# Unlocking the Economic and Social Potential of AgriPV Systems in Denmark,

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Dilnessa, A.A.[1], Pedersen, S.M.[1], Jørgensen, J.R..[2]Gislum, R.[2],Rasmussen, C.[2], Andersen, M.L.[3], Vedde, J.[3], Højgaard, M.I.[3], Pedersen, M.L.[4]

[1]University of Copenhagen, Department of Food and Resource Economics. Rolighedsvej 23, 1958 Frederiksberg C., Denmark

[2]Department of Agroecology, Aarhus University, Slagelse, Denmark

[3]European Energy, Aarhus University, Gyngemose Parkvej 50, 2860 Søborg, Denmark

[4] Slagelse Municipality, Rådhuspladsen 11, 4200 Slagelse, Denmark

**Correspondence: aad@ifro.ku.dk**

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## Abstract

This study examines the economic and social impacts of AgriPhotovoltaic (AgriPV) systems in Denmark, integrating solar energy with agriculture to enhance land productivity and reduce greenhouse gas emissions. It assesses financial feasibility, environmental benefits, and adoption potential through cost-benefit and scenario analyses. The study also quantifies sustainability impacts and explores farmer acceptance via workshops and surveys. Findings will provide policymakers and industry stakeholders with insights on integrating AgriPV and autonomous farming to improve sustainability and energy resilience in Denmark's agricultural sector.

Fig1: Agri-PV system with wide row spacing, allowing sunlight to reach crops and enabling easy access for agricultural machinery between solar panel rows—illustrating effective dual land use for farming and clean energy production.

Fig 2: Agricultural Robotics. The development of a combined system that integrates both the use of PV panels and crop production within the same field, which is further supported by autonomous robotic systems for various in field operations, is regarded as a highly novel innovation that integrate different complementary technologies and practices.

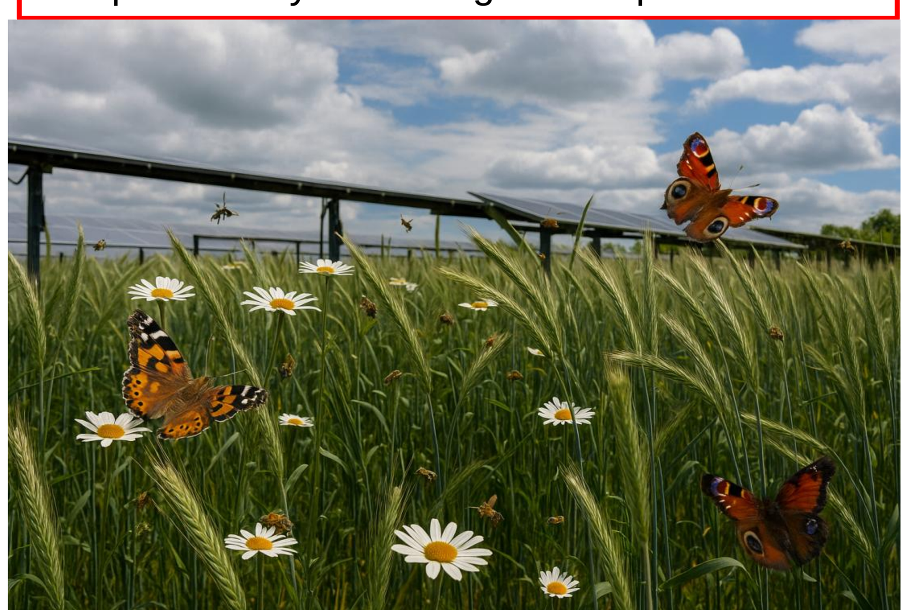
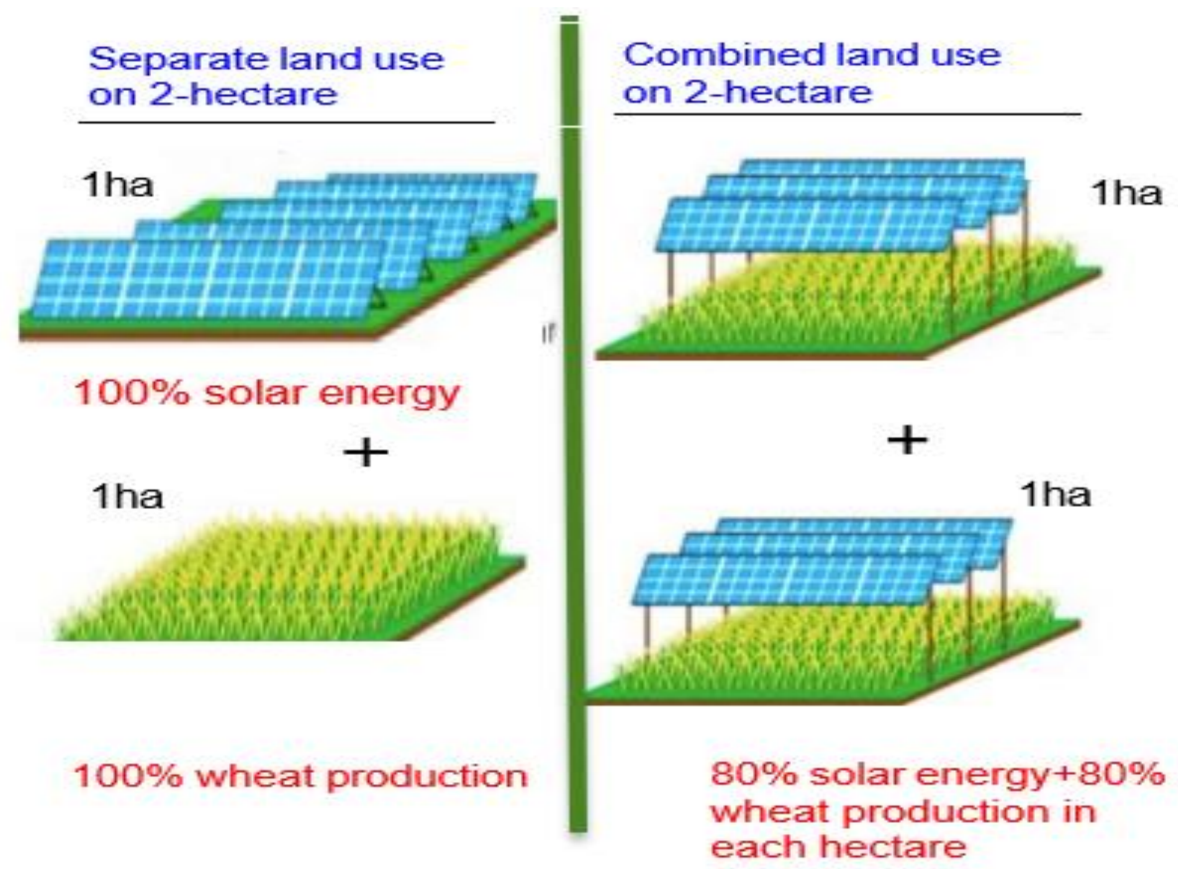


Fig 3: This image illustrates a vibrant Agri-PV landscape where solar panels coexist with diverse vegetation and/or crops, butterflies, and insects, highlighting the potential for renewable energy systems to support biodiversity.

## Introduction

- Denmark aims to reduce GHG emissions by 70% (2030) and reach climate neutrality by 2050.
- 68% of Danish electricity from renewables:
  - Wind: 47%
  - Biomass: 15.1%
  - Solar: only 3.4%
- Combines solar energy production with agriculture on the same land.
  - Supports both **clean energy goals** and **food security**.
  - Offers additional income streams for farmers.
  - Enables rural development and sustainable innovation.
  - Promote biodiversity




In combined production systems, the synergy of solar energy production and agricultural production is contributing to a higher net production.

## Current Research Gaps

- No studies to analyze real-world economic, environmental, and social impacts of AgriPV..
- Few studies investigate farmer adoption behavior or decision-making drivers.

## Research Focus

**Objective 1: Cost and benefits at farm level**

- Analyze market benefits and financial costs of promising system combinations
- Compare capacities, initial investments and adaptation of existing systems to an AgriPV system with and without autonomous farming operations
  - Based on experimental set-up
  - Assessed in field gross margins and net benefits for the selected cropping systems

**Objective 2: Sustainability - Environmental cost and benefits**

- This task will further include non-market benefits of relevant externalities for each system, including social costs of GHG emissions, nitrate leaching and change in biodiversity compared with conventional practices.
- Valuation of social cost and benefits will consider benefit transfer estimates from similar studies, including
  - shadow prices of GHG emissions, nitrate use and leaching,
  - non-market costs/benefits of different levels of biodiversity or a treatment index for pesticides per area unit.
- Non-market benefits will be assessed at field level and according to a certain representative geographical area or group of users.

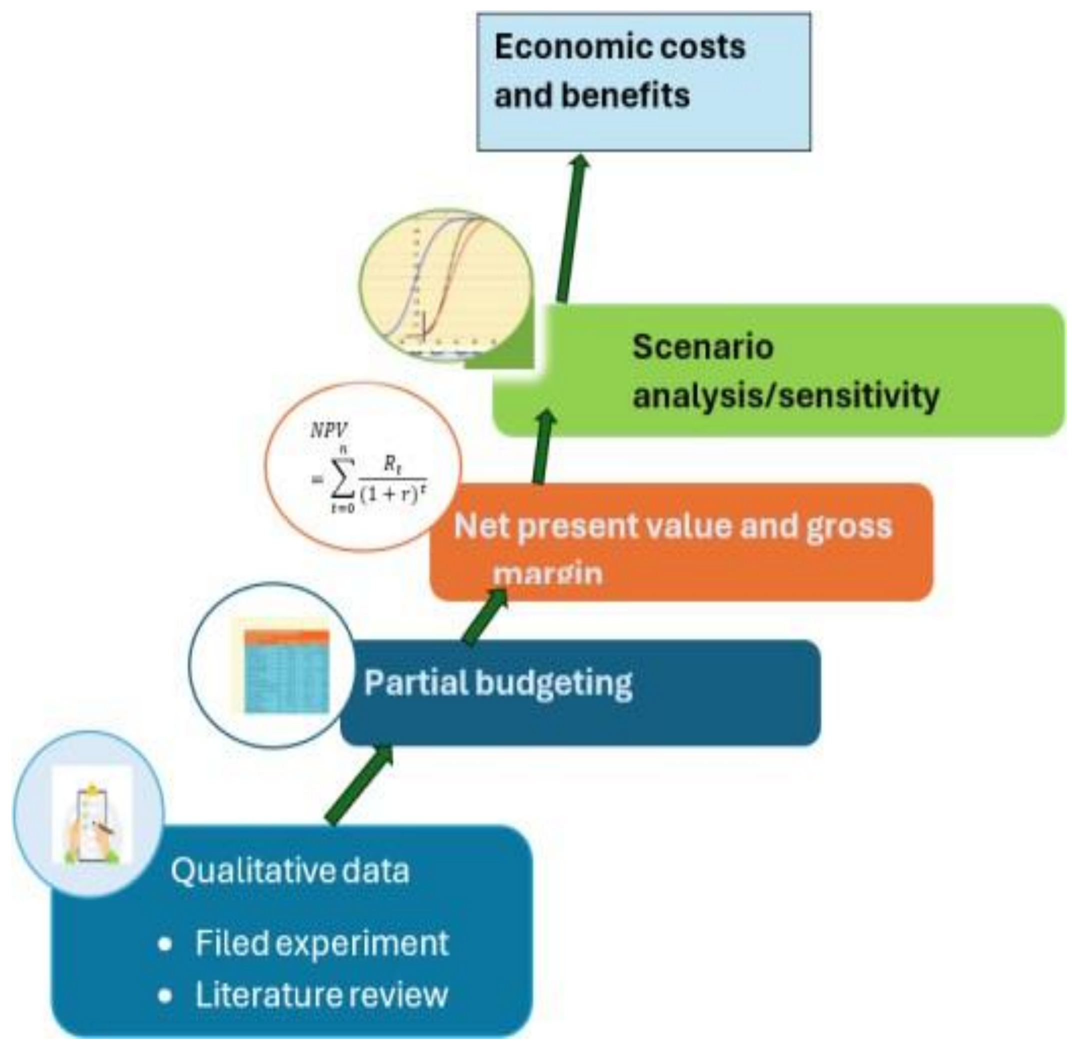
**Objective 3: Acceptance and farmers perception**

- Assess farmers' views on Agri-PV vs. traditional farming practices.
- Analyze willingness to adopt and identify barriers and opportunities.
  - Target >200 farmers across different farm types and sizes (arable/mixed).
  - Use interactive workshops with 20–30 stakeholders for co-creation and insight.



## Research method-Cost benefit analysis (CBA)

- Partial budget approach
- Data will be compiled from field experiments, farm account, market price, survey, interview, expert opinion, literature
- AgroPV-Robotic system compared to conventional practice




## Expected results

- Economic comparison of Agri-PV vs. conventional farming, including gross margins and investment needs.
- Sensitivity analysis on electricity prices and field size impacts.
- Sustainability assessment covering GHG emissions, nitrate leaching, and biodiversity.
- Insights into farmers' willingness to adopt Agri-PV and autonomous systems.
- Practical recommendations for policy and farm-level decision-making.

## Facts

- ***Agri-PV Demonstration Site*** : AU Flakkebjerg
- ***Location***: Slagelse Municipality, 2 ha site at AU-Flakkebjerg
- ***Capacity***: 0.98 MWp total, producing >1 million kWh/year
- ***Impact***: Powers ~200 households annually
- ***Crop Rotations***:
  - **Rotation I**: Rapeseed, Wheat, Spinach (seed), Oat, Barley/Pea mix
  - **Rotation II**: Malting Barley, Faba Bean, Rapeseed, Wheat

- Coordinating organisation:
Aarhus University
- Partners:
European Energy, University of Copenhagen and Slagelse Municipality
- Funding:
Innovation Fund Denmark

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