CURRENT STATUS AND FUTURE PROSPECTS OF COMMERCIAL URBAN AGRICULTURE

Findings and Insights from the FAO&EBRD Report

Food and Agriculture Organization of the United Nations

European Bank for Reconstruction and Development

March 9, 2023, 12 - 13 pm CET

Main Contributors

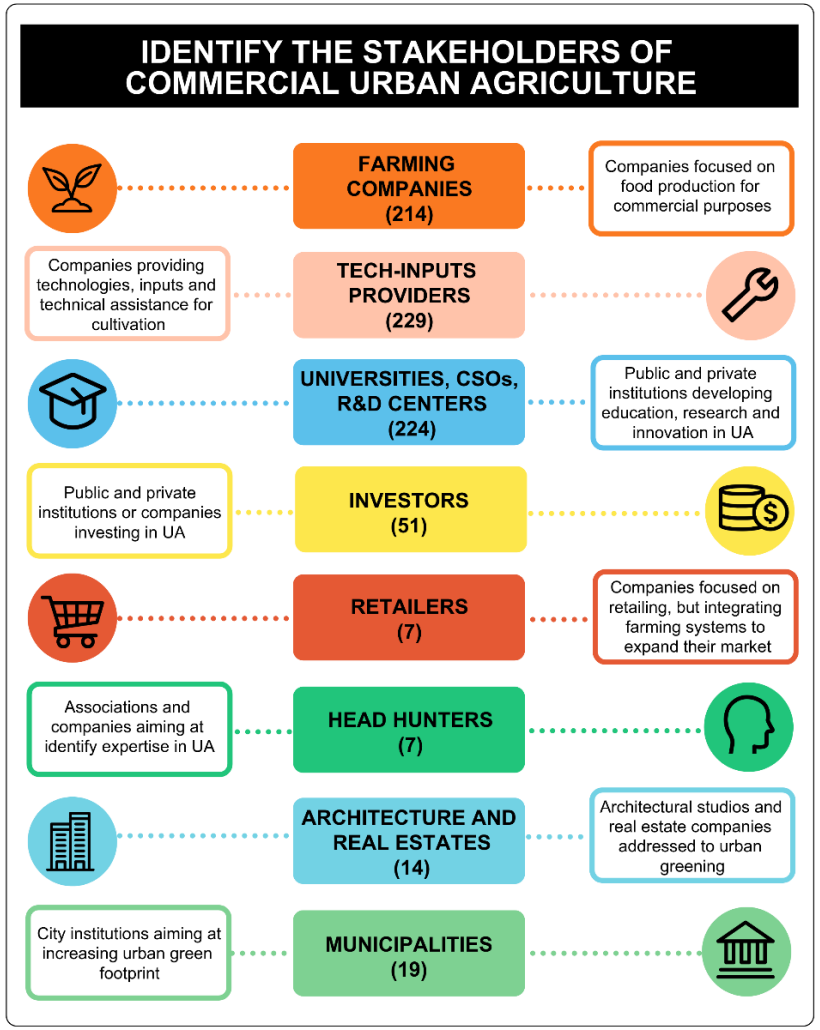
Prof. Dr. Francesco Orsini (University of Bologna Alma Mater Studiorum, Italy)
Dr. Elisa Appolloni (University of Bologna Alma Mater Studiorum, Italy)
Pietro Tonini (Universitat Autonoma de Barcelona, Spain)
Dr. Giuseppina Pennisi (University of Bologna Alma Mater Studiorum, Italy)
Dr. Michael Martin (IVL Swedish Environmental Research Institute and KTH Royal Institute of Technology, Sweden)
Dr. Martí Rufí-Salís (Universitat Autònoma de Barcelona, Spain)
Margot Lutun (AgroCampus Ouest, France)

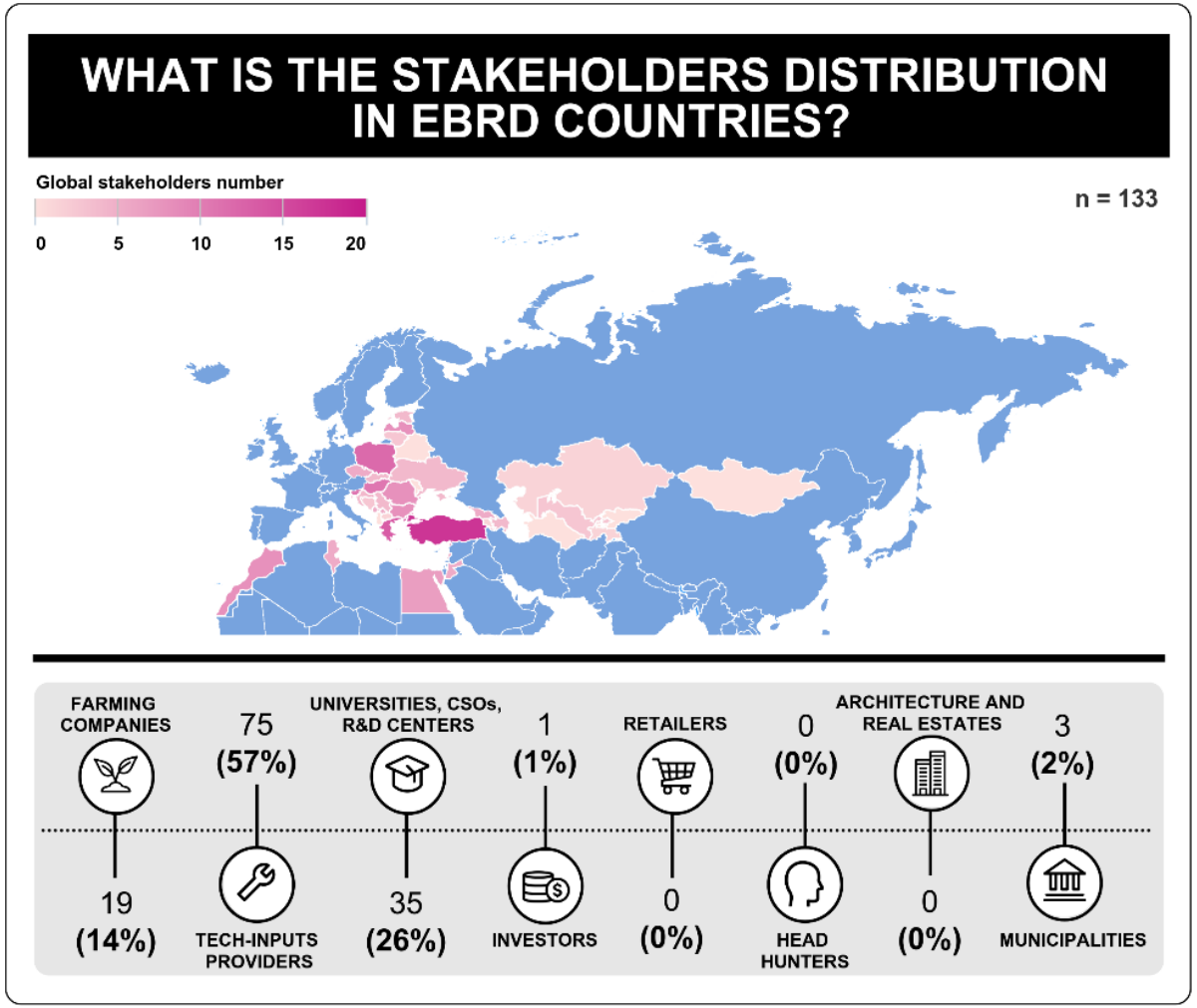
Prof. Dr. Leo F.M. Marcelis (Wageningen University and Research, The Netherlands)
Dr. Paul Kusuma (Wageningen University and Research, The Netherlands)
Dr. Ying Liu (Wageningen University and Research, The Netherlands)

Prof. Dr. Haissam Jijakli (University of Liege)
Vicente Balseca Hernandez (University of Liege)
Nicolas Ancion (University of Liege)

Jacopo Monzini Taccone di Sitizano (FAO)
Eva Pedersen (FAO)
Guido Santini (FAO)
Cecilia Marocchino (FAO)
Tamara Vlastelica (FAO)
Victoire De Wever (FAO)
Emmanuel Hidier (FAO)
Erifyli Nomikou (EBRD)

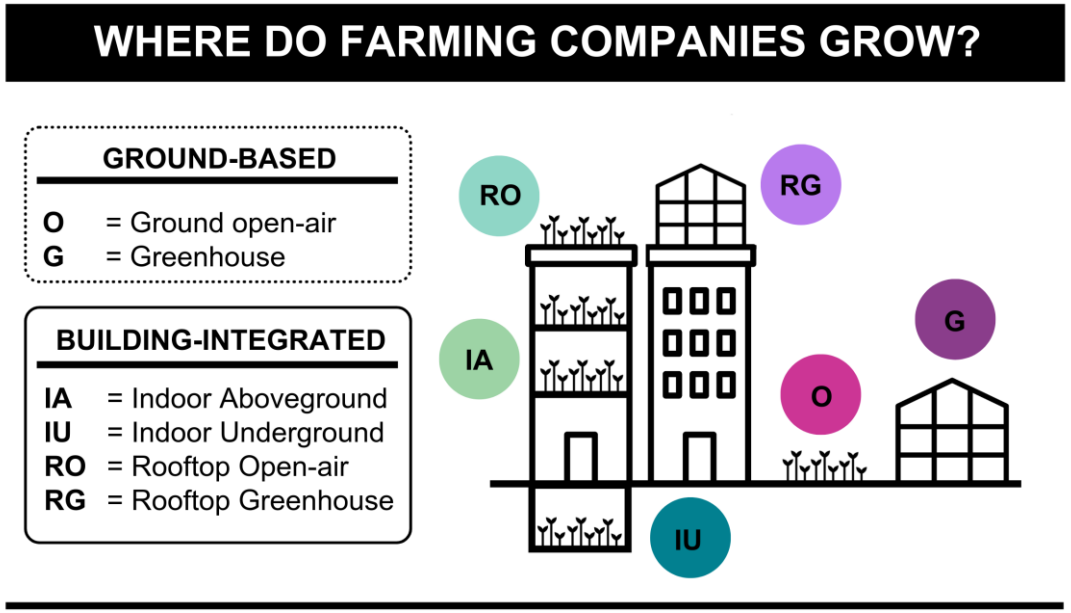
A complex ecosystem

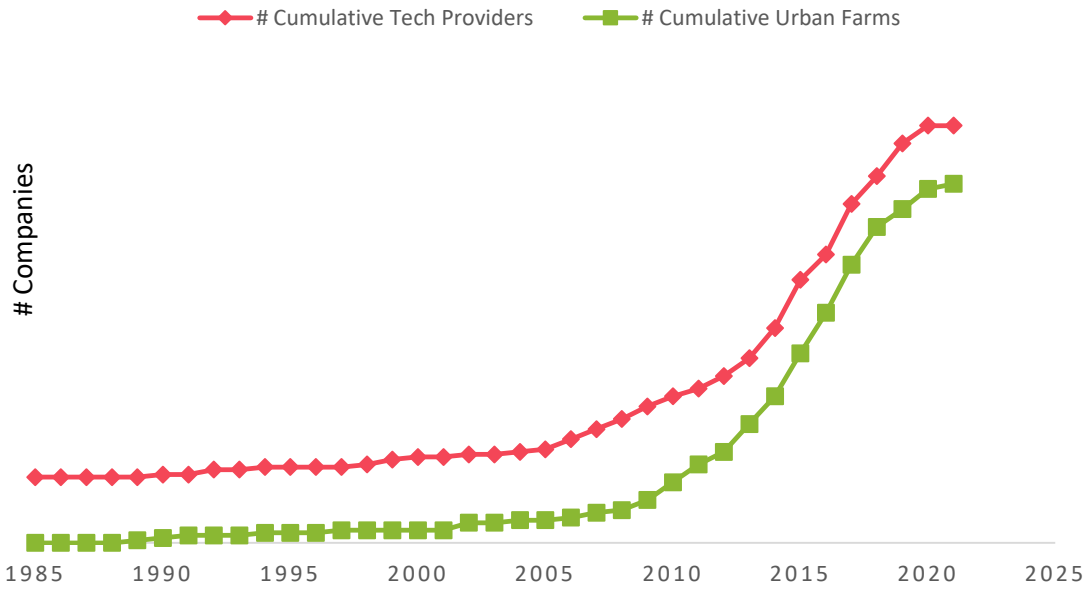




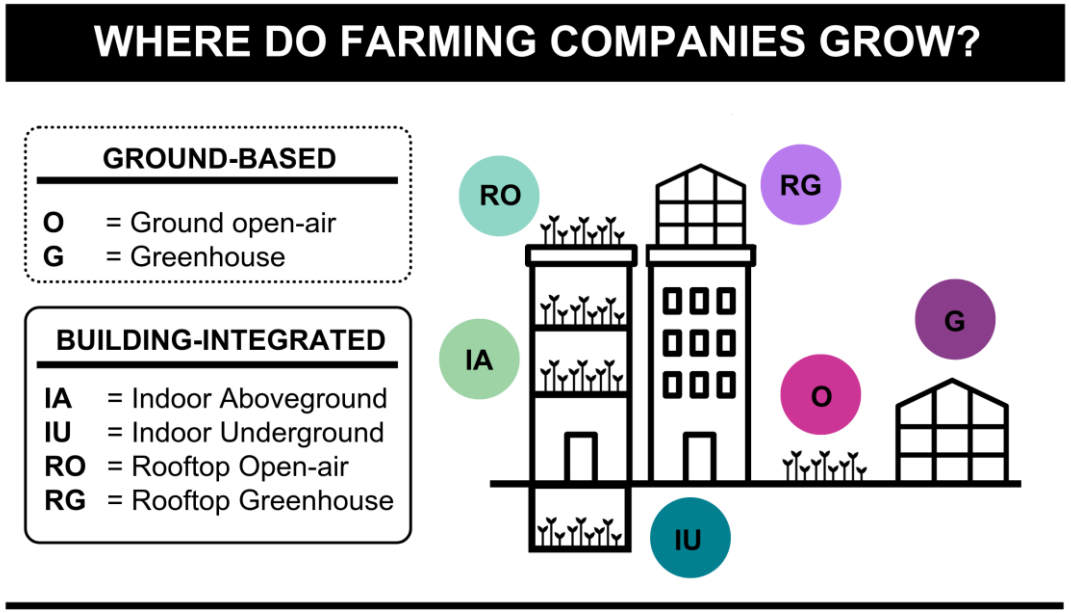
Interacted with over 900+ actors in 95 countries

The sector at a glance (1:2)



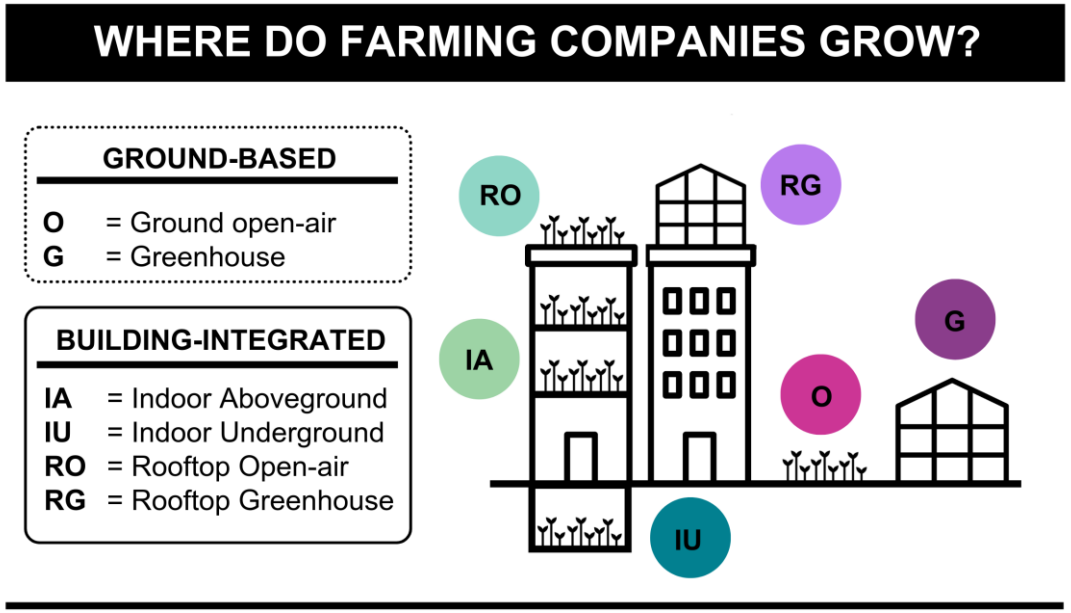


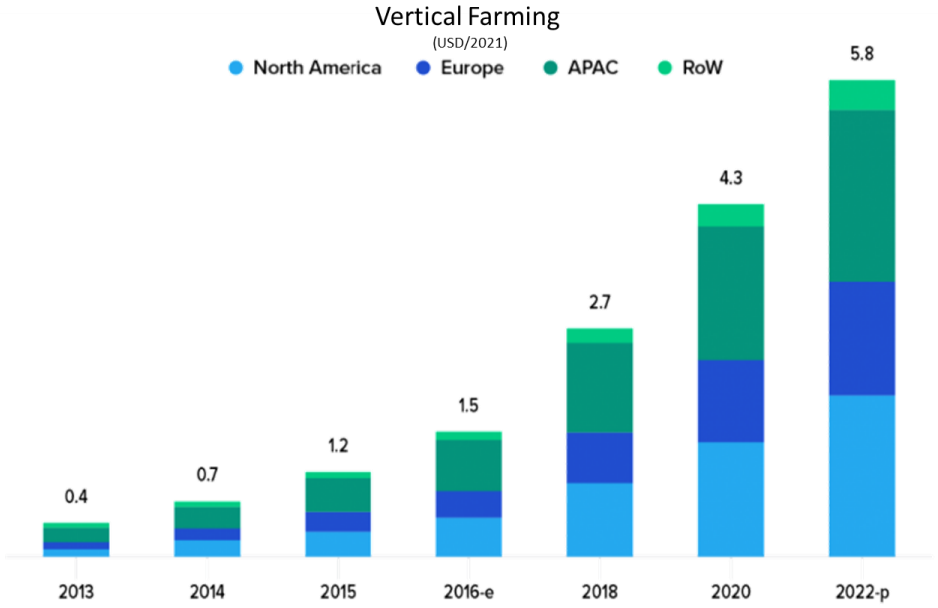
The sector at a glance (2:3)



1. Rent/lease its productive spaces (~ 65%)
2. Work in controlled environments (~70%)
3. Do not use soil (~70%)
4. Adopt vertical farming technologies (~40%)
5. Operate at least 1000 m^2 of surface (~80%)
6. Is certified (~30%)
7. Targets local/national markets (~ 80%)

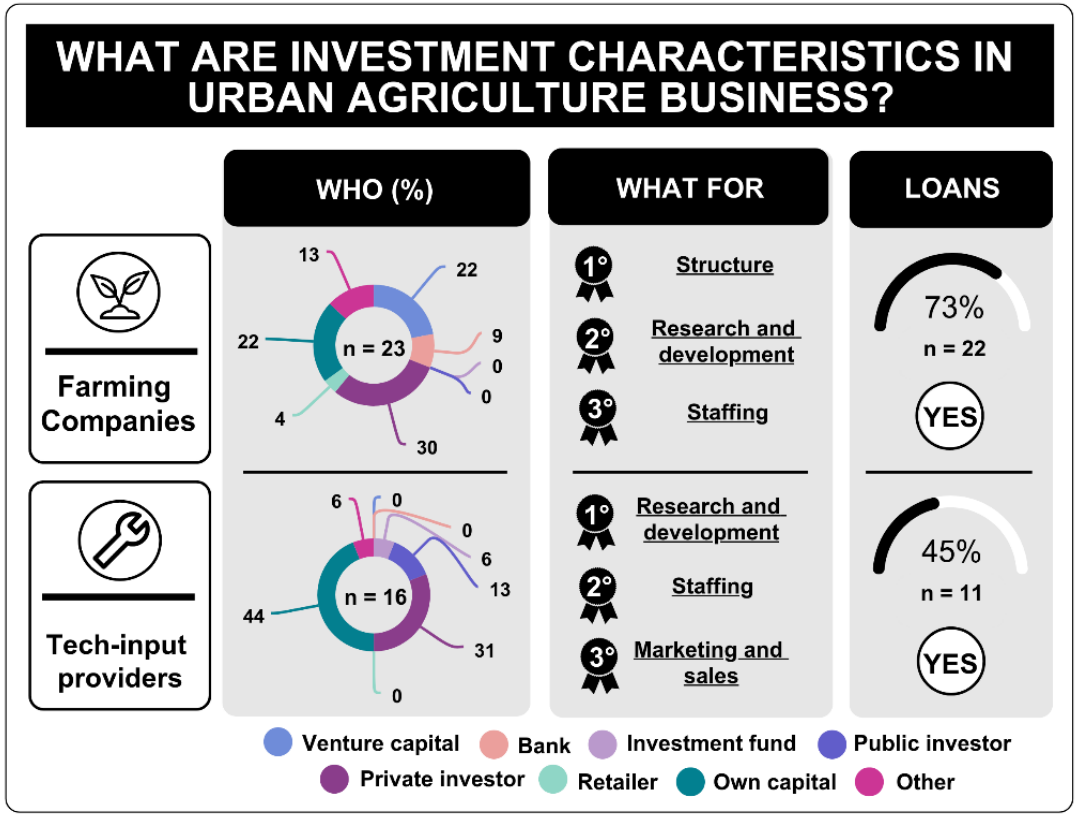
The sector at a glance (2:3)



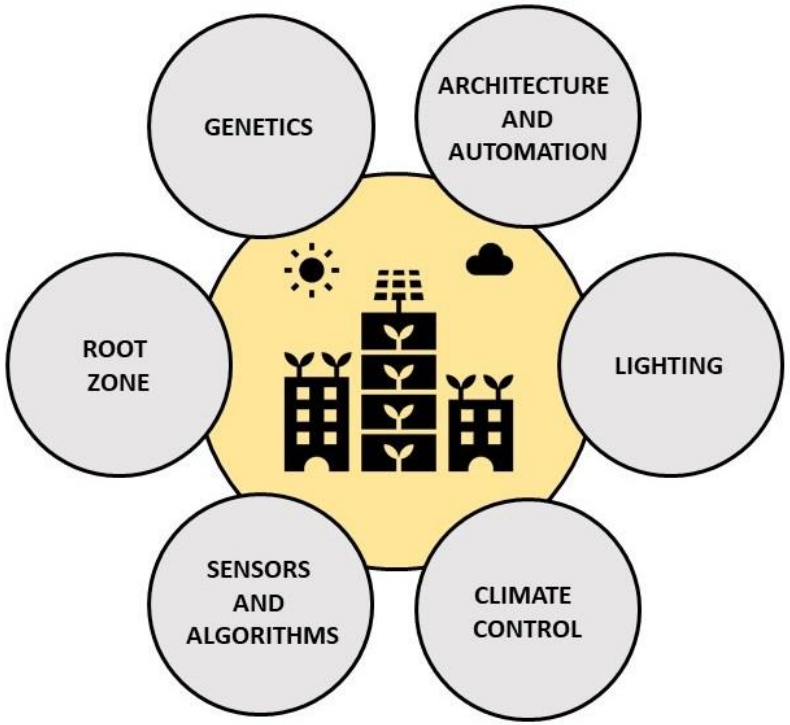


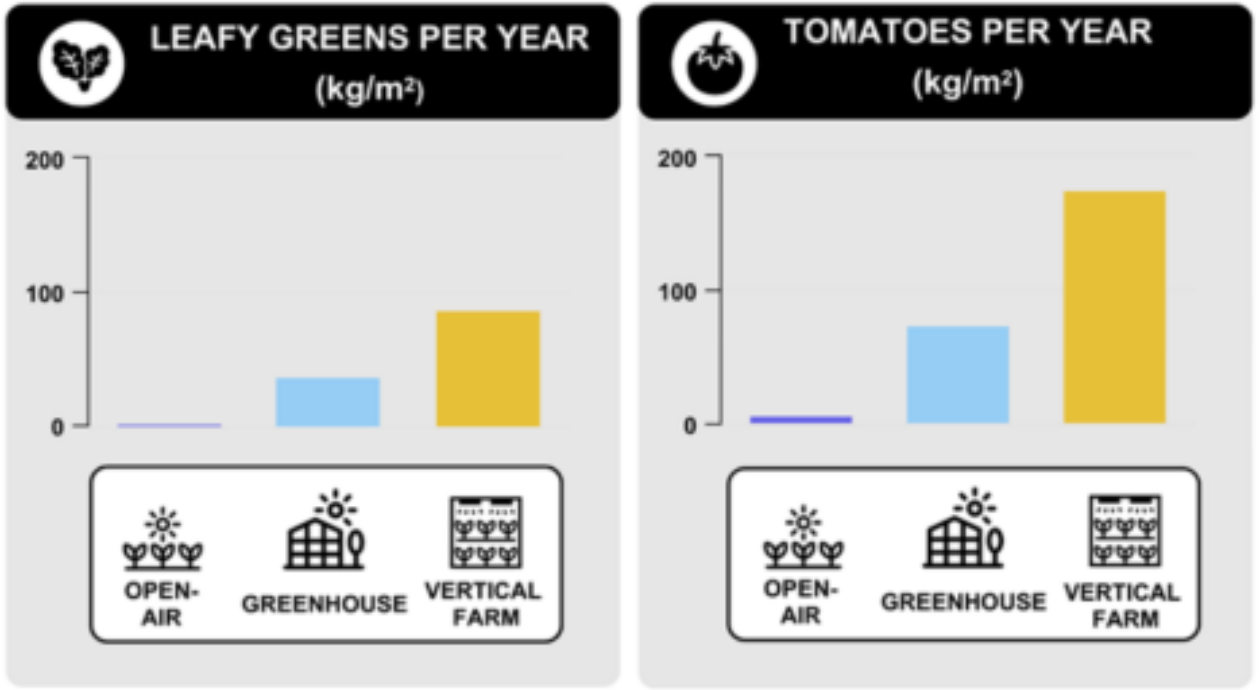
The sector at a glance (3:3)

1. Rent/lease its productive spaces (~ 65%)
2. Work in controlled environments (~70%)
3. Do not use soil (~70%)
4. Adopt vertical farming technologies (~40%)
5. Operate at least 1000 m^2 of surface (~80%)
6. Is certified (~30%)
7. Targets local/national markets (~ 80%)

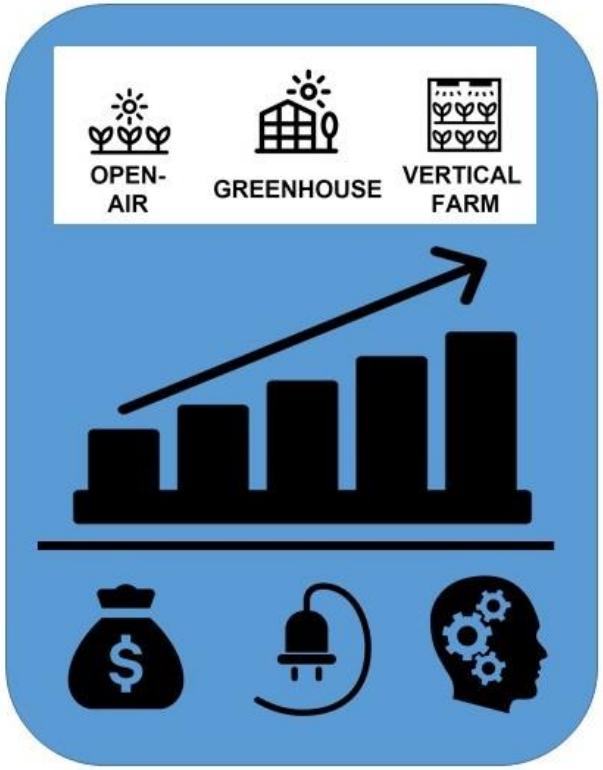


The technology drive (1:2)



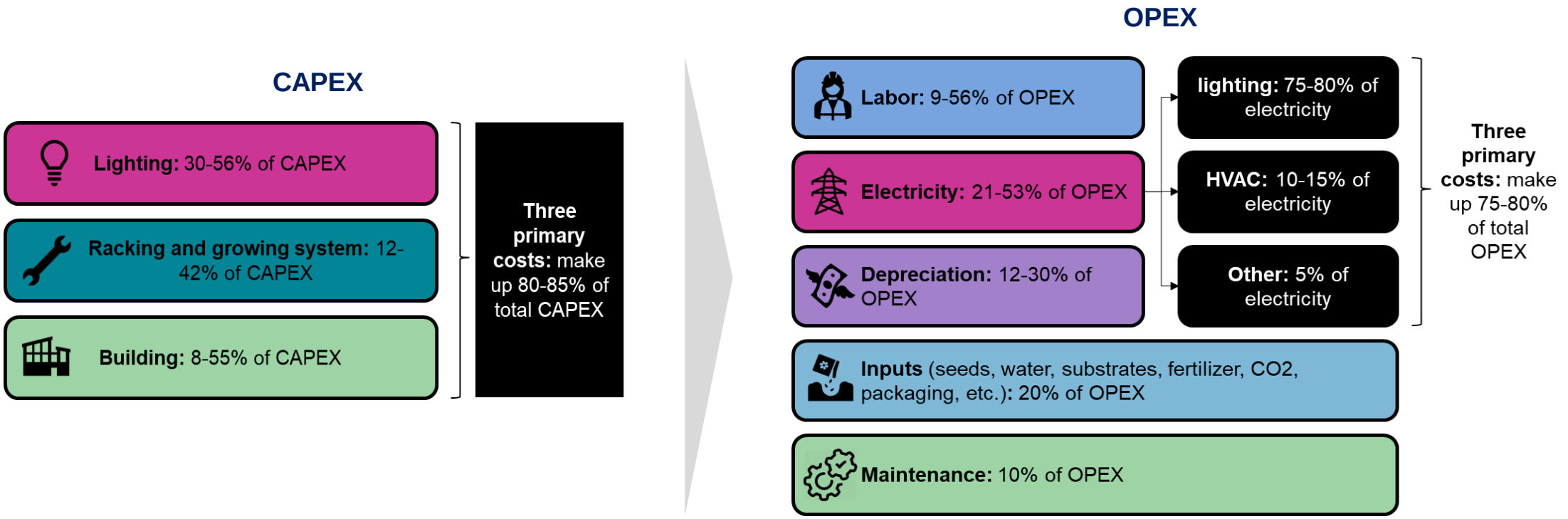


The technology drive (2:2)



CASE STUDY TYPOLOGIES	SOIL-BASED AGRICULTURE (41%)	SYMPLIFIED HYDROPONIC (26%)	ROOFTOP FARMING (22%)	INDOOR FARMING (11%)
How large is it? (ha)	5	0.4	0.9	0.2
How much does the installation cost? (EUR/m²)	0.5-20	40-80	100-200	1 000 - 3 000
What is the annual running cost? (EUR/m²)	0.5-10	30-50	10-30	50-70
What is the production capacity? (kg/m²)	1	15	5	83
How many people does it employ? (n/ha)	20	15	15	35
ADDITIONAL ENVIRONMENTAL BENEFITS (EUR/m²)				
Annual Energy Savings	1.3	-	-	-
Wellbeing	82	-	-	-
Combined Environmental	0.6	-	-	-

Cost reduction case study: Vertical Farming (1:3)



- Cost analyses are **not uniform**, as systems vary and analyses exclude CAPEX and OPEX elements, rendering comparisons **challenging**
- Hardware and software solutions need to be designed to optimize **total cost of ownership (TCO)** costs
- **Rising energy costs** and investments required in **upskilled labor** demonstrate the need to **find innovative solutions to reduce these costs**

Cost reduction case study: Vertical Farming (2:3)

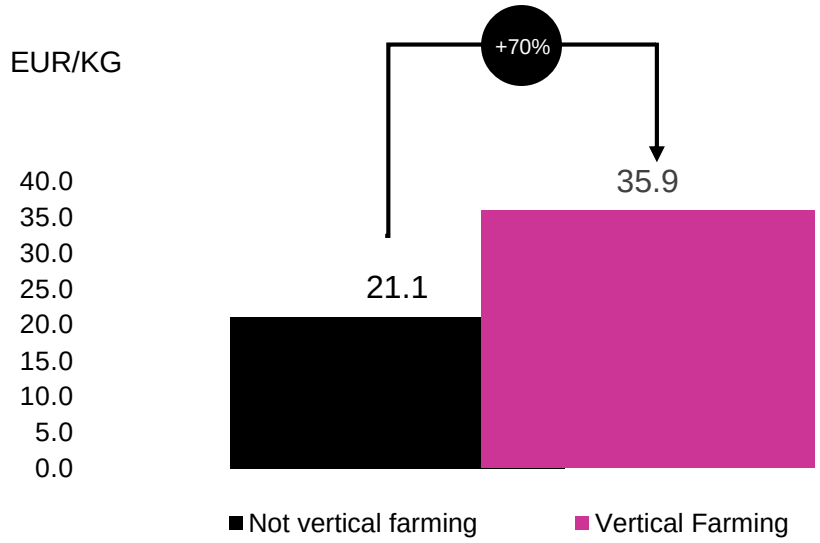
Are VFs profitable?

Observed characteristics	
1	Emerging sector – data can be considered proprietary
2	Many VF studies extrapolate data from greenhouse literature or use projections from VF system vendors
3	Financial analyses are often hypothetical
4	Financial analyses are not uniform (omit or under-estimate cost elements) rendering comparisons challenging
5	Each farm is unique

Some aggregated studies show that the number of profitable VFs is increasing

But the lack of real case studies, benchmarks and frameworks makes it difficult to address claims on profitability

Retail price comparison: VF and non-VF packaged lettuce

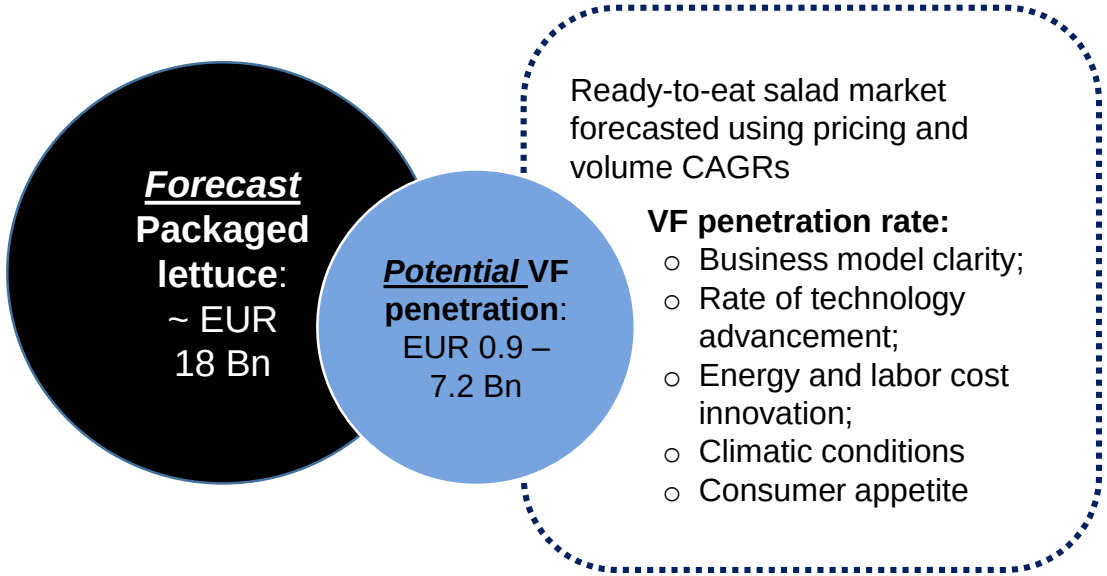


In September 2022, pricing spot checks were conducted across 29 retailers in 11 different countries

VF products offer distinguishable value-added characteristics and these come at a cost. Premium price points are often commanded to cover these costs

Cost reduction case study: Vertical Farming (3:3)

VF penetration of potential packaged salad market by 2025



Challenges and opportunities for scaling up VFs

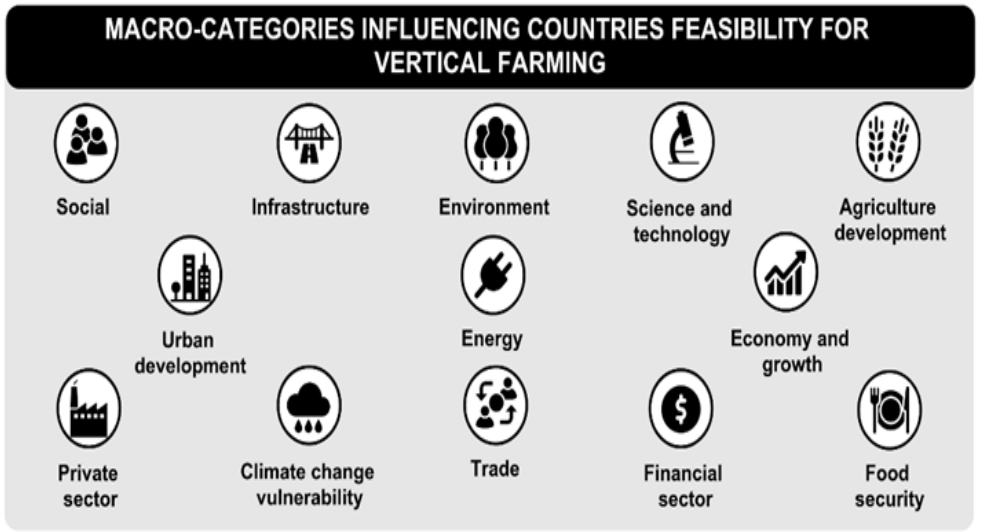
Challenges

- Lack of data sharing, no blueprints or frameworks for scaling and measuring performance of VFs
- Business models in a flux and being refined to respond to challenges/opportunitites
- Lock-in risks for maintenance/services from suppliers

Opportunities

- Energy circularity solutions and intermittent lighting strategies
- Hybrid models
- Optimization of TCO costs

Investment preconditions (1:2)



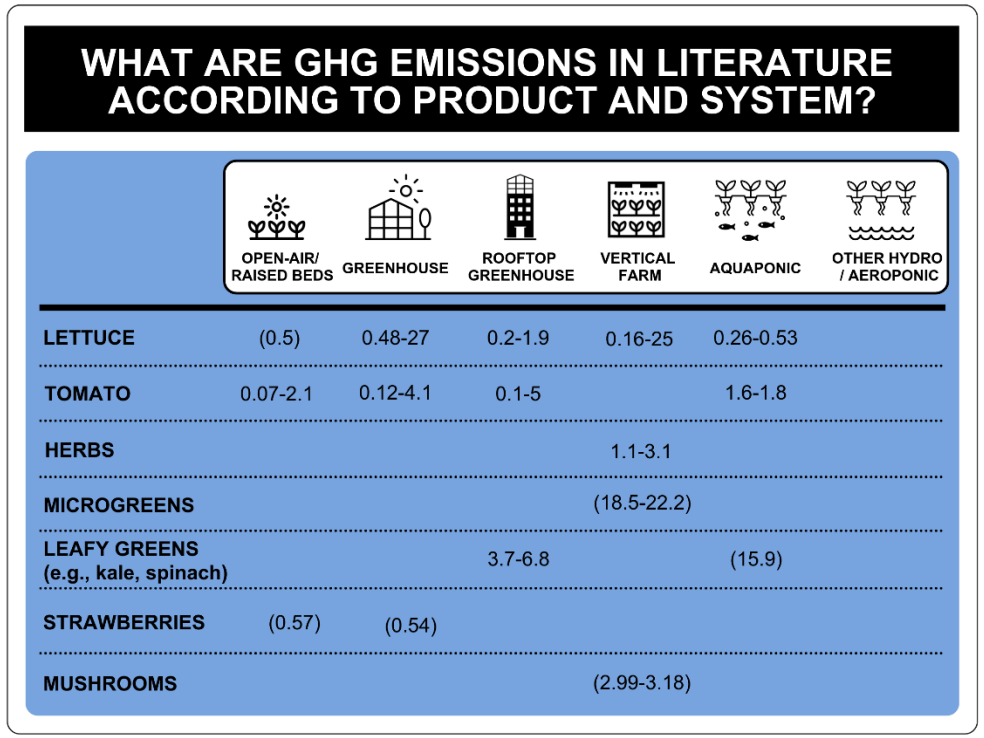
We assessed v**ertical farming preconditions for investments** via a statistical analysis of environmental, economic and social indicators (147) **(**[methodology peer reviewed](#)**in** [Paucek et al, 2023](#)**)**

Investment preconditions among EBRD countries (2:2)

The analysis points out that preconditions are **available mostly** in: Poland, Czech Republic, Estonia, Hungary, Slovenia, Slovak Republic, Türkiye, Cyprus

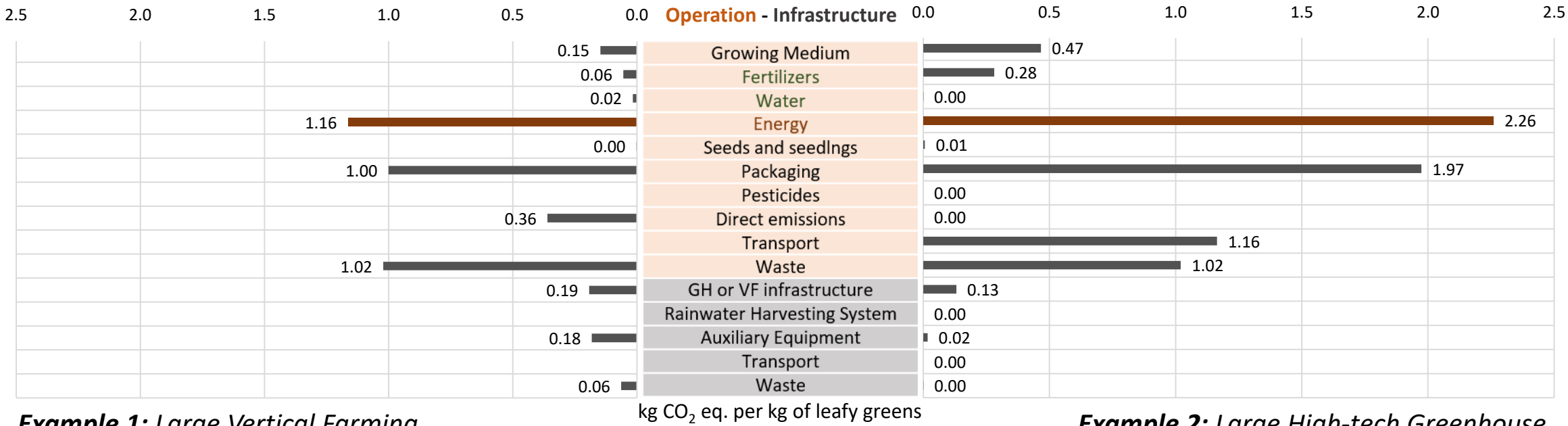
Commercial Urban Farming Life Cycle Assessment (Literature review 1:2)

(results in brackets=only one study available)



- Many **claims may be unsubstantiated** in literature
- **Large span of results** for different products/production methods
- Results are **context/regionally dependent**
- **Need for common metrics and KPIs** for comparisons
- Hard to extract other KPIs
  - Water Use (Lettuce): **VFs (0.5-16 L/kg), GHs (1.5-16 L)**
  - Energy Demand (Lettuce) **VFs 2.4-38 kWh/kg, GHs 2-4 kWh/kg**

Commercial Urban Farming Life Cycle Assessment (Case Studies 2:2)



Example 1: *Large Vertical Farming*

Example 2: *Large High-tech Greenhouse*

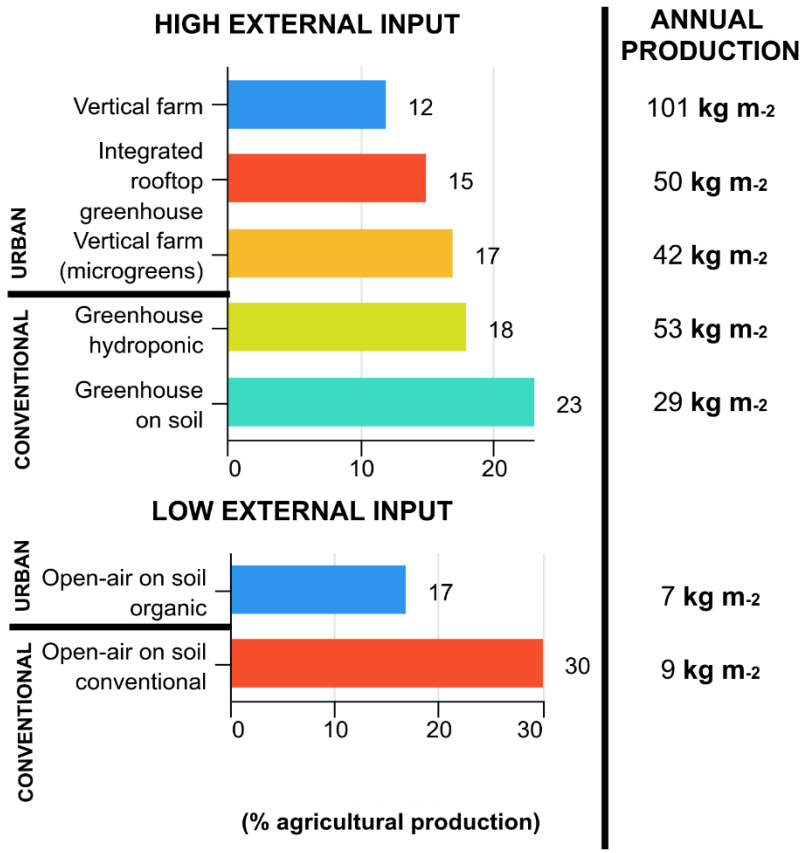
Each system should be evaluated separately

Current availability of **data is not enough to perform robust comparisons** between technologies

Artificial lighting and ventilation are the main impact driver in terms of greenhouse gas emissions (between 27 and 86% of contribution)

Commercial Urban Farming Food Loss and Waste

With high-tech farms FLW are halved in the harvest and post-harvest step and quality losses are minimized

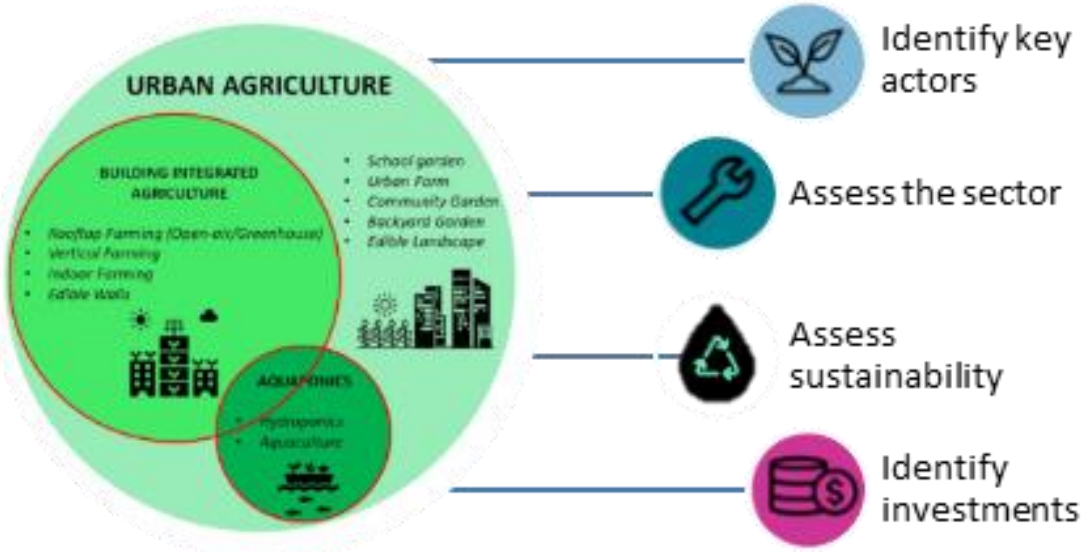


Innovative production systems can reduce FLW thanks to:

- Shorter value chains and higher product marketability
- Reduced time between production and consumption
- Supply agreement with retailer or consumers
- Data-driven production and plant performances models
- Lower losses due to external variables

What have we learnt (1:3)?

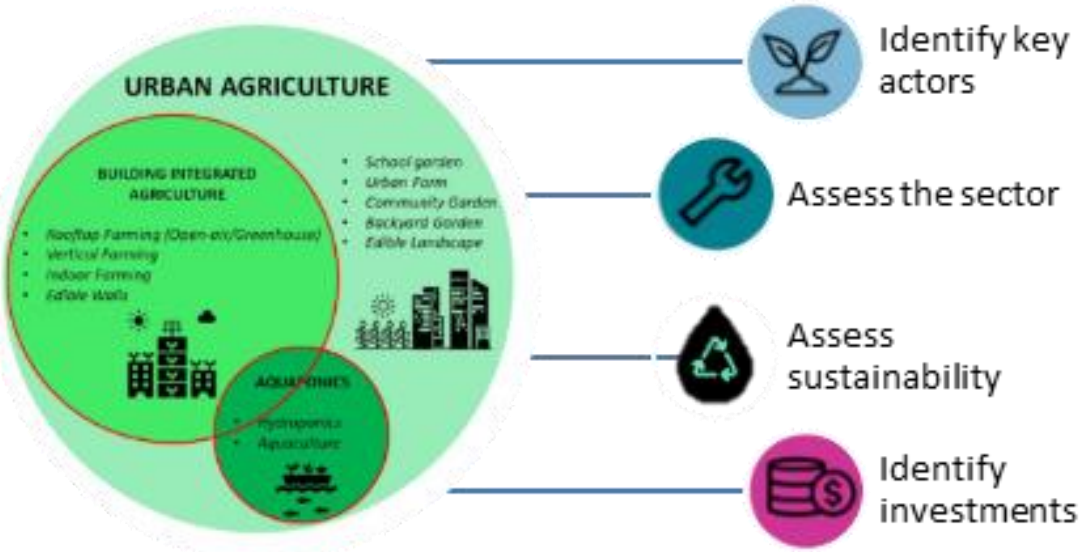
Main Challenges



- Energy and (specialized) HR costs are on the high side, as well as capex costs
- Market standards for VF do not exist yet
- An advanced enabling environment is necessary (infrastructures, skilled HR, etc)

What have we learnt (2:3)?

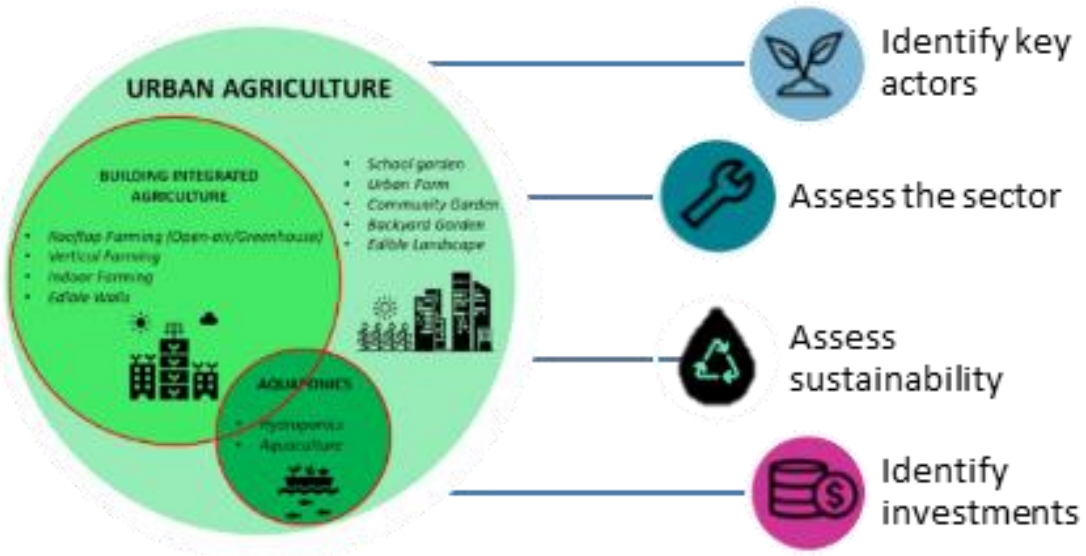
Main Uncertainties



- Limited access to data/information (in particular financial data) -> difficulty to assess profitability
- Confusion around business models: is it an agribusiness or a tech-driven business?
- Unclear size of the markets for VF products

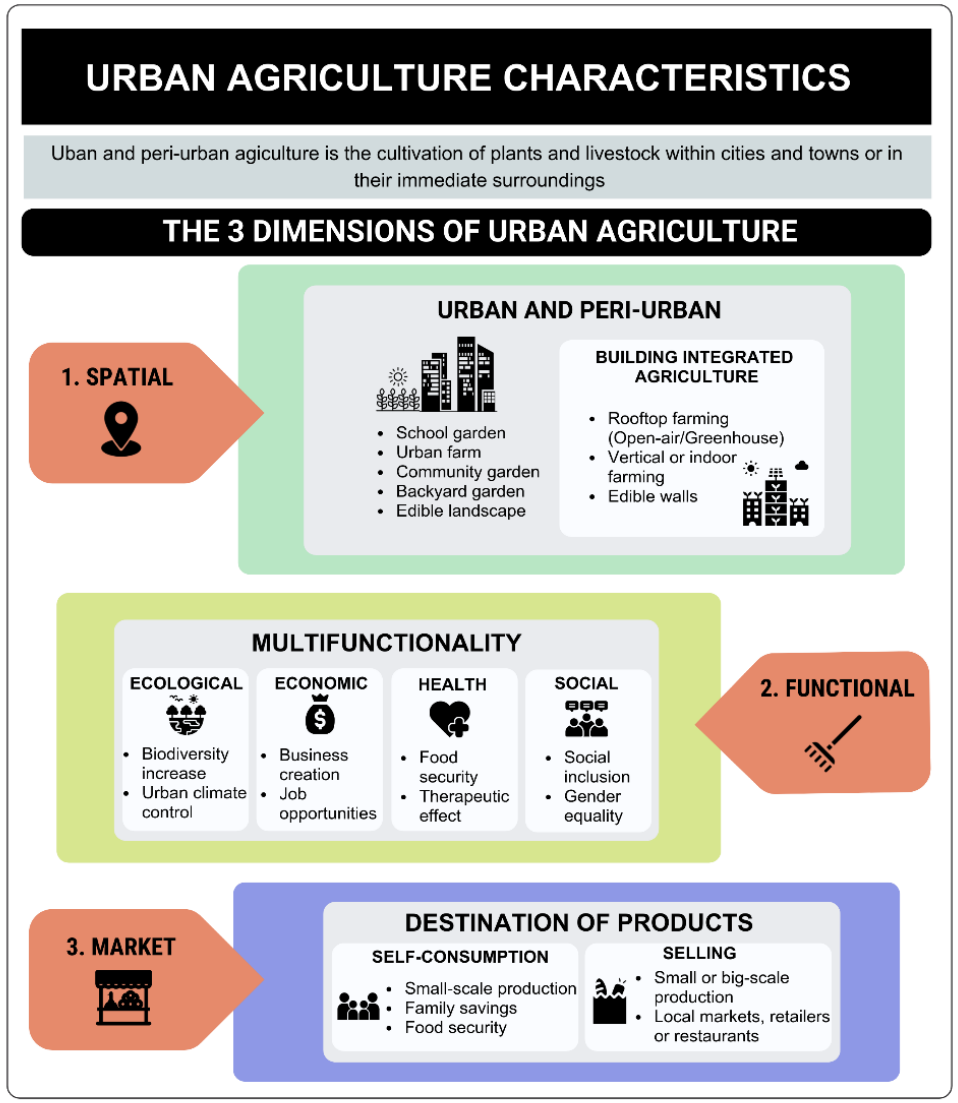
What have we learnt (3:3)?

Main Opportunities



- Novel products, with distinguishable value-added characteristics
- Real possibility of differentiation of the market reflecting product quality (organoleptic, shelf life, etc)
- Room to drastically reduce CAPEX and OPEX
- Demonstrated performance in terms of productivity and certain elements of sustainability (water, less FLW, etc) and ecosystem services provision
- UF brings R&D/innovation/capitals to farming, with applications in other sectors

Investment opportunities (Agribusiness team and other parts of the Bank)?



- Venture capital operations
- Corporate lending to clients with track record
- Municipal lending for greener cities

Special Thanks

65	14	6	18	6	22	800
Companies	Associations	web magazines	Universities	international projects	Municipalities	participants

Japan Plant Factory Association

Association for Vertical Farming

FOOD Food Systems in European Cities

VFarm

ISHS International Society for Horticultural Science

INCITIS FOOD

best micro gardens

iGrow News

verticalfarm daily

City Farmer News

European Bank for Reconstruction and Development

Food and Agriculture Organization of the United Nations

MANY THANKS

Contact Person: Jacopo Monzini (CFIC) Jacopo.Monzini@fao.org