



Fraunhofer UMSICHT
Building integrated food production - inFARMING®

Sustainable indoor horticultural systems of the future **| inFARMING®**



1st Joint Agrospace-MELiSSA Workshop, Rome, Italy 16.-18. May 2018

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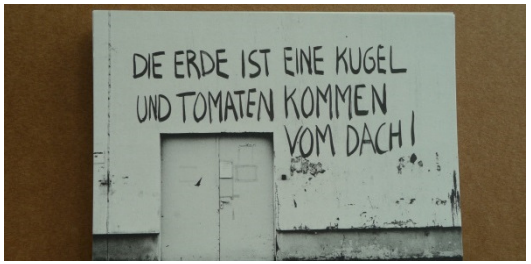
16.05.2018



The Fraunhofer-Gesellschaft

- 69 institutes and independent research facilities
- More than € 2 bn research funds
  - € 2.1 bn contract research
- About 24 500 employees (m/f)
- 40 facilities in Germany
- 13 institutes in North Rhine-Westphalia
- 4 institutes in the Ruhr area

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Content

- Introduction
- Plant lighting systems
- Fertilizer production
- Outlook »Altmarktgarten«, 1st inFARMING® project

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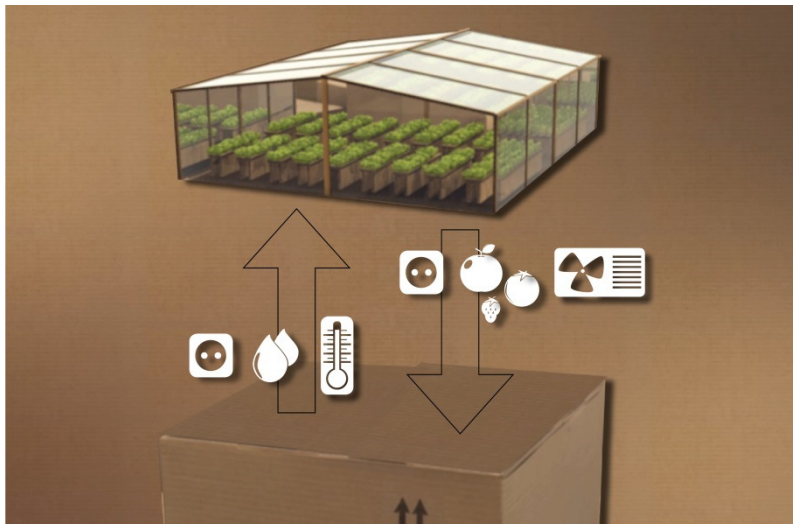
inFARMING® - Motivation of building integrated food production

Local conditions for the cultivation of fresh horticultural products are basically tied up to the availability of **light, water, heat** and **nutrients**. These requirements can be provided efficiently within the urban space.



The systems approach **inFARMING®** is

- local,
- sustainable,
- close to the consumer,
- economically feasible
- by an efficient production and
- closed loops to the greatest possible extent.

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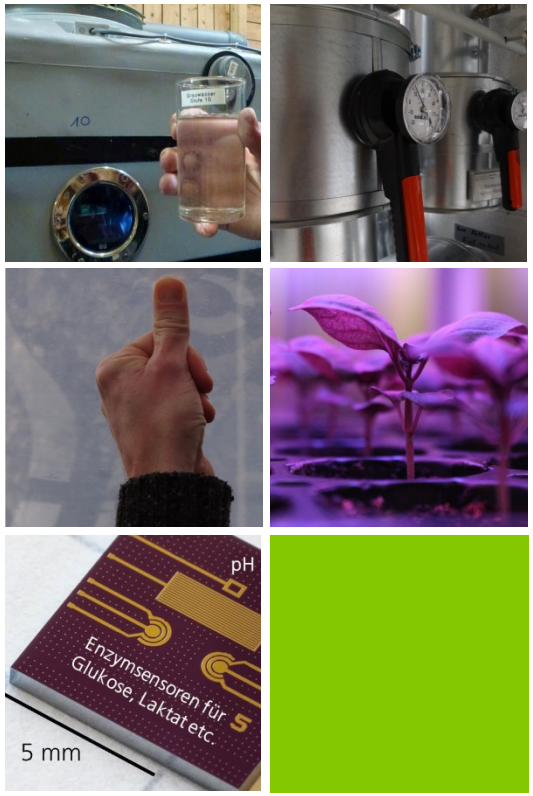
Technical approaches for indoor cultivation



inFARMING® applies to:

- Fertilizer production from indoor waste streams
- Energy recovery
- Material development
- Artificial light management
- Sensor development and application

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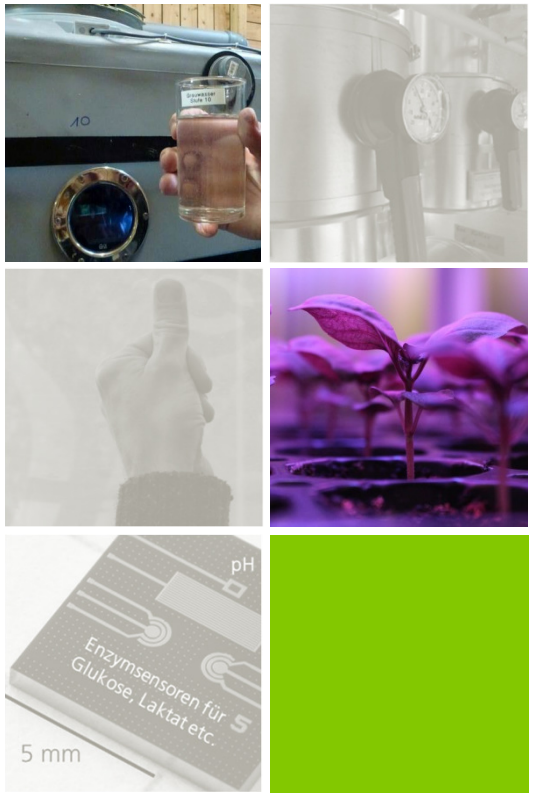
Technical approaches for indoor cultivation



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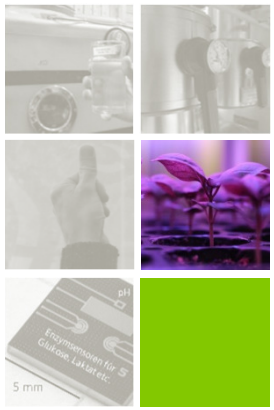
Technical approaches for indoor cultivation – plant lighting



Plant photoreceptors

– **phytochrome** (660 respectively 730 nm)
- control of growth processes
- control of shade protection, flowering induction

– **cryptochrome** (340 respectively 520 nm)
- continuity of the circadian rhythmic
- control of photomorphogenesis

– **phototropin** (340 to 520 nm)
- efficient light use

– **UV-B-photoreceptor** (280 to 350 nm)
- protective function

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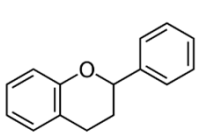
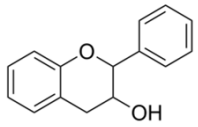
Technical approaches for indoor cultivation – phytochemicals

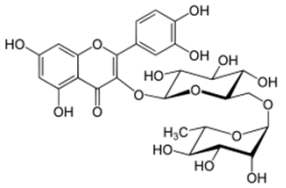
- **Flavonoids**



flavan

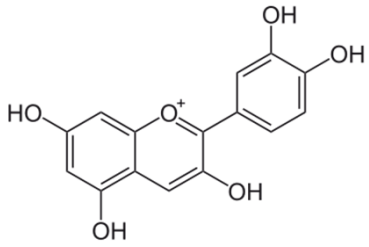


flavanol



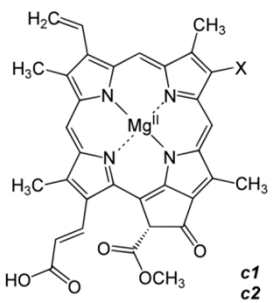
rutin

- **Anthocyanins**
  Group of flavonoids

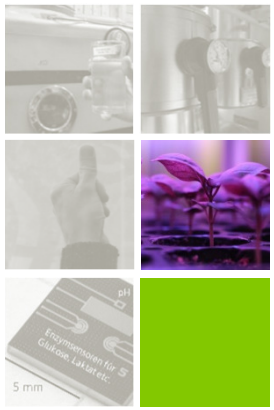


cyanidin

- **Chlorophylls**



c1 X: CH_2-CH_3
c2 X: CH=CH_2



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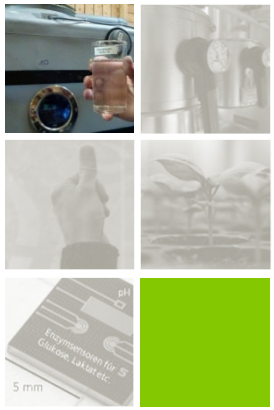
Technical approaches for indoor cultivation – fertilizer production



Motivation:

- Worldwide use of NPK fertilizers: 104 Mio. t N, 46 Mio. t P_2O_5 and 33 Mio. t K_2O
- High energy demand for Haber-Bosch Synthesis and uncertain P-resources
- Growing number of attempts to recycle or convert fertilizers from wastewater and animal excrements e.g. manure.
- Aquaponics has the same idea.
- No technical processes for safe and efficient urban integrated recovery.

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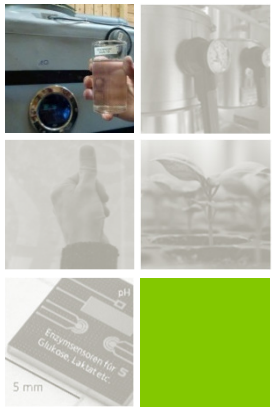

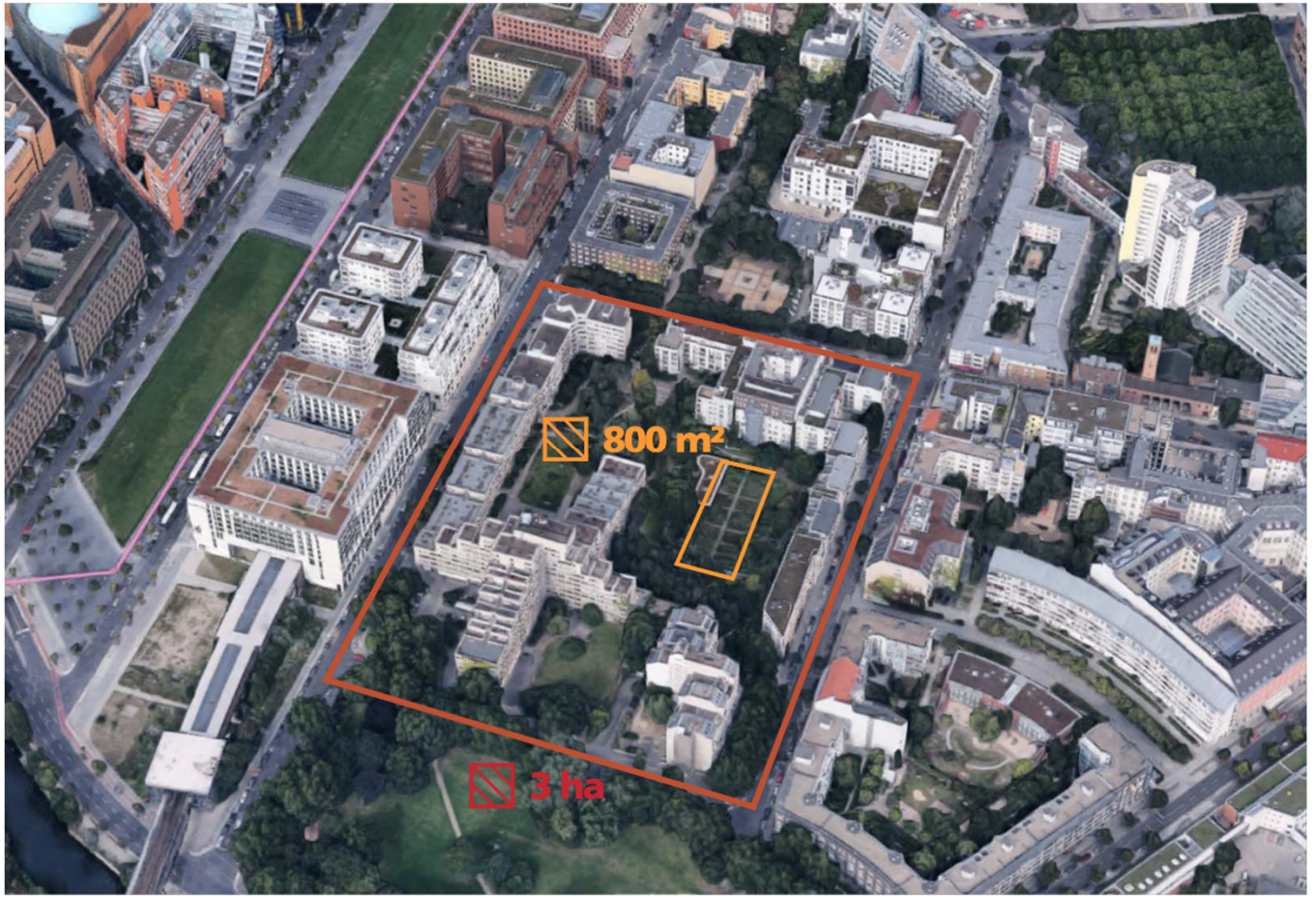

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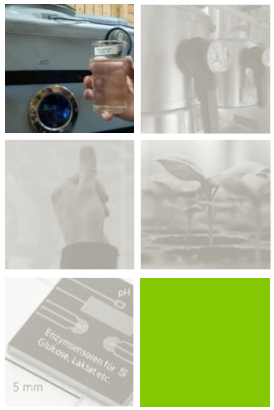

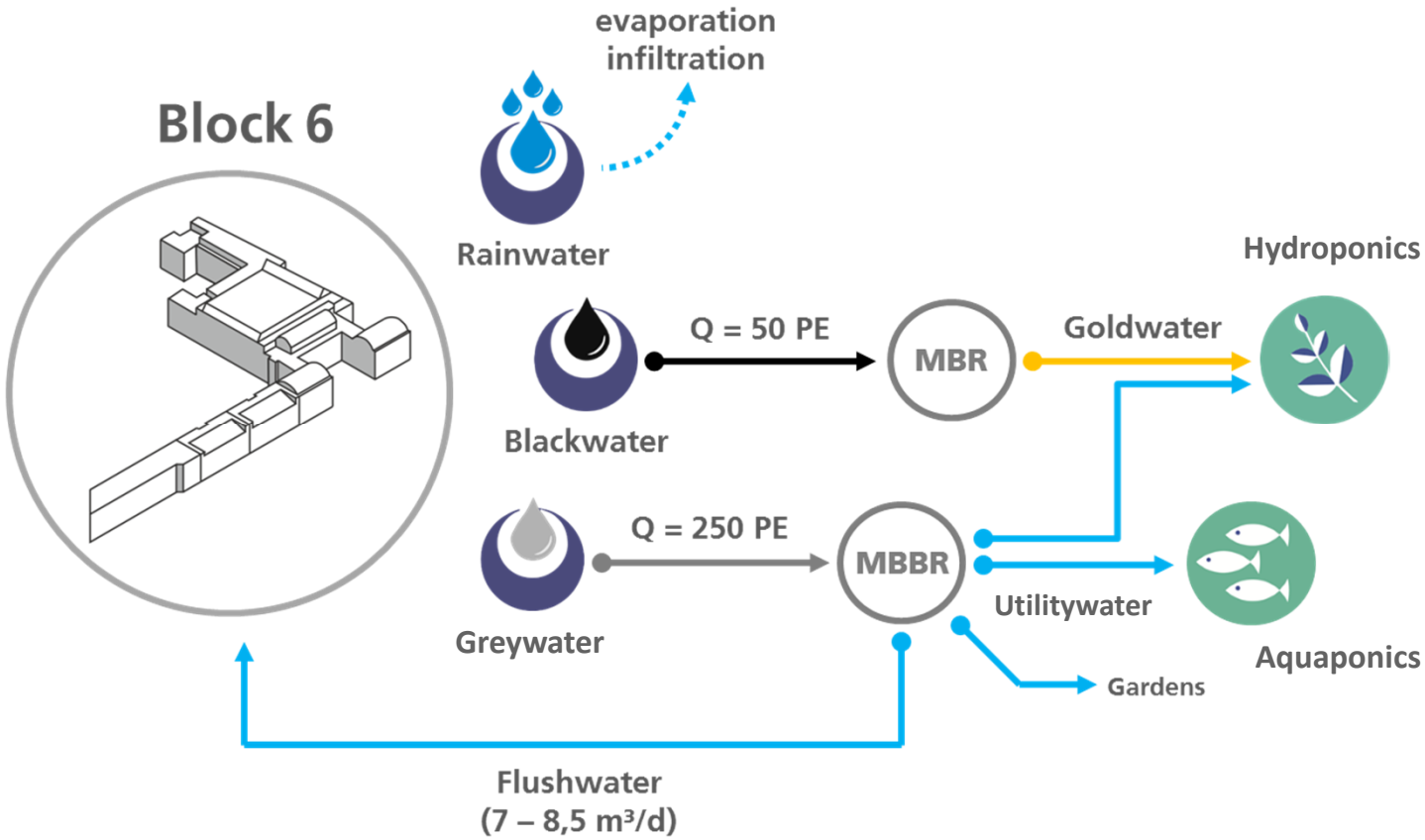

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Outlook 2018: inFarming project realization »Altmarktgarten«

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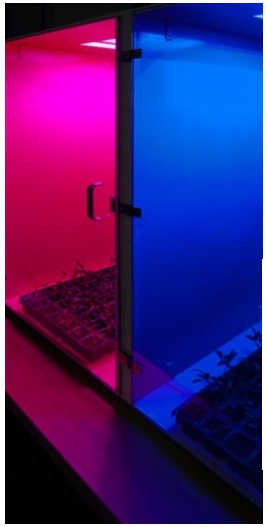

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