Opportunities and challenges for the energy transition - UNIGE

Crops and Energy without compromise

Voltiris

Dominik Blaser
Co-Founder & Chief Product Engineer

Agenda

01. Context

02. Problem

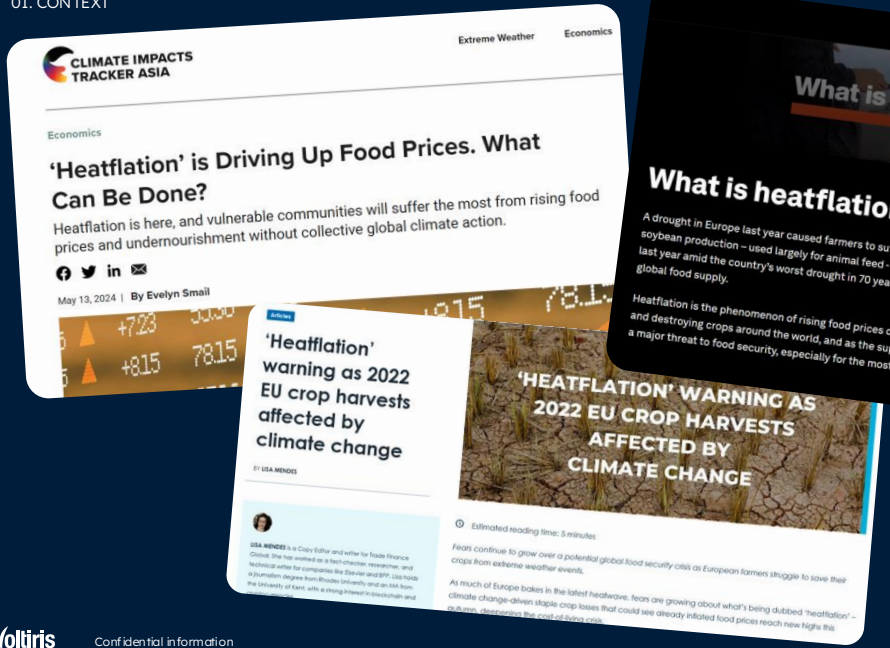
03. Solution

04. Proof

05. Vision

Food systems under pressure

www..ib.barclays/content/dam/barclaysmicrosites/ibpublic/documents/our-insights/food-security/ImpactSeries_10_brochure_final.pdf


CLIMATE IMPACTS TRACKER ASIA
Extreme Weather
Economics
Economics
‘Heatflation’ is Driving Up Food Prices. What Can Be Done?
Heatflation is here, and vulnerable communities will suffer the most from rising food prices and undernourishment without collective global climate action.
May 13, 2024 | By Evelyn Smail
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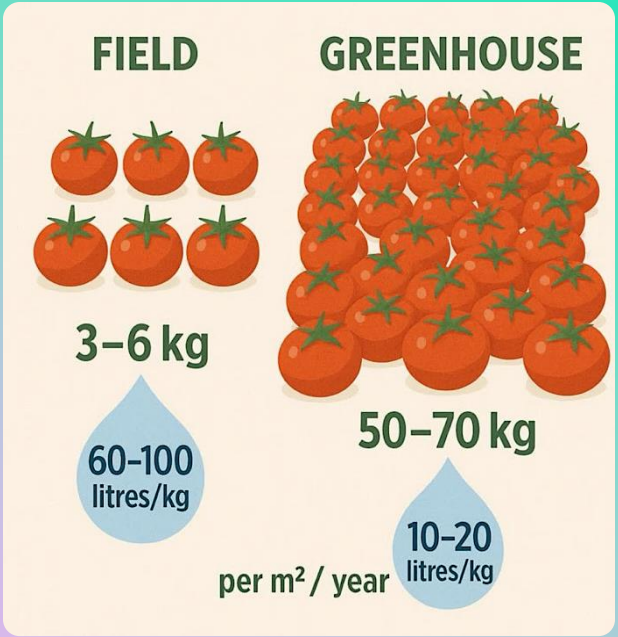
78.15
WORLD ECONOMIC FORUM
What is heatflation?
What is heatflation?
A drought in Europe last year caused farmers to suffer heavy losses. Maize yields fell by 25% while soybean production – used largely for animal feed - fell by 10%. Wheat and rice yields fell by 30% in Italy last year amid the country’s worst drought in 70 years. Wheat, maize and rice make up almost half the global food supply.
Heatflation is the phenomenon of rising food prices caused by extreme heat. Heatwaves are damaging and destroying crops around the world, and as the supply of food dwindles, prices begin to climb. This is a major threat to food security, especially for the most vulnerable people in the world.
Articles
‘Heatflation’ warning as 2022 EU crop harvests affected by climate change
BY LISA MENDES
‘HEATFLATION’ WARNING AS 2022 EU CROP HARVESTS AFFECTED BY CLIMATE CHANGE
LISA MENDES is a Copy Editor and writer for Trade Finance Global. She has worked as a fact-checker, researcher, and technical writer for companies like Elsevier and BPP. Lisa holds a journalism degree from Rhodes University and an MA from the University of Kent, with a strong interest in blockchain and
Estimated reading time: 5 minutes
Fears continue to grow over a potential global food security crisis as European farmers struggle to save their crops from extreme weather events.
As much of Europe bakes in the latest heatwave, fears are growing about what’s being dubbed ‘heatflation’ – climate change-driven staple crop losses that could see already inflated food prices reach new highs this

CEA is part of ensuring a stable food supply

Swiss tomatoes consumption: ≈ 100 million kg/year

	Field	Greenhouse
Needed surface [ha]	3'333	143
Water need in olympic swimming pools	4000	800



Greenhouse surface will double by 2030 to meet food and climate challenges

2x

Global greenhouse area is expected to reach 120,000 hectares by decade's end

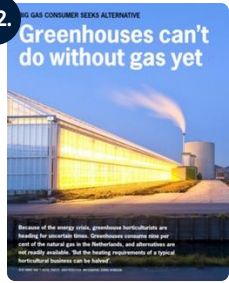
- Increase Yield
- Produce locally
- Control climate
- Lower water needs
- Reduce pests and diseases
- Optimize land use

Greenhouses still have a huge energy need

CHP – Heat and power co-generation	Brunning gas to heat the greenhouse and provide electricity
No viable alternatives to fossil fuels	Cheapest solution and low regulations so far
Grid congestion	Electricity supply is limited by the grid connection

01.

02.



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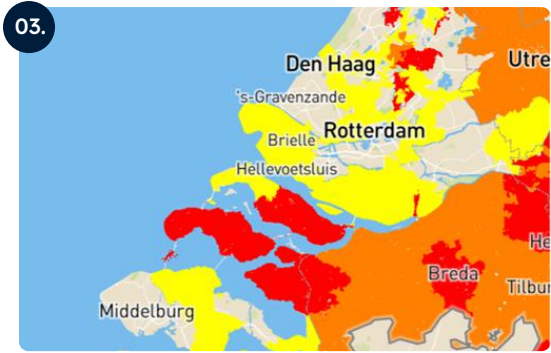
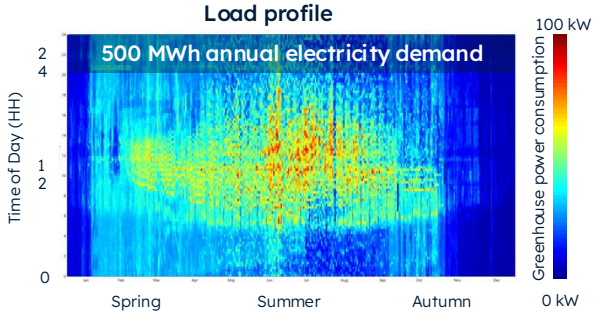


Electrification drives greenhouse efficiency—and aligns perfectly with solar generation



Temperature management

Heat from data centres and active ventilation to maintain an optimal climate

Humidity management

Dehumidification system to improve crop yield

Operations

E.g. Irrigation system, storage area, packaging lines

Future electrification

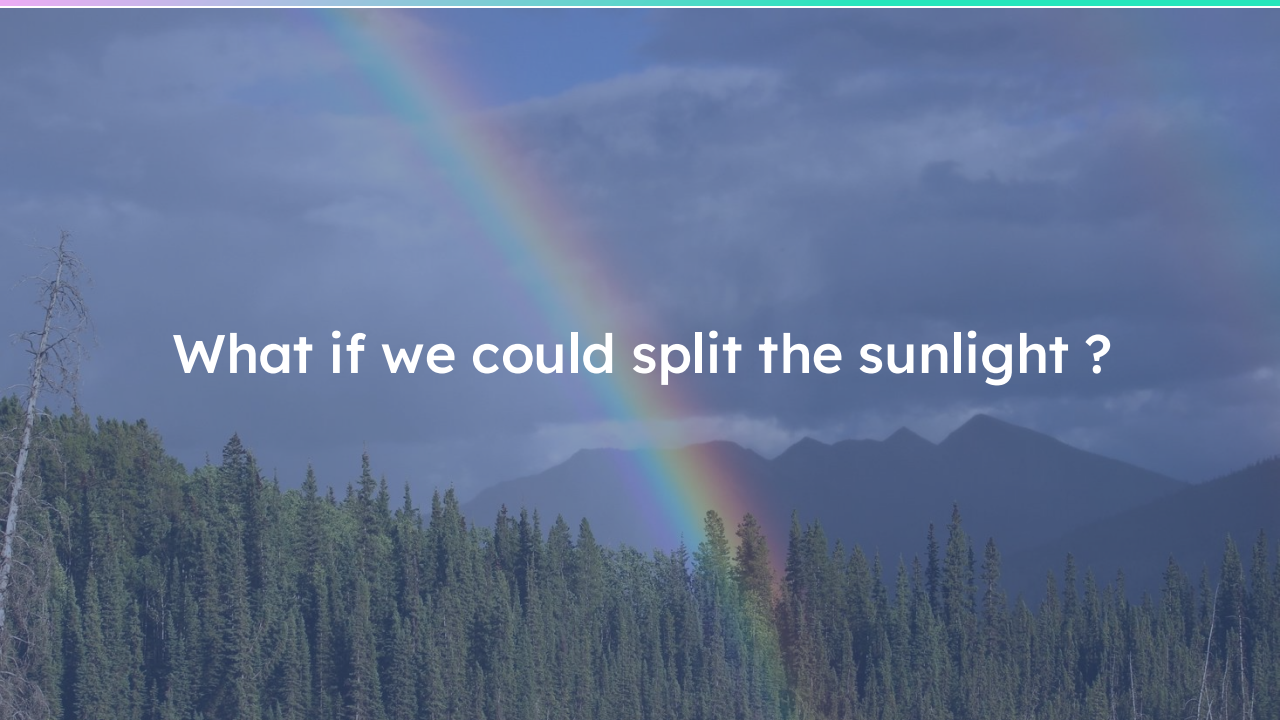
Future electricity needs, such as battery storage, heat pumps, e-boilers, or direct air capture systems

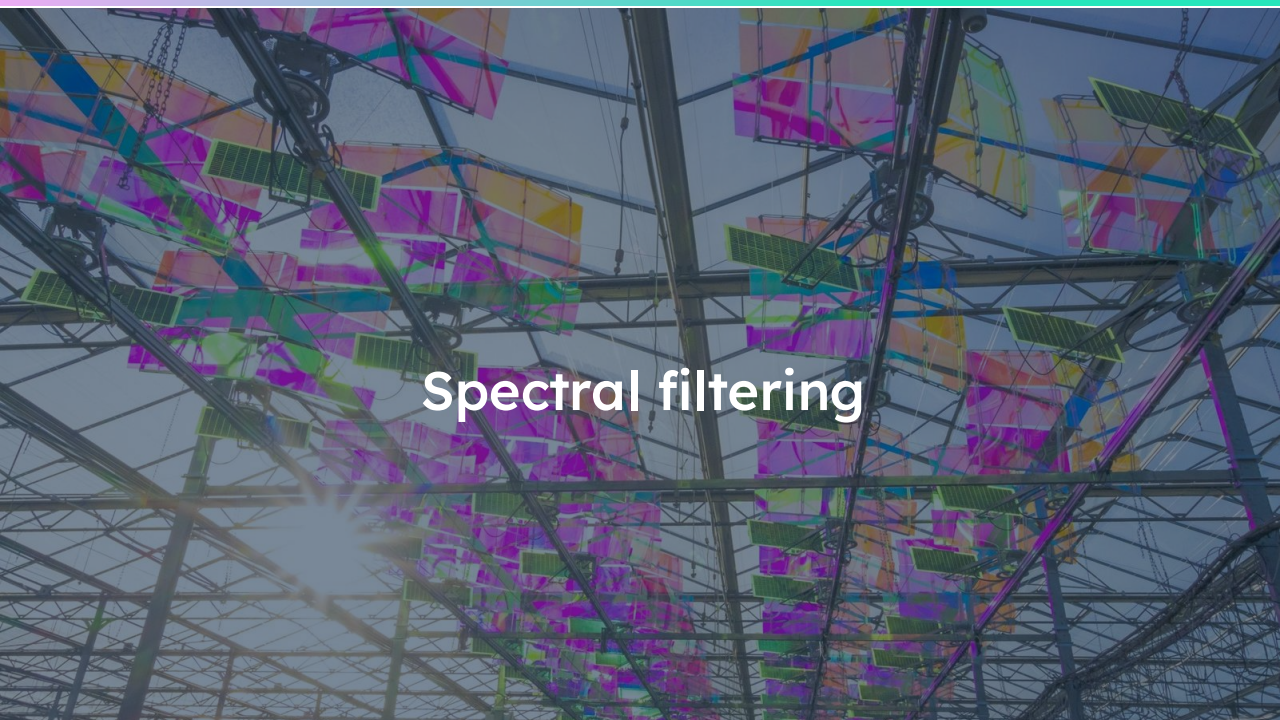
Greenhouses have untapped potential to generate renewable energy

Conventional solar fall short of fully powering high-tech greenhouses

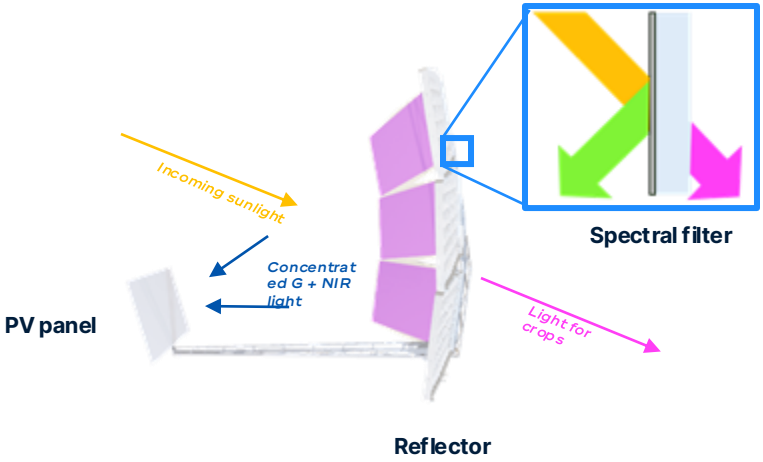
01.	**PV on buildings around greenhouses**	Buildings around greenhouses lack the space for sufficient photovoltaic capacity
02.	**PV on agricultural fields around greenhouses**	Installing PV on agricultural land requires permits that take years for approval—if granted at all
03.	**PV on greenhouse roof**	PV installation on greenhouse roofs is limited to niche crops (8% of greenhouse surface) due to shading


Plants are green.


What if we could split the sunlight ?


Spectral filtering

Panels that filter and concentrate sunlight onto small PV cells



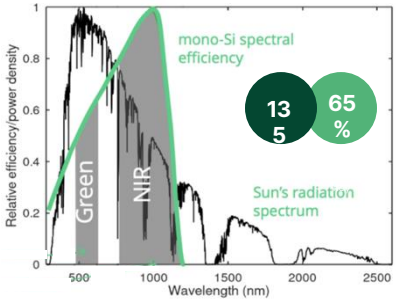
how it started

how it's going

Technology

Light concentration

Understanding spectral efficiency



1 Solar module

Design specification of solar module, **optimization for concentration**

x 0.6 5

2 Spectral filtering

x 6

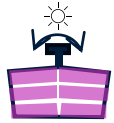
Expertise in spectroscopy and agronomy and **filter specifications**

3 Concentration

Patent on **reflector design** protecting **efficiency of dichroic low concentration system**

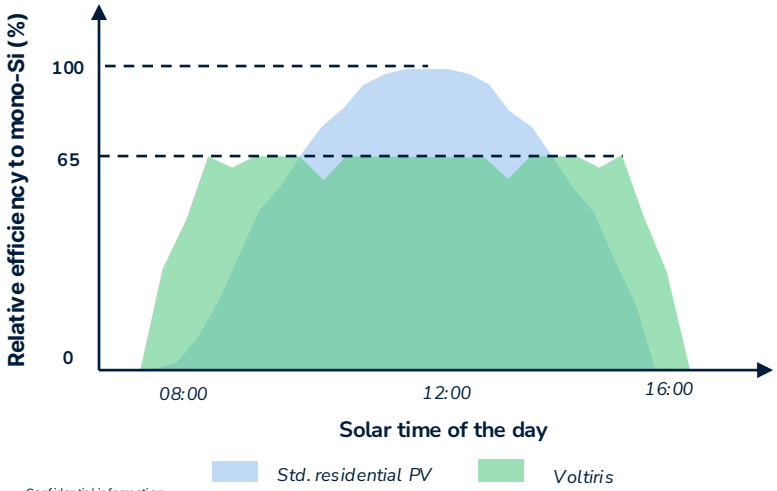
+20% kWh/kW h

4 Solar tracking

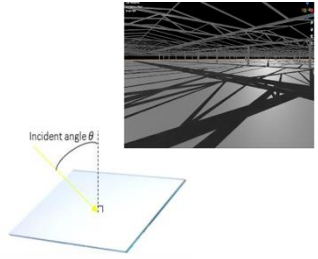


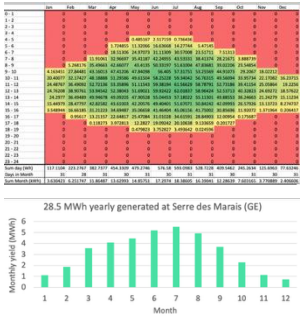
Patent on **solar tracking mechanism** adapted for greenhouses

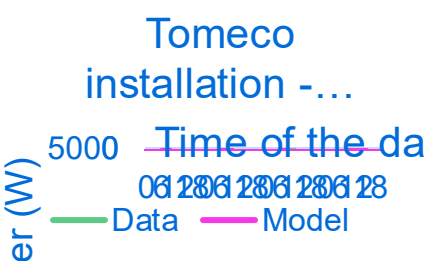
Two-axis tracking boosting self-consumption potential with a more even production profile



Our proprietary energy generation model forecasts yields based on geographic and greenhouse specificities



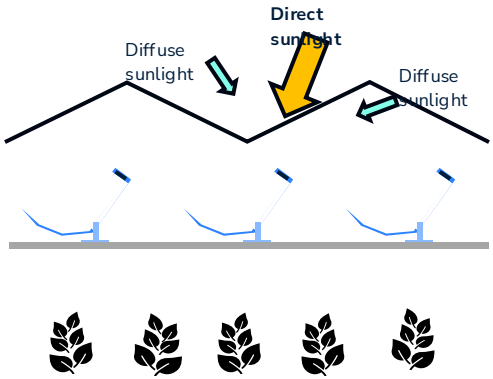




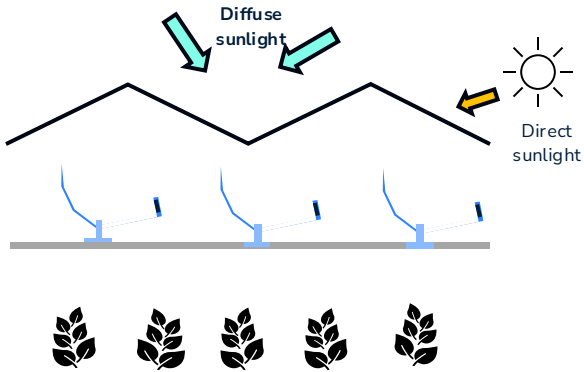
1. Proprietary greenhouse transmission model
2. Voltiris energy yield model based on historical data
3. INSTALLATION LIVE DIGITAL TWIN TO FOLLOW PROJECT PERFORMANCE AND VALIDATE MODEL

Indoor PV system on tracker to optimize seasonally for the best growth climate.

Summer – Excess direct sunlight



Winter – Diffuse sunlight fully transmitted



Results of APREL Study on the Impact of Traditional Solar PV for Greenhouses (Southeastern French Research Institute)

Parmi les 40 espèces étudiées, la majorité montre un mauvais comportement sous serre photovoltaïque. Quelques résultats corrects ont été observés sur des plantes aromatiques en été, des betteraves et choux raves en hiver.

Espèces	Observations	Rendement (perte/ abri classique même créneau)
Tomate	Bouquets pliés, plantes étiolées, maturation longue	-60 à -70%
Melon	Retard de production, dégâts d'oïdium, petit calibre	-55 %
Aubergine	Floraison et nouaison difficiles, pucerons	-50%
Poivron	Floraison et nouaison difficile, entrée en récolte tardive	-81%
Courgette	Défauts de pollinisation, coulures de fleurs, production par vague	- 50 %
Concombre	Oïdium, pucerons	-20 à -80%
Fraise	1 mois de retard, petit calibre, botrytis	-53%

Tomato: 60-70% yield reduction

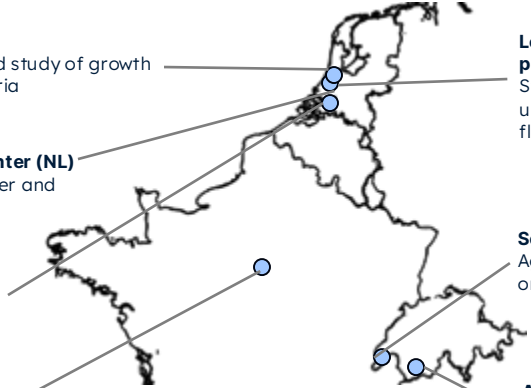
Cucumbers: 20-80% yield reduction

Strawberry: 53% yield reduction

Voltiris vs emerging PV greenhouse tech

	High-tech Greenhouse (HTG)	HTG + semi transparent PV (tomato)	HTG + Voltiris (tomato)
	(tomato)	SOLICULTURE insolight Brite **Max 80%** necessary light transmission	VOLTIRIS **100%** necessary light transmission
Agro Revenue	50kg/m2 **100 CHF/m2**	**40** kg/m2 **(-20%)** **80 CHF/m2 (-20%)**	**50** kg/m2 **100 CHF/m2**
Energy Revenue	/	40 kWh/m2 **8 CHF/m2**	40 kWh/m2 **8 CHF/m2**
Total Revenue	**100 CHF/m2**	**88 CHF/m2 (-12%)**	**108 CHF/m2 (+8%)**

Agronomic validation performed on various crops with industry leaders and respected research institutions



Royal van Zanten (NL)
Micro-climate improvement and study of growth and development of Alstroemeria

Delphy Light Improvement Center (NL)
Study with Delphy on Bell pepper and growing climate improvement

Wageningen University (NL)
Growth of vine tomatoes below Voltiris modules.

CVETMO (FR)
Cucumber growth and impact on thrips

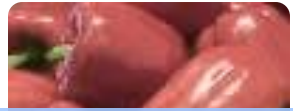
Leading international young plant producer (NL)
Study the compactness improvement using spectral filtering for young plants in floriculture

Serres des Marais (CH)
Agronomic study on cherry tomatoes on 1000m2 in industrial greenhouse setting.

Agroscope (CH)
Study of various greenhouse crops and their development

No agronomical losses validated on most greenhouse vegetables, and on various flowers

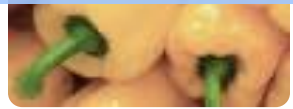
Tomatoes
- Similar total yield
- Need to adjust irrigation to accommodate lower transpiration (lower water intake)



Bell Peppers
- Similar total yield
- Higher Light Conversion Efficiency
- Up to 4°C lower plant leaf temperature in the summer

Cucumbers
- Similar total yield
- Reduction of thrips occurrence below spectral filters

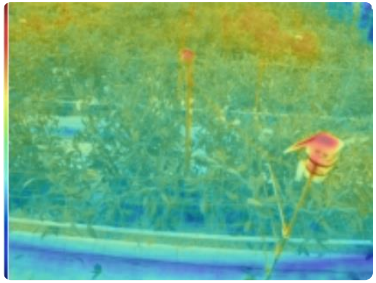
Floriculture
- Improve crop compactness for young plants by tuning the far red : red ratio
- Lower crop temperature as potential white-wash substitute



Spectral filtering as a tool to improve crop morphology, and growing climate

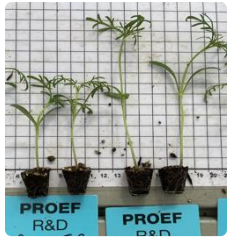
Alstroemeria at Royal van Zanten (NL)

The installed filters lead to an **average temperature reduction of -2°C** during direct sunlight exposure, illustrating our solution's ability to improve the climate within a greenhouse.



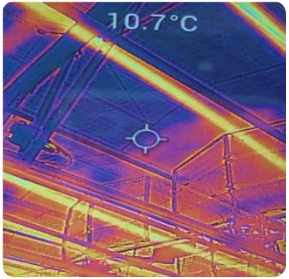
Young plants (NL)

Tailoring the solar modules' transmission spectrum helped enhance the red : far-red ratio leading to an **improved crop compactness**. The spectral effect comes on top of the lower plant temperature that also promotes more compactness.

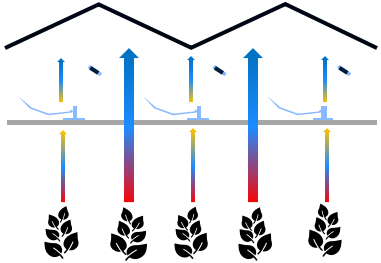


Voltiris modules acting as a radiation shield during the night, reducing crop stress

Increase isolation in the night
Voltiris modules act as an additional radiation shield for the crops, decreasing the annual heating needs by as much as 5% in the case of a greenhouse with insulation screen and reducing crop stress



More balance to the crops
The radiation shielding is also beneficial for the crops during daytime, as it prevents radiative energy losses of the crops.

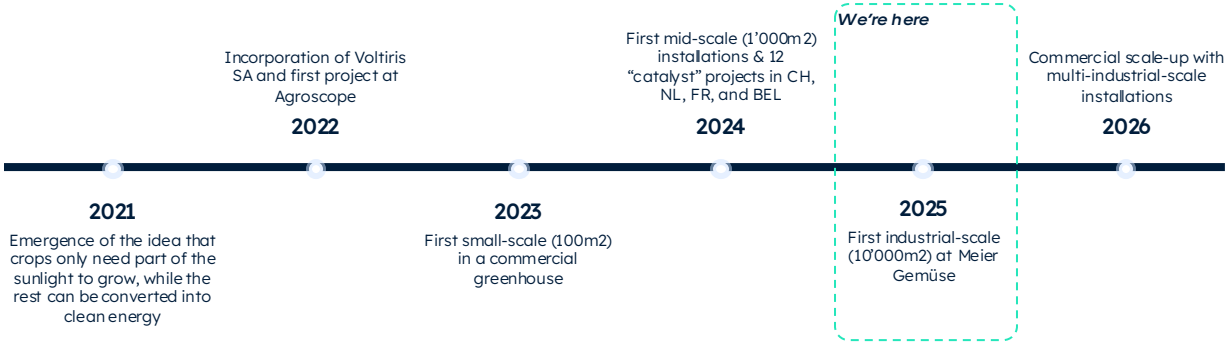


Voltiris-modules reduce the need for screen closure and consequently facilitate humidity control in the greenhouse

A. Eschbach

"Before, we had to close two screens at 9h30. Currently, we only need to ***close one screen and only from 11h00****. This change, greatly helped in* ***controlling humidity*** *in the greenhouse."*

The Meier Gemüse project is the result of more than four years of developing our solution



The flagship ha scale - project

Meier Gemüse AG – a family-owned company committed to sustainable production

60

Years

A family-owned business based in Rütihof, growing vegetables in 65,000 m² of high-tech greenhouses

2.7

x1000 tons

of high-quality tomatoes and cucumbers produced every year and distributed throughout Switzerland

Pioneering electrification

The greenhouse is equipped with solar panels, a dehumidification system, and data centers

The world’s first tomato greenhouse powered by a spectral-filtering solar system

Voltiris solar modules

1736

Offered as a turnkey solution - including inverters, cabling, grid connection, and commissioning

Installed capacity

236 kWp

Each module delivers 135 Wp, enabled by a 6× concentration factor of the spectral films

Summer daily production

800 kWh

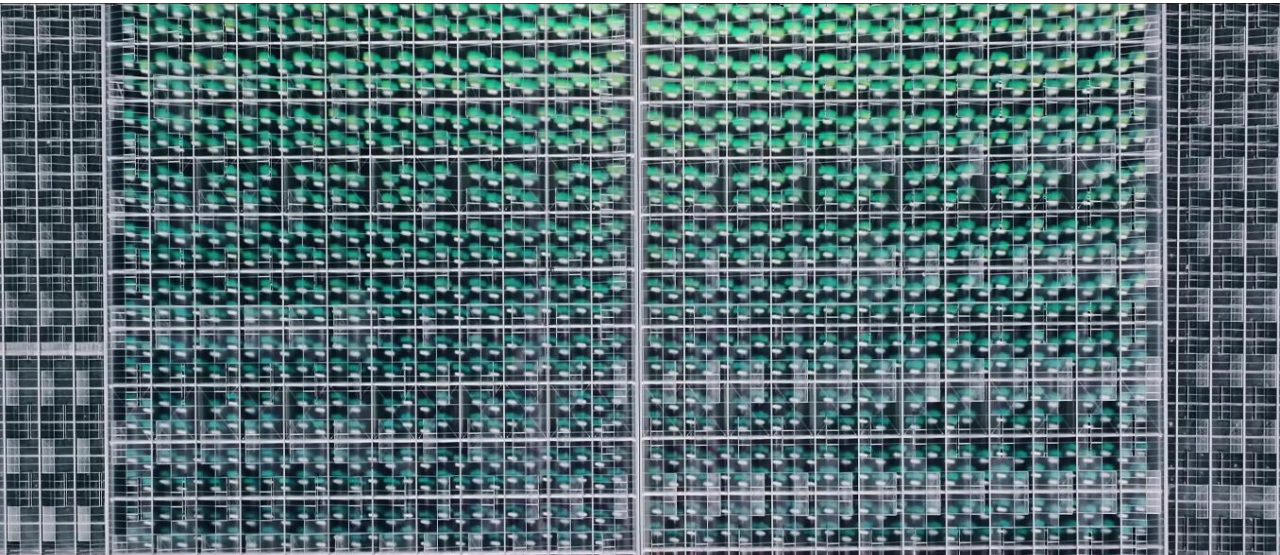
Powering the operations and equipment of the 4.5 ha greenhouse

Installation time

4 Weeks

Executed by the Voltiris team in partnership with greenhouse builder Horconex

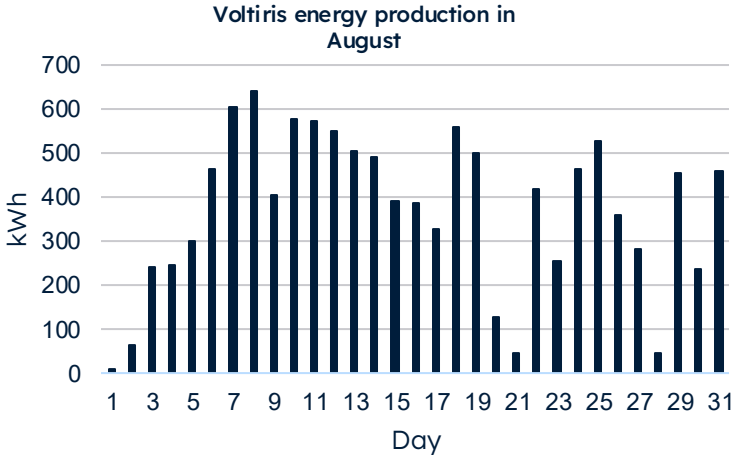
1736 Voltiris solar modules installed in a cherry tomato greenhouse



Energy & Agriculture

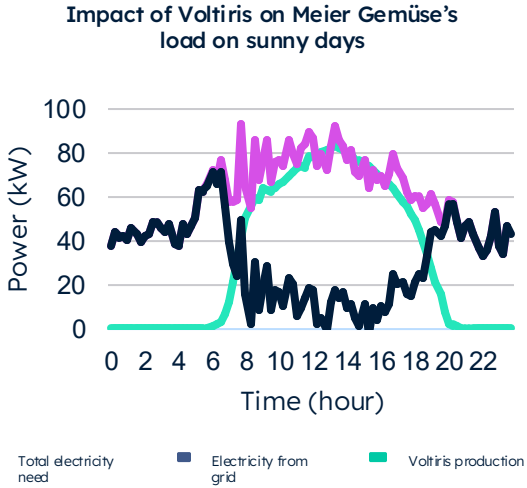
Energy & Agriculture

The Voltiris modules produce renewable energy in the range of 1MWh per day at Meier Gemüse



Voltiris generated a total of 11.5 MWh in August, reaching peak daily production of about 640 kWh – all without compromising crop growth

The greenhouse can optimally self-consume this energy to cover its operational needs



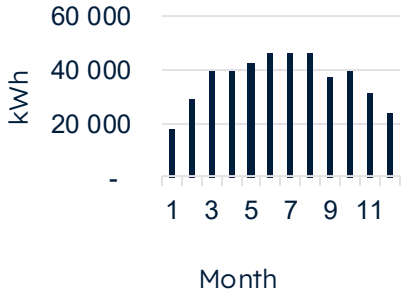
This graph shows how Voltiris supports Meier Gemüse's summer electricity demand: on this day, the greenhouse used 89% of Voltiris production, covering 54% of its total needs.

The Voltiris installation significantly increases energy independence of Meier Gemüse

From grid

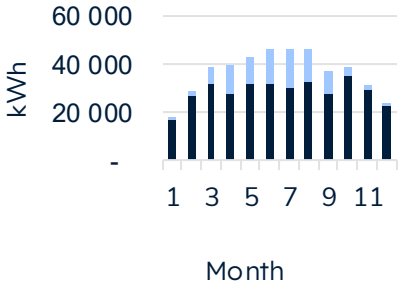
From Voltiris

Meier Gemüse load before Voltiris



Before installing Voltiris, Meier Gemüse sourced its electricity exclusively from the grid

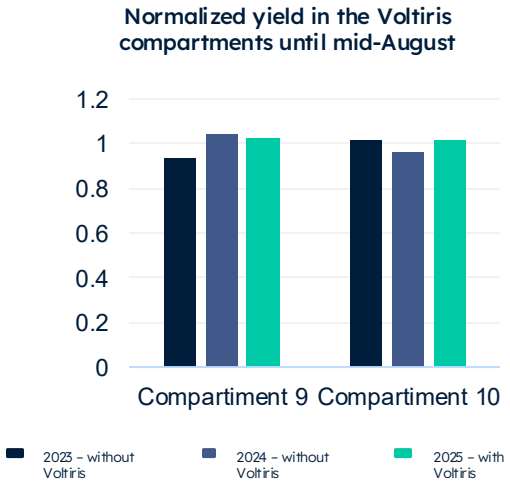
Meier Gemüse load after Voltiris



With the Voltiris installation, Meier Gemüse significantly reduces its reliance on the grid, up to ~35% during summer

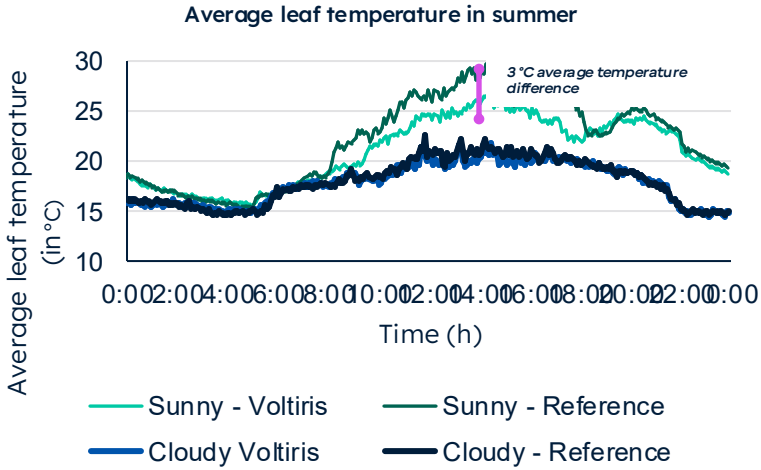
Energy & Agriculture

Agronomic yields under Voltiris have remained fully stable with no negative impact observed



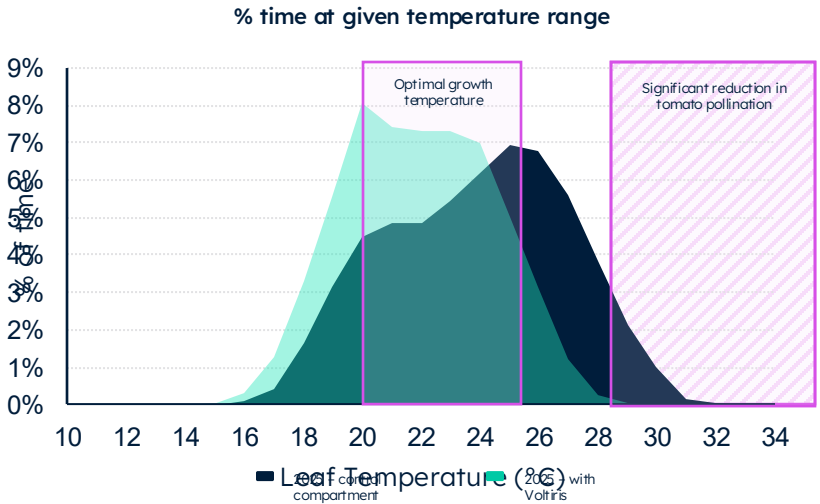
The data at Meier Gemüse suggest that the 2025 yield up to mid-August is in line with the previous years when the modules where not installed. Optimizations on the growth climate management to be continued to fully leverage the benefits of the Voltiris solution.

A significant temperature decrease is observed under Voltiris on sunny days, averaging 3 °C



This graph shows a significant temperature reduction on sunny days (-3 °C) with no impact on cloudy days. This benefits crops: they avoid excess heat when it's sunny but still receive needed warmth when it's cloudy

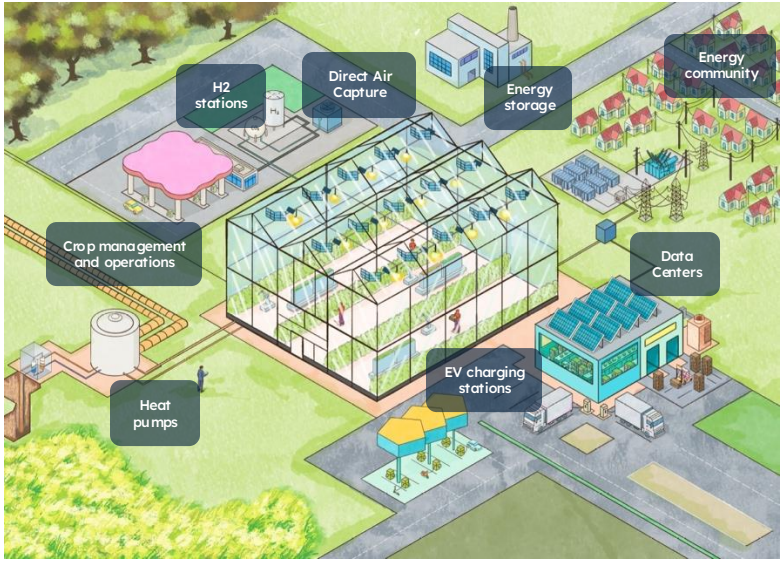
This temperature reduction helps crops remain in their optimal temperature range for longer



Tomatoes thrive at 20–25 °C, but growth declines as pollination falters above 28 °C. Voltiris extends the time crops spend in the optimal range—74% vs. 57% in tests—while rarely surpassing 28 °C.

What’s next

Vision: fully carbon-free electrified greenhouses, powered by Voltiris



Our solar modules improve the greenhouse growing environment

Improve growth climate

Better growth climate achieved with a lower plant leaf temperature, improving CO2 fertilization and contributing to improved yield

Decrease plant stress

Voltiris modules to limit outwards (blue-sky) radiation, limiting energy losses on the plant

Enhance crop morphology

Enhancement of crop morphology (floriculture) through adjustment of the far-red spectrum

Reduce pest population

Positive effect of the filtered light on the thrips population beneath the solar modules

Building an offering that fully addresses growers' needs and the underlying financing structure

Voltiris is developing a offer…

Voltiris solar modules

Energy storage

Energy management software

VoltiCrop (IoT platform)

… and creating the underlying financing models for various ownership structures

Owned by the grower

Owned by Voltiris

Owned by 3rd party (e.g., energy utility)

The Meier Gemüse project has best prepared us for large-scale commercial deployment across multiple sites next year

Commercialization

2025

Meier Gemüse
nachhaltig,
effizient, natürlich

1st hectare-scale project of the Voltiris solution

Commercial scale up

2026

10+ industrial-scale projects to be conducted in core markets (CH, NL, FR, BEL)

Full deployment

2027+

Commercial acceleration with projects worldwide & comprehensive electrification platform

https://www.youtube.com/watch?v=3ZwLYDyi9qw&t=8s

Thanks for your attention!

Voltiris

Voltiris SA

Based in Lausanne, Switzerland, & The Hague, Netherlands

www.voltiris.com

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They support us