Dual Land Use for Agriculture and Solar Power Production: Overview and Performance of Agrivoltaic Systems

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Overview of the report

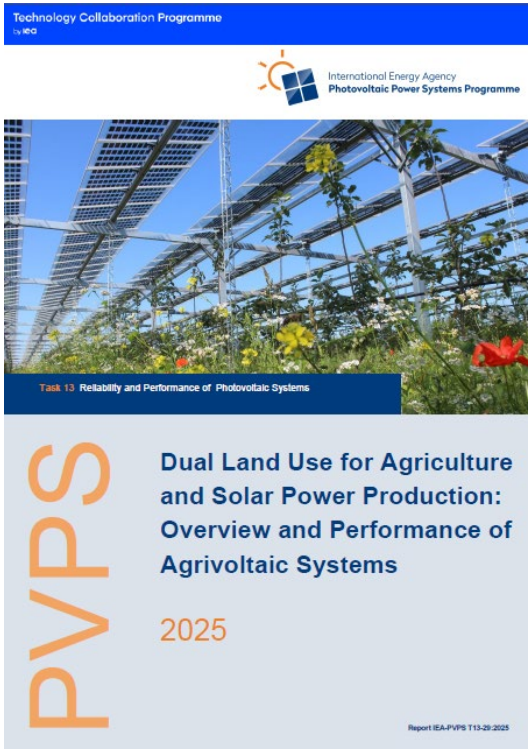
Enhance understanding of agrivoltaics concepts and key performance indicators (KPIs)

Provide an overview of various technologies and the current market status

Offer insights into operation and maintenance, performance, and reliability specific to agrivoltaic systems

Target audience: PV customers, PV industry, agricultural stakeholders, policy makers, standardization authorities, research institutions

30 contributors from 12 countries



Co-location of agriculture and PV production

Land use efficiency

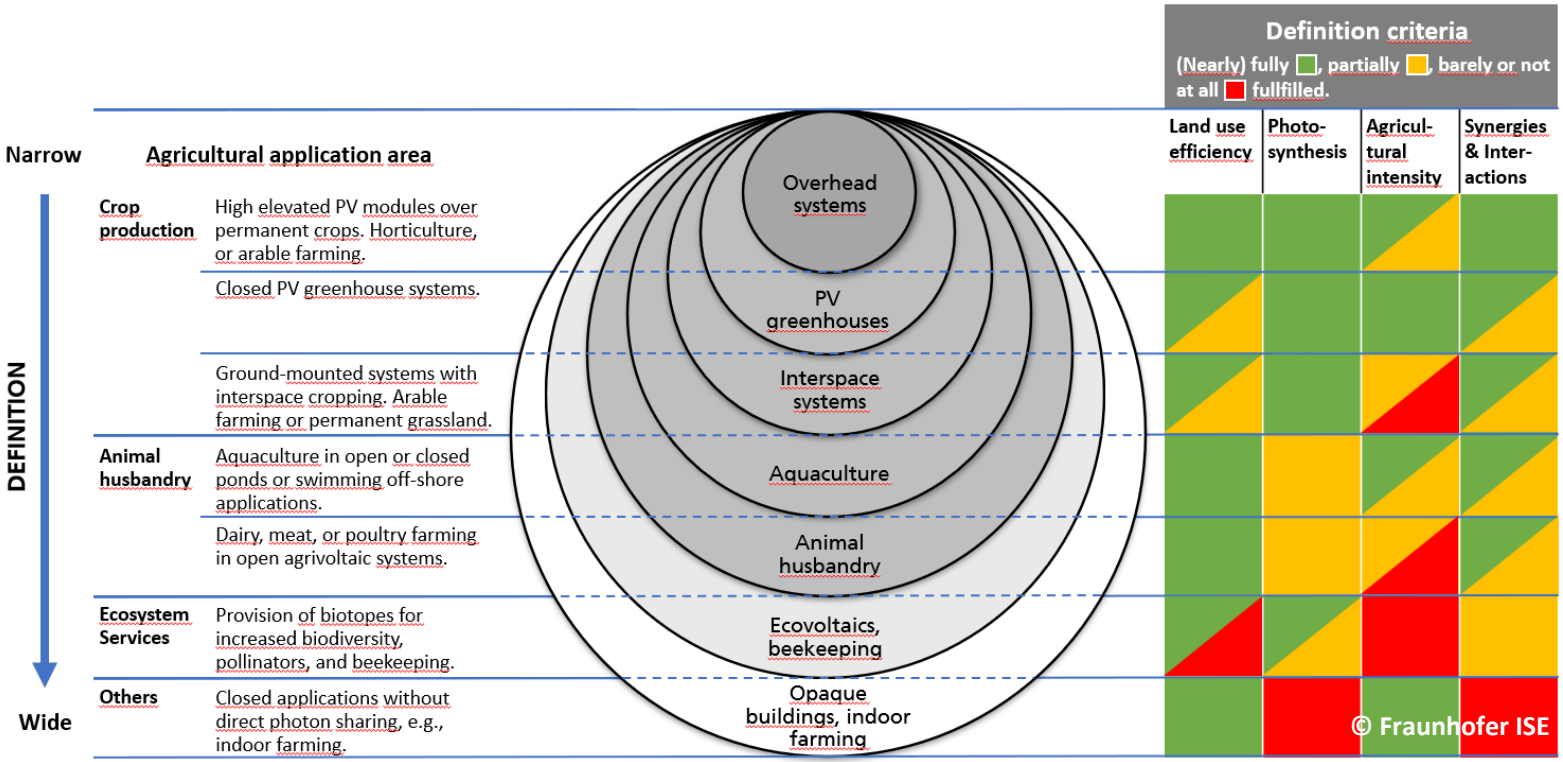
Sharing light between photosyntesis and photovoltaic

Intensity of agricultural activities

Synergies and interactions

Measurable and verifiable

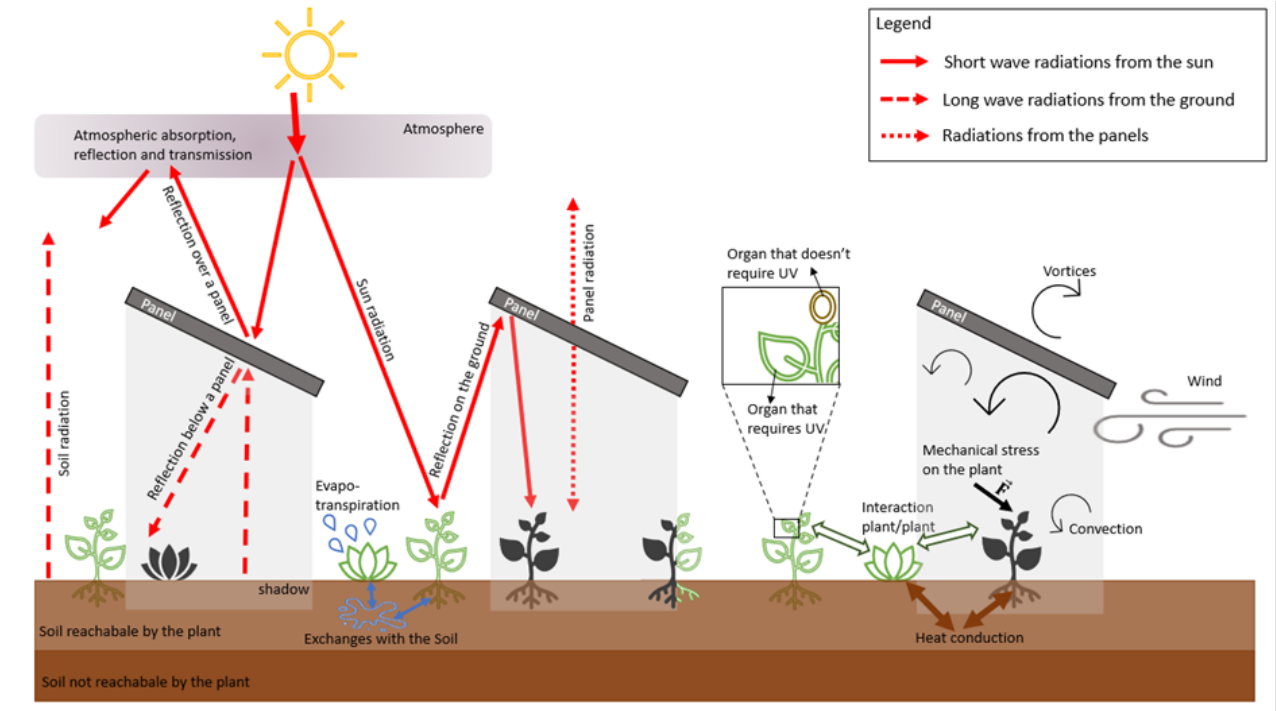
Agrivoltaics definition



PVPS

Modelling and simulation

Prediction of the agricultural yield is crucial for legal standards



J. Vernier, "A coupling method using CFD, radiative models and a surface model to simulate the micro-climate.," Master Thesis, Engineering Mechanics, School of Engineering Sciences (SCI)., KTH, 2023. Accessed: October 2024. [Online]. Available: https://www.diva-portal.org / smash/ record.jsf? pid= diva2%3A1819058& dswid= 7740

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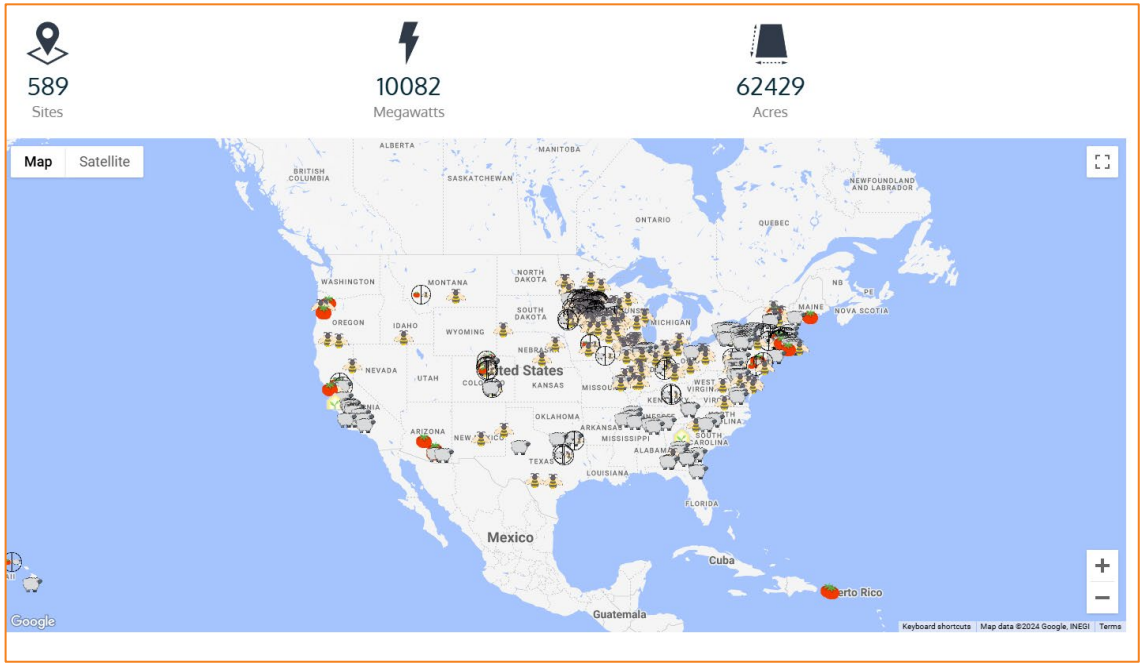
Monitoring

Monitoring microclimatic parameters and the agricultural and PV performance is key to better understand interactions and synergies



More data → more accurate models → better meet regulatory frameworks or standards → better economies

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Operation and maintenance

- Aboveground and belowground cable management
- Minimizing soil compaction
- Creating access spaces for agricultural operators
- Soiling, increased damages, corrosivity of PV components

Jung, D., Gareis, G. H., Staiger, A., & Salmon, A. (2022, December). Effects of soiling on agrivoltaic systems: Results of a case study in Chile. In AIP Conference Proceedings (Vol. 2635, No. 1). AIP Publishing.

Legal frameworks

- **Japan,** max 20% crop reduction
- **France,** max 10% crop reduction, max 10% land loss
- **Germany,** max 34% crop reduction, max 10-15% land loss
- **Italy,** max 30% crop reduction, required reporting
- **Isreal,** max 30% crop reduction
- **USA** (complex situation: Federal vs State vs Local)
  - **State of Massachusetts**
    - Incentives (feed in tariffs)
    - 50% light reduction
    - Compatibility of PV design and agriculture
    - Reporting

Social aspects

Industry perspective

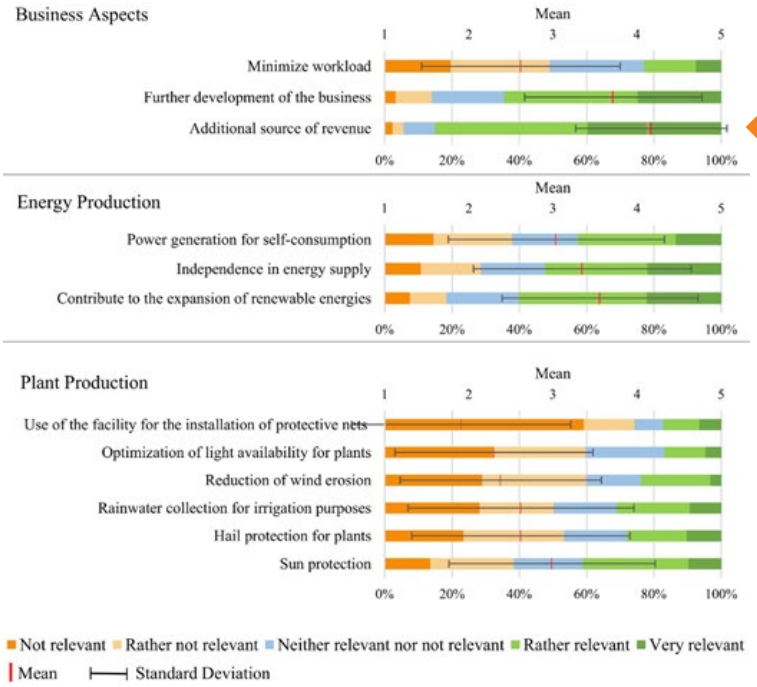
Gaps in knowledge, cost-benefits uncertainties, and challenging regulatory framework

Farmers perspective

Proof of concept to validate techno-economic viability

Local community perspective

Stakeholder involvement for successful project implementation



J. Wagner, C. Bühner, S. Gölz, M. Trommsdorff, and K. Jürkenbeck, "Factors influencing the willingness to use agrivoltaics: A quantitative study among German farmers," Applied Energy, vol. 361, p. 122934, 2024, doi: 10.1016/j.apenergy.2024.122934.

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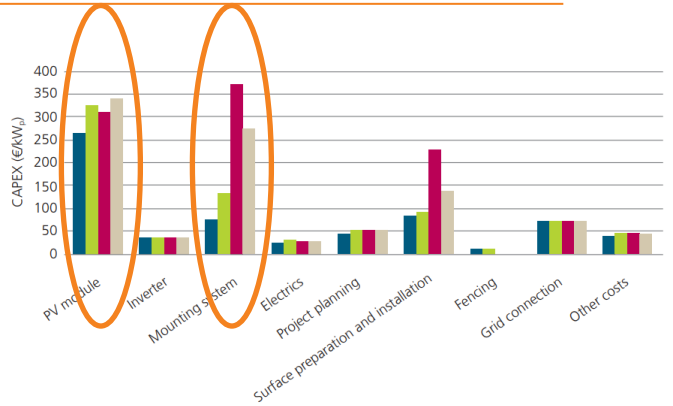
Economic aspects

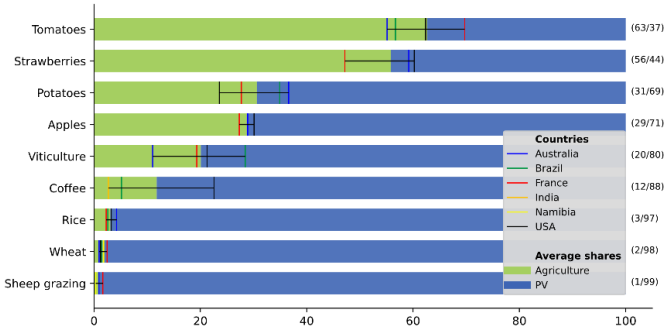
Economic performance largely depends on agricultural application, system design, business models, and local conditions

Typically, CAPEX of agrivoltaic systems are higher than conventional ground-mounted PV

PV OPEX and revenue varies according to application and local conditions

Revenues of the agricultural activity varies significantly with agricultural applications





https://www.ise.fraunhofer.de/en/publications/studies/agrivoltaics-opportunities-for-agriculture-and-the-energy-transition.html

Trommsdorff, M., Nekolla, J., Schwendemann, N., Butt, N. Z., & Feuerbacher, A. (2024). Economic performance of agrivoltaic systems: a comprehensive analysis.

Conclusions

Providing a clear definition of agrivoltaics is crucial to harness the potentials given the novelty of the technology, stakeholders involved, and complexity of interactions

Modelling and simulation represents an important task to reliably predict agricultural and electrical performance and to optimize system design

Key drivers for successful project implementation are stakeholder involvement in an early stage, a supportive policy environment and incentive programs, and transparent performance standards

Report available in few days

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Thank you for your attention!

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