AGRI-PV: HOW SOLAR ENABLES THE CLEAN ENERGY TRANSITION IN RURAL AREAS

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Executive summary

Reaching the ambitious objectives of the European Green Deal will require a profound shift in the EU's agricultural and energy sectors. Agricultural photovoltaics ("Agri-PV") offers an innovative, efficient, and cost-effective solution to simultaneously promote sustainable agriculture and the clean energy transition. Agri-PV reduces land competition between solar and agriculture under conditions that guarantee the efficiency, sustainability, and viability of both activities. By combining agricultural infrastructure with solar, the EU can make rural communities more competitive and sustainable.

Solar, as the most scalable and cost-effective clean energy technology, empowers farmers to be at the heart of the European Green Deal and the post-COVID green recovery. Agri-PV supports the transition to a sustainable food supply and ecosystem, channeling new investments in solar capacities, and supporting the objectives of the Common Agricultural Policy and of the Farm to Fork Strategy. As a disruptive set of technologies, innovative Agri-PV solutions can drive the modernisation of the EU's food system and increase its resilience to climate change. Finally, thanks to its high land-use efficiency, Agri-PV is particularly suited to boost the clean energy transition in land-scarce regions, such as EU islands.

The potential for Agri-PV in the EU is immense: if Agri-PV were deployed on only 1% of Europe's arable land, its technical capacity would be over 700 GW. Tapping into this potential would place the European solar industry at the forefront of global solar innovation. The sector is already emerging in Europe, with certain Member States actively supporting its development, and this has triggered strong interest from emerging countries faced with the challenge of droughts and climate-related transformations. It is time for a coordinated effort to boost the development of Agri-PV across Europe.

To kick-start the Agri-PV sector in Europe, the EU and its Member States should:

POLICY RECOMMENDATIONS:

1. Integrate a "European Agri-PV strategy" within the future Common Agricultural Policy
2. Develop Agri-PV regulatory frameworks and prioritise investments into solar within Common Agricultural Policy Strategic Plans
3. Mainstream Agri-PV within the implementation of the Farm to Fork Strategy
4. Support Agri-PV research through dedicated calls in Horizon Europe
5. Integrate Agri-PV within climate change adaptation strategies
6. Incentivise the use of Agri-PV in EU islands' decarbonisation strategies

1. Introducing Agri-PV

The European Green Deal sets out a vision to achieve climate neutrality by 2050. This will require a deep transformation of Europe's society and economy; particularly of its energy and agri-food sectors.

The Clean Energy Package ("CEP"), adopted by the European Union in 2019, set out a framework to reduce greenhouse gas emissions by 40% by 2030, partly by reaching at least 32% renewable energy in the final energy demand. In 2020, the European Commission proposed the European Climate Law, which would set a legally-binding target of net zero greenhouse gas emissions by 2050, in addition to more ambitious 2030 targets.

Since 1962, the principal policy in the field of agriculture at the EU level is the Common Agricultural Policy ("CAP"). The CAP provided €58.82 billion in support for farmers in 2018[1] across its two pillars: the first pillar involves direct support for farmers, and the second pillar targets sustainable rural development. The European Commission proposed a revision of the CAP in 2018 for the 2021–2027 period, which is currently being negotiated. The revision aims modernise and 'green' the EU's agricultural policy, adapting it to the changing agricultural, energy, and climate change context.

Within this framework, agricultural photovoltaics ("Agri-PV") offers an opportunity to simultaneously realise the European Green Deal, meet the EU's decarbonisation targets, and achieve the objectives of the CAP.

The principle behind Agri-PV is straightforward: the smart combination of agricultural infrastructure with a photovoltaic installation. This combination unlocks a variety of disruptive applications that capitalise on synergies between solar and agriculture. Agri-PV allows for solar to be combined with specific rural and agricultural activities, providing solutions to the needs of farmers and rural communities by driving investments and creating jobs in rural areas, supporting traditional and sustainable agricultural practices, or increasing the climate resilience of agricultural activities.

The EU has a key role to promote the multiple synergies between agriculture and solar electricity generation enabled by Agri-PV systems. Installed directly above crops, solar provides shade, protects crops against hail or frost, enables stable crop yields, and increases the electrical yield of PV panels.[2] Solar can be installed on agricultural hangars or on greenhouses and can support the development of modern infrastructure that improves the competitiveness of the agricultural sector. Utility-scale solar farms provide the perfect setting for sheep to graze.[3] Overall, there have already been a vast number of methods of integrating solar onto agricultural infrastructure,* with innovations regularly appearing on the market. Public policies should boost the deployment of established Agri-PV systems, while simultaneously supporting innovative Agri-PV solutions.

AGRI-PV TYPE	TYPE OF AGRICULTURAL ACTIVITY
Ground PV	Grazing, Beekeeping, Gardening
Vertical PV plant	Grazing or Gardening
Fixed shades (heightened)	Field crops, Viticulture, Arboriculture, Breeding, Grazing
Dynamic shades (heightened)	Viticulture, Arboriculture, Gardening, Horticulture
PV Greenhouses	Arboriculture, Gardening, Horticulture
PV on building	Breeding, Fish Farming, Storage, Agricultural Machinery
Floating Power plant	Fish Farming
Other Agri-PV solutions	Irrigation Ramps, Machinery

* For an exhaustive list of Agri-PV applications, see Achtuel & Artifex (2020) "Agrivoltaïsme. Recensement des principals applications"; ADEME (Forthcoming) "Définition de l'agrivoltaïsme : Etat de l'art des systèmes photovoltaïques dans le secteur agricole, collecte de retours d'expérience et production d'un guide de recommandations à destination des pouvoirs publics".

Dynamic shades Agri-PV system, viticulture. © SUN'AGRI

Agri-PV greenhouse. © AMARENCO

Agri-PV fixed shade system over raspberry farming. © BAYWA R.E.

Fixed shades Agri-PV system, fish farming. © AKUO

It has been estimated that deploying Agri-PV on only 1% of global cropland could help meet total global energy demand.[4] Since 2014, around 2,800 Agri-PV systems have been deployed worldwide, with a total capacity of about 2.9 GWp[5]. The sector has seen significant growth in Japan, South Korea, and China, where regulatory frameworks and support schemes have already been in place for a number of years.[6]

The potential for Agri-PV in Europe is huge: the technical capacity, if Agri-PV were deployed on only 1% of the EU's arable land,[7] is over 700 GW. However, the development of Agri-PV in Europe is fragmented among EU Member States, with growth concentrated in France. The development of Agri-PV in Europe could establish the European solar industry as a global leader in this rapidly growing market segment.

For the EU to meet its potential and become a global leader in Agri-PV, a European framework to boost the growth of the sector is necessary In this briefing, we aim to highlight the synergies between Agri-PV and EU policies on sustainable rural development, the future of the agri-food sector, climate change adaptation, and the decarbonisation of islands. In addition to this, we provide concrete policy recommendations that can be taken on board by policy- and decision-makers working on the topic of agriculture, energy, climate, and environment, at the EU, national, regional, and local level.

2. Enabling sustainable development in rural areas

In addition to the full implementation of the CEP, and specifically the Renewable Energy Directive,[8] the European Union and its Member States should encourage the development of Agri-PV in Europe through at least four policy initiatives:

1. **The revision of the CAP:** Agri-PV can enable the achievement of the CAP's objectives. The second pillar of the CAP should promote the deployment of Agri-PV and Member States should include Agri-PV development plans in their CAP Strategic Plans.
2. **The implementation of the Farm to Fork Strategy:** Agri-PV can be at the core of a modern, sustainable, healthy, and equitable food system. The horizontal implementation of the Farm to Fork Strategy should integrate the various contributions of Agri-PV to increase sustainability, improve resilience, and boost innovation in the agri-food sector.
3. **The revision of the EU Climate Change Adaptation Strategy:** Agri-PV solutions contribute to the climate resilience of agricultural practices. The revised EU Climate Change Adaptation Strategy should provide targeted support for Agri-PV solutions that improve the resilience of agriculture to climate change.
4. **The Clean Energy for EU Islands initiative:** land-scarce regions are particularly suited for the deployment of Agri-PV. The EU islands should integrate plans to deploy Agri-PV to support food and energy security for their clean energy transition agendas.

2.1 Agri-PV and the future of CAP objectives

One of the headline objectives of the European Green Deal is to ensure that the revised CAP fully reflects the EU's climate ambitions. This is to be achieved in part by ensuring at least 40% of the overall CAP budget contributes to climate action. In addition to this, the CAP includes funding and measures to support rural development, the "second pillar". In the 2014–2020 budget, the funding instrument for the second pillar, the European Agricultural Fund for Rural Development ("EAFRD"), had a budget of around €100 billion.

The Commission's CAP proposal aims to modernise the governance and the delivery of the second pillar by setting clear objectives and letting Member States come up with their own strategies for sustainable rural development. The Commission has proposed 9 specific objectives (see Figure 1) that "focus on the economic viability, the resilience and income of farms, on an enhanced environmental and climate performance, and on the strengthened socio-economic fabric of rural areas".[9] EU Member States are currently preparing "CAP Strategic Plans" that will detail the interventions they will carry out to reach these objectives, which will be financed by EAFRD funds. These plans will be assessed by the European Commission and shall include concrete targets and will be subject to annual reporting by Member States.

FIGURE 1 THE FUTURE CAP 9 OBJECTIVES

In line with the objectives of the future CAP, EU Member States should integrate Agri-PV within their CAP Strategic Plans. Doing so will drive investments into rural communities, provide employment opportunities in rural areas, contribute to the resilience of agricultural practices, increase land-use efficiency, and improve water management, as well as enabling the achievement of the 9 CAP objectives.

2.1.1 How Agri-PV contributes to the CAP objectives

The variety of applications addressed by Agri-PV leads to multiple benefits contributing to the CAP objectives outlined above.

1. Solar investments for agriculture
>> Objectives 1, 2, 7, 8

The income of EU farmers is still significantly lower than average incomes in many Member States.[10] The Agri-PV sector generates investments that support the competitiveness of the agricultural sector through farm and equipment modernisation. Both individual farmers and farmer cooperatives can benefit from the deployment of Agri-PV, which has been shown to increase farm incomes by over 30%.[11]

Different models exist depending on the ownership of the Agri-PV system. Agri-PV developers can act as "third-party investors", in which they develop a project at no cost to the farmers. Developers receive remuneration from the sale of renewable electricity while farmers benefit from new agricultural infrastructure, such as new local storage space or durable crop protection systems, that increases farm productivity, or from a revenue complement in the form of rent paid on the use of their land.

Farmers can also invest and contract an Agri-PV developer to develop an Agri-PV system. Under this model, farmers must contribute to the CAPEX costs associated with the project. They then benefit from reduced energy bills if they self-consume the electricity and a stable revenue complement if they feed the energy into the grid.

> **Mr. Tucholski -** *"I didn't have storage space to protect my equipment and fodder from the weather. Now, thanks to the Amarenco building, I no longer need to leave everything outside and cover it with a tarpaulin."*

2. Solar jobs for rural communities
>> Objectives 6, 8

Unemployment in rural communities, specifically for young people, is an important challenge. Between 2015–2017, the average unemployment rate for young people in rural areas was 18%.[12] Furthermore, the rural population is decreasing across the EU. Between 2013–2017, approximately 500,000 people left rural areas in favour of larger urban centres.[13] The solar industry stimulates the social and economic fabric of rural areas, generates new employment opportunities, and diversifies the economic structure of rural communities.

Solar creates more jobs per megawatt of power generated than any other energy source.[14] The development of Agri-PV projects supports jobs in the downstream activities of the PV sector, such as the installation, the engineering, or the operations and maintenance of the Agri-PV installations.

The modernisation of rural infrastructure and increased farm productivity makes rural communities more dynamic. When an Agri-PV installation replaces temporary infrastructure (e.g. a plastic greenhouse), it can contribute to stabilise employment opportunities and reduce worker seasonality.

3. Solar protecting crops
>> Objectives 2, 3, 4, 9

Agriculture is particularly vulnerable to climate change. Higher temperatures, water scarcity, new pests, or extreme weather events endanger the resilience of our agri-food systems. In addition to this, the area cultivated within greenhouses is increasing in the EU, which has varied environmental impacts depending on the type of greenhouse used.[15] Agri-PV addresses both challenges, by increasing the climate resilience of agriculture and improving greenhouse sustainability.

Deploying solar above crops delivers synergies that increase the climate resilience of agriculture. Dryland environments are particularly suited to Agri-PV installations, enabling synergies between the production of certain crops, water conservation, and renewable energy production, in addition to providing local ecosystem services.[16] Agri-PV installations also provide opportunities to deploy physical pest control measures, reducing the need to use chemical pest control products.

M. Pierre Escudié, Nidolères Vineyard in France, 4.5 ha - *"The vineyard in an open field suffered a lot (from intense heat) while remained undamaged under dynamic agrivoltaics system."*

Agri-PV creates a business case to substitute plastic from low-cost greenhouses and to provide clean electricity for high-tech greenhouses. In the former situation, plastic is replaced by more durable materials, with added costs being offset by the generation of clean electricity. In the latter, the high-energy use from heating, cooling, and maintaining complex digital services can be met with self-produced electricity.

4. A more efficient use of land
>> Objectives 4, 5, 6

Around 80,000 hectares of agricultural land was lost each year between 2000–2017.[17] The loss of agricultural land is mainly attributed to land abandonment, and land sealing poses a risk to climate resilience.[18] To address this, the European Commission proposed in 2011 to set a "net-zero land take" objective.[19] Agri-PV enables a dual-use of land, reducing land take and minimising land competition between agriculture and renewable energy.

Agri-PV solutions above crops can improve productivity per hectare, while simultaneously reducing soil degradation and water usage. Productivity is increased by using dynamic tracking systems that can regulate the shade provided to crops.[20]

5. Solar to improve water management
>> Objectives 1, 2, 4, 5, 6

Agriculture, forestry, and fishing represent the lion's share of water consumption in the EU, accounting for approximately 40% of water resources in 2015.[21] Sustainable management of scarce water resources will be essential to maintaining agricultural practices in the EU. Agri-PV contributes to lowering the water needs of agriculture by shielding crops from heat and by reducing evapotranspiration.[22]

Soil under the shade of PV panels maintains soil moisture, providing ideal conditions for certain types of crops.[23] Water consumption can be further optimised with digitalised Agri-PV solutions that can track solar irradiation and better regulate the microclimatic conditions under the solar panels. Further, solar energy can be used to power the pumping of underground water for irrigation, replacing diesel generators.

2.1.2 Integrating Agri-PV in CAP Strategic Plans

The synergies between Agri-PV, the objectives of the future CAP, and the EU climate and energy targets must be harnessed. To this end, appropriate support mechanisms that stimulate private investments into the Agri-PV sector are needed. Reaching a sufficient level of investments will generate the necessary economies of scale to drive the competitiveness of the European Agri-PV sector.

A **"European Agri-PV strategy" should be formalised within the future CAP.** This strategy should boost the deployment of established Agri-PV systems, promote EU leadership in Agri-PV technological innovation, enhance the productivity of the agricultural sector and enable the deployment of renewable energy resources in rural areas. Designed in close collaboration with agricultural experts, an Agri-PV strategy should aim at enabling the clean energy transition in rural areas, drawing on the objectives of the CAP and of the Energy System Integration Strategy.[24]

At national level, **solar investments should be prioritised within CAP Strategic Plans**, as highlighted in the Farm to Fork Strategy. The European Commission should issue clear guidance to Member States on how their CAP Strategic Plans can maximise Agri-PV deployment, in line with their National Energy and Climate Plans.

Beyond this, **Member States should include plans to develop Agri-PV regulatory frameworks** as part of their CAP Strategic Plans. Several countries and sub-national regions around the world have already developed Agri-PV regulatory frameworks. These include Japan, South Korea, China, France, and Massachusetts.[25] Regulatory frameworks for Agri-PV are under development in the Netherlands, Switzerland, Austria, Germany, India, and California.

When designing regulatory frameworks to support the development of Agri-PV, policymakers should focus on 6 concrete actions:

1. Implement targeted financial mechanisms to support small, mid, and large scale Agri-PV through grants, Agri-PV Feed-in-Tariffs ("FiT"), and Agri-PV energy tenders, respectively.

2. Design an enabling framework for Agri-PV, ensure farmers deploying Agri-PV systems receive CAP subsidies and promote community-led Agri-PV.
3. Develop Agri-PV indexes that that capture the agro-economic, environmental, and social externalities of Agri-PV systems.
4. Set clear and robust quality assessment criteria for Agri-PV projects and ensure independent and periodical assessment of project sustainability.
5. Ensure Agri-PV frameworks are policy coherent across energy, agriculture, environment, and climate policies, and that their development is a participatory process that involves all relevant stakeholders.
6. Prioritise public R&D funding towards research programmes supporting the energy transition in rural areas.

1. Financing mechanisms for Agri-PV

Despite their important benefits, Agri PV projects face important administrative barriers and have a higher Levelised Cost of Energy ("LCOE") due to their innovative component. Agri-PV regulatory frameworks should therefore support the development of Agri-PV through targeted support schemes until Agri-PV systems reach price parity with traditional PV installations. These support schemes include Agri-PV specific energy tenders, Agri-PV FiTs, or grant schemes for farmers looking to deploy renewable energy capacity.

For projects with capacities between 750 kWp and 10 MWp,[26] EU Member States should organise Agri-PV tenders that reward both on the price proposed by developers and alignment with the achievement of CAP Objectives. As noted by IRENA, to be fully effective, these tenders should be introduced in coordination with an enabling policy framework for Agri-PV.[27]

Agri-PV projects smaller than 750 kWp should be supported with Agri-PV specific FiTs,[28] in a proportional way to small-scale rooftop PV. This has been implemented in the state of Massachusetts, USA, which has set an Agricultural Solar Tariff Generation Unit ("ASTGU").[29] Under the Solar Massachusetts Renewable Target ("SMART") Program, solar projects receive a tariff-based incentive. The ASTGU provides a bonus remuneration in addition to the SMART tariff.

Another measure is to directly support innovative farmers looking to develop Agri-PV installations. The Polish government launched the "Agroenergia" program that aims to increase renewable energy generation from the agricultural sector.[30] This program offers grants and loans that may be used to deploy photovoltaic installations between 10–50 kW, with further subsidies awarded for the deployment of storage capacity.

2. Regulatory incentives for Agri-PV

Complementing sound financing mechanisms, CAP Strategic Plans should aim to set up an up an enabling framework for Agri-PV, ensure CAP support is provided for farmers deploying Agri-PV systems, and support the development of Agri-PV installations by rural Renewable Energy Communities.

CAP Strategic Plans should aim to create an enabling framework for Agri-PV promote and facilitate the development of Agri-PV in rural communities. Concretely, they should address unjustified administrative barriers for projects, support project financing the financing of projects, and provide technical support for farmers and rural communities who are looking to develop Agri-PV projects. To simplify the permitting process, Member States should create a single contact point per region to coordinate the approval of Agri-PV projects, which should span the various relevant administrations.

Furthermore, farmers who deploy Agri-PV systems on their land should benefit from CAP financial support. Subsidies should be provided for farmers that develop projects that contribute to the CAP Objectives, as validated by the competent authorities.

Rural communities have a strong potential to jointly develop Agri-PV projects by forming Renewable Energy Communities.[31] Renewable Energy Communities are "a legal entity through which citizens, with or without their local authority, and local SMEs can set up projects to produce renewable energy".[32] By coming together to develop Agri-PV projects, rural communities can drive social and economic innovation and ensure the project benefits local citizens and businesses.

3. Develop Agri-PV indexes that maximise land use efficiency, sustainability, productivity, and quality

Indicators to evaluate the performance of Agri-PV projects should be developed. One such method, implemented by the US State of Massachusetts, is to use the Land Equivalent Ratio ("LER"). The LER measures whether the combined value of agricultural production and solar electricity is equal or higher than it would be from the singular use of land.

Member States should go one step further and develop holistic Agri-PV Indexes that capture the impacts of Agri-PV beyond land productivity such as the microclimatic impacts on crop performance, the effects on soil humidity and social impacts of Agri-PV projects. Such indexes can be based on existing modelling approaches[33] and should be used to evaluate the suitability of projects.

4. Set clear and robust quality assessment criteria for Agri-PV projects

Clear and robust frameworks to evaluate the quality of Agri-PV projects, based on agricultural and energy performance indicators should be developed. These criteria should be in line with the Agri-PV index and focus on the expected agricultural feasibility, whether agricultural activity is improved, or at least maintained.

These indicators should be the basis of prior and periodical assessment of the sustainability of an Agri-PV installation, to be carried out by independent experts. This "quality assurance framework" should be combined with training and support for farmers and technicians to understand how to maintain the sustainability of an Agri-PV installation, both on its agricultural and renewable energy dimensions.

5. Involvement of all rural stakeholders

Developing an Agri-PV framework is politically challenging, as Agri-PV is a cross-sector technology. To ensure policy coherence, the development of Agri-PV regulatory frameworks should be a collaborative effort between the energy, agriculture, environment, and climate ministries. Developers already work hand in hand with agricultural partners to ensure that the Agri-PV devices placed above crops create the correct microclimatic conditions required to enable plant growth. Building on this multi-sectorial collaboration, the development of Agri-PV frameworks should be a participatory process, that includes the views of all rural stakeholders.

6. Promote Agri-PV R&D

As part of their Agri-PV regulatory framework, Member States should ensure public agri-food R&D funds are oriented towards research programmes focused on the decarbonisation of the agri-food sector. As identified by the JRC, Agri-PV R&D programmes should focus support on the identification of suitable crops, the impacts of Agri-PV on yields and profitability, and on the demonstration of different PV concepts.[34] In addition to this, research should support the development of analytical models to underpin Agri-PV Indexes that improve the sustainability of Agri-PV projects.

2.2 Agri-PV and the future of the agri-food industry

The Farm to Fork Strategy of the European Commission presented the long-term vision for agri-food sector, aiming to "make the EU food system a global standard for sustainability".[35] Agri-PV can make a unique contribution to this objective by enabling the transition towards healthier, more equitable, environmentally-friendly, and innovative agricultural practices.

Agri-PV can help deliver the next generation of climate neutral farms, that contribute to climate change mitigation and more sustainable agricultural practices. The Farm to Fork Strategy highlighted the need to prioritise investments into solar as part of the future CAP Strategic Plans for rural development. These investments should provide targeted support to farmers and rural communities interested to develop Agri-PV projects as well as those who have already taken the step.

"The fig trees are completely protected from stable flies (Stomoxys calcitrans) thanks to the anti-insect nets. We are now in a position to sell 80% of our production with Amarenco's closed Agri-PV infrastructure, compared to only 20% outside."

The implementation of the Farm to Fork Strategy should place Agri-PV at the centre of the Energy System Integration strategy in rural areas. By enabling the development of Agri-PV projects through collective self-consumption schemes and rural renewable energy communities, Europeans living in rural areas can be part of the transition towards a more circular and sustainable energy system. This would support a Just Transition, allowing rural communities to benefit from electrified transport, heating and cooling, and agricultural machinery.

Furthermore, Agri-PV can drive innovation in the agricultural sector and enable the next generation of climate neutral farms. The upcoming Horizon Europe, through the Farm to Fork Green Deal call area,[36] should include specific project calls to support Agri-PV research, with a focus on projects at TRL 5 to 9.

Concretely, several initiatives of the Farm to Fork Action Plan[37] have significant potential to promote Agri-PV. The "proposal for a legislative framework for sustainable food systems", expected for 2023, should include the launch of a European Agri-PV strategy. The European Commission should develop a database of land suitable for Agri-PV development, as part of its "Farm Sustainability Data Network" proposal to be published by Q2 2022. This database should be complemented by the development of national tools to determine solar panel orientation to provide optimal sunlight for crop growth, following the example of Massachusetts' shade analysis tool[38]. Finally, the European Commission should develop an Agri-PV label within the "Sustainable food labelling framework" proposal in addition to promoting food produced in combination with solar through the EU's agricultural and food product promotion programme.

Agri-PV storage facility.

2.3 Increasing the EU's agriculture resilience to climate change

Between 2007 and 2016, land temperatures in Europe were about 1.6°C warmer than in pre-industrial times.[39] The reported economic losses, between 1980 and 2016, from weather and extreme climate-related events are estimated to be over € 436 billion. To face this challenge, in 2013 the European Commission adopted an EU strategy on adaptation to climate change that aims to increase Europe's climate resilience[40]. This strategy was evaluated in 2018[41] and the European Commission is currently preparing a proposal for a new EU Adaptation strategy.

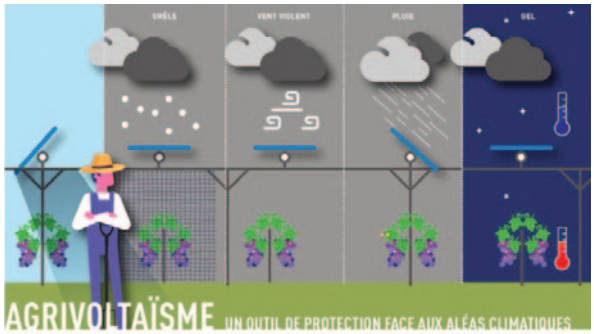
Agriculture is one of the most climate-dependent socio-economic sectors, with climate change affecting the sector in complex ways. Agriculture is particularly vulnerable to climate change, from changes in the timing and amount of precipitation, extreme weather (such as frost or hail) and extreme climate events (higher average temperatures and long droughts)[42]; and changing pest patterns. The agricultural community is aware of its responsibilities and that it is both part of the problem and the solution to the climate change challenge.

As stated above, many Agri-PV solutions are designed to address the negative effects of climate change on agriculture. Solar can therefore be used to shade crops from high temperatures and water stressed caused by agriculture that can exacerbate droughts. Agri-PV installations can also be used shield crops from extreme weather events, such as hail, and pests. These benefits can be increased thanks to digital solutions that adapt to the needs of the crops by optimising the level of shading or humidity needed with the generation of electricity.[43] Furthermore, by protecting agricultural output and providing a revenue complement to farmers, Agri-PV systems reduce the need for government intervention in case of crop failures due to climate change impacts.[44]

Agri-PV can address the impacts that climate change is already having on traditional agricultural practices. For example, viticulture in Europe is impacted by earlier harvests, water stress, unpredictable grape quality, and a higher grape sugar content.[45] Studies show that by 2050, the land suitable for viticulture in Europe will have decreased by 68%.[46] Placing dynamic Agri-PV systems over vines has shown to reduce water demand by 12% to 34%, preserve and increase yields, reduce the alcoholic content and improve the aromatic properties of the wine.[47]

The contribution of Agri-PV should be integrated within the upcoming EU Strategy for adaptation. Member States should provide additional support to Agri-PV projects that increase the climate resilience of agricultural practices.

Marc Portier, *apricot farmer in Gard (France)* - *The Agri-PV solution "remains an interesting niche because we avoid sunburn, rain, hail ... So many parameters that make the difference."*



How Agri-PV protects against extreme weather events.

2.4 Sustainable energy for land-scarce regions – Islands

Most islands are reliant on expensive and pollutant fossil fuels, which has a high impact on the cost of life for local populations and energy security of supply. For this reason, the European union launched the Clean Energy for EU Islands forum to provide a long-term framework to help islands generate their own sustainable, low-cost energy.

The European Commission and 17 Member states signed the Valetta Political Declaration, that stated the determination to "promote and support tailor-made clean energy transitions for islands".[48] In February 2019, 26 officially launched their transition,[49] with 6 of them having published their clean energy transition agendas.[50]

Islands should deploy Agri-PV as part of their clean energy transition agendas. Agri-PV allows islands to increase their energy security by diversifying their power mix while enabling the competitiveness of their agricultural sector. Thanks to their high land-use efficiency, Agri-PV is solutions can provide a unique contribution to the decarbonisation of EU islands. Notably, one of the islands that launched its transition, Marie Galante, is already placing Agri-PV at the core of its strategy.[51]

Ground mounted Agri-PV installation in Réunion Island. © AKUO

Agri-PV greenhouse in Réunion Island. © AKUO

3. Six actions to boost rural development through Agri-PV

The EU and its Member States have a golden opportunity to boost rural development while simultaneously deploying renewable energy. The deployment of Agri-PV solutions can enable the achievement of the 9 objectives of the CAP, power future climate-neutral farms, make the agricultural sector more resilient, and support the decarbonisation of EU islands. Supporting Agri-PV would further put the EU at the forefront of a key innovative solution to the challenges of the clean energy and sustainable agriculture transitions.

To unleash these benefits, the EU and its Member States should implement 6 key actions:

1. The European Council and the European Parliament should integrate a "European Agri-PV strategy" within the future CAP that aims to promote the development of the Agri-PV sector across Europe.
2. Member States should, as part of CAP Strategic Plans, develop Agri-PV regulatory frameworks and prioritise investments into solar.
3. The European Commission should mainstream Agri-PV across initiatives part of the Farm to Fork Strategy.
4. The European Commission and EU Member States should provide targeted support for Agri-PV research programmes.
5. The European Commission should integrate Agri-PV within its upcoming Climate Change Adaptation Strategy.
6. EU islands should deploy Agri-PV as part of their clean energy transition agendas.

Agri-PV storage facility.

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Please get in touch with SolarPower Europe if you have any comments or feedback on the report and its content in order to enrich our ongoing work in this field.

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