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Energy Efficient Cities initiative (EECi)

Research group addressing the following broad objectives

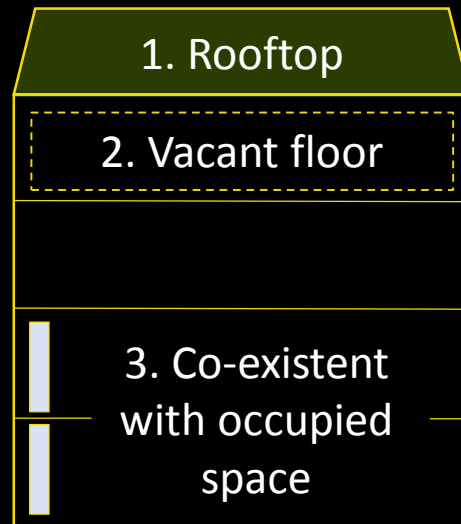
- City-scale energy analysis of buildings and related infrastructure
- Quantifying and propagating uncertainties in decision-making models
- Synergistic urban energy systems: **urban farming**, GSHPs, etc.



- location: Engineering
- Approx 3 PDRA and 4 PhD students

<https://www.eeci.cam.ac.uk/>

1. Growing plants in cities model



Expand to
city scale



FORGOTTEN
SPACES



Urban farming today



Gotham Greens,
New York



Urban Farmers,
The Hague



Lufa Farms,
Montreal

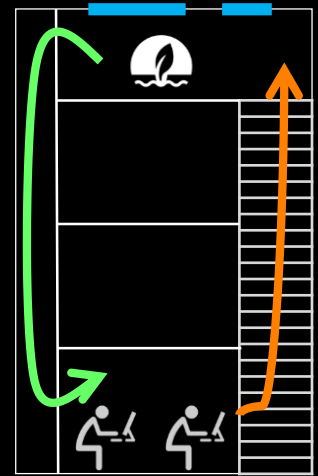


Plant factory,
Chiba University



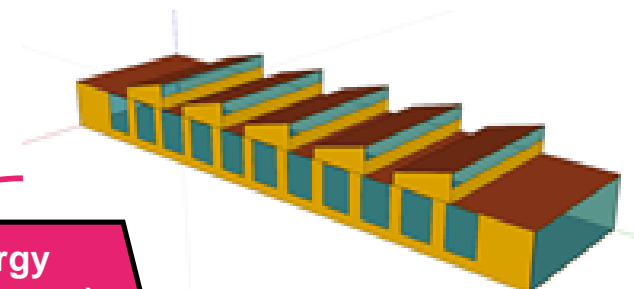
SeaWater
Greenhouse's roof,
London

Warm air,
rich in O_2



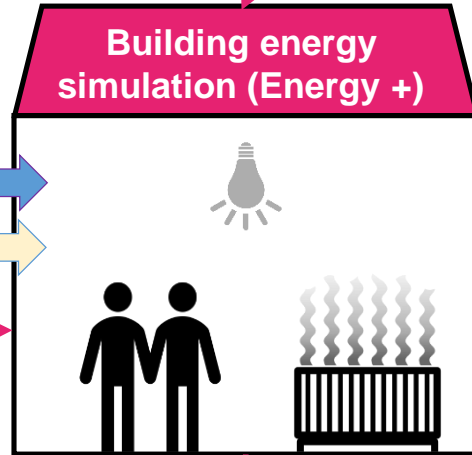
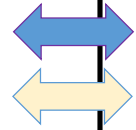
Warm air,
rich in CO_2

Combining with building energy simulation

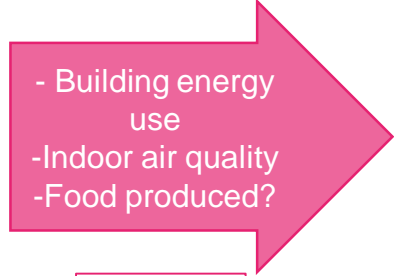


Solar radiation
Temperature
Humidity

Infiltration/
Ventilation/
Radiation



- Building geometry
- Heat gains (lighting, equipment, occupants)
- Ventilation/ Heating



Key
Input
Output
Process

Humidity



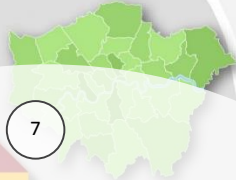
- Temperature
- CO2 level

- Light level
- Temperature
- Humidity
- Occupancy
- CO2 level



- Greenhouse parameters

Growing Support...



Working
across
33
boroughs

2012 -

Taskforce Report

- Identifies the key to successful 'Food Growing Schools'
- School leadership
- Professional development
- Resources
- Community involvement

Develop tool further

- Interviews with schools
- Geospatial analysis (overlay datasets)



In your borough...



- Garden Organic
- Capital Growth
- Soil Association: Food for Life
- Royal Horticultural Society
- School Food Matters
- Trees for Cities

100s of
businesses

1:1
Support

Engagement Officers

1000s of
volunteers

**FGSL
Directory**

85 support
organisations

The future →

Growing inspiration...

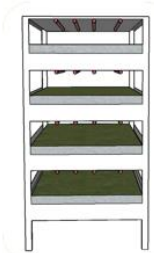


2.
Monitoring
the
performance
of a farm in
a tunnel

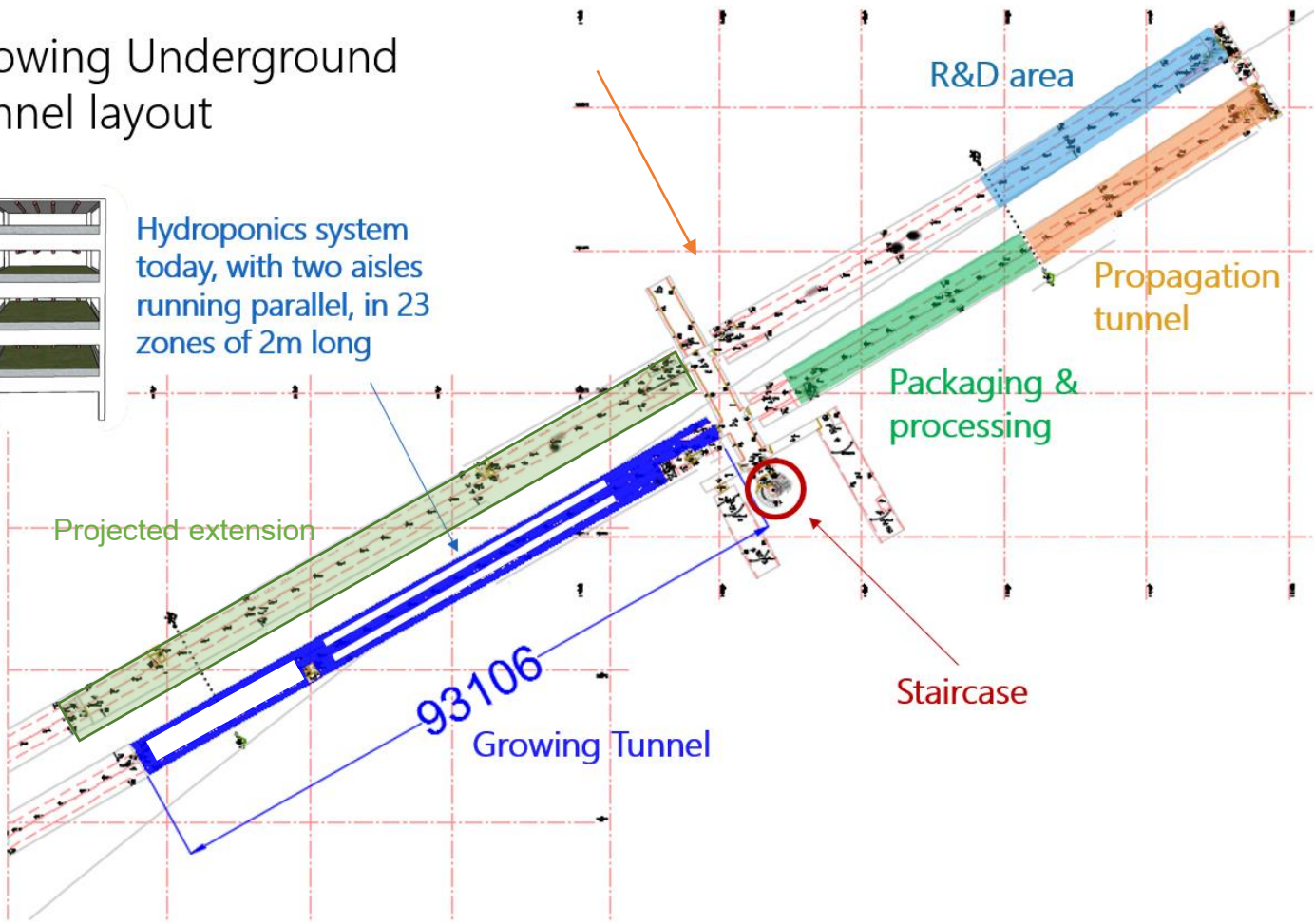


Growing Underground Tunnel layout






Growing Underground, London



Hydroponics system today, with two aisles running parallel, in 23 zones of 2m long



Sensors

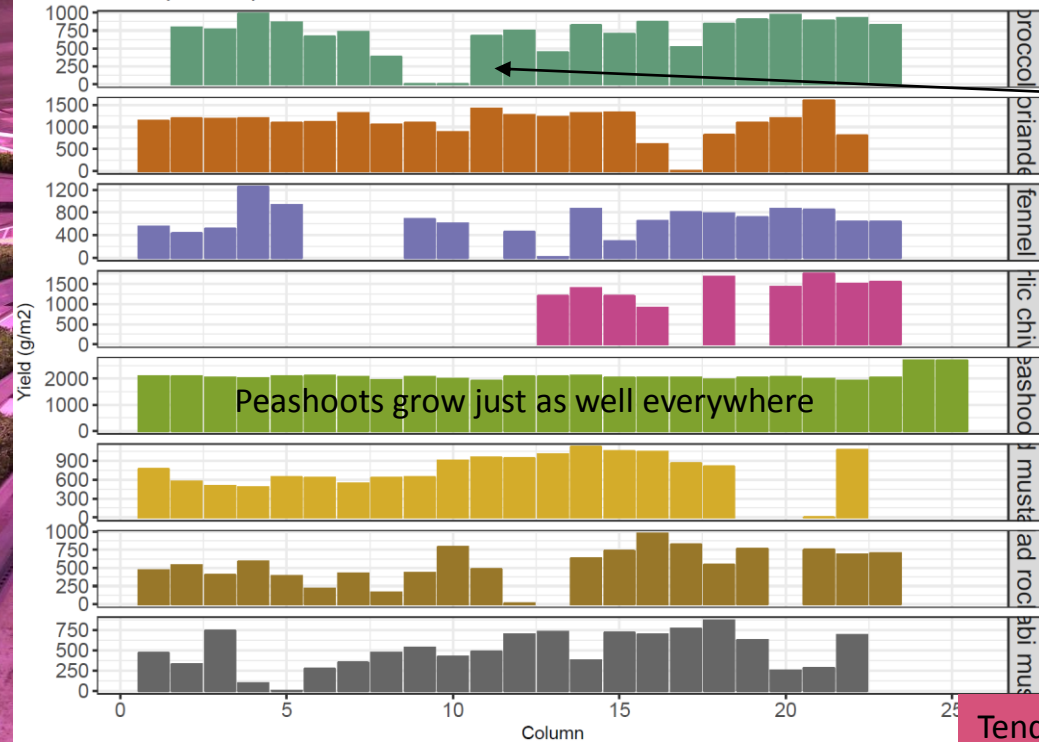
-  Water level
-  Temp, RH, CO2
-  Air velocity
-  Growing crops
-  On/off light sensors

Measure performance



Mean Yield per column over

Yield per crop and columns in 2017



Yield of coriander not so good here

- Crop
- broccoli
 - coriander
 - fennel
 - garlic chives
 - peashoots
 - red mustard
 - salad rocket
 - wasabi mustard

Peashoots grow just as well everywhere

Tend to have less good yields at front of tunnel



Green cities for climate and water resilience, sustainable
economic growth, healthy citizens and environments

<http://growgreenproject.eu/>

GrowGreen vision



- **Investing in nature-based solutions (NBS) creates cities that:**
 - Are climate and water resilient
 - Are healthy and liveable
 - Have social, environmental and economic benefits
- NBS are **innovative and inspiring solutions** to urban challenges
- Embedding NBS in **long-term city planning** creates harmony between people, the economy and the environment



About GrowGreen



- **Horizon 2020 project** under topic SCC-02-2016: Demonstrating innovative NBS for climate and water resilience in cities
 - European Commission contribution of **11.2 million EUR**
 - Involves **23 partners** and is coordinated by Manchester City Council
 - **Five-year project** from 01/06/17 to 31/05/22
 - Partners with the cities of Manchester (UK), Valencia (Spain), Wroclaw (Poland), Wuhan (China), Brest (France), Zadar (Croatia) and Modena (Italy)
-

Core objectives



- 1) **Benefits:** demonstrate that NBS/green infrastructure (GI) delivers quantifiable climate resilience and other benefits
 - 2) **Replicable process:** demonstrate a replicable process for the co-design, co-delivery and co-management of NBS/GI projects
 - 3) **Systemic change:** embed NBS/GI as part of long-term city planning, investment, development and management
 - 4) **EU:** contribute to EU 'Community of Practice' on NBS and capacity building in other cities
 - 5) **Global:** establish EU leadership and support global market for NBS
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Valencia Demo



Action 4: Solutions to thermal stress, and
Action 5: Spaces for collaboration

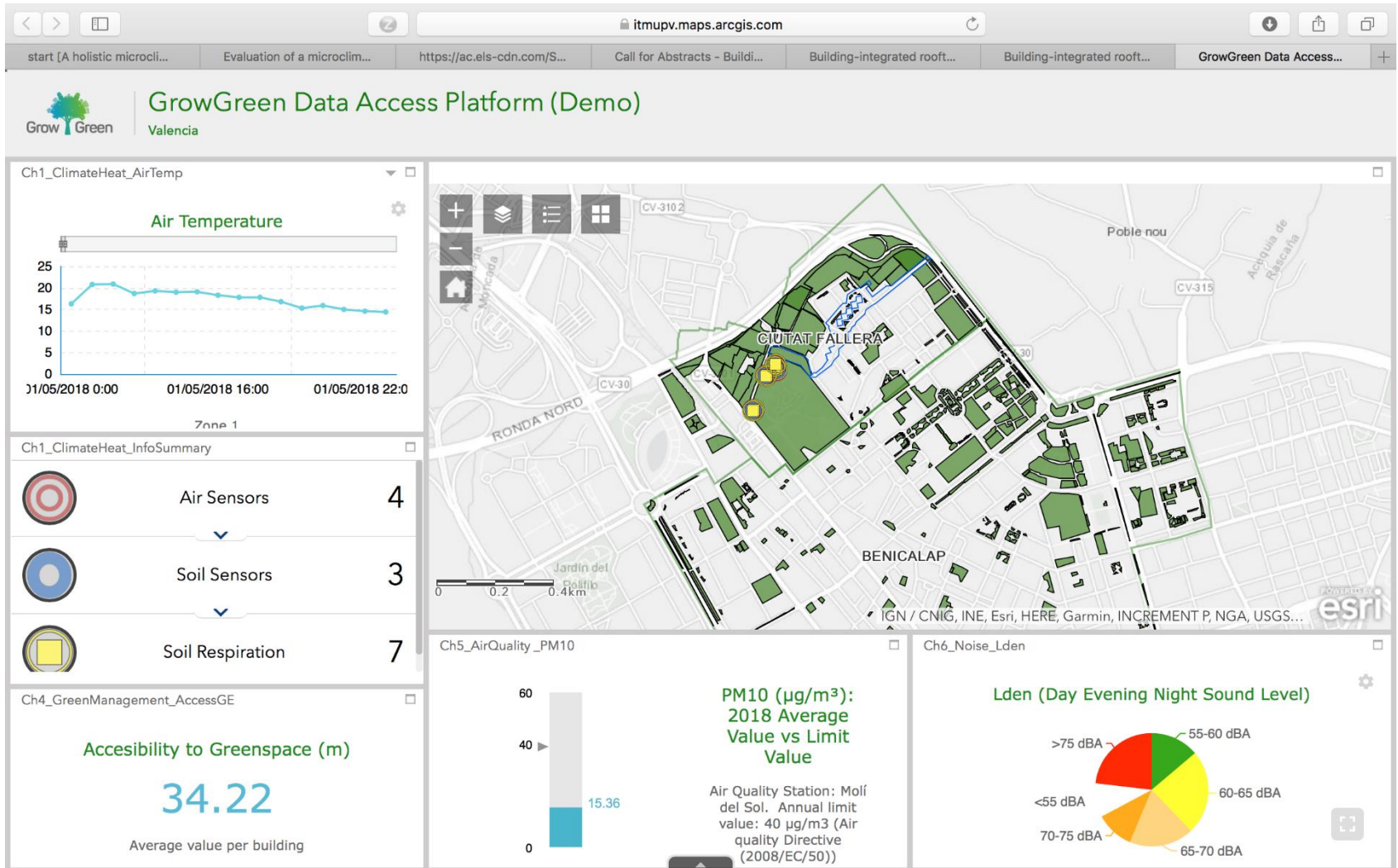
Action 3: Green and blue corridor

Action 2: Small sustainable forest

Action 1: Vertical ecosystem



WP 2.2 Data Management



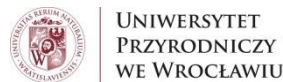
Thank you!



MANCHESTER
CLIMATE CHANGE AGENCY



GMCA
GREATER
MANCHESTER
COMBINED
AUTHORITY



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