Position Paper

Symbiosyst

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Key Premises

The decarbonisation of the energy sector is one of the top priorities at various political levels including at the European level. Photovoltaics (PV) is widely seen as one of the key technologies to drive the energy transition. Difficulties often arise when the targets for PV (usually set at the national level) need to be implemented at regional and local levels.

PV rooftop potential is extremely large, as shown in many studies, and could potentially contribute to the ambitious targets. However, the rate of installation of PV rooftop systems will not be fast enough to support a rapid energy transition.

Large utility-scale PV installations in open fields are not an option in many regions, due to current spatial planning, topography, social acceptance, touristic vocation, and landscape related issues.

It is in this context that the concept of Agrivoltaics (also called Agri-PV), making dual use of land for both agriculture and PV generation, has been emerging over the last 15 years. The existing deployments of a large variety of novel agrivoltaic projects and the diverse range of interpretations and definitions for agrivoltaics have provided a base for ongoing debates.

While appropriately-designed and deployed agri-PV can strengthen and accompany paradigm shifts towards integrated PV (IPV) and the agriculture of the future, there is also a high risk that the label "agri-PV" is incorrectly associated with PV projects on which agricultural production is significantly constrained or impeded due to improperly-designed PV arrays, and/or PV projects with a low degree of landscape integration. This eventuality would cause a rapid transformation of the landscape which might be nor sustainable, neither acceptable by society.

Several decades of efforts developing Building Integrated PV (BIPV) products and systems for rooftops and façades has taught us that there are multiple levels of integration and various stakeholders across the value chain which can all generate significant barriers to widespread adoption. It has been proven that highly customized solutions drive costs up, therefore agri-PV is in the unique position to learn from the past mistakes made with BIPV which delayed the development of cost-effective BIPV solutions and market acceptance. Agri-PV innovation must be pursued by adapting standardized cost-effective solutions in terms of PV modules, mounting structures and operation and maintenance (O&M) practices to the specific needs of various crops in different climates and landscapes.

Key Ambitions

Adoption of mass-manufactured aesthetically acceptable solutions integrated on farmland in a harmonious way while maintaining robust agricultural production can enable a fair, positive agrivoltaic future. Interdisciplinarity is key to advance these objectives, requiring contributions from diverse stakeholders with expertise across the spectra of agriculture, electromechanical technology in both PV and farming, social and cultural sciences, climatology, economics, ecology, and other disciplines. Other ambitions include the following:

- Explore all the degrees of freedom and potential provided by the synergy between land & crop.
- Aim at obtaining 2-way optimizations where the Agri-PV systems can be adapted to different climates and crops, but also that the on-site crops and cultivation methods can be adapted to benefit from the presence of the PV system.
- Create a fully integrated solution, from the design to the implementation, a symbiosis where PV and agriculture can sustainably coexist on the same plot of land.

Key Message

At this stage, Agri-PV cannot be decoupled from innovation where field experience is needed to ensure that the ambition can be reached. To this extent, it is important to deliver a message that it is not intended to create barriers towards extensive deployment of Agri-PV, but rather crucial to prevent an overly-broad definition. This in turn can lead to misinterpretations and speculative approaches to Agri-PV.

Labelling PV projects that greatly constrain farming or significantly impact agricultural yield as "agrivoltaics" will damage the credibility of this promising discipline, set back already-achieved progress, leading to rejection by the public, and potential legislative action against PV in general.

Key Elements
to be included in normative efforts

Various countries are currently preparing guidelines for a normative definition of Agri-PV. It is not the scope of this document to provided exhaustive detailed recommendations for such new legislation; however, the following elements are strongly emphasized:

- The difference between non-agri photovoltaics on ground in agricultural areas, and agrivoltaics must be clear.
- The presence of some mitigation measures to photovoltaics systems does not guarantee that the PV plant is compatible with farming.
- In an Agri-PV system, the agricultural area impeded by the presence of an Agri-PV plant must be clearly defined by an agricultural specialist, limiting, or avoiding any impact in the activities of farmers and machinery.
- The definition of the impeded area must consider the primary goal of farming and the health and safety of operators especially farmers who should not be affected by the presence of the photovoltaic system.
- An estimate on the impact on crop yield must be given through modelling or based on similar field experience.
- Monitoring of crop and electricity yield must be mandatory.

For the definition of the impeded area geometrical considerations need to be included by differentiating between the area where cultivation is impeded, and the area where cultivation is possible considering the following elements:

- Proposed crop & care (species, cultivars, cultivation methods, proposed machinery);
- Local climate (adequate exposure to solar irradiance; temperature, humidity, wind, seasonality and climate change adaptation considerations);
- Mounting system configuration (height, and in the case of trackers, tilt angles and adjustability);
- Health and safety considerations.

It is encouraged that, even if not available for cultivation, impeded areas are planted with low-maintenance local and/or functional vegetation systems, capable of supplying ecosystem services such as habitat and crop disease prevention, and contributing to the overall biodiversity.

A system can thus be defined as Agri-PV if and only if it can fulfil well-defined criteria in terms of:

- Impact on crop yield over the total area;
- Ground cover ratio or other geometrical parameters that define the ratio between the impeded area and the total area;
- Three-dimensional pattern including geometrical consideration on area free for cultivation height, distance between crop and structures, distance between operators and structure;
- Assessment of the project by experts in agronomy, ecology, landscape ecology, landscape architecture and health and safety expert;
- Considerations on biodiversity and if relevant, compatibility with animal grazing.

It is urged to be vigilant for proposed PV system configurations with exceptionally dense PV arrays and/or very low-to-the-ground mounting structures, which may not be able to support any vegetation (neither biodiverse nor crops); these are thus discouraged.

Systems which do not fulfil the criteria cannot be labelled as Agri-PV. This does not preclude the cultivation of crops in such systems as a mitigation measure for land use and the introduction of a category between Agri-PV and non-Agri photovoltaics.

It must be noted that PV sites featuring majority grass land cover, in which animals are used as the primary method of landscape maintenance, are an alternate type of agrivoltaics known as "pasture" or "grazing" agrivoltaics. This remains outside the scope of the Symbiosyst consortium. It is encouraged that this topic should be addressed in future studies.

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