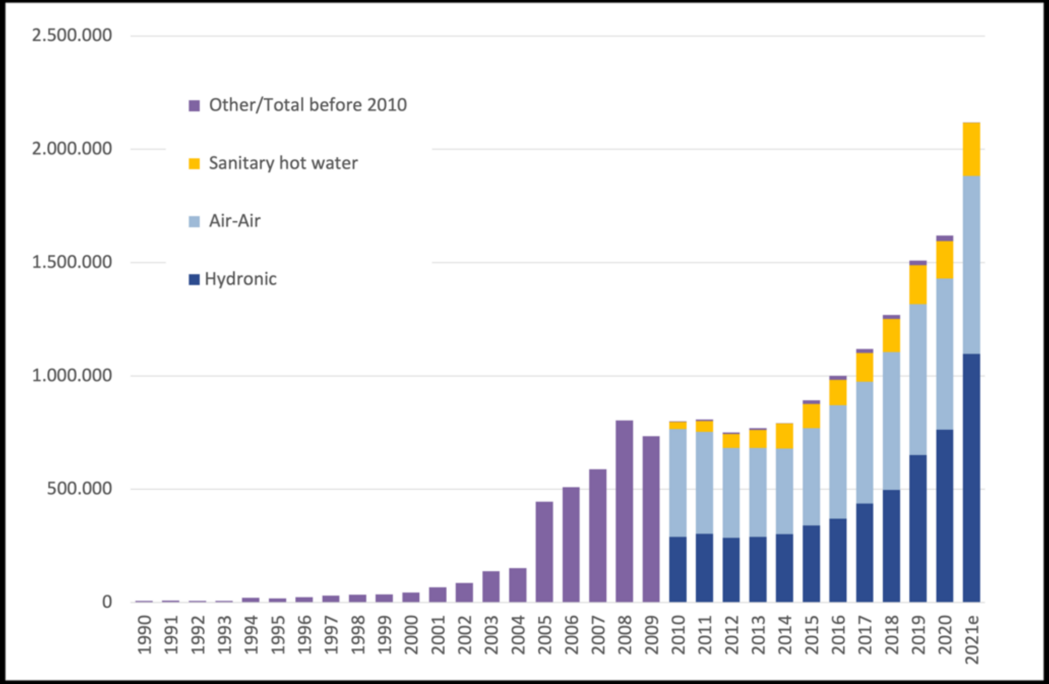
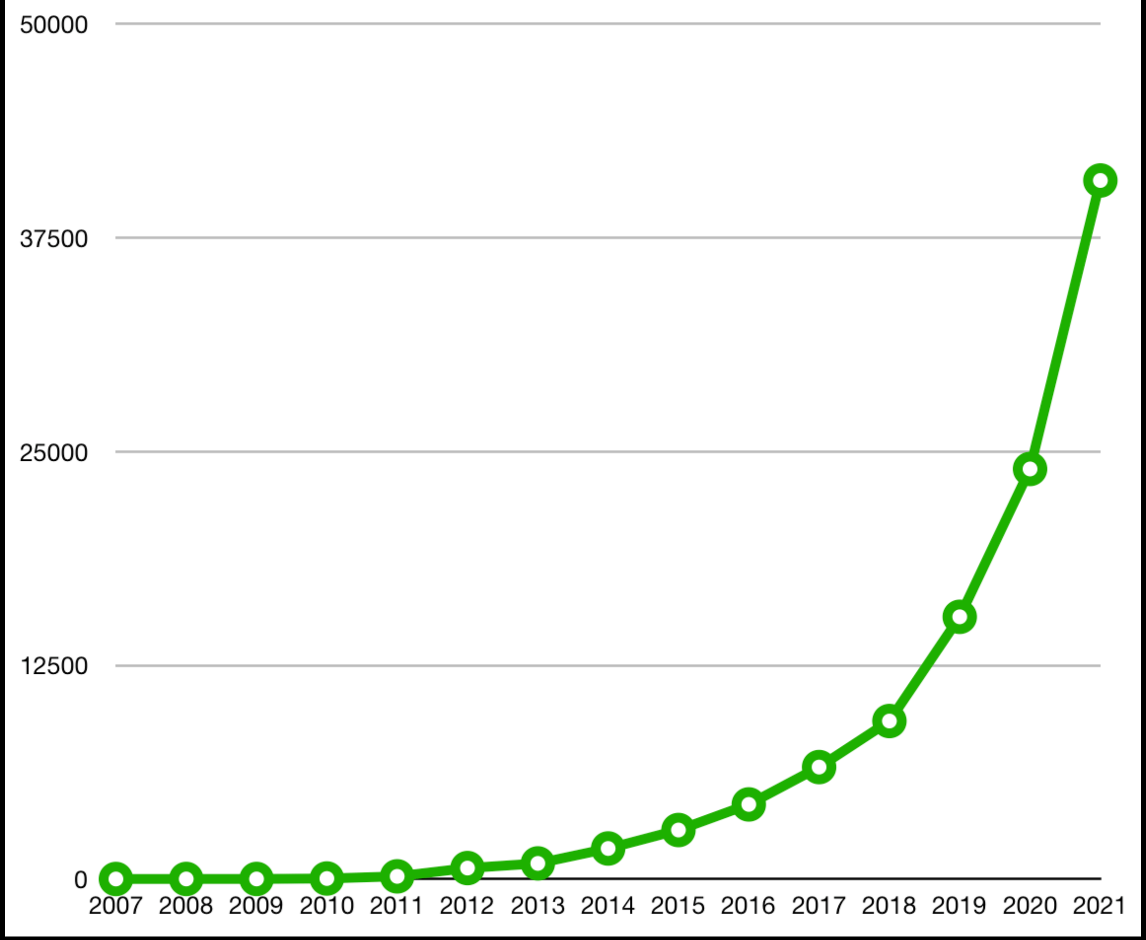
The Belgian perspective on Agrivoltaics

Motivation: the electricity consumption will rise



Heat pumps in Belgium



Electric cars in Belgium

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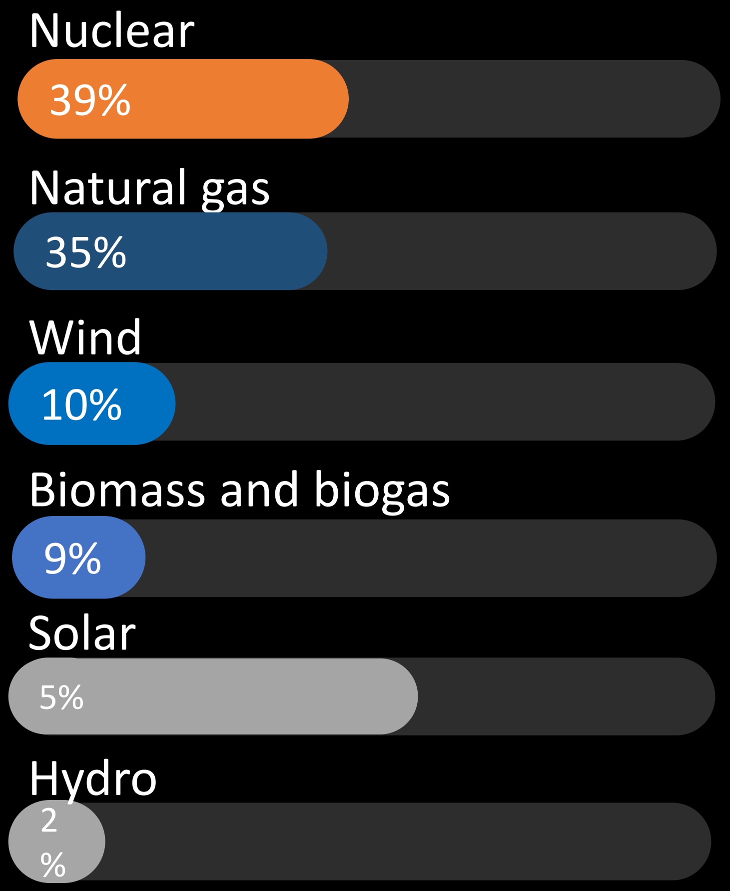
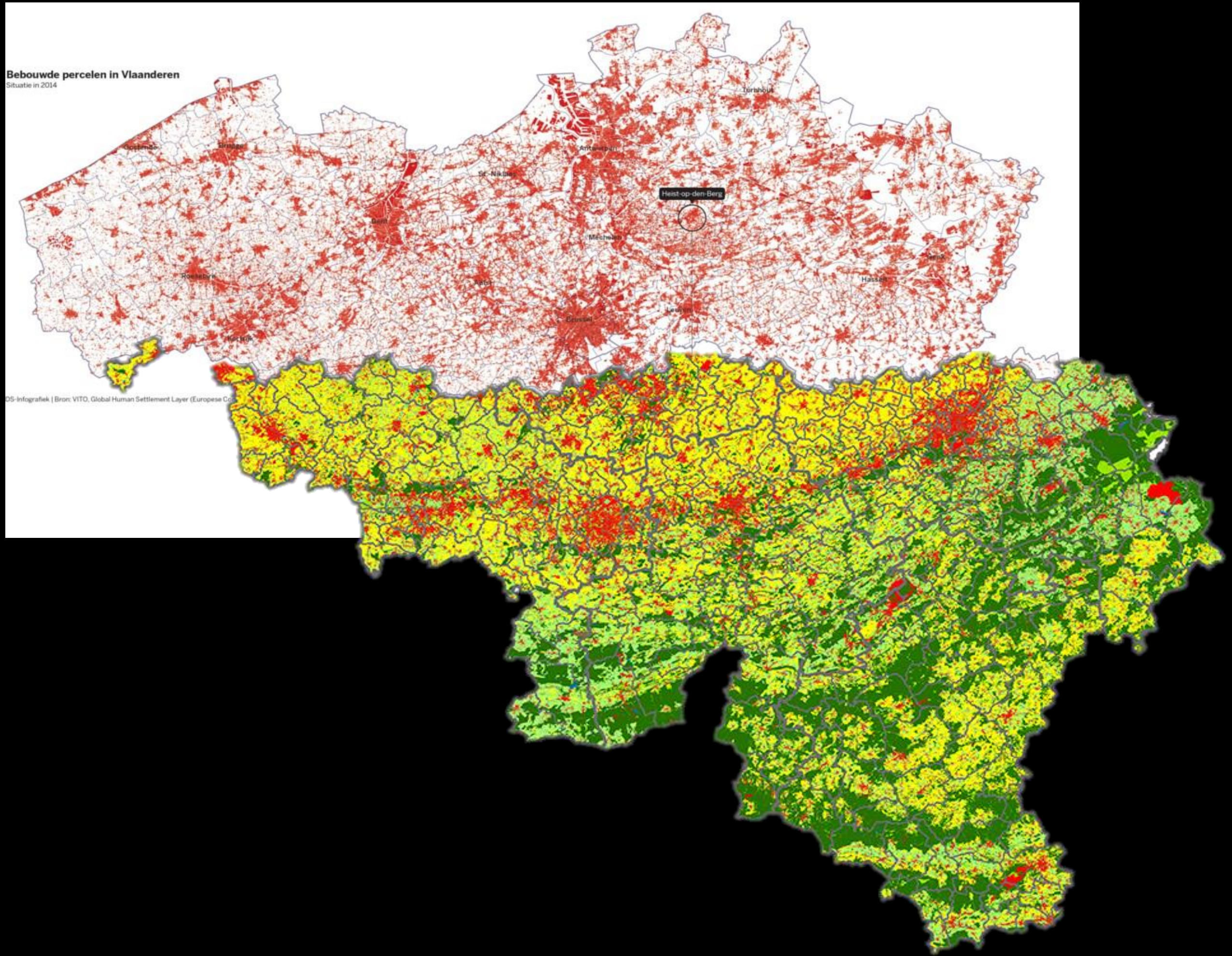
Motivation: the need for more renewable energy

- Global warming: full decarbonization in 2050
- Nuclear phase out in 2025



Motivation: the limited open space

A densely populated country with limited open space



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50% of Belgium is Agricultural land

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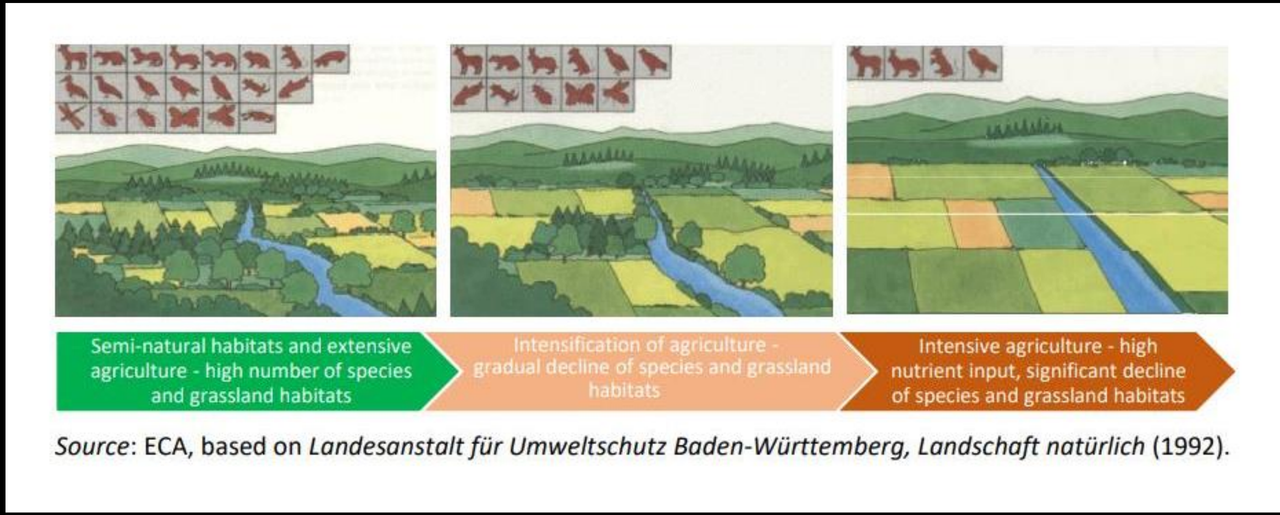
What could be a solution?

- Agrivoltaics

  *PV application that **combines** energy and crop production on the same area, where the primary objective is **sustained crop growth** and the energy production act as added value*

The advantages for agriculture?

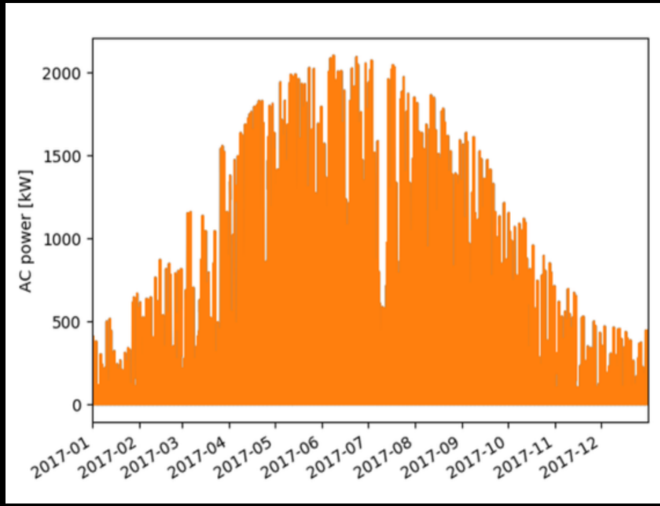


Intensive agriculture results in biodiversity loss

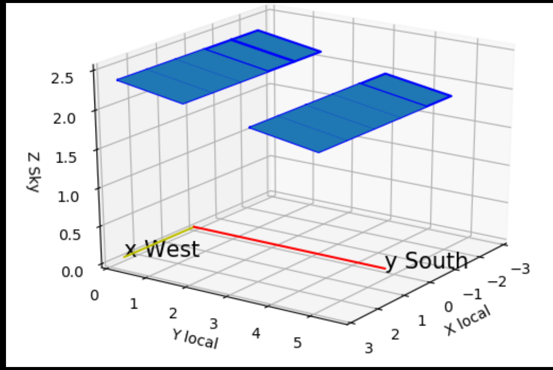
More extreme weather events with huge food losses

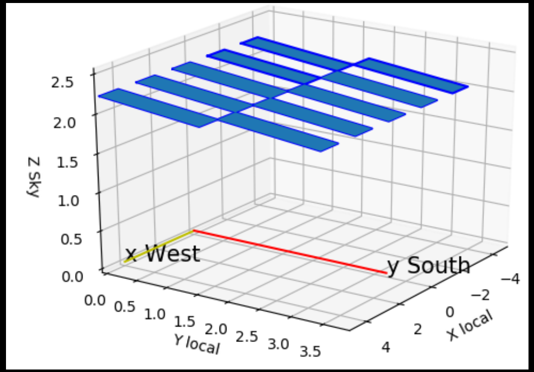
The story begins in 2018…

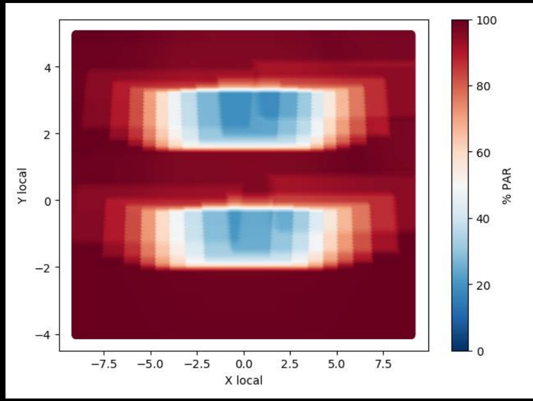
Agrivoltaics 2018 – 2019: first thesis

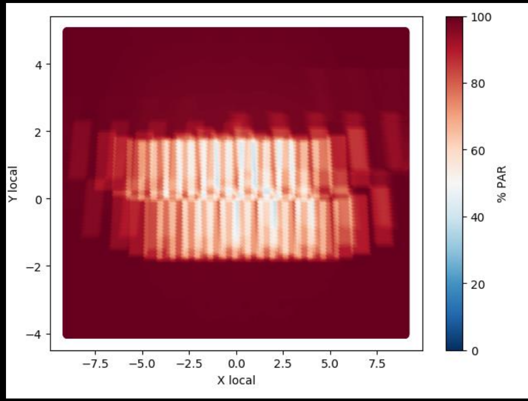


Electricity yield









Ground radiation impact

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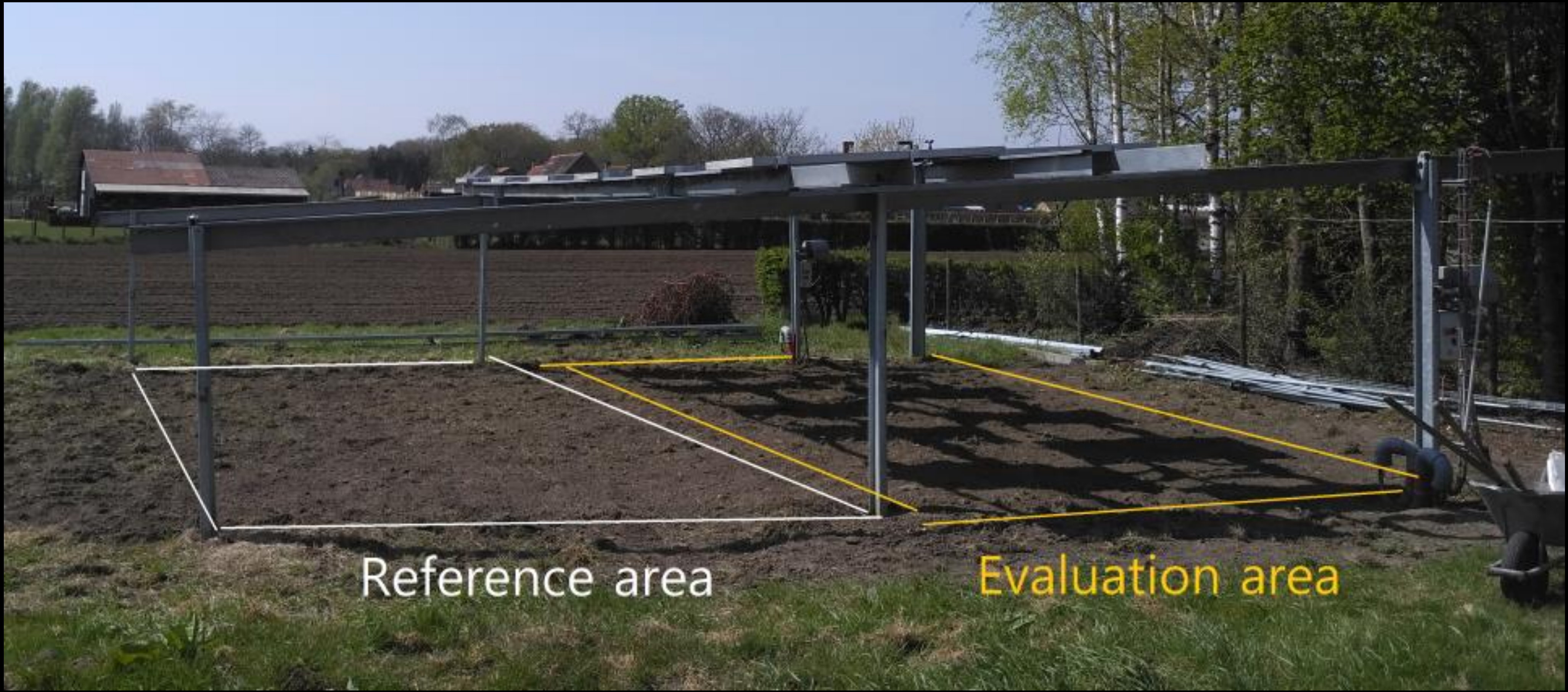
Agrivoltaics 2018 – 2019: first thesis



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Agrivoltaics 2018 – 2019: first thesis

Still potatoes….

Agrivoltaics 2019 – 2020: first funded project

AGENTSCHAP INNOVEREN & ONDERNEMEN
Vlaanderen is ondernemen

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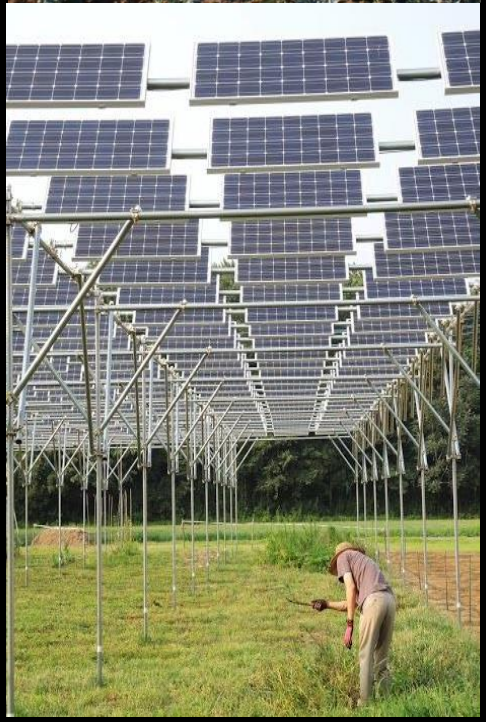
Innovatiesteunpunt voor landbouw en platteland

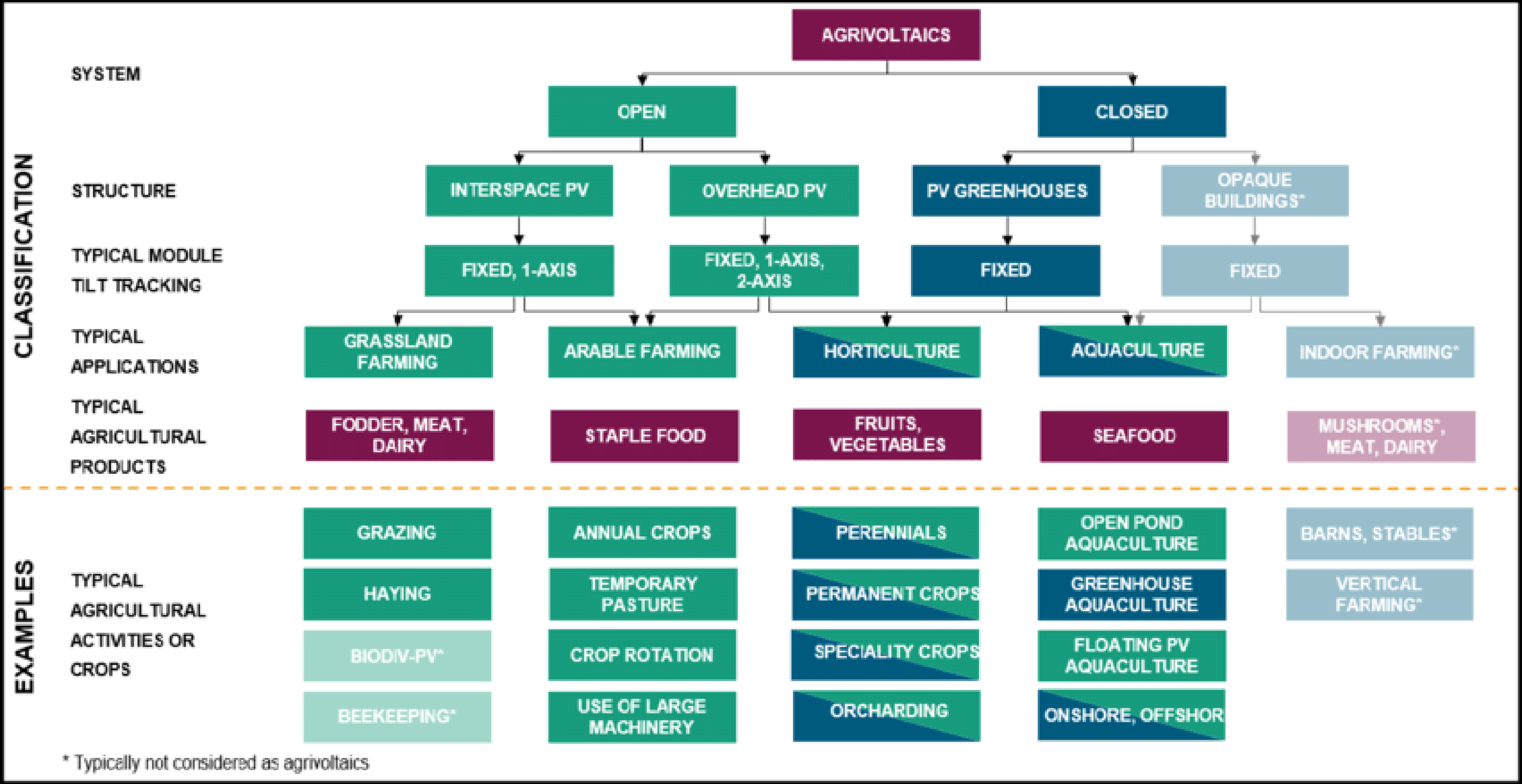
Many design options are possible …





Meaning there is a need for a framework



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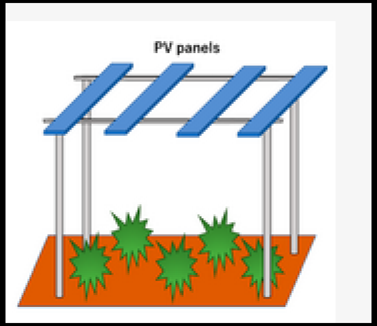
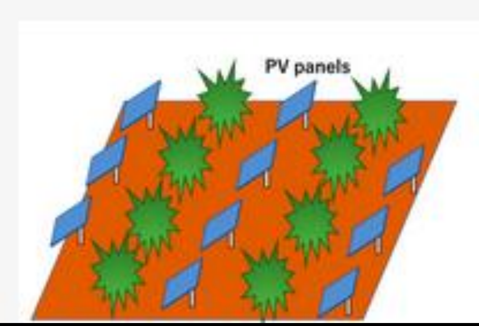
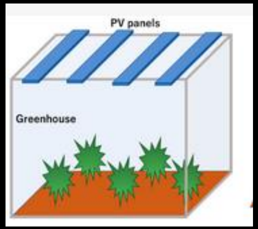
This framework includes structure types….



overhead



interspace



greenhouse

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And crop types….

grassland

arable farming (annual field crops)

horticulture (permanent crops)

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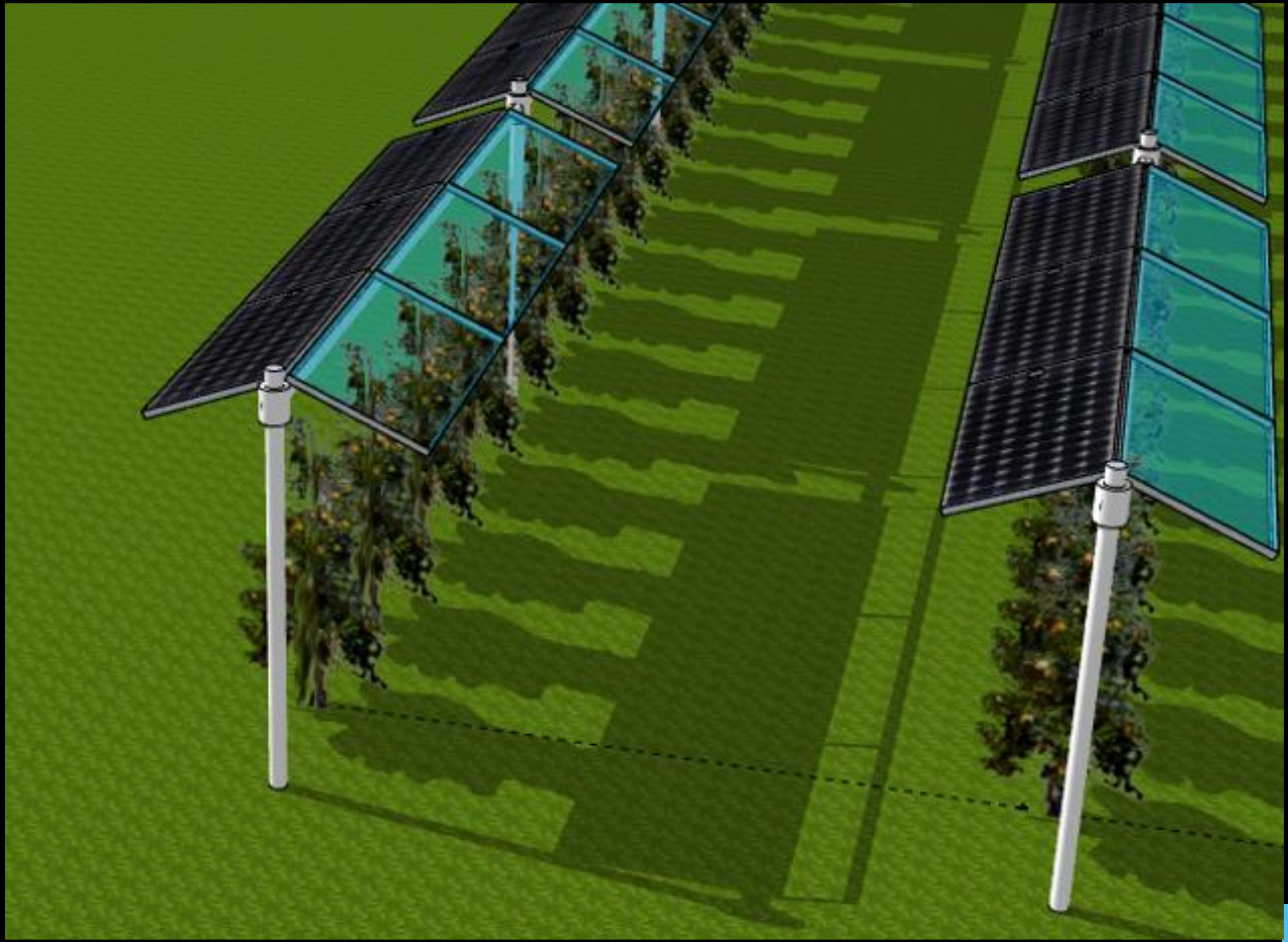
We designed and built all types of agrivoltaics

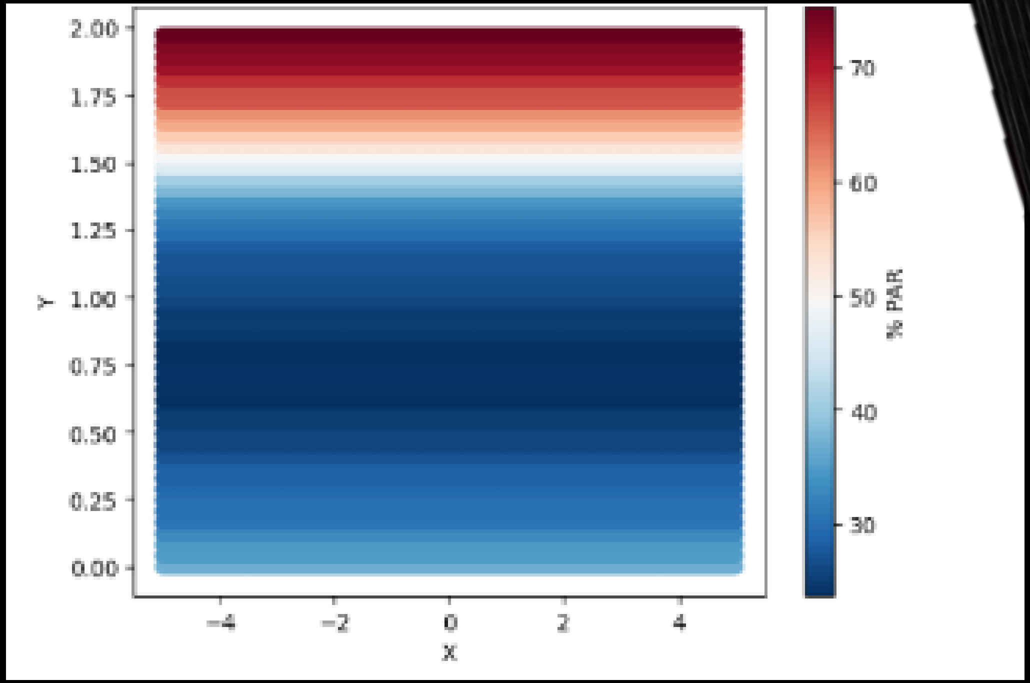
Horticulture
Overhead agrivoltaics

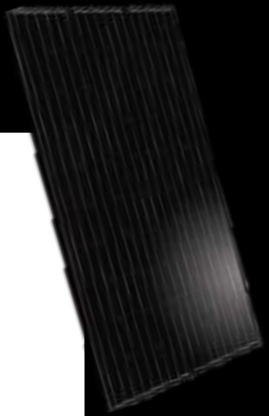


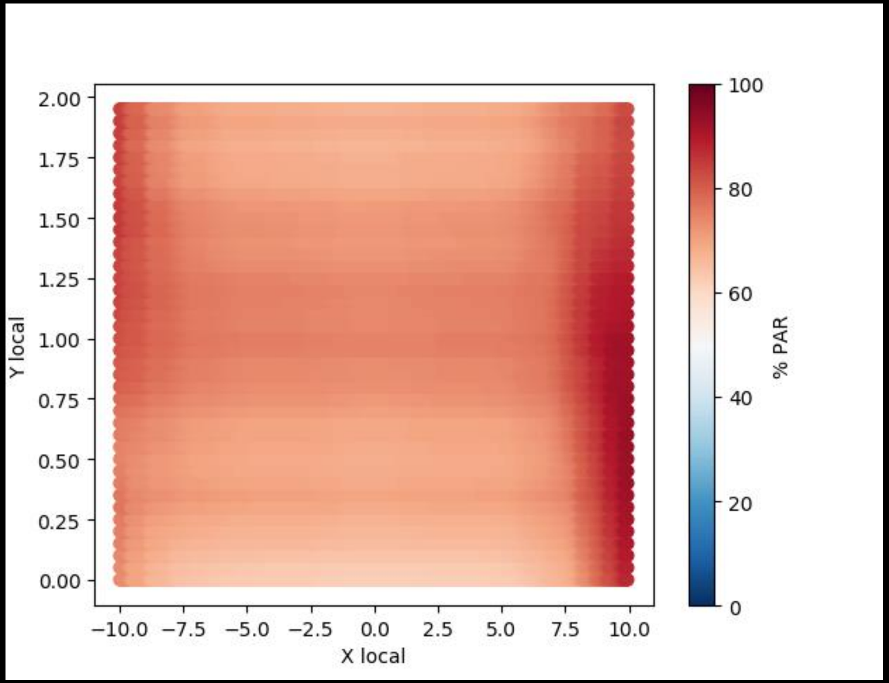
Agrivoltaics 2020: first pilot

Balancing yields: Electric vs Agricultural

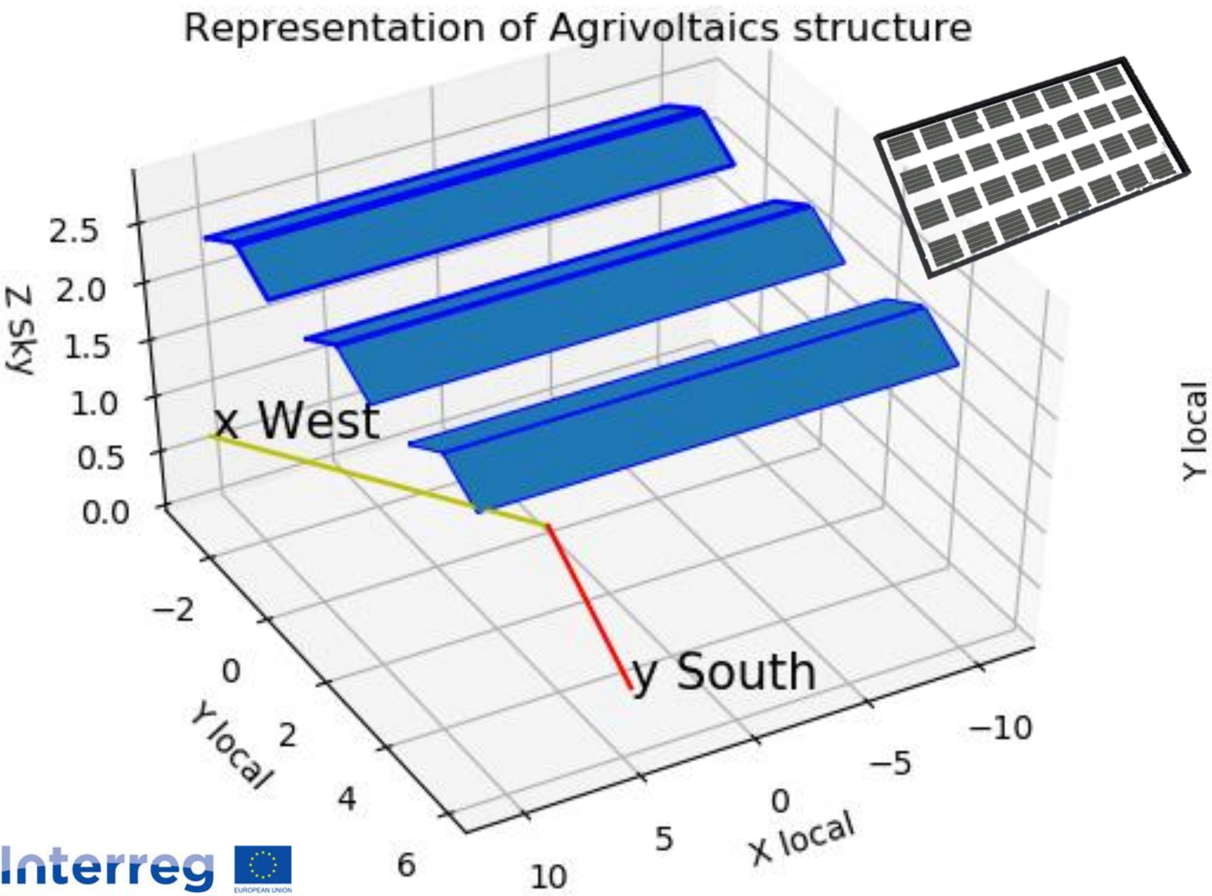
Traditional or (semi)transparent?

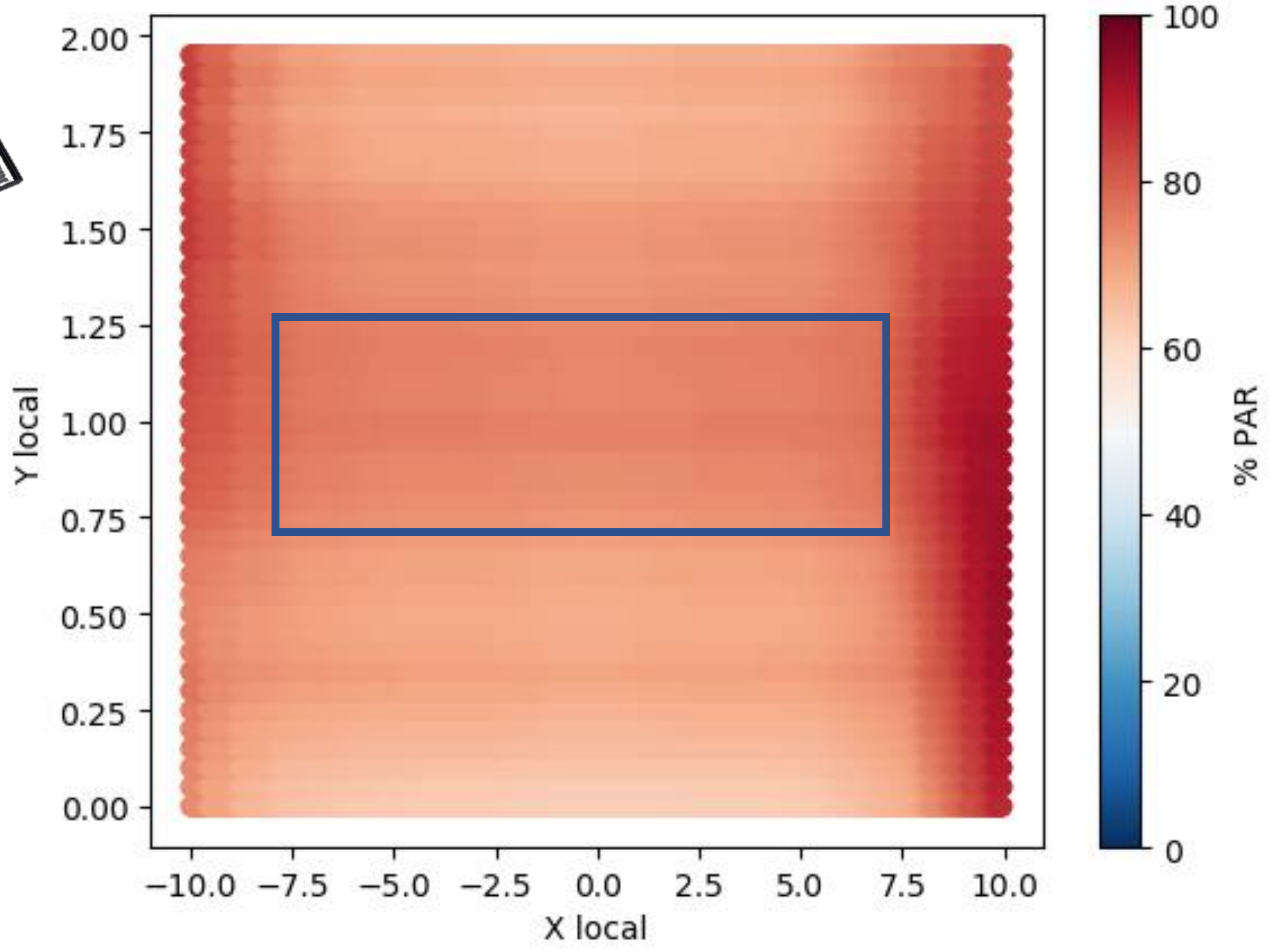






Agrivoltaic system design – Pear Pilot





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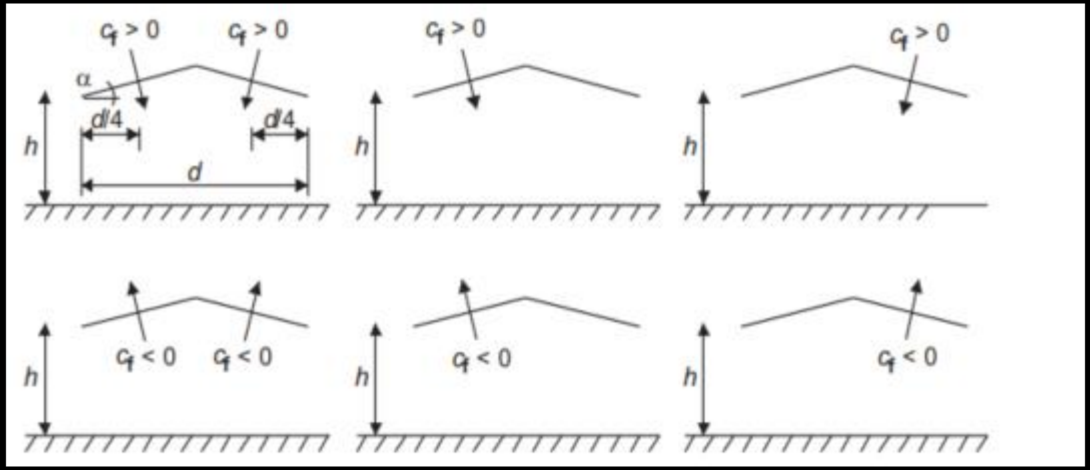
Construction and windload

Permanent or concrete foundations not permitted in agriculture

- Soil anchors and steel cable
- Modify roof design to optimize wind loads (standard)



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Innovatiesteunpunt

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Building process: modifying hail netting for Agrivoltaics

Additional wooden supports

Soil anchor positioning

Link anchor to top structure

Longitudinal wind bracing

Building process: PV top structure

Aluminium frame on poles with L-profiles

PV deployment

Rigid lateral wind bracing


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No land losses
Land use efficiency improved by 44%
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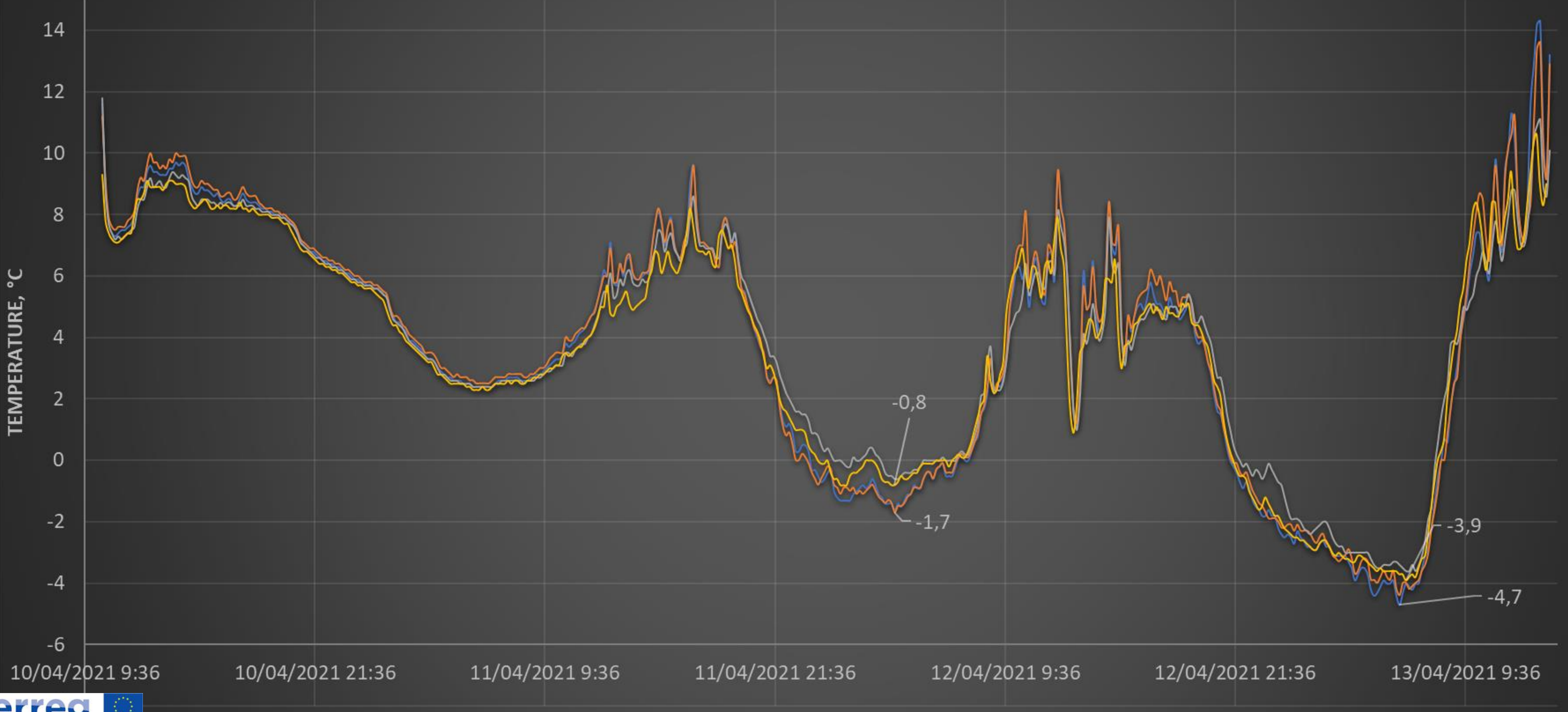
Air microclimate



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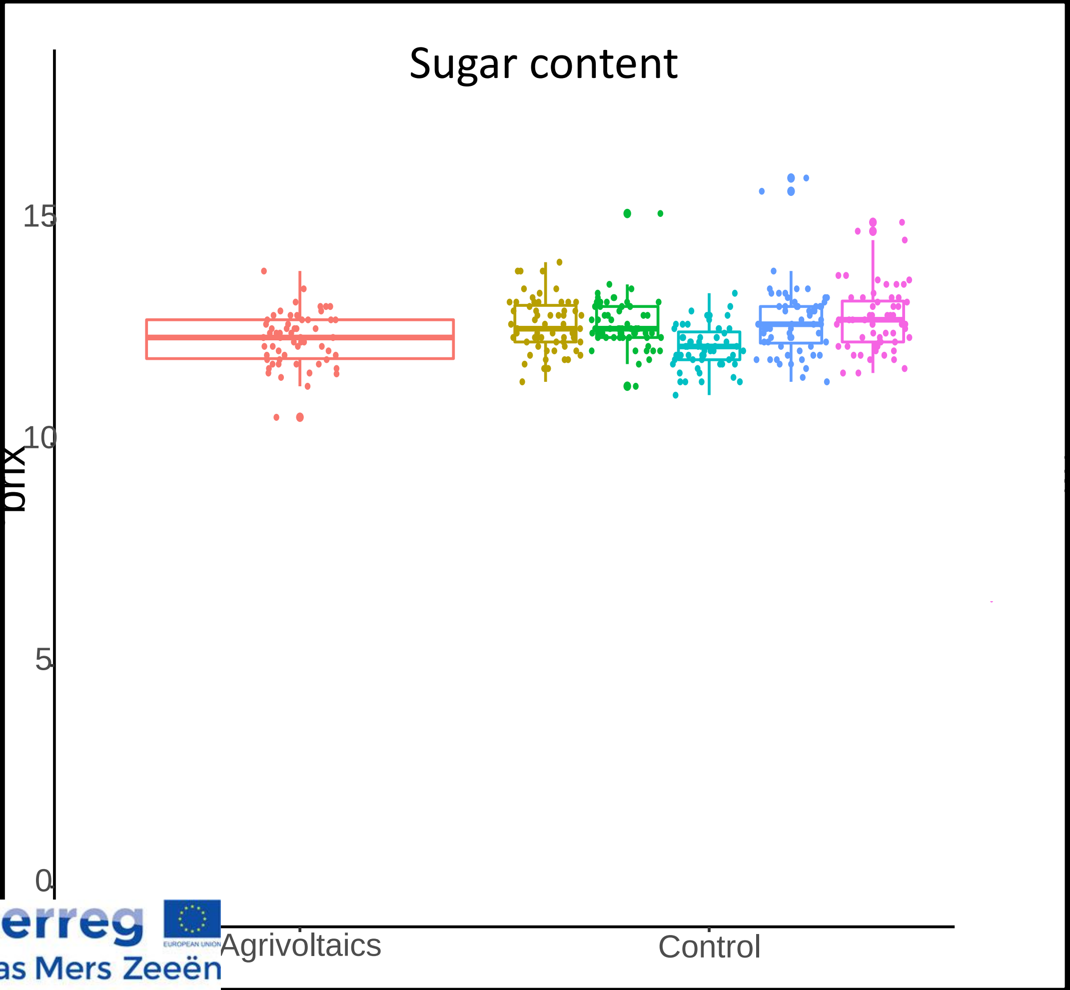
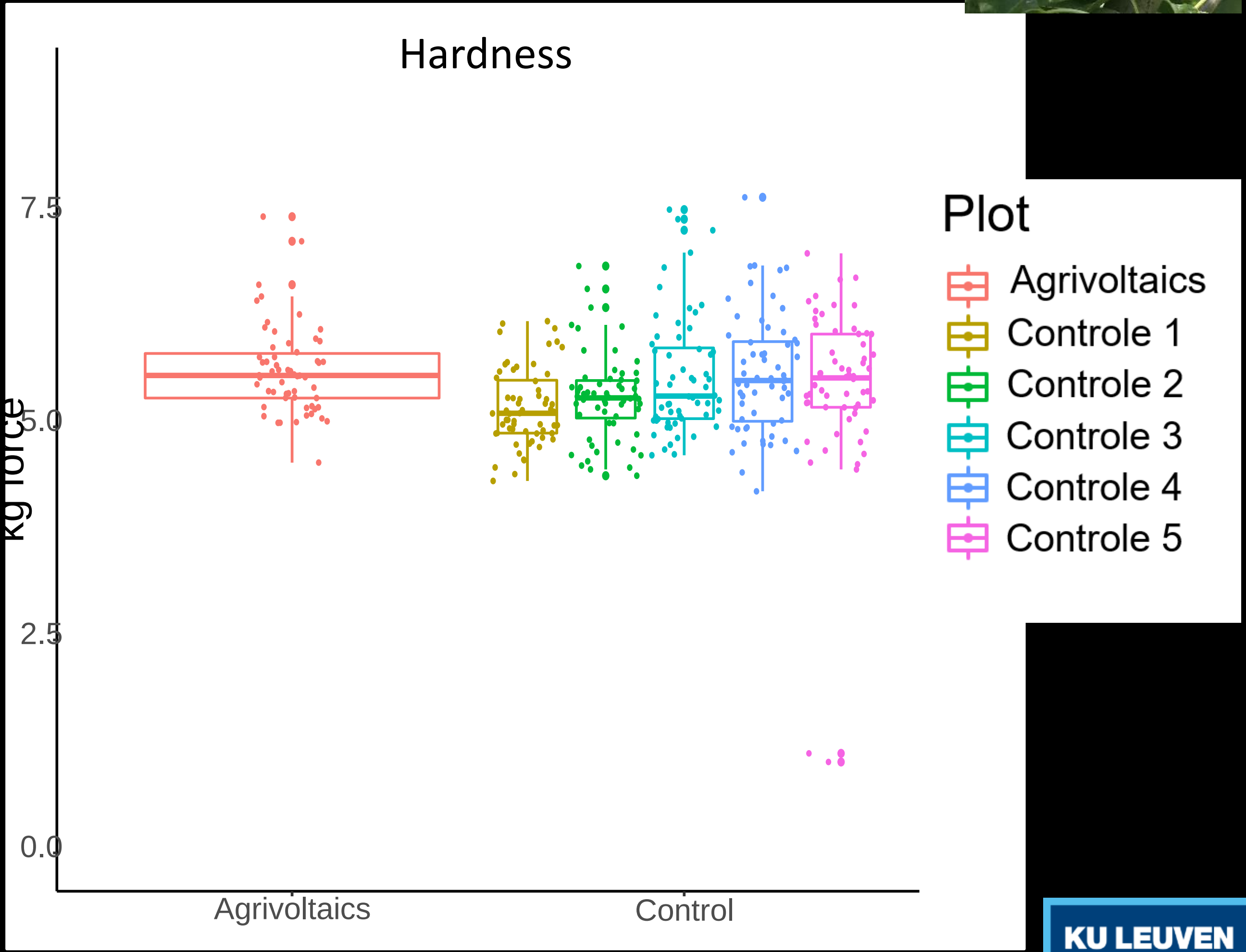
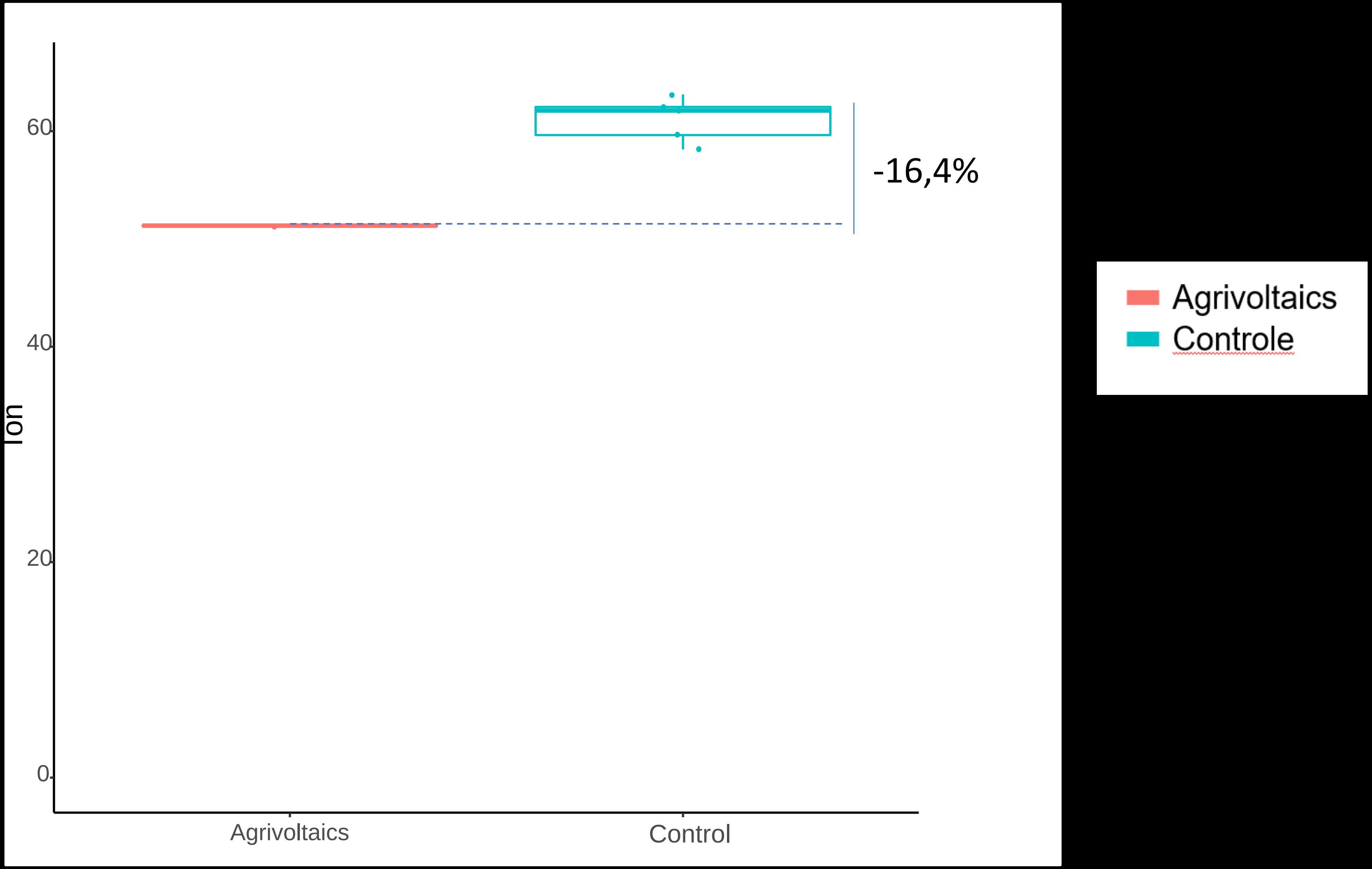
Controle middle canopy [°C] Controle lower canopy [°C] Agrivoltaic middle canopy [°C] Agrivoltaic lower canopy [°C]

Fruit quality

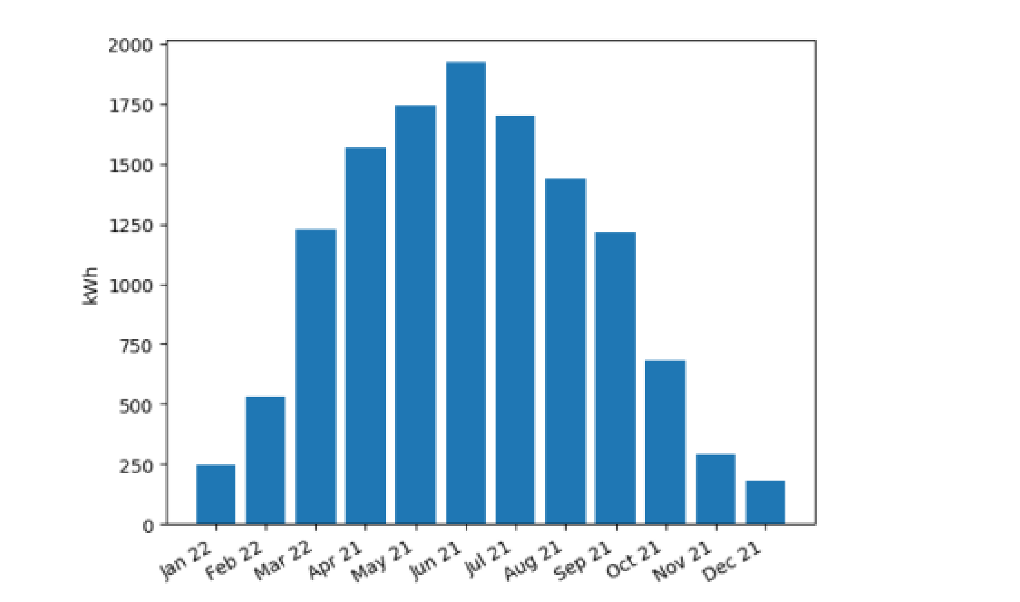


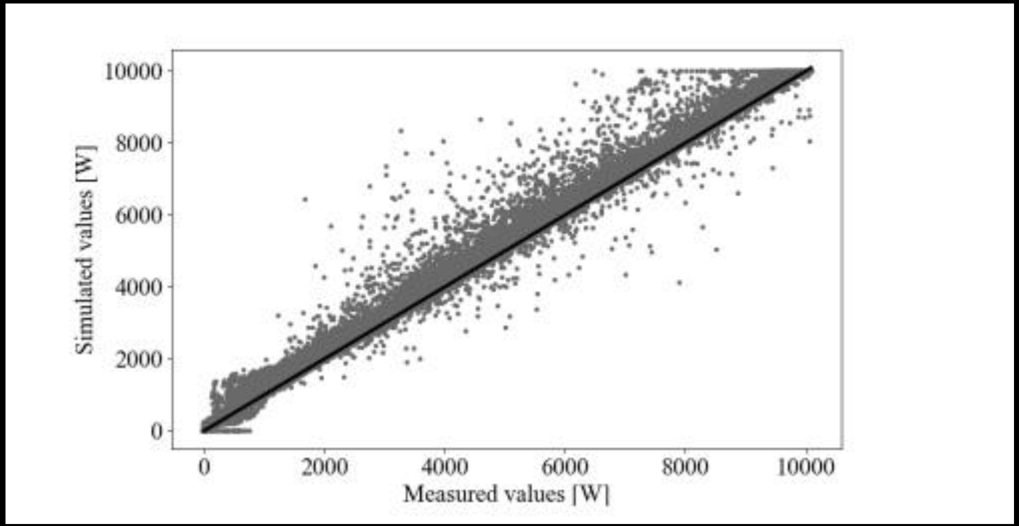


Fruit quality



Electricity





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Arable pilot overhead

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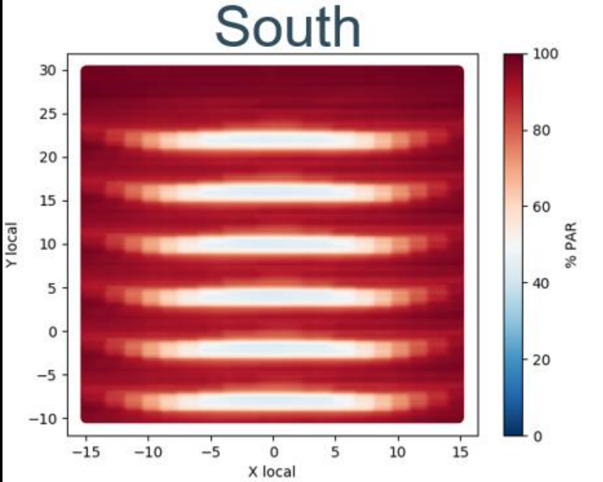
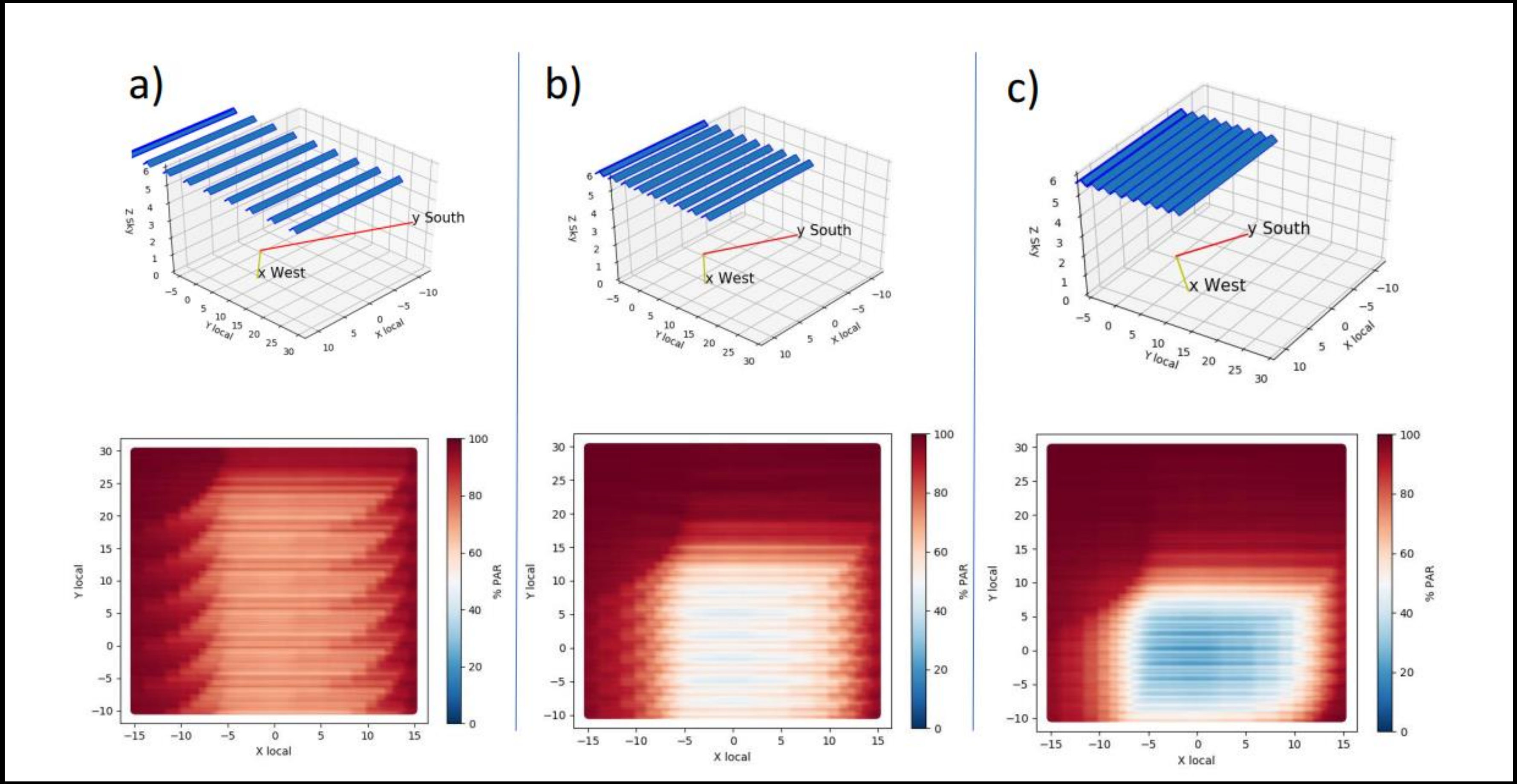
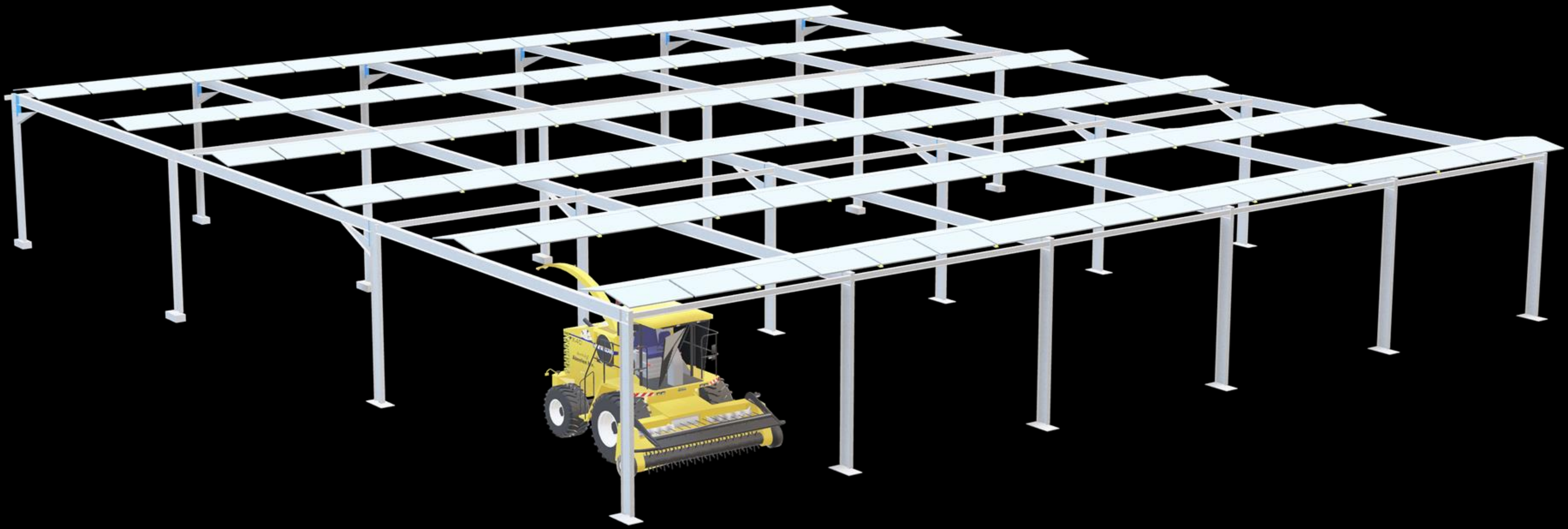
Southwest orientation to ensure homogeneous radiation







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Rigid structure with concrete foundation

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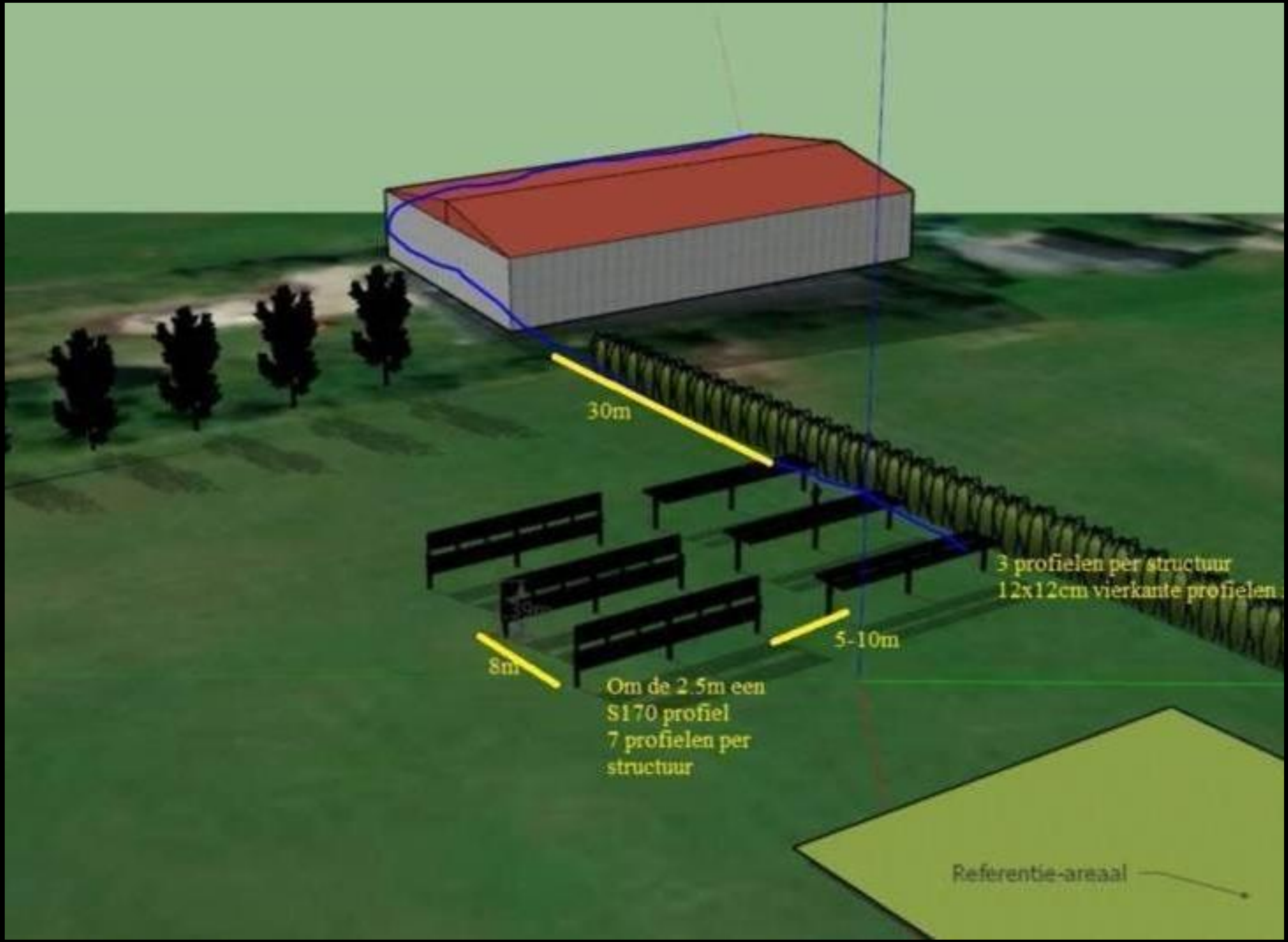
Arable pilot interspace



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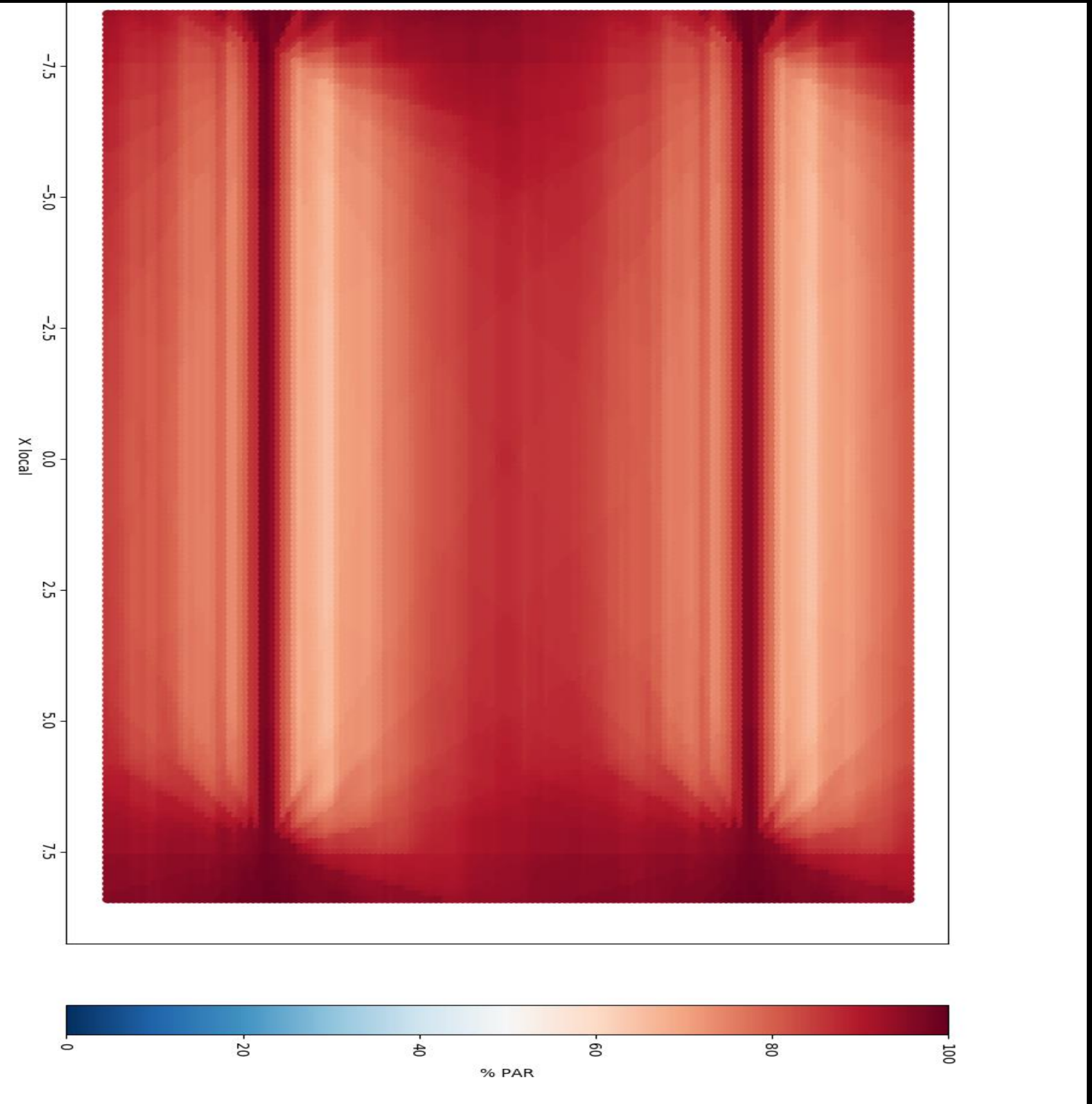
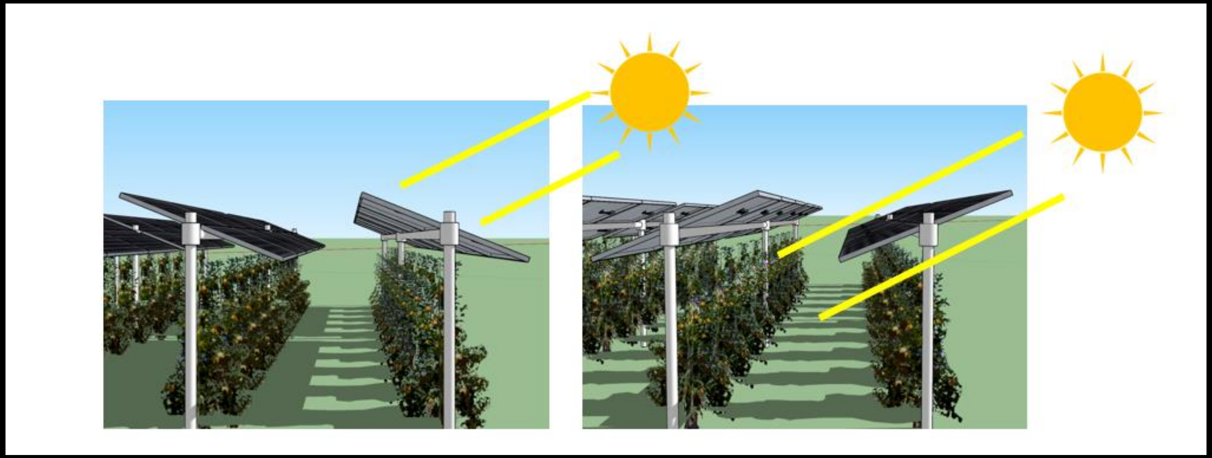
Vertical bifacial with interrow distance 9 m



Solar tracking offers the advantage of shade and energy control




Almost no change in land use efficiency
Land loss area
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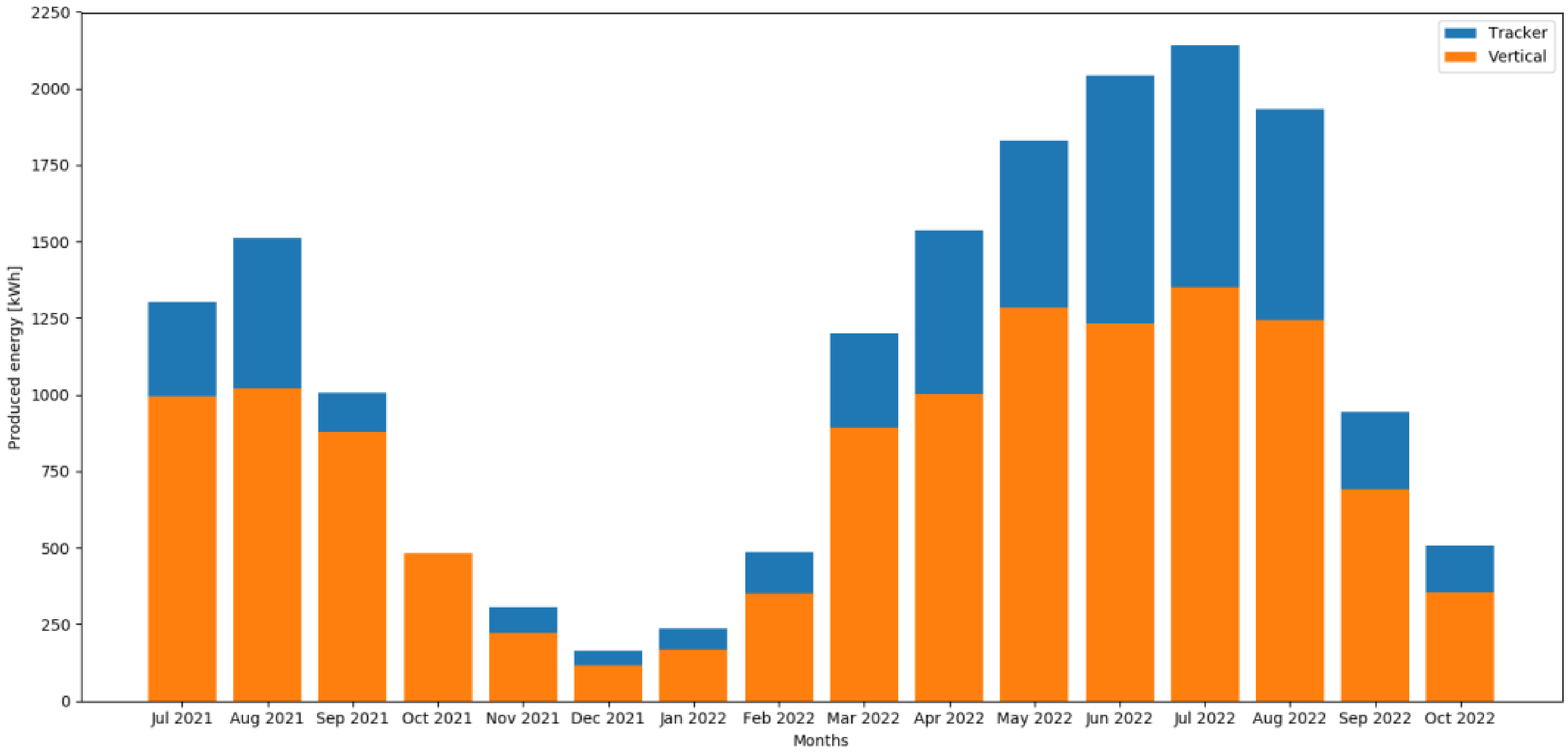
Energy



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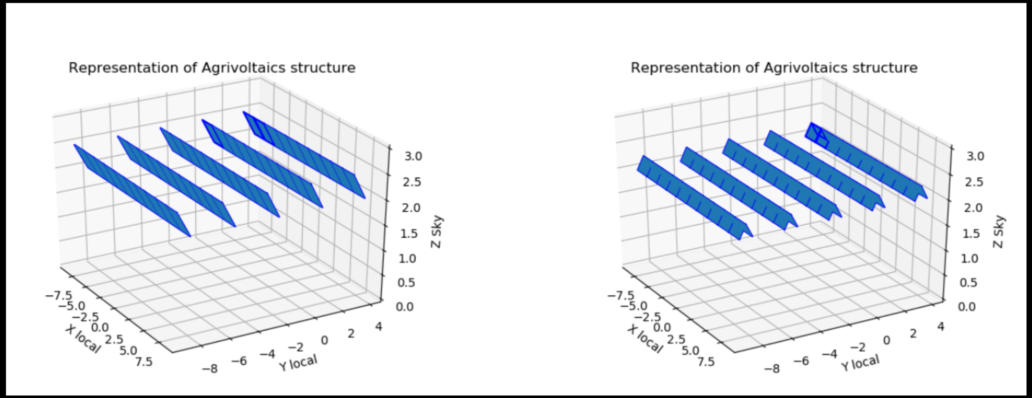
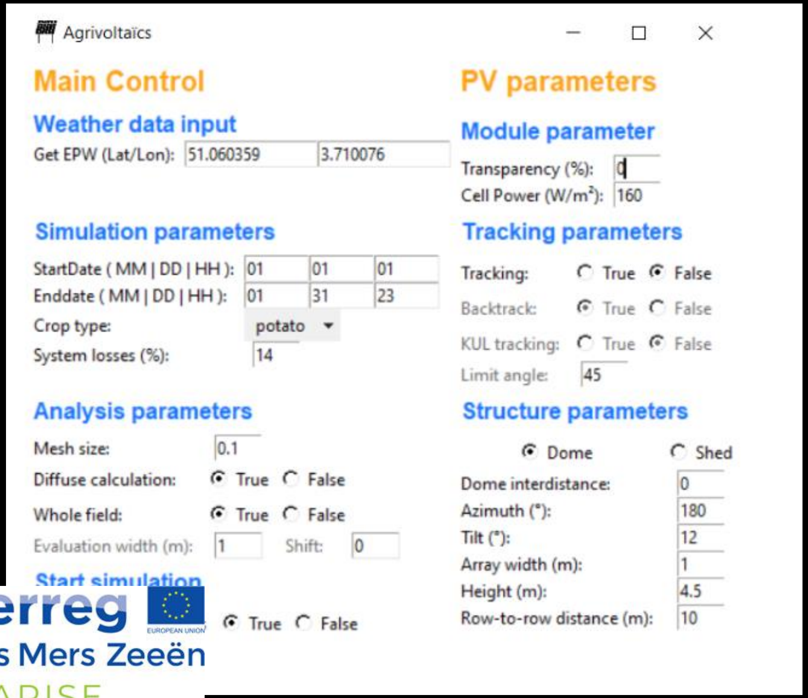
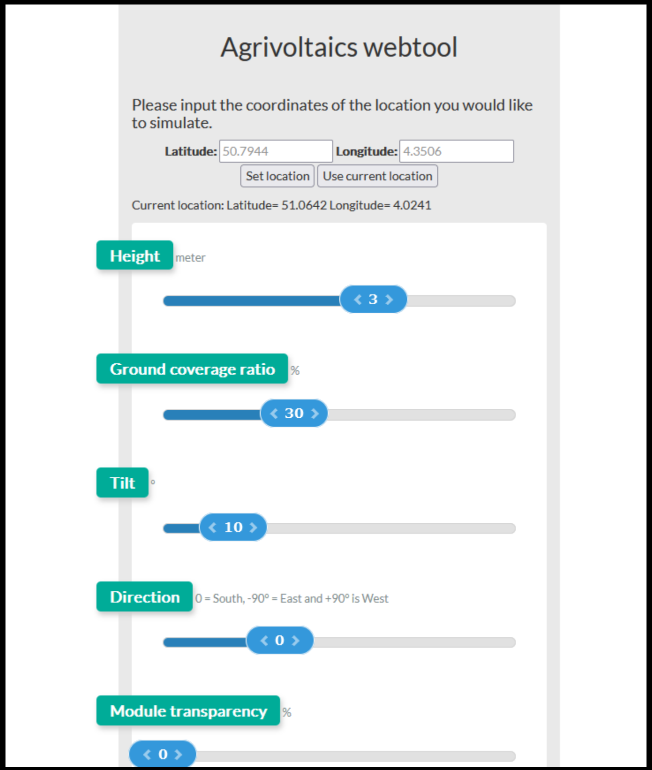
And the software from 2018?







https://iiw.kuleuven.be/apps/agrivoltaics/index.html

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Conclusions: what happend between 2018-2022?

- First step in legal framework: distinction between field crops, greenhouses and permanent crops
- From proof of concept to market ready technology
- Software that evolved from python code to a user friendly webtool
- 1year of measurements to improve software, measurement method, new designs and decision making
- 2years of practical experience (what is the real land loss vs theoretical expected)

Takeaways

- Crops + PV: great potential but not always a clear win-win in Belgium!
  - Not yet a standardized way to measure the difference in yield & quality
  - Long term effects not yet proven
  - Optimal PV configuration for next 30 years difficult to estimate in advance (shade-crop yield relations)
    - More crop types and varieties should be tested
    - Impact of climate change
- Do not forget other synergies on agricultural land!