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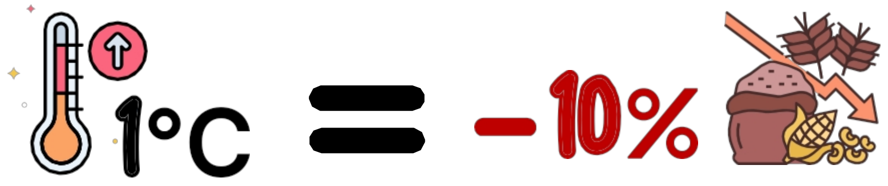
AGROVOLTAICS AS AN INTERDISCIPLINARY SYSTEM FOR CLIMATE ADAPTATION IN STRAWBERRY CULTIVATION

‘Preparing Eastern Partnership countries for the European Green Deal (PROGRESS)’

GLOBAL CHALLENGES

Why the agricultural sector needs to transition to climate-smart agriculture

Demand for food and energy is growing, whilst climate change and resource constraints are increasing the vulnerability of agricultural production.



Climate change

+1°C = –10% in crop yields

Rising temperatures, heatwaves and weather instability are increasing risks to crop yields, water management and product quality.

Demand for food

8.2 → 10.3 billion; +60%

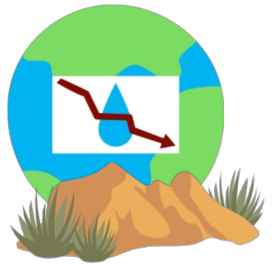
The world's population is growing, and with it the need to produce more food.

Energy demand

40% increase → by 2050

Agricultural production is increasingly dependent on energy for irrigation, cooling, storage, processing and digital systems.

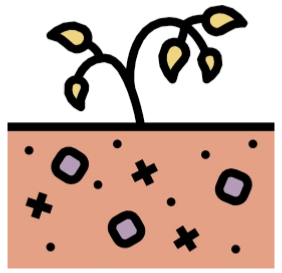
Water and soil



25% degradation; 40% shortage

Soil degradation, erosion, salinisation and water scarcity are eroding the resource base for agricultural production.

Yield risks



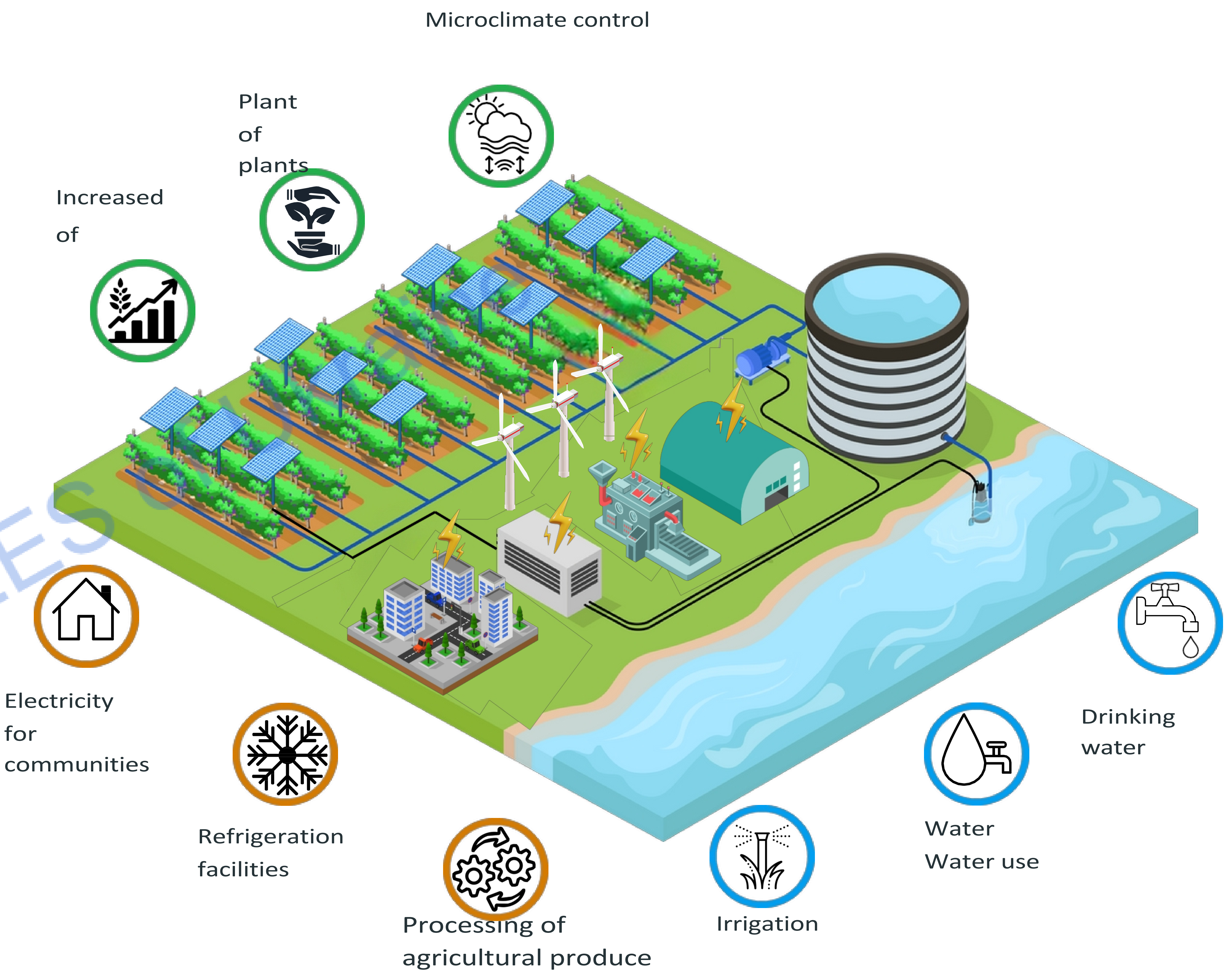
heatwaves, droughts, anomalies

Traditional models are becoming less resilient to heatwaves, droughts, temperature fluctuations and weather anomalies.

Conclusion: climate-smart and resource-efficient agricultural models are needed, which simultaneously take into account food, energy, water and land components.

AGROVOLTAICS

Agrovoltaics is a form of sustainable land use, which enables combines farming agricultural farming and electricity electricity without sacrificing the main function of the land as agricultural land.



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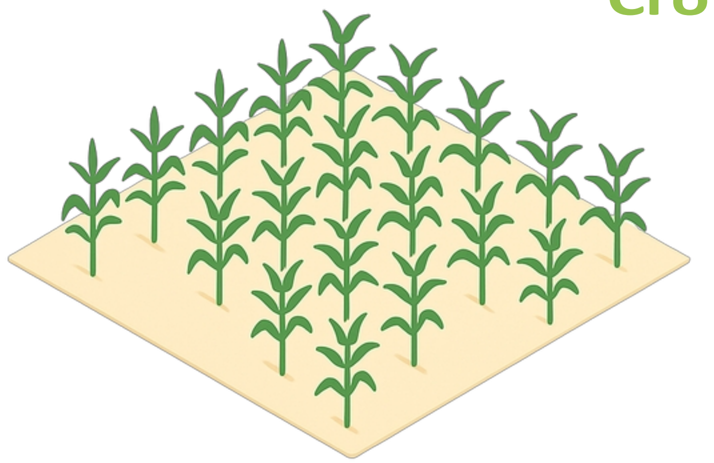
DOUBLE EFFICIENCY OF AGROVOLTAICS

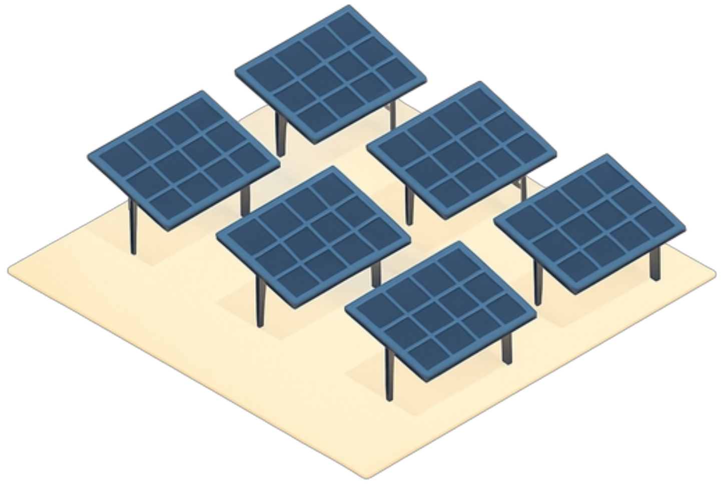
About agri-PV

100%
Crops

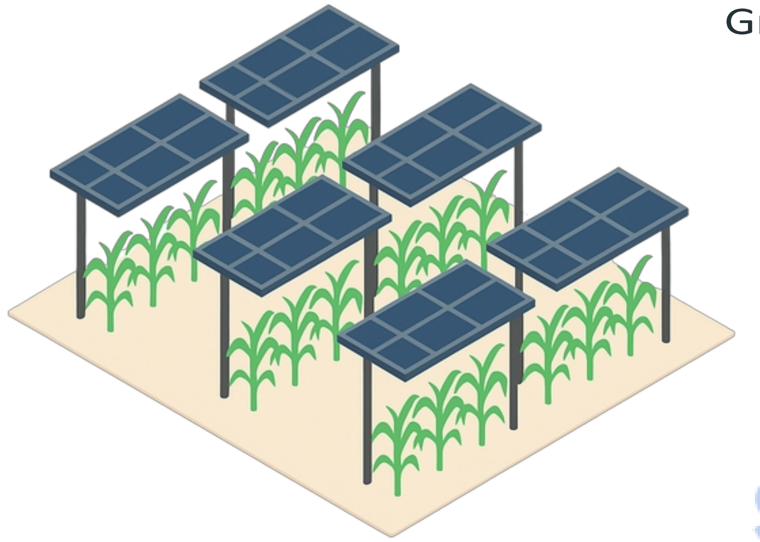


or

100%
Solar panels



2 MAIN TYPES OF AGRO-PHOTOVOLTAIC SYSTEMS



OVERHEAD AGRI-PV SYSTEMS

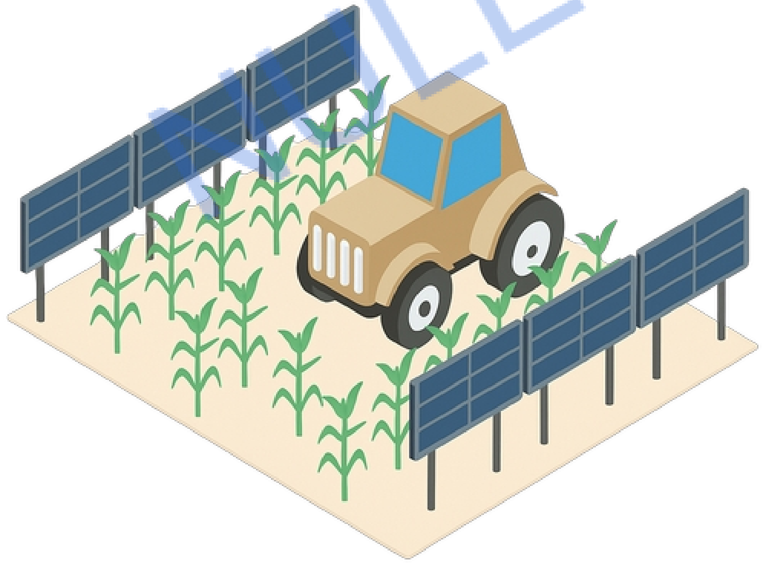
Growing shade-tolerant crops under solar panels.

Land use efficiency:

63% sun + 90–116% crops = **153–178%** Overall efficiency

Suitable crops

Berries, Leafy vegetables, Fruit vegetables, Fruit



Interspaced Agri-PV

Cultivation with access for agricultural machinery.

Land use efficiency:

25% sun + 83–113% crops = **108–123%** Overall efficiency

Suitable crops

Root crops, Cereals, Forage grasses

AGROVOLTAICS AS A TOOL FOR CLIMATE ADAPTATION

WHAT IT OFFERS PLANTS

- control of peak insolation without a significant drop in PAR
- less overheating of leaves, berries and the root zone
- more stable water regime and lower evaporation
- A better combination of light, temperature and moisture during critical phases

WHAT IT OFFERS THE FARM

- electricity for pumps, fertigation, automation and sensors
- power for pre-cooling, cold stores, freezing and sorting
- less dependence on grid constraints and tariff instability
- a new economic cycle: berries + energy + processing

WHAT IT OFFERS RISK MANAGEMENT

- reduction of climatic risks: heatwaves, heavy rain, hail, substrate overheating
- income diversification: agricultural produce + electricity
- less susceptibility to quality loss during periods of high temperatures
- greater control over the production cycle and post-harvest logistics

STRAWBERRIES as a Promising Crop for Agrivoltaics

Strawberries are well suited to overhead Agri-PV due to their crop architecture: low growth habit, fixed rows, drip irrigation and high market value of the berries.

Prevention of photoinhibition and sunburn

Strawberries have a lower light saturation point than maize or sunflowers, so excessive insolation (>1000–1200 μmol/m²·s) can cause photoinhibition. Agrovoltaic panels provide partial shade and diffuse light, which is utilised more efficiently by plants.

Thermoregulation and heat management

Strawberries are a temperate climate crop. At temperatures above +30 °C, pollen viability decreases and the risk of berry overheating increases. The panels reduce the microclimate temperature by 3–5 °C.

Water balance management

In open fields during the summer, strawberry transpiration is high. Partial shading reduces the vapour pressure deficit (VPD) and evaporation, allowing for savings of 20–30% in irrigation water and maintaining a more stable water regime. What exactly is this vapour pressure deficit?

Reduction of abiotic stresses

Agrovoltaic structures act as a protective screen: they partially shield plants from hail and heavy rainfall, and also reduce the formation of morning dew on the leaves. This lowers the risk of grey mould (Botrytis) and powdery mildew and reduces the need for fungicide treatments.

Synergy with engineering systems

Agri-PV steel structures provide a ready-made framework for installing misting systems, anti-hail nets or rainwater harvesting systems. This allows for the creation of a fully autonomous and controlled plant community, where engineering solutions work to maximise the biological potential of strawberries.

THE IMPACT OF AGROVOLTAICS ON STRAWBERRY CULTIVATION

Light regime

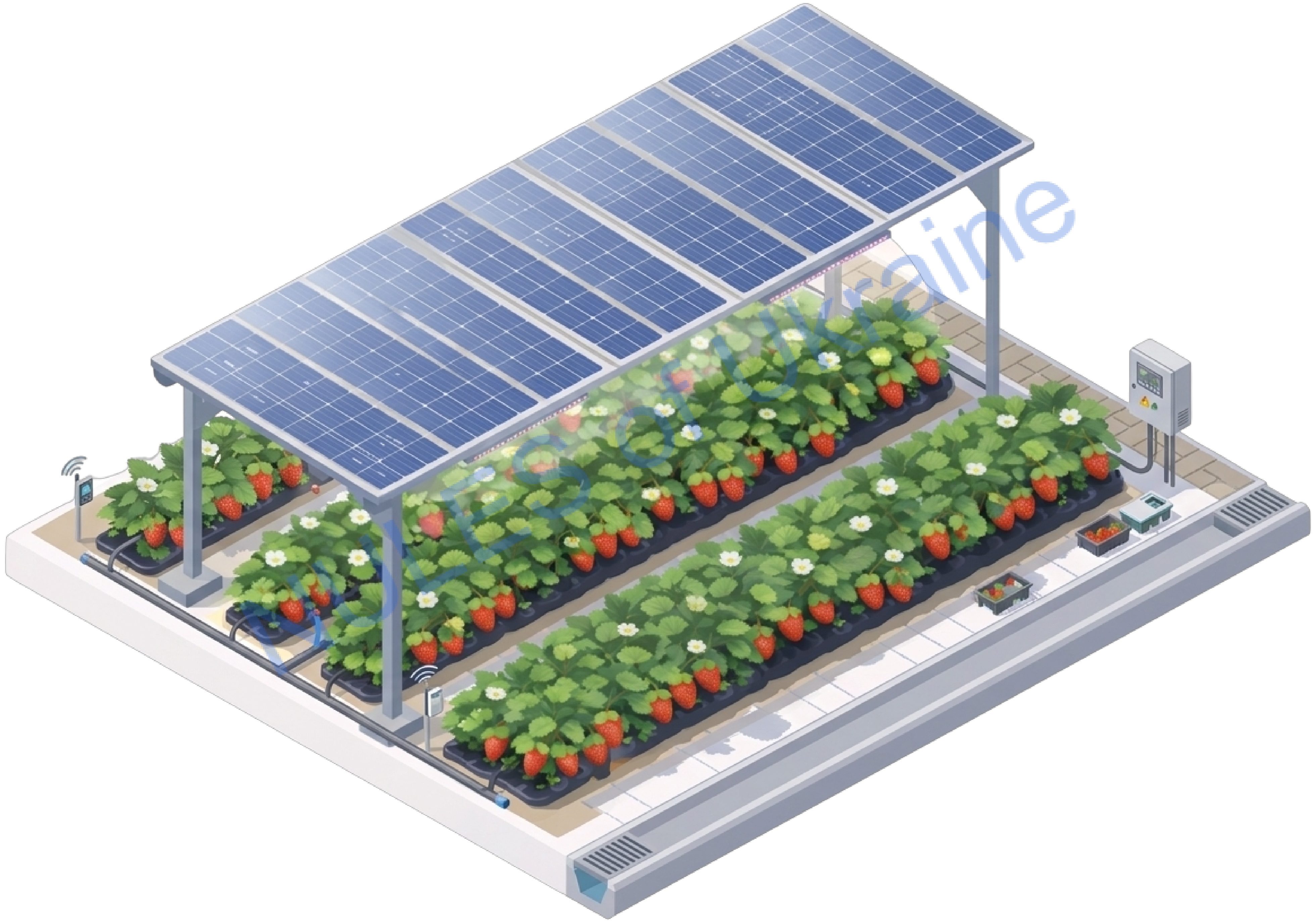
- less peak PAR during the hottest part of the day
- more diffuse and uniform light
- Critical factors: module transparency and row spacing

Temperature regime

- less leaf and fruit overheating
- a milder microclimate during the hottest hours
- lower risk of heat stress on the berries

Water regime

- the topsoil dries out more slowly
- lower transpiration and lower VPD
- more stable water balance and irrigation



Berry quality

- less sunburn and overheating
- less uneven ripening
- Higher marketability and consistent quality

Plant protection

- partial barrier against excessive sunlight
- additional protection against hail and rainfall
- greater resistance to extreme weather

System controllability

- The effect depends on height and canopy cover; transparency, orientation and row spacing
- Agri-PV is all about proper design

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WHAT RESEARCH ON STRAWBERRIES HAS SHOWN

1) WUR field trial, Netherlands

In the WUR study, strawberries received approximately 50% (APV1) and 37% (APV2) of PAR from full daylight.
Yields decreased under both regimes.

	Control	APV1	APV2
PAR from full daylight	100	50	37
Leaf area	100	81	61
Yield	100	76–75	73–60

WUR conclusion: configurations with 50% and 37% PAR were too shaded for strawberries. Even at 50% PAR, yield decreased by 23–25%, so strawberries require higher module transparency or a wider row spacing for Agri-PV.

2) Controlled and generalised studies

Meta-analysis 2024

Shade tolerance across berry crops

Strawberries did not show a shade-tolerant response: in the meta-analysis, strawberry yield decreased with increasing shading, whereas some other berry crops tolerated around 35% shade without yield loss.

Transparency study 2025

Thin-film PV, low-light controlled setup

At 70% module transparency, fresh weight was 140.6% of the control; at 40% transparency, over 80% of the yield was retained. This supports highly transparent or semi-transparent solutions for strawberries.

Canada comparison 2025

Uniform vs non-uniform light distribution

Semi-transparent c-Si modules with non-uniform lighting increased fresh weight by 18% compared to control, whilst simultaneously lowering soil temperature and increasing moisture levels.

Key findings for the design of Agri-PV for strawberries

1) avoid excessive shading;
2) give preference to modules with high transparency;
3) monitor not only PAR but also the uniformity of light, temperature and humidity in the surface layer.

Sources: WUR (2022); Hermelink et al., Scientia Horticulturae, 2024; Jamil & Pearce, Solar Energy, 2025; Jamil et al., Renewable Energy, 2025

STRAWBERRIES IN UKRAINE: THE CULTURE AND LOGIC OF AGRI-PV

Areas

8.6 → 7.1 thousand ha

↓ -17%

Gross yield

62.3 → 53.4 thousand tonnes

2020 → 2023

↓ -14%

The decline is due to a combination of factors: the impact of the war, the loss of some production areas in the south of the country, logistical difficulties, and a shortage of high-quality planting stock. This indicates that the berry sector, despite its economic appeal, remains vulnerable to external risks.

Market

Predominantly domestic consumption

Strawberries in Ukraine are primarily aimed at the domestic market; fresh exports are low, and in 2023 exports to the EU fell to approximately 0.10 thousand tonnes due to the complex logistics involved in transporting perishable berries. This reinforces the importance of local cooling, freezing and processing.

Sources: State Statistics Service of Ukraine (via Ukraine Country Report, 2024); UN Comtrade; EU Access2Markets.

WHY THESE SECTORAL CHARACTERISTICS ARE IMPORTANT IN THE CONTEXT OF AGRI-PV

1. **Strawberries are a microclimate-sensitive crop**

   Critical factors for them include fruit overheating, sun stress and unstable water conditions. Against the backdrop of climate change, it is precisely these factors that are increasingly determining the yield and market quality of the berries.

2. **The economics of strawberry production depend not only on the field but also on rapid post-harvest processing**

   For the producer, the costs of irrigation, cooling, sorting and the short sales window are critical. Consequently, energy and the microclimate on such a farm are directly linked.

Therefore, Agri-PV is relevant here not only for shading, but as a system for managing production conditions

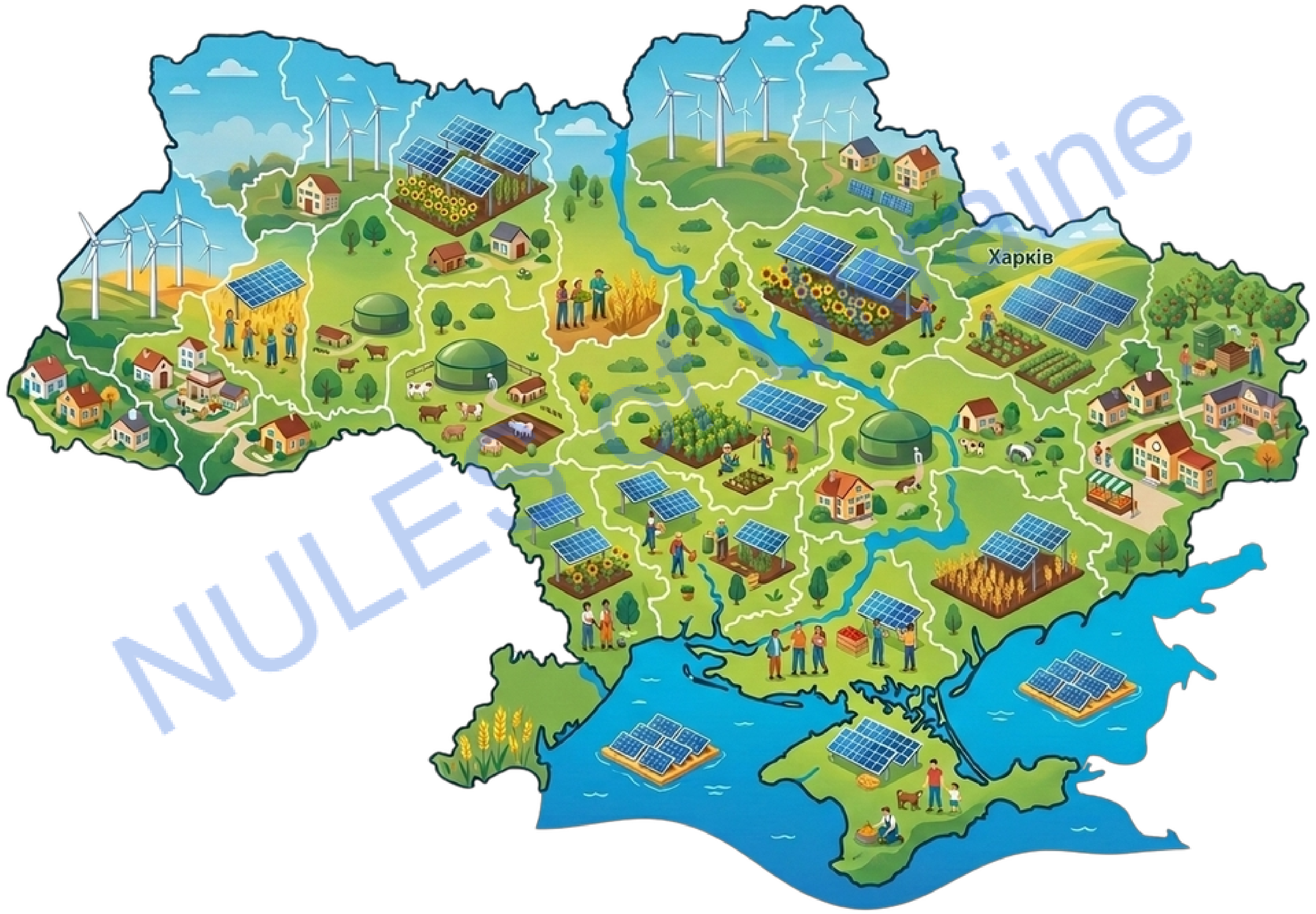
The panels can partially regulate insolation and temperature, reduce water stress and, at the same time, generate electricity for irrigation, cooling, processing and freezing of the berries.

PLANT	FARMING	LOGISTICS
MICROCLIMATE	energy	cold chain

AGROVOLTAICS IN UKRAINE: FROM SCIENCE TO IMPLEMENTATION

Today, agrivoltaics in Ukraine is moving from the stage of explaining the concept to the formation of its own scientific, demonstration and partnership ecosystem.

- Research
- Demonstration sites
- Education and training
- Communities and territorial regeneration



- International consortia
- R&D and system certification
- Policy and regulatory environment
- Communication and conferences

Key idea: in the Ukrainian context, agrivoltaics is not just a technology for growing crops under solar panels, but an infrastructure for science, energy, community rebuilding and new international projects.

OUR PROJECTS AND WHERE WE ARE HEADING

Our initiatives demonstrate how agrivoltaics combines energy, science, spatial development and the circular economy.

DEMO / LIVING LAB

Agro-energy settlement

The essence of the initiative

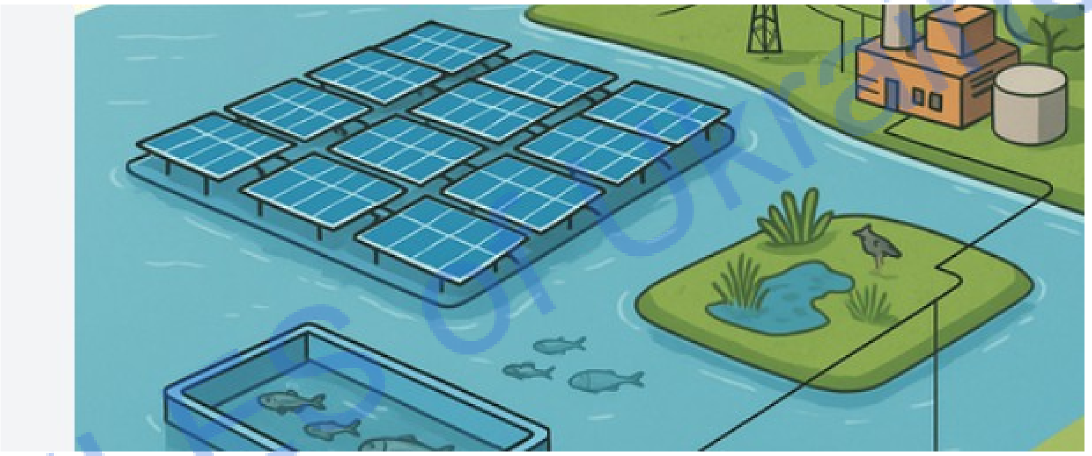
The agrovoltaic settlement combines housing, work, local energy and science — as a recovery model for IDPs, veterans and scientists.

Focus

- housing and jobs microgrid and
- bioenergy
- agricultural zone and experimental plot

CIRCULAR VALUE CHAIN

The circular model of the FPV cluster



The essence of the initiative

Floating PV generation, BSFL, aquaculture, greenhouses and biogas form a closed cycle of resources, energy and fertilisers.

Focus

- organic waste processing electricity and biogas
- production
- added value and community income

TESTING / SCALE-UP

Agrovoltaics R&D centre

The essence of the initiative

A 20–30-hectare centre for the development, testing, adaptation and certification of agrivoltaic systems for Ukraine’s climatic conditions.

Focus

- experimental plots of various types digital laboratory
- and monitoring
- Certification and scaling of solutions

Together, these three areas position Agrovoltaics as a platform: from a demonstration site to a fully-fledged model of economic and spatial development.

CONFERENCE 2026 AND PROCEEDINGS

2nd INTERNATIONAL INTERDISCIPLINARY CONFERENCE

Conference websit

A platform for shaping new research topics, fostering cross-sectoral links and establishing a framework for the development of a climate-resilient agricultural sector

PROCEEDINGS OF LAST YEAR'S CONFERENCE

- abstracts and scientific papers
- analytical conclusions
- Practical implementation case studies

CONTACTS

FACEBOOK

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