AgriVoltaics2022
Conference & Exhibition
Juni 15-17 Piacenza, Italy & Online

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www.agrivoltaics-conference.org/

Welcome to AgriVoltaics2022

In 2020, the AgriVoltaics conference was “launched” and the small community, working to develop innovative solutions to combine agricultural production and PV energy, met for the first time. It was great and surprising to see that this community was actually not so small; it was spread over all five continents, and united by the belief that agrivoltaics are perfectly suited to a sustainable energy transition. We all know that there is no one solution to suit all, and that we have a long road ahead to further understand and improve agrivoltaic systems. And it is in this time, when sustainable solution are urgently needed, that our community must collaborate to accelerate the availability of sound agrivoltaic systems. Exchange of information and experiences was at the core of Agrivoltaics2021, where the importance of “connecting” agrivoltaics worldwide was highlighted, and despite it being held online it was a great success!

The growth of agrivoltaics is exponential, as indicated by the ever-increasing number of scientific publications on the topic, by the number of new agrivoltaic systems installed and last but not least by the interest that large energy players and governments have paid to agrivoltaics. In Italy, for example, the government has decided to invest over 1 bn € of the recovery fund in agrivoltaic technologies. Our community now has a great opportunity, but also a responsibility to develop and bring forward true agrivoltaic systems where the production of PV electricity is necessarily coupled to agricultural production. While we work to optimise AV systems, we must also make sure that the policies supporting their implementation will prevent agrivoltaic projects from being abandoned, and becoming nothing more than ground mounted PV systems. This should be our concern when “bringing agrivoltaics forward”.
Agrivoltaics 2022 will be organised in “hybrid mode”, though I really hope it will be the first Agrivoltaics conference that you will attend in person. The Province of Piacenza has a great tradition of energy production: the largest Italian nuclear plant operated here from 1981 until 1990, when it was closed following the referendum of 1987; there is a large hydroelectric plant on the Po River; but more importantly, you will be able to visit two of the largest and longest-standing agrovoltaic plants in Europe!
Should you need another reason to join us in Piacenza, then I should mention all the traditional foods and wines the area has to offer!
Looking forward to seeing you here,

Stefano Amaducci

Università Cattolica del Sacro Cuore
Conference Chair AgriVoltaics2022

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CONFERENCE HOST

Università Cattolica del Sacro Cuore

Founded in 1921, the university is spread over five campuses in Milan, Cremona, Brescia, Rome and Piacenza. In the 100 years of its existence, UNICATT has become one of the most important Catholic universities in Europe.

CONFERENCE ORGANIZERS

INRAE

INRAE is France's new National Research Institute for Agriculture, Food and Environment, created on January 1, 2020, It was formed by the merger of INRA, the National Institute for Agricultural Research, and IRSTEA, the National Research Institute of Science and Technology for the Environment and Agriculture.

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About Fraunhofer Institute for Solar Energy Systems ISE

With a staff of more than 1400, the Fraunhofer Institute for Solar Energy Systems ISE in Freiburg, Germany is the largest solar energy research institute in Europe. Fraunhofer ISE is committed to promoting sustainable, economic, safe, and socially just energy supply systems based on renewable energies. Its research provides the technological foundations for supplying energy efficiently and on an environmentally sound basis in industrialized, threshold and developing countries throughout the world. Focusing on energy efficiency, energy conversion, energy distribution and energy storage, the Institute develops materials, components, systems and processes in five business areas. One particular feature of Fraunhofer ISE is its excellent technical infrastructure, which is organized into eight laboratory centers and four technology evaluation centers providing testing and experimental services on a production scale. In addition, the Institute has several accredited testing facilities. The Institute is a member of the Fraunhofer-Gesellschaft, Europe's largest application-oriented research organization. For more information, visit us at www.ise.fraunhofer.de

R&D for vehicle-integrated photovoltaics

As the originator of the idea of agrivoltaics, Fraunhofer ISE has more than 12 years of experience in dual land use applications for agriculture and PV power generation. Fraunhofer ISE worked in over 30 agrivoltaic projects in 12 different countries and provides R&D services, ranging from the development of an agrivoltaic design and light simulations, through feasibility studies and GIS-based potential analysis, to economic assessment.

More information:

https://www.ise.fraunhofer.de/en/business-areas/photovoltaics/photovoltaic-modules-and-power-plants/integrated-photovoltaics/agrivoltaics.html5

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Conexio-PSE GmbH

Conferences for the Innovative Energy Industry

Conexio-PSE organizes renowned international scientific and practical business conferences focused on renewable energies, energy balance transformation and the efficient use of resources.

We combine our specialist expertise from the energy industry and science with our years of experience in event organization and cutting-edge concepts to promote innovation through networking and knowledge sharing. In our work, we bring together in-depth content and expert quality with targeted and modern event conceptualization.

Our goal is to ensure a sufficient livelihood for the generations to come. That is why we work toward sustainable use of global resources and the transformation of energy supply. We advance these efforts by uniting science, applied research, industry, politics and finance with real-world users at our conferences.

Our next conferences:

- **SolarPACES 2022** Conference in Albuquerque, NM: www.solarpaces-conference.org
- **PVinMotion 2023** Conference in s'Hertogenbosch: www.pvinmotion-conference.com

For more details, please visit our company website: www.conexio-pse.de/en

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About BayWa r.e.

At BayWa r.e. we r.e.think energy - how it is produced, stored and can be best used to enable the global renewable energy transition that is essential to the future of our planet.

Based in 29 countries, with revenues of almost €3.6 billion and sustained growth throughout the company's history, BayWa r.e. is a leading global renewable energy developer, service provider, distributor and energy solutions provider. Operating throughout Europe, the Americas and Asia-Pacific, we are strategically investing in emerging markets around the world, actively shaping the future of energy and taking a stand against climate change.

BayWa r.e. delivers end-to-end project solutions involving planning, development, construction, and ongoing operations management. Using our innovation, creativity and expertise, we have successfully brought over 4.5 GW of renewable energy online and manage over 10 GW of renewable energy assets, ensuring they operate at peak efficiency for our customers. We are also an Independent Power Producer with a growing portfolio and an expanding energy trading business.

BayWa r.e. is working with businesses and organisations worldwide to provide tailored renewable solutions that reduce carbon footprints and drive down energy costs. Operating 100% carbon neutral, we are also committed to our own sustainability journey and are driving forward multiple social, environmental and economic initiatives globally.

As a leading global supplier to the solar distribution market, we provide a comprehensive range of products and industry leading customer support. Through first in class training, logistical expertise and online services, BayWa r.e. is a preferred partner for thousands of installers and contractors.

BayWa r.e. AG

Embracing equity and diversity, we are committed to creating inclusive environments where everyone can reach their full potential. Every day, we are working hard to find new solutions, push technological boundaries and redefine service standards to make renewable energy even better.

Our joint shareholders are BayWa AG, a globally successful business with revenues of €19.8 billion, and Energy Infrastructure Partners, a market leader in energy infrastructure investment that manages over €2.6 billion from global investors.

Our Agri-PV activities at a glance:

Dual-use of farmland
Overhead PV „Fruitvoltaic“ or „Rangevoltaic“

Parallel-use of farmland
Interspace PV

SolarGreenhouse
Controlled Environment Atmosphere

BayWa r.e.’s Agri-PV mission:

- We enable simultaneous production of sustainable food and solar PV power on one and the same area
- We preserve our natural environment, and secure fruitful soils for food production
- We increase farmers’ resilience by facilitating their climate change adaptation and mitigation strategy

Agri-PV is in our DNA

Together with our mother company BayWa AG, we at BayWa r.e. leverage competencies and networks of both our core segments agriculture and clean energy.

We use our global know-how of successful utility-scale PV engineering for both fixed-tilt and tracker technologies, combined with sustainable agriculture to harvest the synergies of the two sectors in an optimal manner.

With agricultural production between PV rows, so called Interspace PV, we enable a symbiotic generation of food and clean energy in the same area, increasing the land-use efficiency substantially on top of delivering many further ecological and techno-economic benefits for farmers.

BayWa r.e. AG

2.67 MWp fruitvoltaic project Babberich, the Netherlands.

Project Babberich, protecting 31,000 raspberry plants

1.2 MWp fruitvoltaic project Wadenoijen, the Netherlands, protecting 4,500 redcurrant plants

BayWa r.e. AG

Fruitvoltaic project
Boekel, the Netherlands,
for strawberry plantation.

Fruitvoltaic project
Broekhuizen, the Netherlands, with
integrated closed irrigation
and recycling system

Fruitvoltaic project
Gelsdorf, Germany,
for eight different apple variants.
Fully automated water irrigation and
frost protection systems included.
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BayWa r.e. AG

Fruitvoltaic project
Gelsdorf, Germany.
258.3 kWp on 3,600 m^2.
©Fraunhofer ISE

More information:

https://www.baywa-re.com/en/solar-projects/agri-pv

Join us on

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We are bringing the energy revolution!

Photovoltaics have seen impressive development over the past 20 years in terms of falling costs and increased uptake. The sector is now facing more sophisticated challenges, in particular as regards land usage and the continuous availability of renewable energy. Next2Sun was founded to create solutions for the energy revolution with a new system concept. Next2Sun's goal is to consolidate renewable energy generation, reduce the land usage in free field photovoltaics, and develop new areas of application for photovoltaic systems. Since then, Next2Sun has been using its vertical, bifacial system technology and the patented frame system developed for it to create and market a wide range of products for agriculture and the public, commercial and private sectors.

Our solutions enable cost-effective, sustainable, environmentally power generation by combining innovative multiple use with optimized generation profiles. We want to work with you to expand the use of renewable energies, combat climate change and help protect the environment and the natural world. And we have the right team to do it: thanks to many years of experience in renewable energy sources and the variety of professional backgrounds across every member of our team, we are able to

Next2Sun

continually develop our skills and strengths and thus build up solid expertise. As your trustworthy innovation partner, we are bringing the energy revolution – in more ways than one.

AgriPV: a double harvest from agriculture and solar energy!

In densely populated countries competition for land is becoming increasingly fierce between the energy and agricultural industries. To combat this, the Next2Sun concept enables areas to be used simultaneously for both energy generation and agriculture, thus increasing space efficiency. Various investigations have shown that installing PV modules has a positive impact on agricultural yields, thanks to the shade and wind protection they provide. This creates a genuine win-win situation that both generates additional energy and benefits the farm.

Due to the consistent, vertical east-west orientation, peak loads can be reached in the morning and evening hours – counter-cyclically to the existing south-facing plants. This is beneficial for electricity grid stability and enables plants using the Next2Sun-concept to be connected to grid branches that are already operating at full capacity and higher revenues on the electricity exchange.

The solid steel construction consists of mullions and crossbeams. Two mullions and three crossbeams hold two vertically stacked bifacial glass-glass modules. The total height of the bifacial mounting system can flexibly be modified and usually has a height of about 3 meters above the ground. The frame design is developed for an easy and flexible mounting as well as a long lifetime. Combined with the glass-glass modules used in the system, this leads to a very long lifetime for the whole system. It is designed for high strength requirements, especially resulting from wind loads.

Next2Sun

Variable row spacings of at least 8 meters enables versatile agricultural utilization concepts. Furthermore, the freestanding system is suitable for grazing cattle, sheep or chickens. The considerate handling of the resource soil leads to high acceptance. The Next2Sun concept achieves an appropriate balance between agriculture and electricity production of sun power. Up to 90% of the solar park area can still be used for agricultural purposes. The space of at least 8 meters between rows enables the use of conventional agriculture machinery, securing efficient work management. This further reduces “excessive land consumption”. Primarily the plant area is suitable for all types of grassland utilization:

- Meadows used for hay or silage
- Pasture farming (cattle, sheep, etc.)
- Biomass and material use
- Arable land is also possible

Next2Sun

Depending on the type of use, the machinery used for farming as well as the photovoltaic plant itself will be technically adjusted to enable optimal use of the area. (Examples: protection against stone chipping or protection against cable bites in pasture farming).

Due to the linear structures and the low degree of overbuilding, high-quality natural grass areas are created in which specific habitat structures can be established in addition. In addition to agricultural use, the large spaces between rows also offer scope for agri-environmental or compensatory measures. Due to the vertical arrangement of the module areas, the value of the ground area is hardly affected:

- Insignificant level of overbuilding: less than 1% of the ground surface, no sealing, no foundation
- Almost unchanged water supply: no change in the distribution of rainfall
- Only minor changes in insolation: just about 10% to 15% of the annual solar radiation is being used by the photovoltaic plant

This results in very low influence on the vegetation growth. Thus, habitats can be created on either whole plant area or parts of it, as well. Habitats, which have become very rare in today's monotone agriculture landscape can be created:

- Grass and flower strips, e.g. for insects and butterflies
- Deadwood areas, e.g. for birds, fungi and beetles
- Piles of stones, e.g. for reptiles

In addition to linear habitat structures, flat habitat structures such as wildflower meadows can be created on the entire park area or on partial areas. The system concept thus allows for the specific project and site requirements to be met.

Next2Sun

While the optical long-distance effects are comparable to conventional photovoltaic plants, the appearance at close range is less technically characterized as there are no module back panels with visible junction boxes and cables. The low overbuilding is a huge advantage especially for birds, as seen from the bird's-eye view the ground surface remains almost completely open.

Furthermore, dazzle effects outside of the solar plant are almost impossible as any reflections of the vertical constructions due to physics can only go to the ground.

Next2Sun solar fence for agriculture

Numerous farmers have been setting a good example in renewable energy generation for many years. However, not all roofs are ideally suited to installing PV systems. An intelligent alternative and addition to the range is the bifacial solar fence – the fence that pays for itself. The fence is a solar system and enclosure rolled into one and can also provide shade and visual cover from predators. The Next2Sun solar fence can do more than simply generate enough power to cover agricultural requirements – it also serves as a low-maintenance, weather-resistant replacement for traditional fences. In addition, the bifacial solar fence offers another interesting area of application: it can provide independent generation solutions for consumers in adjoining areas (e.g. water pumps), and is also suitable for all animal species, including both large and small livestock.

Next2Sun

The benefits of a premium bifacial solar fence.

- A solar fence performs two tasks at once – providing an enclosure and generating electricity.
- The vertical configuration minimises your PV system's space requirements.
- The ground-level positioning is easy to assemble and maintain.
- A solar fence can be ideally adapted to electricity requirements: in an east-west orientation it provides significantly better results than conventional systems during the morning and evening, whilst in a north-south orientation, the system is able to capture light particularly well when the sun is low.
- The high level of efficiency on the rear side means that electricity continues to be generated even on the side not directly in sunlight.
- Whilst a rooftop system does not produce any electricity or requires time-consuming clearing when it is snowing, the activity of the solar fence will even be improved by increased reflection off the ground.
- The slim construction, modern design and long life of the solar fence make it an ideal space-saving, visually appealing fence replacement offering genuine added value.
- Grazing barriers can be integrated into the system, preventing large livestock from scratching the frame.

Product facts & figures

- Solid steel construction
- Consisting of two posts and two bars
- Height 1.5 m with a standard 40 cm distance from the ground, and length up to 2.15 m
- The size of the PV module is the same, at approx. 1m x 2 m
- If desired, the distance between the solar fence and the ground can be filled with a perforated plate, a stanchion plate or an aluminium plate
- There are various combinations of options available when selecting the lower part of the fence, such as wire mesh, a bar grate or a privacy plate

Next2Sun – your partner for innovative energy solutions!

We look forward to hearing from you!

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Figure 1 Agrovoltaico® wine

REM Tec is an Italian-French company, created in 2015 as a spin-off of REM based its 2 basic worldwide patents of agrivoltaics filed in 2009.

The concept of "Food and Energy" is already promoted since 2011 at the start-up of the Virgilio agrivoltaic site (Italy). By developing new agrivoltaic technologies as well as in agriculture research on his agrivoltaic industrial sites, REM Tec has become a worldwide leading role in the Agri-PV segment. Today, REM Tec has in force or under examination 10 patents for fixed as well as tracking technologies. Our technologies are branded as "Agrovoltaico®" which is a registered trademark.

We are developing our technologies with the basic principle of agriculture first and energy as a second product to allow an optimized use of the irradiation for photosynthesis as well as photovoltaics. Therefore, REM Tec has implemented a multiyear R&D program by studying different crop behavior under several shadow conditions. REM Tec has produced the first Agrovoltaico® wine worldwide (Figure 1) and has presented our newest Cuvée Laura at Intersolar in Munich in May 2022.

All our research activities are conducted under a scientific support of leading R&D institutions from Italy and France (Figure 2).

UCSC – Università Cattolica del Sacro Cuore

CIRAD - Centre de coopération internationale en recherche agronomique pour développement

CNR – Consiglio nazionale delle Ricerche

IFV - Institut Français de la Vigne et du Vin

INRAE - Institut national de recherche pour l'agriculture, l'alimentation et l'environnement

Figure 2 R&D Partners

REM Tec srl

The first technology developed by REM Tec is the mono-axial or bi-axial tracker. The last release of Agrovoltaico® trackers 2.1 (Figure 3), consists in a 14 meter long horizontal tube "primary axis", supported by two poles 4.5 - 6 meters high, crossed by 4 wing rows, each one supporting three photovoltaic modules, typically made by 78 cells; the use of bifacial modules, as demonstrated by experience during the years, can lead to a total increase up to 50% in energy production compared to ground mounted systems, as it allows a greater efficiency of solar radiation reflected from the ground. The trackers are arranged in rows which are typically distant from each other from 12 to 18 meters, accordingly to the geography of the land, the configuration of the existing, or future, crops and the optimized shading for these crops.

The tracking algorithm is designed to optimize crop growth combined with power production through an optimized shadow management. For a bi-axial tracking system, the combined rotation of the two axes allows the modules to be constantly perpendicular to direct radiation when the energy requirement for photosynthesis has been reached. Added to that, the backtracking algorithm VoltaicoPlus avoids the mutual shading between the panels in the initial and final phases of the day, through a correction of the calculated theoretical position returned by the tracking algorithm.

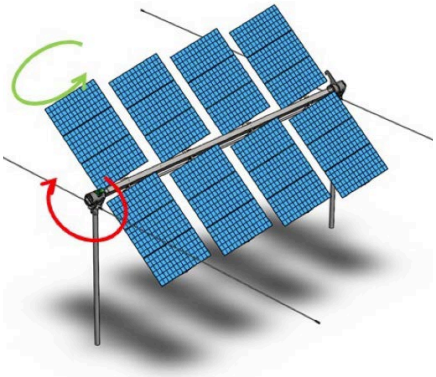


Figure 3 Agrovoltaico® Tracker 3D-T2.1

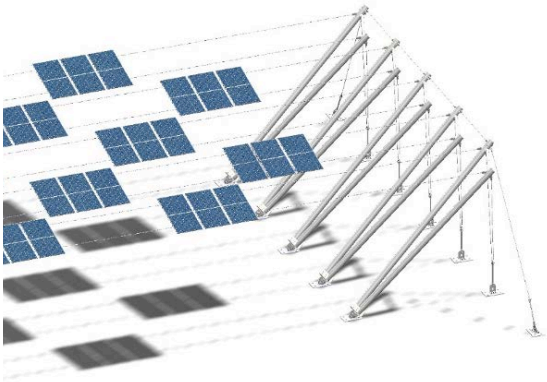


Figure 4 Agrovoltaico® fixed chessboard configuration

In 2021 REM Tec has introduced the fixed Agrovoltaico® technology, with PV modules mounted on suspended wire ropes at around 5 m height. The design is done to have a span up to 25 m between the poles allowing large agriculture machine to optimize agriculture and related operation costs for crop production. This design is also done for large field cultures and has a really low footprint. Then, the PV modules can be arranged in a chessboard placement (Figure 4) generating a homogeneous shadow on the ground, very important for agricultural compatibility, or in a linear configuration with modules continuously along the row. The choice between the 2 configuration is done according to the crop irradiation needs.

REM Tec srl

REM Tec's service provides a one-stop-shop solution tailored to assist project developers and asset managers in all relevant project phases, from the preliminary project phase, to project development phase, construction and O&M services.

The choice between fixed vs. tracking systems depend on various factors, with irradiation reduction and management being one of the most important ones. The tracking system guarantees a homogeneous and dynamic solar radiation for the underlying crops and it allows to manage the percentage of shading on the ground, even making it zero if necessary, in order to optimize agricultural production (Figure 5).

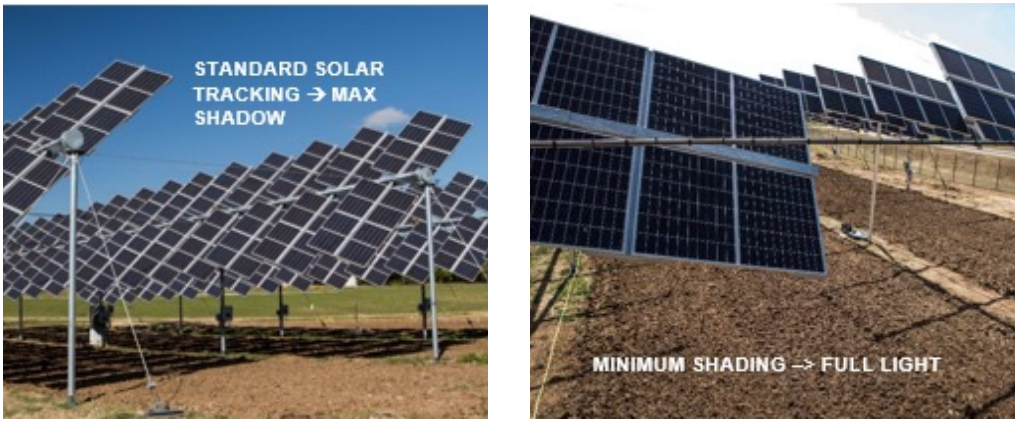
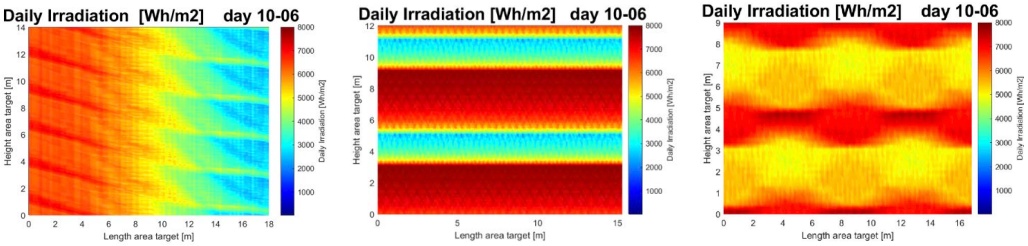


Figure 5 Management of the shadow below Agrovoltaico® tracker 3D

The linear configuration of the fixed AGV produces a very static shadow on the ground with a marked gradient of irradiation, while the chessboard configuration of the fixed AGV allows all part of the ground to receive high amount of irradiation.
The graphs in Figure 6 the cumulative irradiation on the ground on a summer day under different configuration of Agrovoltaico® plants. The area considered is the target area, which is representative of the irradiation over the entire plant. The dimension of the target area varies with the distance between the rows



(a) 3D-T2.1 tracker Agrovoltaico® 45° N oriented, 18 m rows pitch

(b) Fixed Agrovoltaico® system, Stripes configuration, south oriented, 20° tilt, 6 m pitch

(c) fixed Agrovoltaico® system, Chessboard configuration, south oriented, 20° tilt, 3 m pitch

Figure 6 comparison of the cumulative daily irradiation in the target area

REM Tec srl

Studies conducted in cooperation with several R&D centres show that the shadow generated by the modules has a positive impact in terms of water saving and yield; as example, for what concerns corn crops cultivated under a double axis system, a decrease of 26% in water consumption and an increase of 4,3% in agricultural yield can be reached, compared to an open field situation. In fact, Agrovoltaico® technology is helpful for crop production under drought conditions, because it reduces the evapo-transpiration, therefore reducing the water consumption.

Agricultural research conducted by REM Tec on Virgilio site showed positive impact of the Agrovoltaico® system on soil humidity and air temperature, which are respectively increased and reduced under the plant in comparison with open field scenario.

Agrovoltaico® plants are in operation in Italy, France, China as well as in Japan. Further projects are currently under development in other countries. We have a track record of operation since 2011 when the first worldwide three agrivoltaic plants have been connected to grid in North Italy, for a total of 6.7 MWp with 2384 3D trackers over 35 ha (Figure 7).

Castelvetro (PC)

Technology: 3D T1.0
Nominal Power: 1293 kWp
Tracker Nr 462
Plant surface 6,8 ha
Ground cover ratio: 14 %

Virgilio (MN)

Technology: 3D T1.0
Nominal Power: 2150 kWp
Tracker Nr 768
Plant surface 11,4 ha
Ground cover ratio: 14 %

Monticelli D'Ongina (PC)

Technology: 3D T1.0
Nominal Power: 3229 kWp
Tracker Nr 1154
Plant surface 17,1 ha
Ground cover ratio: 14 %

Figure 7 Agrovoltaico® plants built in 2011 in Italy

Said plants are built with the first release of Agrovoltaico® tracker 3D-T1.0, which consists in a 12-meter-long horizontal tube, which supports 5 wing rows, each one supporting a photovoltaic module, typically made by 72 cells. The rows of trackers are distant from each other at least 12 meters. They are connected through a tensile structure to support cabling and to minimize soil footprint. The height of the system is around 4-4.5 m from the ground allowing traditional agricultural machinery work underneath.

A part the feedback of the industrial plants, REM Tec is conducting since many years experimental research on the largescale Virgilio agroPV plant with wheat, corn, alfalfa, soy, rice, grapes, horticultural crops, such as salad, potatoes, tomatoes, pumpkin,

REM Tec srl

melons, raspberries as well as kiwi, etc. Results remains preliminary and until results have been confirmed through multiple harvests, the data mining is ongoing.

With the same technology it has been built 544 kWp in China through our licensee Sharepower in 2016 (Figure 8)

In 2019 a demo plant for EDF R&D has been installed by REM Tec in Les Renardières using the technology 3D-T2.0 (Figure 9). The main differences with T1.0 are:

- The-32 PV modules (60 cells) on 4 secondary axes vs 10 PV modules on 5 secondary axes;
- Improved tracker control system for better efficiency;
- Use of actuators and triphase motors instead of stepper motor

In 2020-21 our Japanese licensee Notus Solar has installed with REM Tec's support 1 MW of Agrovoltaico® plants using both 3D-T2.0 and 3D-T2.1 trackers (Figure 11).

In 2022, REM Tec will install a demo plant as partner of EDF and under support of the French ADEME in Beaucaire. This plant will use a newly developed fixed suspended technology (Figure 10).

China – 2016

Technology: 3D T1.0
Nominal Power: 544 kWp
Tracker Nr 168
Ground cover ratio: 14 %

Figure 8 Agrovoltaico® plant in China (2016)

France – 2019

Technology: 3D T2.0
Nominal Power: 117 kWp
Tracker Nr 12
Ground cover ratio: 40 %

Figure 9 Agrovoltaico® plan in France (2019)

France – 2022

Technology:
Fixed suspended
Nominal Power: 37 kWp
Ground cover ratio: 27 %

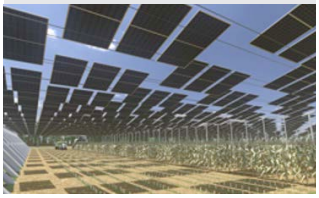


Figure 10 Agrovoltaico® plant in Beaucaire (France)

Ibaraki (JP) – 2020

Technology: 3D T2.0
Nominal Power: 171,5 kWp
Tracker Nr 462
Ground cover ratio: 40 %

Onuki (JP) – 2020

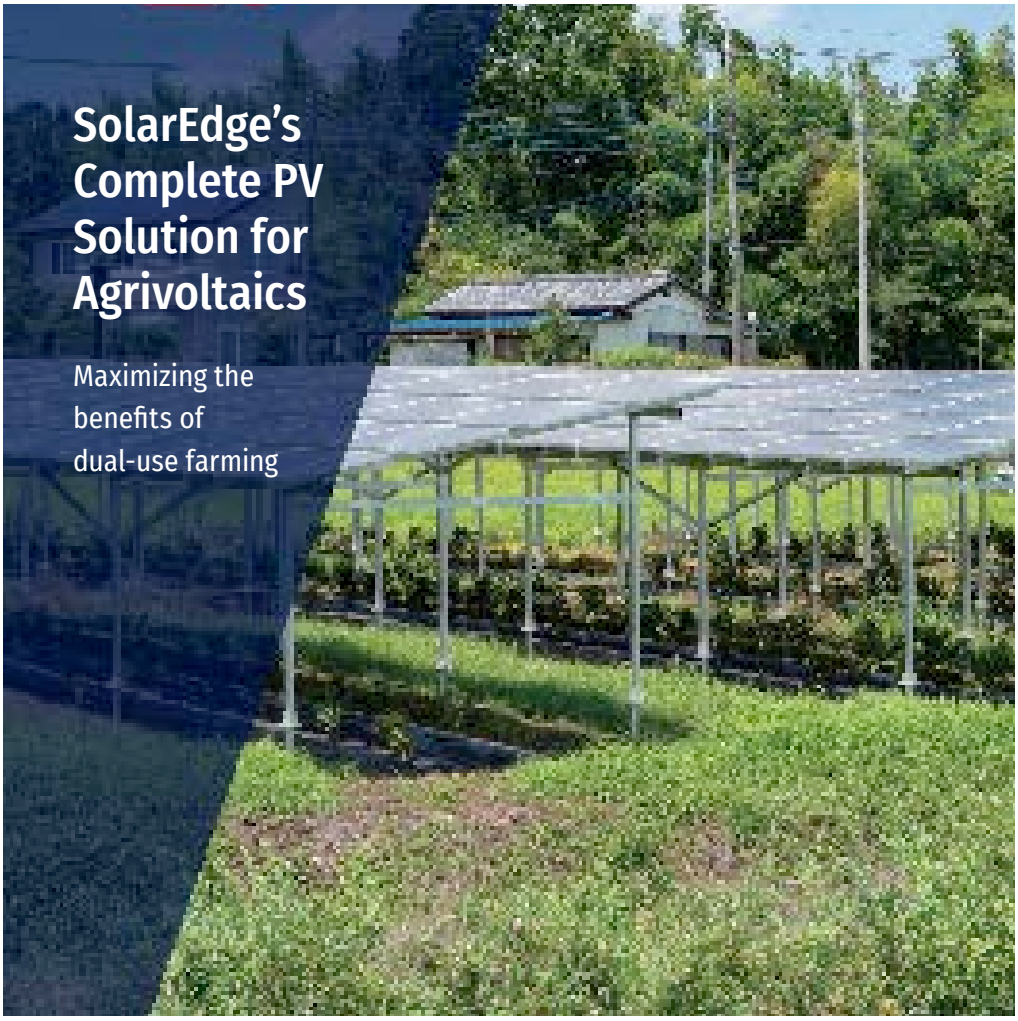
Technology: 3D T2.0
Nominal Power: 834 kWp
Tracker Nr 64
Ground cover ratio: 40 %

Iga (JP) – 2021

Technology: 3D T2.1
Nominal Power: 64 kWp
Tracker Nr 4
Ground cover ratio: 30 %

Figure 11 Agrovoltaico® plants in Japan

SolarEdge Technologies, Ltd.
www.solaredge.com



Farmers today are facing challenges to their profitability from rising energy prices, extreme weather patterns, and lack of available land for both crop cultivation and renewable energy production. Dual-use farming – using the same piece of farmland to harvest both crops and solar power – solves these issues while enabling sustainable farming practices, incentivized by green government subsidies. Solar modules can be installed above or in between rows of crops, as well on rooftops of barns, sheds and greenhouses. The solar power produced can be used on the farm to offset electricity costs and also sold to the grid as an additional source of revenue.

SolarEdge provides an optimized solution for agrivoltaic (agri PV) systems which is uniquely equipped to extract more value from dual-use farming and increase farm profitability.

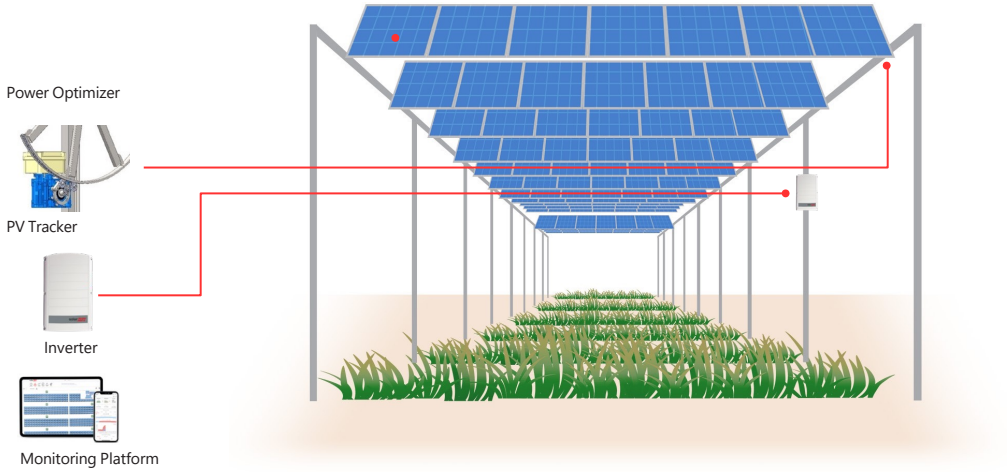
SolarEdge

Harvesting More Energy and More Crops

The SolarEdge agri PV solution is comprised of a DC optimized PV inverter and Power Optimizers together with smart, artificial intelligence-driven PV trackers.

SolarEdge Power Optimizers are connected to the PV modules to mitigate module mismatch related power losses, enabling 2%-5% more energy production in the first year and up to 10% more energy over the system's lifetime compared to PV installations with string inverters. SolarEdge inverters and Power Optimizers are ammonia resistant so there is no problem fertilizing in nearby areas.

The Tracker Control System adjusts the angle of the solar modules according to a smart backtracking and DNI-DHI (direct normal irradiance and diffused horizontal irradiance) optimization program to maximize sunlight exposure and increase system performance by up to 6%.



Combatting Extreme Weather with Agri PV

Extreme weather temperatures due to global climate change can decrease crop yields. Elevated solar modules can reduce the impact of hail, wind and heavy rain. The shade produced by the solar arrays protects crops from over-exposure to the sun and keeps the soil moist so less water is required, saving on irrigation costs. Partial shading has proven to be advantageous to different types of crops such as leafy greens, root vegetables and berries, particularly in hot and dry areas.

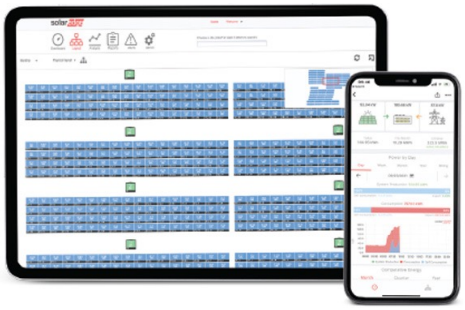
SolarEdge

The dedicated tracker control system understands solar and agricultural seasonal patterns and shifts using a weather-responsive tracking algorithm powered by AI-based self-optimization.

To maximize agricultural yield, the trackers can also be customized according to type of crop, specific environmental requirements, and location.

Monitoring Agri PV System Performance

In order to maximize the benefits of dual-use farming, it is critical to monitor performance data and measure agricultural behavior, changes, and actual output.



The SolarEdge Monitoring platform offers remote module-level tracking and reporting of energy production performance together with a thorough check-up of the health of the entire system. This minimizes the need for on-site visits where modules are hard to reach, and enables remote troubleshooting with almost no interference with agricultural activity. Accessed from a smart phone or PC, the SolarEdge Monitoring platform provides both real-time and historic performance data including real-time alerts for immediate fault detection.

Advanced Safety: Protecting People, Crops and Assets

PV system safety in agrivoltaics is a top priority to protect workers tending crops beneath the solar panels, as well as the crops and farm equipment.

SolarEdge's patented SafeDC™ functionality ensures a safe work environment in the event of grounding or disconnection problems occurring either in the AC or DC circuits, or if the PV system must be shut down. With SafeDC™, the system's high DC voltage is reduced to touch-safe levels within 5 minutes during the day, when necessary. In addition, an Arc Fault Detection and Interruption feature combined with temperature sensing features throughout the system identify imminent arc threats and prevent arcs from happening.

SolarEdge

About SolarEdge

SolarEdge is a leading global innovator of smart energy solutions that power our lives and advance sustainability. SolarEdge developed a ground-breaking intelligent inverter solution that changed the way power is harvested and managed in photovoltaic (PV) systems. Today, the company offers numerous smart energy management solutions for PV, storage, EV charging, UPS, and grid services.

SolarEdge is listed on S&P 500 and is approved by major banks, insurance companies and financial institutions worldwide. More than 30% of Fortune 100 companies use SolarEdge systems.

solaredge

Innovative
Developer of state-of-the-art technologies with 420 awarded patents

Network
Cultivates local networks of vendors, EPCs, installers, insurance companies, investors, and banks

Expert
More than 15 years of proven know-how in efficient energy production and management

Bankable
Nasdaq-traded company, world's #1 solar inverter company in revenue, with over 3.7M inverters installed in 133 countries

Join us

Sun'Agri

Sun'Agri
4 quai des Etroits
69005 Lyon, France
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www.sunagri.fr/en

Sun'Agri, pioneer and leader in dynamic agrivoltaics.

Sun'Agri is a global leader and pioneer in Agrivoltaics, with headquarters in France. Our innovative technology has been developed since 2009 based on extensive academic research and field experiments.

It combines artificial intelligence and in-depth agronomic expertise to provide agro-climatic solutions for crop resilience.

Our solution addresses both the climate change challenge for agriculture and the land scarcity challenge for green energy production.

It has awakened the interest of crop growers and power producers around the world, with commercial scale implementation in France since 2019.

Sun'Agri

With more than 80 MWp currently in operation, under construction or at an advanced stage of development in France, Sun'Agri is ready to capitalize on its achievements on its home territory to expand internationally and bring this solution to growers and IPPs with similar concerns in other regions.

While Agrivoltaics is attracting increased attention around the world, we are focused on strengthening our activities in countries ready to set up a supportive framework for high quality projects.

SUN'AGRI IN FIGURES

2009 Start of R&D program jointly with INRAE* + **10%** of the turnover invested in R&D + **50+** agronomic and IT researchers involved + **35+** achieved and on-going projects

*INRAE : French National Research Institute for Agriculture, Food and the Environment. It is the World's 2nd largest agronomic center.

AWARDS

SITEVI INNOVATION AWARDS 2019

SIVAL INNOVATION 2021 OR

Climate crisis threatens farming

Weather events are increasing in frequency and severity due to climate change, causing disastrous damage to crops each year.

Crop growers must now cope with substantial losses in both yield and revenue, and hence face mounting uncertainty for the future of their agricultural activity and livelihood.

- Disruption of plant cycle and early maturation
- Yield reduction in quality and quantity
- Slowed or stunted plant growth
- Soil imbalance and disturbance
- Increased irrigation needs
- Devastating spring frost
- Frequent hail
- Loss of origin-specific product quality

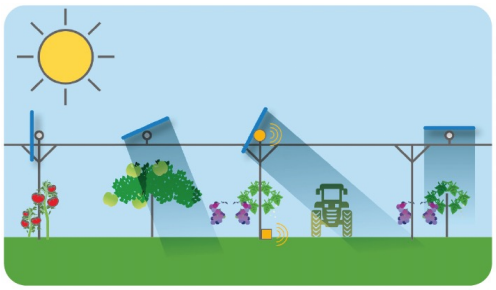
Sun'Agri

We tangibly limit the impacts of such hazards thanks to our solutions that effectively reduce hydric, radiation and thermal stresses. By doing so, we help growers to achieve higher yields and to maintain long-term visibility over their revenues.

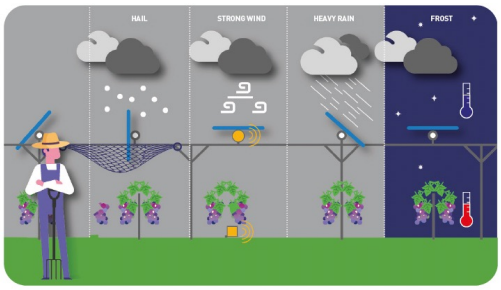
Experimental system in a vineyard – Piolenc, France

The benefits of dynamic agrivoltaics

Thanks to our dynamic agrivoltaic system, the crops and the soil are in optimal agro-climatic conditions, which allows a permanent improvement of the agronomic potential of the plot and stabilizes the yields.

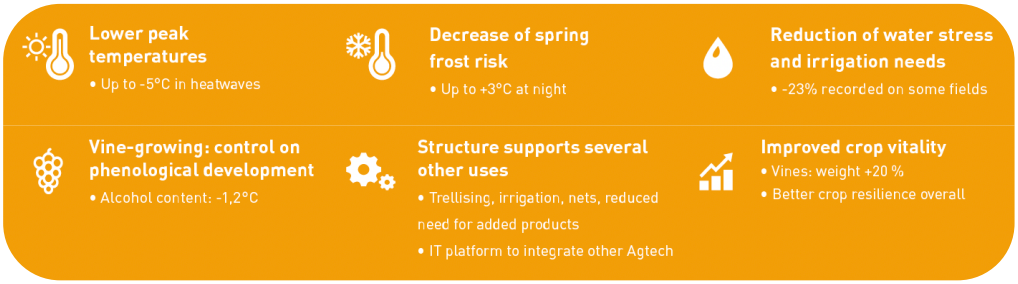


In normal conditions, the solar panel angle is piloted in real time within a range of +/- 90° to match each plant's needs for sunlight and shadow.



In case of climate risks, the solar panels provide protection to crops. At night, they are left in a horizontal position to maintain temperature.

Positive impacts on crop growth



Sun'Agri

Our unique agrivoltaic offer

We bring in a team of experts who tackle challenges with a unique multidisciplinary approach. The team includes computer scientists, agronomic researchers, PV project managers, mechanical and electrical engineers, financial advisors. Depending on your skills and needs, we are ready to adapt the scope of our work.

DYNAMIC AGRIVOLTAIC INFRASTRUCTURE

- Metallic structure designed to last more than 30 years
- Solar trackers operate independently, row by row
- Height and spacing tailored to each crop grower's needs
- Entirely recyclable

REAL-TIME CONTROL

The solar panel position is based on:

- Instantaneous agroclimatic and physiological measurements
- Scientific models of plant growth
- Weather forecasts
- Production targets

AGRONOMIC MONITORING

- Crop conditions checked frequently to ensure growth as planned
- Comparison with a control plot left without solar panels

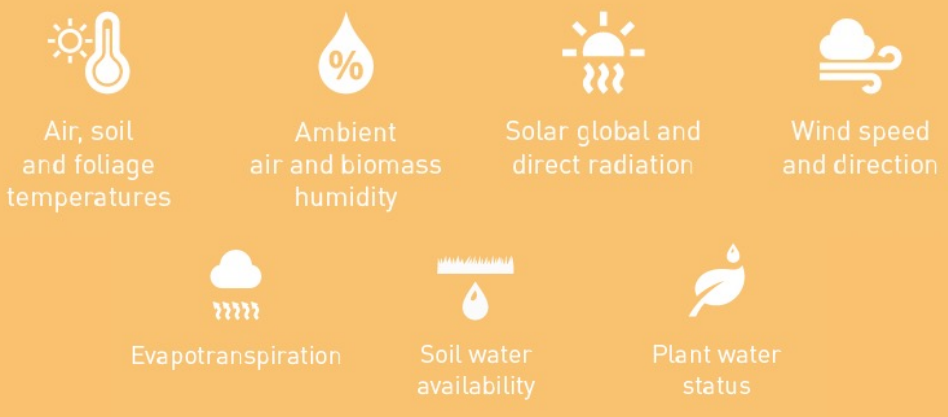
REAL-TIME APP

- MySunAgri® App developed by Sun'Agri for crop growers
- Sharing of all agroclimatic data in real-time

PROJECT DEVELOPMENT SUPPORT

- Agronomic qualification of crop types and individual projects
- Specification of the agri-tracker within the agricultural constraints
- Assistance if needed to convince local authorities
- Support in finding financial solutions and in financial closure

We record data every minute:



Enoé group is a French independent green and local energy producer, managing the overall value chain (design, development, finance, construction, operation, and maintenance).

Enoé was created by 3 experienced entrepreneurs convinced by the urge to respect our environment who have set themselves the objective of producing accessible renewable energies.

Enoé's development strategy is based on innovation and strong local presence to answer the needs of a growing market facing multiple challenges:

- Secure energy prices through PPAs for companies
- Develop agrivoltaic solutions with the key objective of a positive synergy between renewable energy and agricultural productions
- Optimize artificialized areas to enable double-usage

Enoé stands for a sustainable synergy between renewable energies and agriculture, and defines the agrovoltaic approach as follow:

Positive synergy between agricultural production and photovoltaic production, where the agricultural project is at the center of the project and the agrivoltaic tool renders one or more services to the farmer in order to guarantee the continuity of the agricultural activity and its technical-economic performances on the long term while allowing a double use of the land.

Enoé vows to follow recommendations from the various French agricultural federations and institutes on all of their projects:

- Make agricultural activity, animal wellbeing and environmental protection a priority
- Contribute to the durability of agricultural plants and develop modern, efficient, and reliable production solutions
- Fight against major agriculture challenges

Enoé' offers complete production tools, integrating the needs from technical itineraries, while being the simplest possible to guarantee their good usage, longevity, and economical viability.

enoé

FONDAMENTAL PRINCIPLES OF OUR AGRIVOLTAIC PROJECTS

At first, an agricultural project...

- Place the farmer at the heart of the project: the project must be co-designed with the farmer, our teams provide full support and advise to adapt our solutions to his needs, while considering the technical and economic viability of the tool.
- Offer solutions that improve the productions' quality and targeting forecastable productivity to make the agricultural productions sustainable.
- Preserve agricultural land: the land keeps its initial and main agricultural vocation, no modifications of town planning zoning, only mentioning the renewable energy production.
- Project conception scaled to the overall farm and not only to the parcel, to guarantee a viable technical and economic project on the long run.
- Revenue repartition on a working farm: when the project includes a payment, it is divided in a minor share for the landlord and a major share for the farmer
  > The rent paid to the landowner(s) must not increase the price of the land.
  > The payment made to the farmer in the form of a service contract, as additional revenue and not competing with his agricultural revenues, can not exceed 35% of the agricultural revenues.

...fitting with a territory...

- Our solutions are adapted to each agricultural sector and territory
- Consultation and transparency towards all the parties at early stages of development
- Consideration of each territory and farm' specificities in the conception of our solutions
- Economic outcomes adapted to the collective needs of the territory
- Crowdfunding offered to the inhabitants

...Respecting the environment...

- Support and encourage agricultural projects respecting the environment: optimizing the water needs, limiting the inputs, maintaining at least the existing level of biodiversity
- Preserve the ground: monopile, drive piles, peripheral tracks and tailored firemen access defined, usage of trackers - except for >10% gradient in field protection (solutions: ovinoé, arboé, vitinoé).

enoé

- Avoidance as an evidence: our motto “adapt the project to its environment and territory, and not the other way around”. Our teams integrate this philosophy at each stage of the projects’ development, from the conception to the construction, operation, and maintenance. This way, our agrivoltaic projects avoid the important concern of fauna and flora and adapt to the landscape. The wooded elements and the hedges are kept, cleaning is prohibited, the hydrologic network is kept as is, leveling is done at bare minimum.

...reversible...

- Project conception considering the evolution of agricultural activities for the duration of the agrivoltaic station: each solution is based on and adapted to an activity, which can evolve (piloting the modules, space between the rows of modules enabling to consider a change in agricultural activity). The approach scaled on the overall farm enables to consider modifications of productions on parcels.
- Guaranteed dismantling of the agrivoltaic station and rehabilitation of the site, in compliance with regulation

Finally, projects managed to guarantee their agricultural purposes and famers’ wellbeing on the long run

- Improve the working conditions of farmers (physical protection against climate risks, eased path for machines, remote monitoring of the site)
- Guiding the farmer all along the development and operation of the agrivoltaic station
- Offer training to the farmer
- Secure all parties thanks to a contractual agreement: emphyteutic lease between enoé – the landlord - and in presence of the farmer, agrivoltaic convention between enoé and the farmer mentioning the conditions of long term provision, the role of each party, and the services contract if necessary
- Respect the recommendations from the agricultural federations
- Provide an agronomical guidance through an independent organization stated by a convention of agronomic follow up between the farmer – enoé – the agronomical organization

enoé

OUR AGRIVOLTAIC SOLUTIONS

Based on international feedbacks, in collaboration with the representatives of the various agricultural sectors and farmers, enoé has developed several agrivoltaic solutions:

- Arboriculture and viticulture (Vitinoé and Arboé solutions): protection as field shutters where a row of modules is placed on top of the culture rows to bring physical protection against climate hazards et create a microclimate favorable towards plants' growth. These structures integrate irrigation and antifreeze systems by water-saving sparkling. The set-up of nets and usage of the structure for the fence are possible. The modules with various intensity of transparency (0 to 50%) on trackers are piloted depending on the light needs and the optimal microclimate depending on the phenology phases. The objective is to offer a ready to use production tool enabling to secure the productivity and lower the costs of production (water / inputs).
- Market gardening: photovoltaic glasshouse designed depending on the cultures produced by the farmer, in order to adapt in terms of light and ventilation. Some cultures, in specific regions, need to grow in an entirely controlled environment. Thus, the photovoltaic glasshouses are relevant production tools for some farmers, despite the ground waterproofing and specificities sometimes too important to adapt to any type of culture.
- Poultry-farming (Avinoé solution): a combination of solar shelters and agroforestry, enabling the valorization of poultry routes by encouraging animals to move while respecting the recommendations of the profession (a maximum of 10% of the route covered by solar shelters).
- Ovine farming (Ovinoé solution): enoé created an innovative concept where the development of renewable energies offers solutions in terms of support and re-dynamization of the ovine sector, historical production of several French regions. France is the 3rd European producer of ovine meat, while being largely in deficit of ovine meat. The population of farmers is elderly: 51% of the farmers will retire in 10 years. Thus, France faces a strong agricultural loss with lots of farms for sale that can't find buyers: only one opportunity out of 3 succeeds. The candidates can't find the necessary funds to acquire the land and invest in the equipment at the same time. Implementing an agrivoltaic station on the agricultural land, if adapted to the ovine farming and respecting strict specifications in terms of set up enables:
  > To lower operating costs by (1) ensuring a protection of the flock on field, meaning a shorter time in sheepfold, (2) improving the quality and quantity of fodder through a protection against climate hazards and (3) improving the working conditions of the farmer

enoé

> To finance the acquisition of the land by the farmer, thanks to the rent paid by the agrivoltaic station developer to the farmer, and thus to guarantee the transmission of farms with the land to farmers, and the upkeeping of this farming activity on the territory
> To ensure a complementary income to the farmer allowing him to diversify his income and thus reduce his financial risks facing the hazards of the occupation of sheep breeder

Our technical solution is composed of rows of bifacial modules on trackers allowing to distribute in a homogeneous way the rainwater, to bring the necessary light to the meadows while protecting them from the strong heats and the cold in order to lengthen the duration of production and the quality of the fodder. The seven meters separating the rows of modules as well as their mobility allow the passage of all the agricultural machines according to the needs of the farmer. The open field protection offered to the animals improves their well-being and the outdoor period: optimized operating costs and work comfort for the farmer who also has access to surveillance cameras on the site and turning and control strips left free of modules regularly on each plot according to their surface and shape. A watering network is created at the same time, optimizing the grazing and the work of the farmer.

In a process of innovation and continuous improvement, we develop new solutions to meet the needs of new agricultural productions.

AXIAL STRUCTURAL SOLUTIONS

Axial Structural specialises in the design, manufacture and installation of solar trackers and fixed assemblies for PV plants.
As expert manufacturers in PV structures, Axial Structural represents a partner with experience, international presence, an innovative approach and a high level of accumulated expertise. With over 300 projects executed across 30 countries, the company benefits from extensive experience in designing and manufacturing customised solutions for every project.

AXIAL
agritracker

INTEGRATED**GREEN**TECHNOLOGY
www.axialstructural.com

In Axial Structural we work to offer tailored solutions, efficient and safe for any type of photovoltaic project. Within our range of products, we have the Axial Tracker 1V Twin, the 2VTT tracker, the new Axial Agritracker and our Ground Mounted Systems.

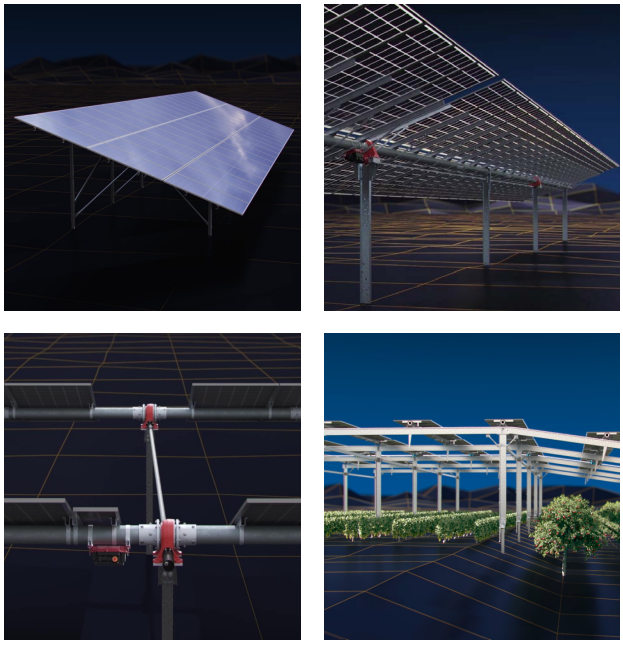
AXIAL'S PRODUCT RANGE

AXIAL FIXED
As an international leader of fixed structures, we design and manufacture customized solutions for any type of solar project.

AXIAL TRACKER 2VTT
Our solar tracker with multipoint stiffening system.

AXIAL TRACKER 1VTWIN
The first tracker dual-row using homokinetic technnology.

AXIAL AGRITRACKER
The Axial Agritracker combines the technology of solar tracking with agriculture.



GridParity AG from Karlsfeld / Munich is active in 4 business areas:

GRID PARITY next generation photovoltaic
in cooperation with AGORA

Business area 1: Modules and components
This division includes the trade with PV modules (mainly double glass design), the unique waterproof mounting, the sale of inverters and batteries.
Due to the participation in Agora Solar a.s. (35 % with option for majority participation) this business area will experience a great dynamic. A module production facility with the latest European technology is currently being built in Vranov/Slovakia. The production volume is to be expanded to up to 150 MWp by the end of 2022 (sales volume approx. € 45 million p.a.) and to up to 450 MWp by the end of 2025.

Business area 3: Carport and large roof systems
Only recently the market segment of large PV parking lot systems has been developed. Due to the PV obligation for larger parking lots introduced in Germany and also in other countries, the offer of aesthetic carports gains considerable importance.

Business area 2: Kits for BIPV
The 2nd division includes the construction of kits for Building Integrated PV-BIPV. More than 500 small and large systems have been sold in the last 10 years. An example is shown in the picture below.

Business area 4: Agri-PV
The AgriPV system concept of GridParity offers two different application possibilities: Highly elevated semi-transparent modules that offer plants protection from the elements (e.g. hail or strong UV radiation), reduce water evaporation by up to 80%, and still involve only minor growth losses due to the semi-transparent design. The 2nd variant is a vertical elevation of the modules in rows with distances that even allow mechanical harvesting. For this, bifacial double glass modules are used, with solar cells that generate electricity on both sides. AgriPV has the potential to become an important driver of the energy transition: By dual-using agricultural land, such systems can be built where normal ground-mounted PV systems are not approved. GridParity is a pioneering company that took solar power generation to a new level 10 years ago with the first installation of its Agri-Photovoltaic system concept: Combining the generation of 100% renewable energy with the preservation and ecological enhancement of agricultural land.

GridParity AG
next generation photovoltaic

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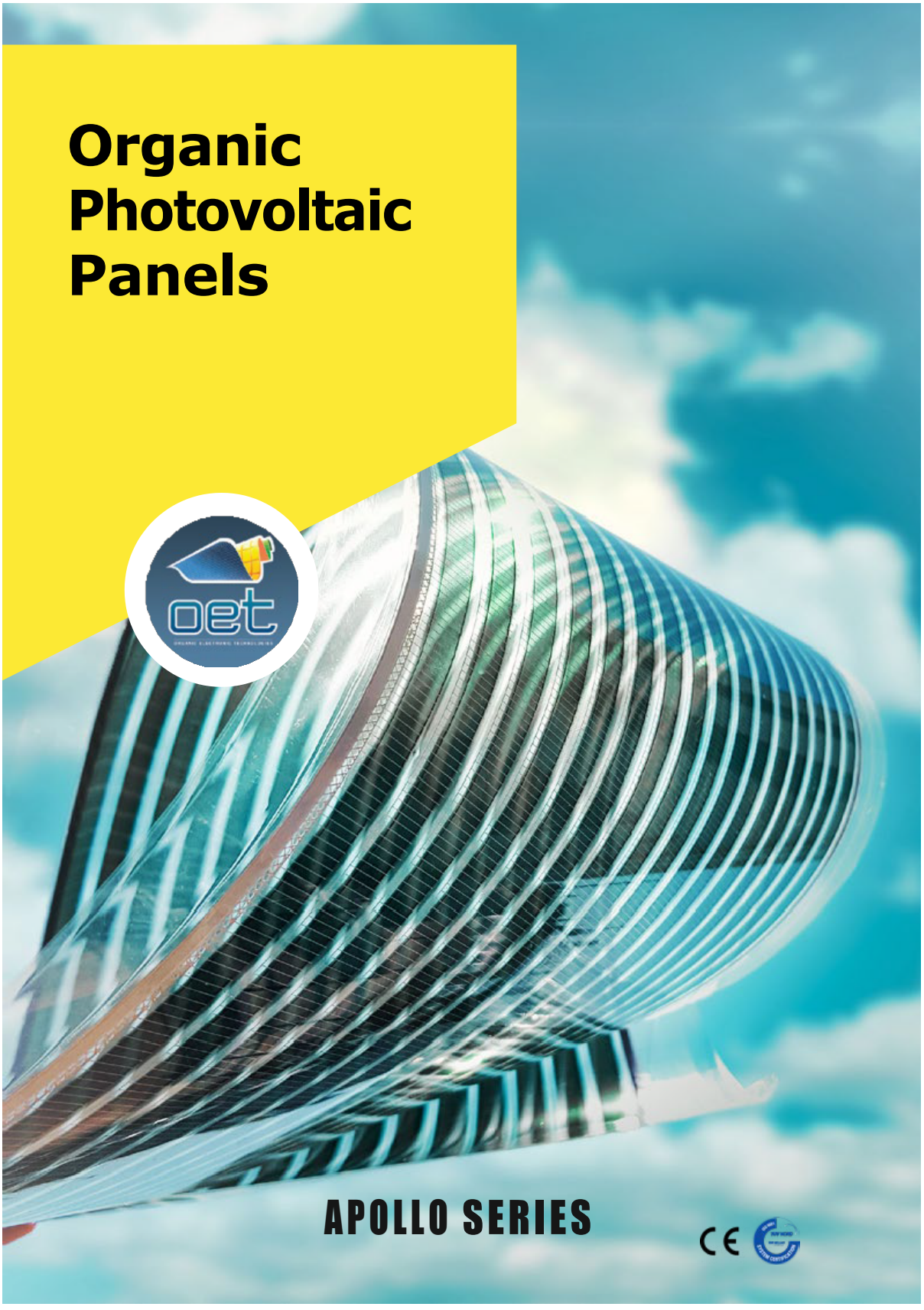
GridParity Catalogues


Organic
Photovoltaic
Panels
oet
APOLLO SERIES
CE

Die Phoenix Contact-Gruppe

Phoenix Contact ist weltweiter Marktführer für Komponenten, Systeme und Lösungen im Bereich der Elektrotechnik, Elektronik und Automation. Das Familienunternehmen beschäftigt heute rund 20.300 Mitarbeiter weltweit und hat in 2021 einen Umsatz von 2,97 Mrd. Euro erwirtschaftet. Der Stammsitz ist im westfälischen Blomberg. Zur Phoenix Contact-Gruppe gehören vierzehn deutsche und vier internationale Unternehmen sowie 55 Vertriebs-Gesellschaften in aller Welt. International ist Phoenix Contact in mehr als 100 Ländern präsent.

Weltweit wird in elf Ländern mit einer hohen Fertigungstiefe produziert. Das Produktspektrum umfasst Komponenten und Systemlösungen für die Erzeugung, den Transport und die Verteilung von Energie, den Geräte- und Maschinenbau sowie den Schaltschrankbau. Ein vielfältiges Programm von Reihen- und Sonderklemmen, Printklemmen und Steckverbindern, Kabelanschlusstechnik und Installationszubehör bietet innovative Komponenten. Elektronische Interfaces und Stromversorgungen, Automatisierungssysteme auf Basis von Ethernet und Wireless, offene Steuerungssysteme, Sicherheitslösungen für Mensch, Maschine und Daten sowie Überspannungsschutzsysteme bieten Errichtern und Betreibern von Anlagen, Liegenschaften, Stadt- und Verkehrskonzepten smarte Lösungen. Die Märkte der Fertigungsindustrie, regenerativer Energiegewinnung, Mobilität und Smart Buildings werden durch ganzheitliche Konzepte inklusive Engineering- und Serviceleistungen gemäß ihrer spezifischen Bedürfnisse betreut.

Die digitale Transformation unterstützt Phoenix Contact mit Produkten, Systemen und Lösungen. Durch die Erfahrungen im hauseigenen Maschinenbau ist das Unternehmen mit den Anforderungen der Digitalisierung und des durchgängigen Datenflusses, vom Engineering über die Fertigung bis Installation und Wartung, entlang des gesamten Produkt-Lebenszyklus, vertraut.

In Entwicklungsbereichen an den Standorten Deutschland, China und den USA entstehen Produkt-Innovationen und spezifische Lösungen für individuelle Kundenwünsche. Zahlreiche Patente unterstreichen, dass viele Entwicklungen von Phoenix Contact einzigartig sind. In enger Zusammenarbeit mit Hochschule und Wissenschaft werden Zukunftstechnologien wie Elektromobilität und die Digitalisierung erforscht und in marktgerechte Produkte, Systeme und Lösungen überführt

Bei Phoenix Contact handeln wir innovativ, nachhaltig und partnerschaftlich. Das gilt im Umgang mit Mitarbeitenden genauso wie mit unseren Kunden. Mit der Vision der All Electric Society möchten wir auch unsere Kunden zu nachhaltigerem Handeln befähigen, indem wir mit unseren Produkten und Lösungen die umfassende Elektrifizierung, Vernetzung und Automatisierung aller Sektoren von Wirtschaft und Infrastruktur ermöglichen.

www.phoenixcontact.com 03/2022

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energiezukunft.eu

energiezukunft.eu provides news, background information and opinion pieces on renewable energy, citizen energy, energy and climate policy, green economy, sustainable architecture as well as sustainable transport.

Visit our website **www.energiezukunft.eu**

The editorial team of energiezukunft wishes all participants of Agrivoltaics 2022 a great time, fruitful discussions and lots of new insights.

zek KOMMUNAL Zukunftsenergie + Kommunaltechnik (kommunal.zek.at) ist ein führendes Fachmagazin für erneuerbare Energien und zukunftsorientiete Technologien sowie Management im kommunalen Bereich mit einer Auflage von 10.800 Stück und erscheint
4 Mal jährlich in deutscher Sprache.

Die Verteilung erfolgt flächendeckend in Österreich, Schweiz, Südtirol, Bayern und Baden-Württemberg.

Zielgruppe: Bürgermeister · Leiter kommunaler Einrichtungen · Energieversorgungsunternehmen · Bauhöfe · Abwasserverbände · Planer & Technische Büros · Behörden · Fachverbände · Branchenrelevante Unternehmen.

Zusätzlich erfolgt die Verbreitung auf den wichtigsten nationalen und internationalen Energie- und Kommunalveranstaltungen.

In jeder Ausgabe finden Sie:

- Energieeffiziente Gemeinden
- Projektberichte und Best Practice Beispiele
- Biomasseanlagen und Heizkraftwerke
- Abwasser- und Kläranlagentechnik
- Kommunalfahrzeuge und Anbaugeräte
- Winterdienst-, Streu- und Räumtechnik
- Messen und Veranstaltungen
- Neuheiten

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