Article:

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OPEN LETTER

REVISED AgriPV system with climate, water and light spectrum control for safe, healthier and improved crop production

[version 2; peer review: 2 approved, 1 approved with reservations]

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Abstract

The PV4Plants project aims to optimise the synergy between agriculture and photovoltaic (agriPV) systems to improve crop yield, land use efficiency, and renewable energy conversion. Using cutting-edge nanoparticles coated between PV panels to optimise light transmission, the system tailors conditions for specific crops and climatic regions. Demonstrations in Türkiye, Spain, and Denmark test the adaptability and effectiveness of these systems, to evaluate improvements in crop health and renewable energy output. Central to the project are efforts to increase recyclability and promote farmer engagement through innovative financing models and policy recommendations.

Keywords

Agrivoltaics; renewable energy; nanoparticle technology; sustainable agriculture; crop health; circular economy; light spectrum control; climate adaptability

HE

This article is included in the Horizon Europe gateway.

This article is included in the Sustainable Places 2024 collection.

Open Peer Review

Approval Status ✓ ✓ ?

	1	2	3
version 2 (revision) 06 Mar 2025	✓ view	✓ view	? view
version 1 18 Dec 2024	? view	? view	

1. **Silvia Ma Lu**, Mälardalen University, Västerås, Sweden
2. **Sharon Hilarydoss**, Indian Institute of Petroleum and Energy (IIPE), Visakhapatnam, India
3. **Meita Rumbayan**, Sam Ratulangi University, Manado, Indonesia

Any reports and responses or comments on the article can be found at the end of the article.

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Author roles: Çelikbilek Ersundu M: Conceptualization, Investigation, Supervision, Validation, Writing – Review & Editing; **Ersundu AE**: Conceptualization, Investigation, Supervision, Writing – Review & Editing; **Osborne C**: Conceptualization, Formal Analysis, Investigation, Supervision, Writing – Review & Editing; **Ruiz M**: Writing – Original Draft Preparation, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

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The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

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First published: 18 Dec 2024, **4**:267 https://doi.org/10.12688/openreseurope.18876.1

REVISED **Amendments from Version 1**

In this revised version, we have restructured the manuscript and refined the conclusions to better align with the open letter format. Our primary focus is now on the impact of the PV4Plants project within the community, emphasizing its social significance.

We have strengthened the discussion on the project's social impact, providing deeper insight into how we contribute to social engagement, policy recommendations, and the shaping of the next legal framework for agrivoltaic projects.

Additionally, we have addressed key technical comments from reviewers that required further clarification. Specifically, we have provided a more detailed explanation of the necessity of GCC materials between PV panels. We have also expanded on the role of diverse climatic regions, discussing how varying environmental conditions influence our technology's performance.

Furthermore, we have elaborated on how our approach enhances agricultural outcomes while maintaining high energy output from PV systems. These improvements ensure a more comprehensive and impactful discussion of both the technical and societal contributions of our work.

Any further responses from the reviewers can be found at the end of the article

Introduction

The growing need for sustainable AgriPV systems in agriculture and energy

The agricultural sector is a significant contributor to greenhouse gas (GHG) emissions, accounting for approximately 10% of all GHG emissions in the EU, a percentage that is set to increase as other sectors rapidly decarbonise. As part of European efforts to meet ambitious climate targets, such as those outlined in the Farm-to-Fork strategy and the Common Agricultural Policy (CAP), decarbonizing agriculture has become a primary objective. The sector's heavy reliance on fossil fuels for energy—used in heating, cooling, irrigation, and appliances like large refrigerators—poses serious environmental challenges. This dependence on fossil-based energy, coupled with the constant pressure on farmers to increase productivity, creates a cycle that both harms the environment and discourages innovation.

Farmers often face a dilemma: adopting innovative technologies can carry the risk of uncertain yields, which in turn makes them hesitant to experiment. On the other hand, increasing agricultural production often leads to higher energy consumption, frequently in the form of inefficient power systems such as diesel-powered generators, which further intensifies the use of fossil fuels. Additionally, renewable energy technologies, like solar and wind power, are often seen as competitors for arable land, a precious resource in farming. Therefore, solutions that address both the energy needs of agriculture and land-use efficiency are critical if Europe is to meet its Green New Deal targets, which include the goal of full decarbonization by 2050.

AgriPV: a dual-use solution

One promising approach is agrivoltaics (also known as AgriPV), a technology that integrates photovoltaic (PV) energy conversion directly into agricultural fields. According to DIN SPEC 91434, "Agrovoltaics is the combined use of the same land area for agricultural production as the primary use and for photovoltaic electricity production as a secondary use." AgriPV presents a strong opportunity to minimise the agricultural sector's reliance on fossil fuels while simultaneously boosting the efficiency of land use. This dual-use technology offers several key advantages:

1. **Improved land efficiency**: AgriPV avoids the competition for land between agriculture and energy conversion, utilising the same area for both purposes.
2. **Renewable local energy conversion**: AgriPV provides farmers with locally generated, renewable energy that can be consumed directly, minimising energy transmission losses, reducing dependency on external energy sources, and helping to alleviate energy poverty.
3. **Social and financial opportunities**: AgriPV creates new revenue streams for farmers, offering higher turnover per hectare of cultivated land, new income potentials, and the creation of rural jobs, which can help combat the depopulation of rural areas

In addition to these economic and environmental benefits, AgriPV systems offer direct advantages for agricultural productivity. The shading provided by PV panels can create a favourable microclimate beneath the structures, mitigating extreme temperatures, reducing evapotranspiration, and protecting crops from excessive sunlight, heatwaves, rainstorms, high winds, and hail. These protective qualities allow for more resilient agricultural practices, particularly in arid regions.

However, several challenges must be addressed for AgriPV to fully realise its potential as a game-changer for agriculture and renewable energy. These challenges include the need for technological adaptability to different climates and crop types, cost affordability, and the acceptance of these innovations by end-users like farmers. Cooperation among stakeholders, including policymakers, farmers, and renewable energy developers, is crucial. Additionally, increased circularity, new business models, and supportive policies and regulations are needed to facilitate the widespread adoption of AgriPV technology[1–8].

Objectives of PV4Plants

The overarching goal of PV4Plants is to improve the synergy between agricultural production and photovoltaic (PV) energy conversion, maximising land-use efficiency. The specific objectives of the project include:

1. **Optimise light spectrum**: Through the application of glass color converter (GCC) materials between PV panels, PV4Plants aims to adjust the light spectrum for enhanced photosynthetic activity, targeting specific wavelengths that support crop growth without comprising energy conversion. The gap between panels is necessary to achieve an optimal light-to-electricity output ratio for the designed GCC panels.They are highly transmissive, allowing light to pass through and reach the crops beneath the agrivoltaic system. In contrast, conventional Si solar cells are opaque and do not permit light transmission.

the design intentionally incorporates gaps between GCC panels and Si solar cells to balance energy generation and agricultural productivity.

2. **Increase crop yield and health:** The system improves growing conditions beneath PV panels by controlling key variables such as light, water, and microclimate conditions. The focus is on healthy, high-yield crops, with real-time monitoring to adjust conditions dynamically.

3. **Sustainability and circular economy:** A key priority is to ensure the system is sustainable. This includes designing PV components for recyclability, promoting reuse, and certifying the system under the **Environmental Product Declaration (EPD)** and **ISO 14021** standards.

4. **Boost renewable energy conversion** through an improved PV panel design that adapts to agricultural needs without compromising energy output.

5. **Demonstrate scalability and replicability:** Testing and validating the PV4Plants system in diverse climatic regions with different crops ensures that the technology is adaptable and scalable across Europe.

6. **Stakeholder engagement and financial sustainability:** Through innovative engagement strategies with farmers and policy recommendations, the project seeks to boost trust in AgriPV technologies and provide models for financing and scaling the system in rural and agricultural communities.

These goals align with broader European Union objectives of achieving a sustainable, secure, and competitive energy supply while enhancing agricultural productivity.

System design, implementation, and testing

Advanced system design

PV4Plants integrates an innovative nanoparticle-enhanced PV system (Figure 1) designed to optimise light transmission for both crop growth and energy conversion. The system features:

- **Nanoparticle-coated PV panels:** The PV panels are coated with **perovskite-based glass nanocomposites,** which modify the light spectrum. These materials enhance red light transmittance, which is crucial for plant photosynthesis, while reducing UV, blue, and green light transmittance and maintaining or improving solar energy conversion efficiency.

- **Rainwater harvesting:** The system incorporates rainwater collection features, especially vital for arid regions. The collected rainwater will be directed either to a separate ground-level tank or to the existing irrigation tank for later use. The amount of harvested water will be measured and monitored. This function ensures efficient water use for irrigation and minimises the reliance on external water sources.

- **Proactive microclimate control:** PV4Plants employs a real-time monitoring and control system, using sensors to track soil moisture, air temperature, humidity and light intensity. This system dynamically adjusts the microclimate under the PV panels, including panel tilt and irrigation levels, optimising both crop conditions and energy conversion.

Real-time monitoring and proactive control

The system's **real-time monitoring and dynamic control** is one of its most innovative aspects. Data collected from a range of sensors (light, temperature, humidity, soil moisture) are processed to make proactive adjustments to the environment. For example, during hot weather, panels may be adjusted to increase shading, reducing plant stress and improving water use efficiency. Conversely, during low-light conditions, panel angles are adjusted to increase light penetration. This dynamic approach not only enhances agricultural outcomes but also ensures the PV system's energy output remains high.

Each site incorporates local stakeholder engagement and policy alignment to ensure that the technology addresses specific regional needs, increasing the likelihood of adoption and scalability.

Material innovation and light spectrum optimisation

A key aspect of the PV4Plants system is the **nanoparticle-based light spectrum tuning.** The use of **perovskite-based glass nanocomposites** allows for the customisation of light conditions beneath the PV panels, optimising the photosynthetically active radiation (PAR) range. This enables the system to increase light intensity for photosynthesis while maintaining or enhancing the PV efficiency, particularly during the peak growth period of crops. For example, tomato plants thrive under red light,

Figure 1. A schematic of the AgriPV system (left). Panels with regular and GCC glass on an agriPV system (right).

so the panels are turned to maximise red light transmission while ensuring energy conversion.

Demonstration sites and testing

PV4Plants is being piloted at three geographically and climatically diverse locations to test its adaptability and scalability:

- Bursa, Türkiye (Figure 2) : A semi-arid region, focusing on crops like tomatoes and green peas. This site tests the system's efficiency in hot, dry conditions while utilising the rainwater harvesting mechanism.
- Avila, Spain: Focusing on microalgae production (Figure 3), this site evaluates the system's adaptability in a Mediterranean climate and its ability to support non-traditional crops under agriPV systems.
- Hoje Taastrup, Denmark: In this northern European climate, leafy vegetables such as cress and spinach are grown, testing the system's capability to function in cooler, wetter conditions.

The project will use a dedicated strategy to ensure stakeholder engagement as well as civil society involvement in the field. This will be done through interactive roundtables organised with the community of stakeholders (created from the beginning of the project) having at least 10 relevant local stakeholders per each pilot. External actors with technical expertise in the agricultural sector and energy engineers, together with representatives of the academia, will be involved in cross-knowledge activities (e.g. thematic workshops) to provide a unified view on the potential development of the PV4plants system in their locations. Through this, the project ensures an alignment on actors needs and project objectives.

Multi-criteria assessment and financial models

The project incorporates a **multi-criteria assessment** methodology to evaluate its impact across environmental, economic, and social factors. In each demonstration site, the following metrics are tracked:

- **Energy conversion:** Energy efficiency and total energy output from the PV panels.
- **Crop yield and health:** Crop productivity and plant health metrics compared to control fields.
- **Water efficiency:** Water usage per crop and efficiency improvements due to the rainwater harvesting system.
- **Environmental impact:** Recyclability of PV materials and lifecycle assessments to evaluate the system's overall environmental footprint.

Additionally, the project explores innovative financing and business models, ensuring that the system is not only effective but also financially viable for farmers and investors. Policy recommendations are also being developed in collaboration with public authorities to support the broader adoption of AgriPV systems across Europe.

How the community can gain from PV4Plants

Policy Recommendations & Regulatory Frameworks. PV4Plants contributes to policy development by creating a comprehensive framework that supports the large-scale adoption of AgriPV across Europe. By analyzing existing regulations and engaging both agricultural and energy stakeholders, the project ensures that future policies balance renewable energy goals with agricultural sustainability. The project will provide clear guidelines on AgriPV design, addressing key factors such as land-use preservation, light and water availability, environmental impact, and economic feasibility. It will also propose strategies for financial incentives, stakeholder inclusion, and regulatory support to facilitate AgriPV implementation.

Sustainability and circular economy

PV4Plants incorporates a strong emphasis on sustainability, from the design phase to the end-of-life cycle of the system.

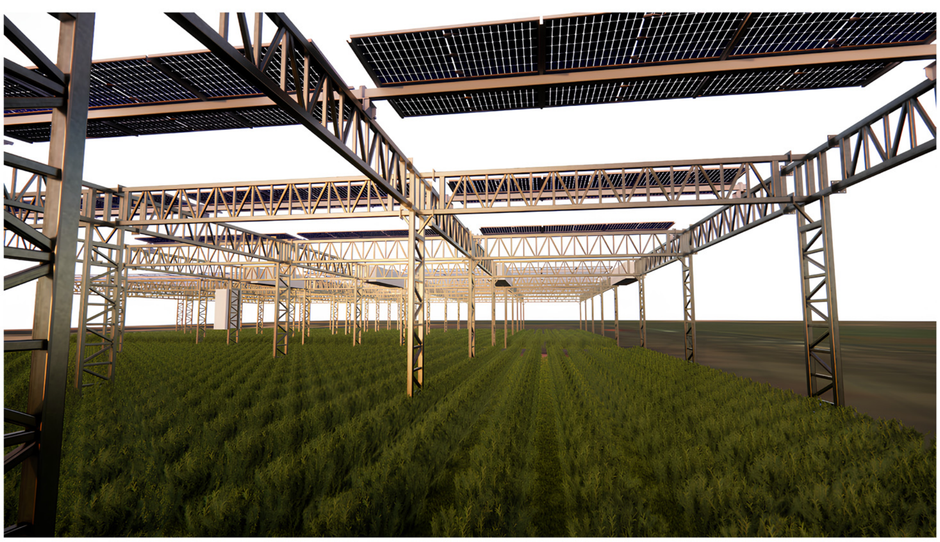

Figure 2. Crop field with PV4Plants technology in Bursa.

Figure 3. **Microalgae that will be cultivated in Avila.**

All materials used in the PV panels are designed to be recyclable, and the project is working toward certification under **Environmental Product Declarations (EPD)** and **ISO 14021** standards. The system's life cycle analysis indicates that PV4Plants reduces environmental impact by using recycled materials in panel construction and optimising water use through rainwater harvesting as well as using a cradle-to-cradle approach (Figure 4) for luminescent GCC panels.

Stakeholder engagement and social impact

A significant part of PV4Plants' success lies in its engagement with local stakeholders, including farmers, public authorities, and NGOs. Early-stage feedback from farmers at the Turkish and Spanish sites indicates a high level of acceptance, with enthusiasm for the water-saving features and the potential for increased crop yields. Moreover, the development of tailored policy recommendations will facilitate the broader adoption of AgriPV systems, contributing to rural development and sustainability goals.

Evaluation of results and broader implications

PV4Plants' early trial results confirm the potential of AgriPV systems to simultaneously improve agricultural productivity and generate renewable energy. The optimised light spectrum, coupled with real-time environmental adjustments, could prove effective in enhancing crop yield, particularly in climate-sensitive crops in arid regions. This dual benefit suggest the future viability of AgriPV systems in regions with diverse climates, where both agricultural output and energy conversion are priorities.

The project's sustainability efforts—focusing on recyclability, water conservation, and life cycle impact reduction—make PV4Plants a model for future AgriPV systems. The inclusion of rainwater harvesting systems further highlights the system's potential for water-scarce regions. Moreover, the positive response from stakeholders and local farmers suggests that PV4Plants can be widely adopted, provided sufficient policy support and financial mechanisms are in place.

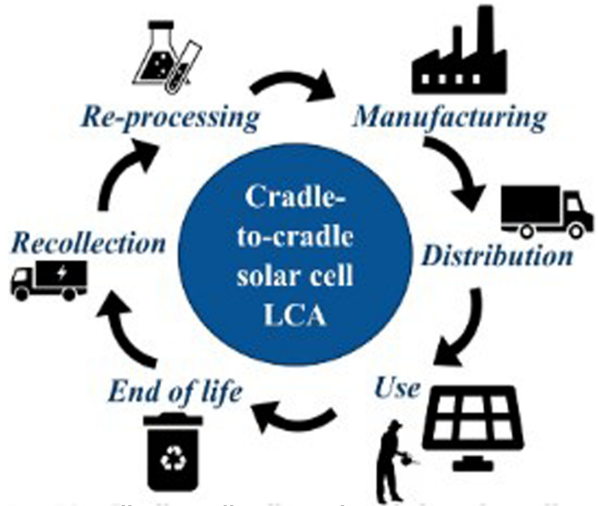

Figure 4. **Cradle-to-cradle approach.**

Conclusion and future directions

PV4Plants offers a groundbreaking solution to one of the most pressing challenges of modern agriculture: the need to balance food production with renewable energy conversion on limited land. Through its innovative use of nanoparticle-enhanced PV panels, real-time monitoring systems, and sustainability-driven design, the project presents a scalable model for AgriPV systems that can be adapted to different climates and crop varieties.

Future directions for the project will include further refinement of the light spectrum optimization for additional crops and continued expansion of the system to other regions. The next phase will also focus on developing long-term financial models and working closely with policymakers to create supportive frameworks for large-scale implementation.

Ethics and consent

After completion of the Horizon Europe proposal ethics self-assessment, no ethics issues were identified, therefore ethics approval is not required.

Disclaimer

The views expressed in this article are those of the author(s). Publication in ORE does not imply endorsement by the European Commission.

Data availability

No data is associated with this article.

Acknowledgements

We thank all PV4Plants consortium partners for their contributions. We also acknowledge the farmers and local authorities at the demonstration sites for their invaluable cooperation and feedback.

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Open Peer Review

Current Peer Review Status: ✔ ✔ ?

Version 2

Reviewer Report 31 March 2025

https://doi.org/10.21956/openreseurope.21373.r51850

✔

Sharon Hilarydoss
Department of Mechanical Engineering, Indian Institute of Petroleum and Energy (IIPE), Visakhapatnam, Andhra Pradesh, India

My comments have been addressed

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: SOLAR ENERGY, DESALINATION, PV-WATER SYNERGY, ALTERNATE FULES

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 27 March 2025

https://doi.org/10.21956/openreseurope.21373.r51977

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Meita Rumbayan
Sam Ratulangi University, Manado, Indonesia

The article partly explains recommendations and next steps clearly, but there is room for improvement. Here's the evaluation:
Strengths:

1. Policy Recommendations: The article outlines plans to develop a regulatory framework for AgriPV adoption, including guidelines on land use, financial incentives, and stakeholder inclusion (e.g., *"The project will provide clear guidelines on AgriPV design... and propose*

strategies for financial incentives").
2. Future Directions: It mentions refining light spectrum optimization for additional crops, expanding to new regions, and developing long-term financial models, which provide a roadmap for further research.
3. Stakeholder Engagement: The project's approach to involving farmers, policymakers, and local communities (e.g., roundtables, workshops) offers a replicable model for similar initiatives.

Weaknesses:
1. Lack of Specificity: While the article mentions policy recommendations, it does not detail actionable steps (e.g., specific policy changes or legislative proposals).
2. No Clear Guidelines for Replication: The technical setup (e.g., panel configurations, sensor systems) is described, but exact parameters (e.g., optimal light spectra for crops, tilt adjustments) are not provided, making it difficult for others to replicate the system.
3. Missing Quantitative Benchmarks: The article lacks measurable targets (e.g., "increase crop yield by X%") or performance thresholds, which would help others assess feasibility.

Conclusion: Partly
The recommendations are broadly outlined but lack granularity for direct implementation. The next steps are directionally clear (e.g., scalability, policy work) but would benefit from concrete, actionable details.
Suggestions for Improvement:
- Include specific policy proposals (e.g., subsidy structures, zoning laws).
- Provide technical guidelines (e.g., panel-to-crop ratios for different climates).
- Define success metrics (e.g., energy output thresholds, crop yield improvements).
- Add a timeline for future phases (e.g., pilot expansions, policy advocacy milestones).

This would better enable the research community to engage constructively or replicate the work.

Is the rationale for the Open Letter provided in sufficient detail? (Please consider whether existing challenges in the field are outlined clearly and whether the purpose of the letter is explained)
Yes

Does the article adequately reference differing views and opinions?
Yes

Are all factual statements correct, and are statements and arguments made adequately supported by citations?
Yes

Is the Open Letter written in accessible language? (Please consider whether all subject-specific terms, concepts and abbreviations are explained)
Yes

Where applicable, are recommendations and next steps explained clearly for others to follow? (Please consider whether others in the research community would be able to implement guidelines or recommendations and/or constructively engage in the debate)

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Renewable energy

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 18 March 2025

https://doi.org/10.21956/openreseurope.21373.r51851

Silvia Ma Lu
Mälardalen University, Västerås, Sweden

The authors have revised the open letter in response to the comments on the previous version and have incorporated several of the suggested improvements. The revised version aligns more closely with the intended format of an open letter, and I have no further comments. I look forward to seeing the results of this very interesting project in the future.

Is the rationale for the Open Letter provided in sufficient detail? (Please consider whether existing challenges in the field are outlined clearly and whether the purpose of the letter is explained)
Partly

Does the article adequately reference differing views and opinions?
Partly

Are all factual statements correct, and are statements and arguments made adequately supported by citations?
Partly

Is the Open Letter written in accessible language? (Please consider whether all subject-specific terms, concepts and abbreviations are explained)
Partly

Where applicable, are recommendations and next steps explained clearly for others to follow? (Please consider whether others in the research community would be able to implement guidelines or recommendations and/or constructively engage in the debate)

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Agrivoltaics, Solar Energy, Spectral Irradiance, Wavelength-Selective Solar Photovoltaic

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Reviewer Report 27 January 2025

https://doi.org/10.21956/openreseurope.20426.r49421

Sharon Hilarydoss
Department of Mechanical Engineering, Indian Institute of Petroleum and Energy (IIPE), Visakhapatnam, Andhra Pradesh, India

Include quantitative results also in abstract
“Through the application of glass color converter (GCC) materials between PV panels” Why gap is required between panels? Tinted semi-transparent solar modules can be used? Give your opinion and discussion on this
“diverse climatic regions” What are climatic conditions considered?
“For example, during hot weather, panels may be adjusted to increase shading” Does it not affect PV performance? Is there an optimum trade-off between PV performance and crop yield?
“This dynamic approach not only enhances agricultural outcomes but also ensures the PV system’s energy output remains high”. How this is possible if PV is tilted from its optimum position? Clarify this
Quantitative results are missing all over. Include them
Farming environment will be mostly dusty. What’s the plan to handle dust deposit?

Include quantitative results also in abstract
“Through the application of glass color converter (GCC) materials between PV panels” Why gap is required between panels? Tinted semi-transparent solar modules can be used? Give your opinion and discussion on this
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Is the rationale for the Open Letter provided in sufficient detail? (Please consider whether existing challenges in the field are outlined clearly and whether the purpose of the letter is explained)
Partly

Does the article adequately reference differing views and opinions?
Partly

Are all factual statements correct, and are statements and arguments made adequately supported by citations?
Yes

Is the Open Letter written in accessible language? (Please consider whether all subject-specific terms, concepts and abbreviations are explained)
Yes

Where applicable, are recommendations and next steps explained clearly for others to follow? (Please consider whether others in the research community would be able to implement guidelines or recommendations and/or constructively engage in the debate)
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: SOLAR ENERGY, DESALINATION, PV-WATER SYNERGY, ALTERNATE FULES

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 17 Feb 2025

María Ruiz

Through the application of glass color converter (GCC) materials between PV panels” Why gap is required between panels? Tinted semi-transparent solar modules can be used? Give your opinion and discussion on this “diverse climatic regions” What are climatic conditions considered?
The gap between panels is necessary to achieve an optimal light-to-electricity output ratio for the designed GCC panels. GCC panels are highly transmissive, allowing light to pass through and reach the crops beneath the agrivoltaic system. In contrast, conventional Si solar cells are opaque and do not permit light transmission. Therefore, the design intentionally incorporates gaps between GCC panels and Si solar cells to balance energy

generation and agricultural productivity.While tinted semi-transparent solar modules can be used, the current innovation action project is designed around standard Si solar cells due to their widespread use and large-scale production, making them the most accessible and commercially viable option at present. “Diverse climatic regions” What are climatic conditions considered.

“For example, during hot weather, panels may be adjusted to increase shading” Does it not affect PV performance? Is there an optimum trade-off between PV performance and crop yield?
By "diverse climatic regions," we are not referring to seasonal weather changes but rather to the different geographic locations where the demonstration sites will be installed—Türkiye, Spain, and Denmark. While Türkiye and Spain share a warm Mediterranean climate, Denmark has a completely different climate. Therefore, the term specifically highlights the variation in environmental conditions across these locations, where the novel GCC agrivoltaic sites will be implemented. Regarding the second question, yes, there is an optimal trade-off between PV performance and crop yield. This balance will be determined through data collection and analysis after the installation of the demonstration sites. The impact of panel adjustments on both shading and PV efficiency will be evaluated for different crops in various geographic regions to find the most effective configuration.

“This dynamic approach not only enhances agricultural outcomes but also ensures the PV system’s energy output remains high”. How is this possible if PV is tilted from its optimum position? Clarify this.
This is possible due to the unique properties of the GCC panels. These panels incorporate nanosized luminescent glass nanocomposites, which not only convert sunlight to enhance red light for improved plant growth but also function as waveguides, similar to luminescent solar concentrators (LSCs). Since GCC panels can guide sunlight towards the silicon solar cells regardless of the direction of incoming light—whether under direct or indirect illumination—they help compensate for potential energy losses caused by panel tilting. By increasing the incoming photon flux to the silicon cells, the GCC panels minimize the impact of non-optimal panel angles and help maintain a high energy output. Clarify whether all test sites will use the same system layout as Figure 1 or if there will be variations. If differences exist, explain what aspects will be common or not common and how the sites will be compared.

Quantitative results are missing all over. Include them
There will be variations in the system layout depending on the geographic location of the demonstration sites and the types of crops being cultivated. While the general concept remains the same, specific design parameters—such as the ratio of silicon panels to GCC panels—will be adjusted to optimize both energy output and crop growth under different climatic conditions. For example, since Türkiye and Spain receive higher annual sunlight levels, the proportion of silicon panels will be higher to maximize energy generation. In contrast, Denmark, with its lower sunlight levels, will have a higher GCC panel ratio to allow more light to reach the crops. The exact designs are still under investigation, and quantitative results will be provided once data collection begins at the demo sites. Comparative analysis will focus on key performance metrics, including energy yield, crop

growth rates, and light distribution, to assess the effectiveness of different layouts across varying climatic conditions.

Farming environment will be mostly dusty. What's the plan to handle dust deposit?
Dust deposition is not a specific issue for our GCC panel design but rather a common challenge for all agrivoltaic systems. Mitigation strategies such as periodic cleaning, self-cleaning coatings, or optimized panel tilting to reduce dust accumulation can be considered, but addressing this challenge is beyond the specific scope of our design.

Competing Interests: No competing interests were disclosed.

Reviewer Report 16 January 2025

https://doi.org/10.21956/openreseurope.20426.r49166

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Silvia Ma Lu
Mälardalen University, Västerås, Sweden

The open letter titled "AgriPV system with climate, water and light spectrum control for safe, healthier and improved crop production" provides an overview of the objectives of the PV4Plants Horizon Europe project. The project aims to investigate the feasibility of combining agricultural production and solar energy conversion using perovskite-based PV panels optimized for light spectrum transmission. With three test sites across different countries, the project explores various crops, sustainability aspects, recyclability of systems, stakeholder engagement, financial models, and policy recommendations to advance AgriPV systems.

The letter appears to primarily introduce the project's plans rather than offering recommendations or policy implications. However, this is not fully clear, particularly given the inclusion of a "Results and analysis" section. Below are comments and suggestions to clarify and enhance the letter's message.

Responses to Peer-Review Form Questions:
1. Is the rationale for the Open Letter provided in sufficient detail?
Response: Partly.
The challenges in agrivoltaics are outlined in the introduction, and the project's objectives are clear. However, the letter's purpose, whether to announce the project's initiatives, encourage similar research, or discuss guidelines and policy was not clearly stated. Please, clarify this in the letter.
2. Does the article adequately reference differing views and opinions?
Response: Yes.
The authors briefly mention perspectives from various stakeholders, such as farmers and

policymakers.
3. Are all factual statements correct, and are statements adequately supported by citations?
Response: Partly.
In general, statements in the letter lack citations (e.g., “agricultural sector [...] accounting for approximately 10% of all GHG emissions in the EU”, “tomato plants thrive under red light”, among others). Relevant references should be added at the end of each specific statement or group of statements, rather than grouping them all at the end of the section to make it easier for the reader to distinguish where each statement comes from.
4. Is the Open Letter written in accessible language?
Response: Yes.
The language is clear, but some abbreviations (e.g., NGO) are unexplained, and others (e.g., PV) are defined multiple times. Additionally, the term "energy generation/production" could be replaced with "energy conversion" for accuracy.
5. Are recommendations and next steps explained clearly for others to follow?
Response: Not applicable.
The letter does not explicitly offer recommendations or actionable next steps for the broader community. It primarily outlines project goals and future plans.
Additional Comments and Suggestions:

- Structural improvements:
  The “System design, implementation, and testing” section is somewhat disorganized. The subsections could be reordered for clarity:
    - I suggest moving “Demonstration sites and testing” before “Multi-criteria assessment and financial models”. This way, the bullet points in "Advanced system design" and their apparent linked subsection are next to each other.
    - Elaborate on the bullet point about “Rainwater harvesting” to match the level of detail in the other bullet points which appear to have their own subsection “Real-time monitoring and proactive control” and “Material innovation and light spectrum optimisation”. How is the rainwater harvesting system done? Will it also be monitored?
- Demonstration sites and testing subsection:
    - Clarify whether all test sites will use the same system layout as Figure 1 or if there will be variations. If differences exist, explain what aspects will be common or not common and how the sites will be compared.
    - Provide details on stakeholder engagement and policy alignment methods, such as interviews, workshops, or surveys, to help readers understand how this part of the project will be carried out.
- Figure 3:
    - Suggestion to replace or complement this figure with an image or layout specific to the microalgae production AgriPV site, as this would better represent the content, similar to Figure 2.
- Results and analysis section:
    - According to Open Research Europe’s guidelines, open letters should not present new data or analysis. If this section includes unpublished results, the authors might consider submitting them as a research article instead.
    - If the results reference previous publications, add citations.
    - Those preliminary results involving laboratory tests or indoor trials seem to not be performed under the described AgriPV systems, kindly clarify their relevance and how the results can be translated to be used in the described open-field AgriPV systems.

Else, I recommend to focus on expected outcomes (e.g., tools, guidelines, decision-making frameworks) and to emphasize what the community can gain from the project instead of experimental findings at this stage. This would perhaps align better with the open letter format.

Is the rationale for the Open Letter provided in sufficient detail? (Please consider whether existing challenges in the field are outlined clearly and whether the purpose of the letter is explained)
Partly

Does the article adequately reference differing views and opinions?
Yes

Are all factual statements correct, and are statements and arguments made adequately supported by citations?
Partly

Is the Open Letter written in accessible language? (Please consider whether all subject-specific terms, concepts and abbreviations are explained)
Yes

Where applicable, are recommendations and next steps explained clearly for others to follow? (Please consider whether others in the research community would be able to implement guidelines or recommendations and/or constructively engage in the debate)
Not applicable

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Agrivoltaics, Solar Energy, Spectral Irradiance, Wavelength-Selective Solar Photovoltaic

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.