas**
HOW?

Brakes and opportunities identification

Development and experimentation With the four Pilots

HELP and FOLLOW-UP Roof greenhouse project leaders

2017

2021

Fertilecity. ICTA-UAB Food System in European Cities. FoodE Spin off: Tectum Greenhouses to Reduce CO2 on Roofs
Main Groof Pilots:

4 pilots: to experiment and demonstrate the reduction of energy emissions from roof greenhouses

Bürstadt (DE)

Gembloux (BE)

Bettembourg (LU)

Saint-Denis (FR)

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Food System in European Cities. FoodE

Spin off: Tectum

Greenhouses to Reduce CO2 on Roofs
Support pioneering projects

Diversity in selected projects: Objective and business model

Research Rooftop Greenhouses

Yncrea - Lille

Educative Rooftop Greenhouses

Les petits poucets - Namur

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Food System in European Cities. FoodE

Spin off: Tectum

Greenhouses to Reduce CO2 on Roofs
Social bonding creator Rooftop Greenhouses

Symbiose - Nantes

Productive Rooftop Greenhouses

Les jardins perchés - Tours

Toits vivants - Paris

Les amis de l’entrepote – Bruxelles

Habitat participatif - Lux

e - Paris
Novacitis - Liege

Fertilecity. ICTA-UAB

Food System in European Cities. FoodE

Spin off: Tectum

Greenhouses to Reduce CO2 on Roofs
Small scale and independent production Reduce food chain

- local production, local consumption

Opportunity for socio economic solutions with food production

- Learning and sharing and teaching
The EBF pilot

Example: Community center around horticulture businesses

- Creating bonding spaces in alienated cities
- Improving mental health and social security

- Using ebf’s own greenhouse design
- Build on an old packaging hall from the 50s
- Located in an old and rundown market garden which is now being renewed by ebf
The packaging hall (pre-GROOF)
The packaging hall (pre-GROOF)
The packaging hall (pre-GROOF)
After the removal of the old roof
After the removal of the old roof
Installation of the concrete foundation
Aerial view of the foundation
Wooden beams for the support platform
Reusing old materials
Chipboards and bituminous sheeting
Installation of the steel structure
Installation of the steel structure
Installation of the aluminium roof arch
Finished raw structure
Plank installation as a basis for the walls
Plank installation as a basis for the walls
Installation of the hempcrete walls
Installation of the hempcrete walls
Finished back roof
Aerial view of the film installation
Only a few details missing...
Rooftop greenhouse connected to water, heat and CO2 flows of the building

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