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pv magazine webinars

Agri-PV: Let's talk about technology, finance and regulation

Thursday, 18 January 2024

2:00 pm - 3:00 pm | GMT, London
3:00 pm – 4:00 pm | CET, Berlin
4:00 pm – 5:00 pm | EET, Athens

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Welcome!

pv magazine webinars

Do you have any questions? ❓ 🙋

Send them in via the Q&A tab. 👉 We aim to answer as many as we can today!

You can also let us know of any tech problems there.

We are recording this webinar today. 📹

We‘ll let you know by email where to find it and the slide deck, so you can re-watch it at your convenience. 👀 💡

Agri-PV

Let’s talk about technology, finance and regulation

Eng. Chiara Tarisciotti
Regional Engineering Manager for EMEA

Agenda

1 **Background**
Valmont & Convert

2 **Products**
Valmont Solar Agri-PV Solutions

3 **Agri-PV V2.1**
Research & Development

4 **Agri-PV V.4.0**
Research & Development

About Us

A Stable Partner for 78 Years. Our commitment to sustainability by conserving resources and improving life requires financial sustainability, as well.

Valmont is publicly traded on the NYSE under the symbol (VMI).

$4.3bn

ANNUAL REVENUE

100+

COUNTRIES WHERE WE DO BUSINESS IN

27

DISTINCT VALMONT BRANDS

11,000

EMPLOYEES WORLDWIDE

$200M

BONDING CAPACITY (AGGREGATE)

84

MANUFACTURING FACILITIES WORLDWIDE

About Us

1946

Valmont Industries Founded

1970's

Valmont Utility begins service

1981

Convert Italia SpA founded

2018

Valmont purchases Convert Italia

2019

Expansion into North America

2022

Valmont Solar Brand Launched

valmont SOLAR

78 YRS

Financial Stability

40+ YRS

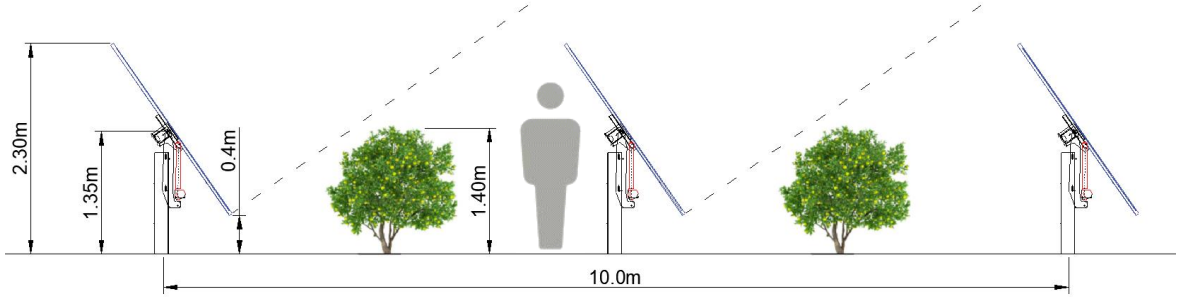
Modernizing the Grid

17+ YRS

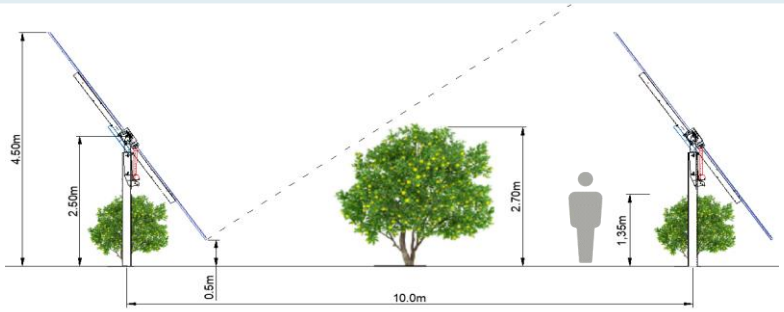
Solar Tracker Technology

Valmont Solar Agri-PV Products

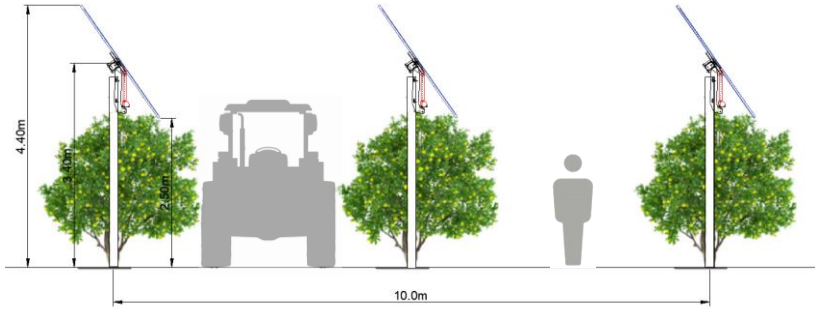
Convert-1P Tracker
AGRI-PV STANDARD



Convert-2P Tracker
AGRI-PV STANDARD



Elevated Tracker for Agricultural Applications
AGRI-PV ADVANCED



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Agri-PV v2.1 & v4.0

AGRI-PV STANDARD

Convert-1P and Convert-2P Tracker [*Low*]
Vegetable crops or livestock characterized by limited vertical development

- Minimum height ≈ 0.4 m
- Crop row spacing ≈ 5.0 m

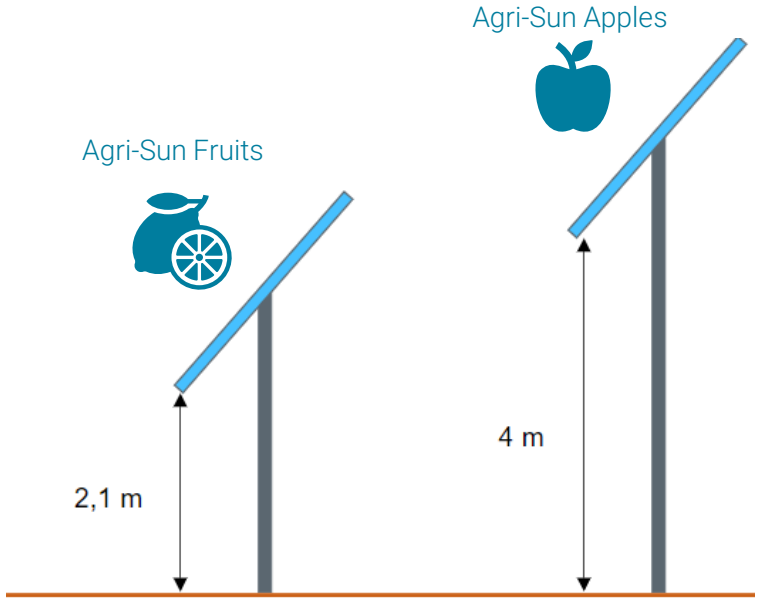
AGRI-PV ADVANCED

Agri-PV v2.1 [*Medium*]
"Classic" configuration: three-dimensional fruit tree growth

- Minimum height ≈ 2.1 m
- Crop row spacing ≈ 5.0 m

Agri-PV v4.0 [*High*]
"Guyot" system and vineyards: two-dimensional fruit tree growth

- Minimum height ≈ 4.0 m
- Crop row spacing ≈ 2.5 m

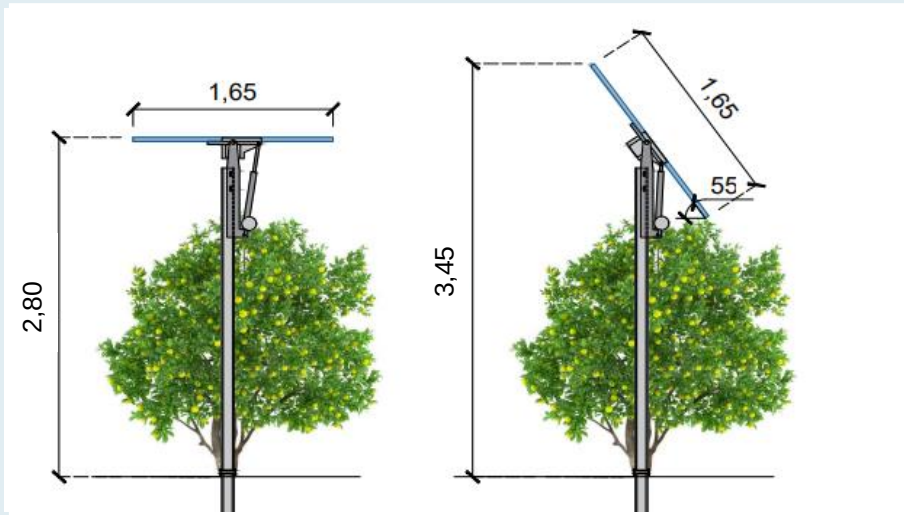


Product: Agri-PV v2.1

SCALEA PROTOTYPE:

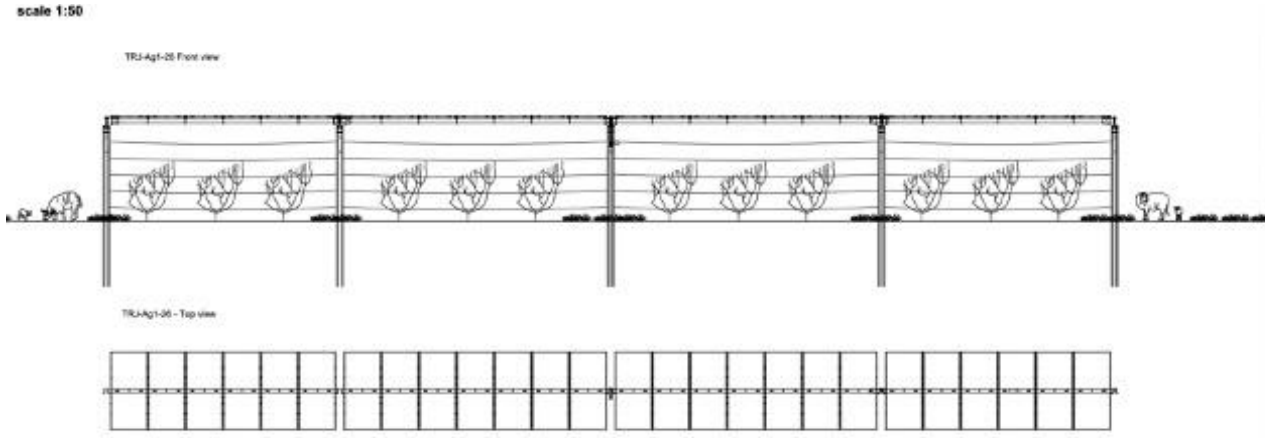
The first Valmont Solar approach to agrivoltaic experimentation

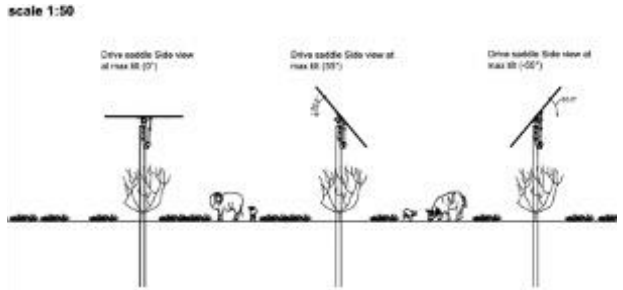
EFSolare / Valmont Solar-Convert Italia / LeGreenhouse



PILOT PROJECTS IN FRANCE & ITALY:

A recent example of Valmont Solar Agri-PV v2.1





Agri-PV v2.1 | R&D – Weathering Steel

A product supported by the results of European Research Project GOPV [H2020]

Weathering Steel (Corten):
Low visual impact & low cost of galvanizing

Product: Agri-PV v4.0

Product under development in the contest of Symbiosyst Project [Horizon].

"Create a Symbiosys where PV an agriculture can have a mutually beneficial relationship"

Symbiosyst

Demo 1

Agrivoltopolis, Barcellona
Production of vegetables, horticultural crops, flowers characterized by a limited vertical development

Minimum height of module > 2.1 m

Demo 2

Laimburg, Bolzano
Growth of fruit trees (apples, pears, citrons, lemons) in "traditional" and "Guyot" configuration

Minimum height of module > 3.5 m

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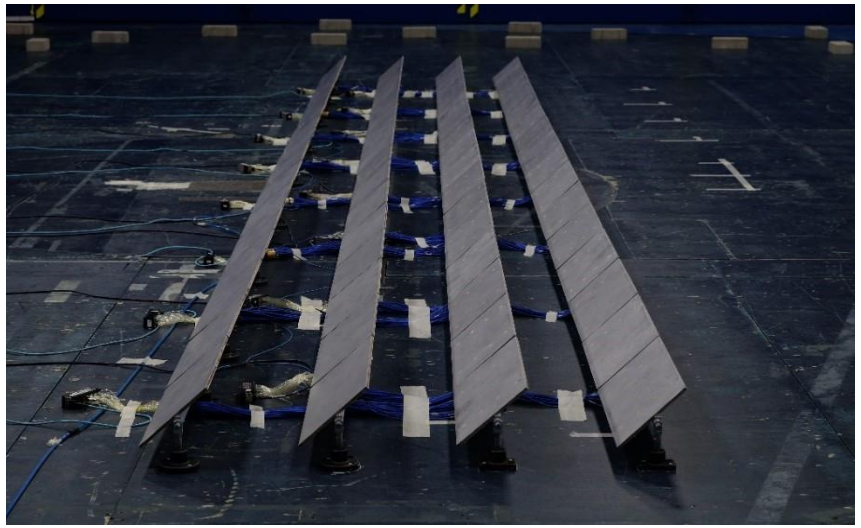
Agri-PV v4.0 | R&D - Wind Tunnel

Politecnico di Milano Wind Tunnel
2.793 follower
9m •
+ Segui

Photovoltaic (PV) systems with tracking mechanisms are steel structures that benefit from wind tunnel tests in order to reach an optimal aerodynamic design. A new frontier is the application of PV trackers in agriculture, and we are pleased to contribute to the research in this field. We tested in our wind tunnel the new Convert Agri-PV tracker by Valmont Solar also considering the aerodynamic interaction with the crops. Part of the work is carried in the framework of the Horizon Europe SYMBIOSYST project.



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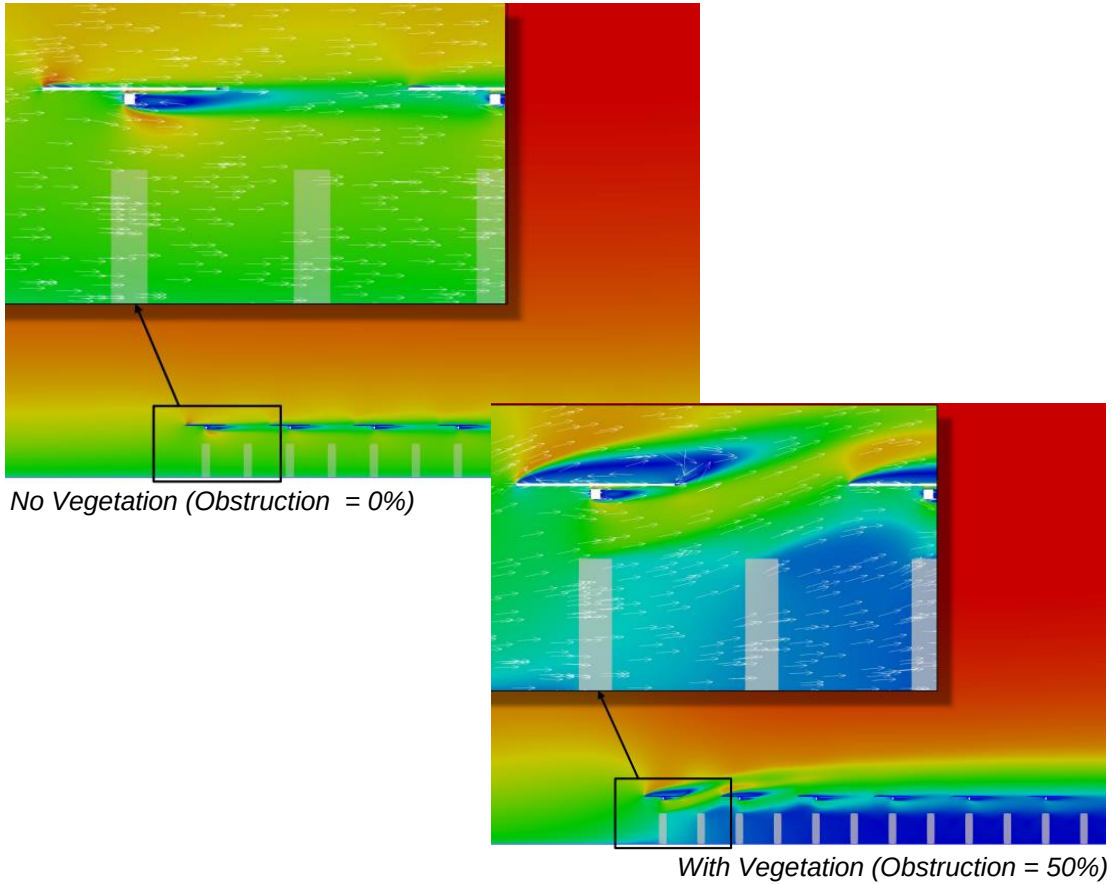
Agri-PV v4.0 | R&D - CFD



No Vegetation (Obstruction = 0%)

With Vegetation (Obstruction = 50%)

To substantiate our wind tunnel test findings, we previously conducted Computational Fluid Dynamics (CFD) simulations, assessing the impact of the presence of crops beneath the trackers

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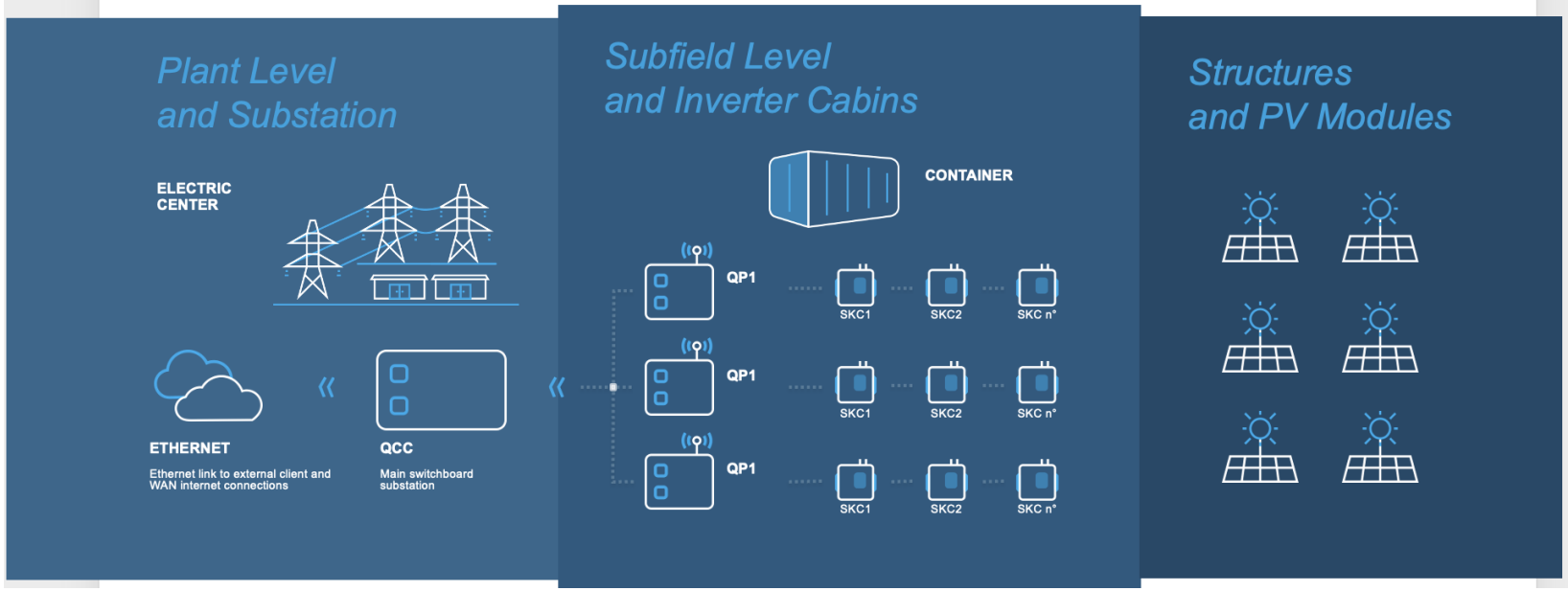
Agri-PV v4.0 | R&D – Control System

SCADA - INTEGRATION

- New sensors for agriculture integration: temperature, humidity, plant growth, etc.
- Wired or wireless communication
- Protection from adverse weather events



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Thank You

Eng. Chiara Tarisciotti
Regional Engineering Manager for EMEA

Agri-PV: Let’s talk about technology, finance and regulation

Harvesting the future - the sustainable intersection of Agriculture and Solar Power

Ing. Marco Martini
Environment, Archaeology and Biodiversity (EAB)
Enel Green Power – Rome

January 18, 2024

pv magazine

enel Green Power

Enel Green Power

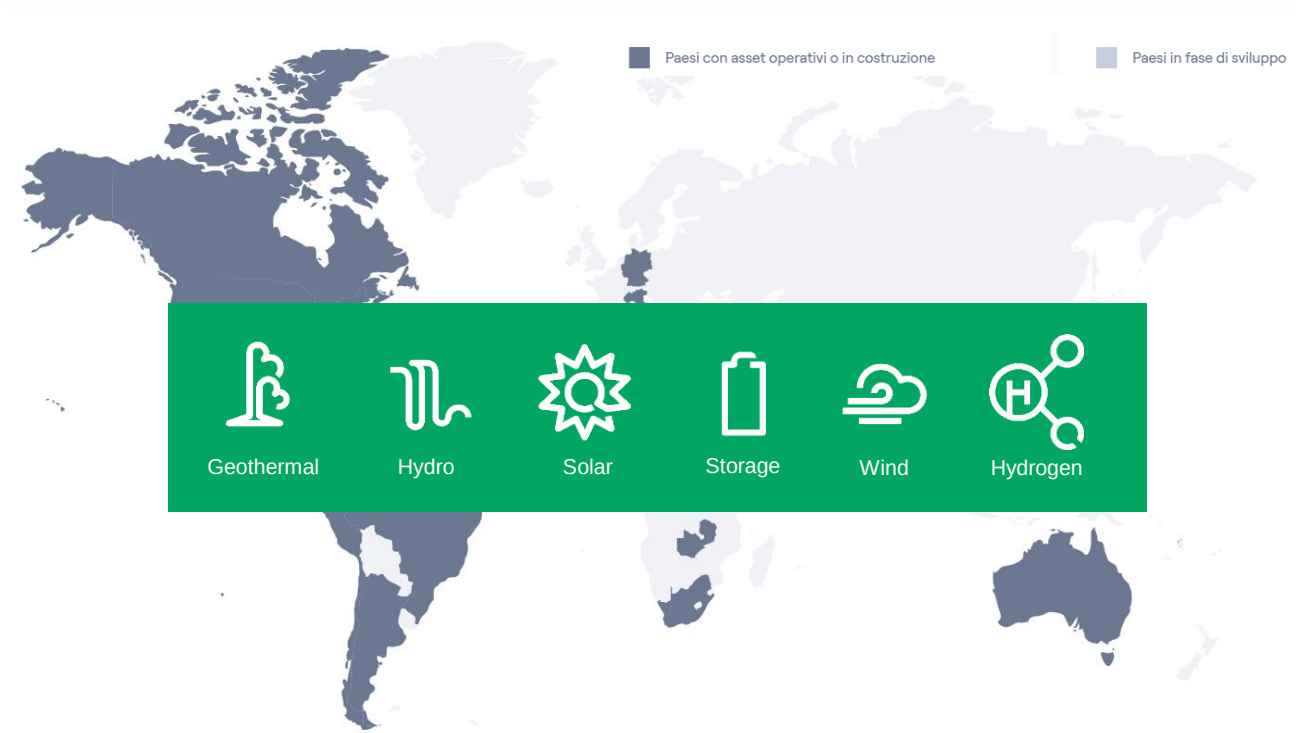
Company presentation

Enel Green Power and Thermal Generation | Enel Grids | Enel X Global Retail | e-Mobility Enel X Way | Global Energy and Commodity Management

63 GW Renewable capacity

> 1,2k plants

25 country



2026

- **73 GW of renewable capacity**
- **+12.11 €bn investment**

Focus on the entire value chain...

(Development, Engineering, Construction, Operation and Maintenance, End-of-life Management)

Agenda

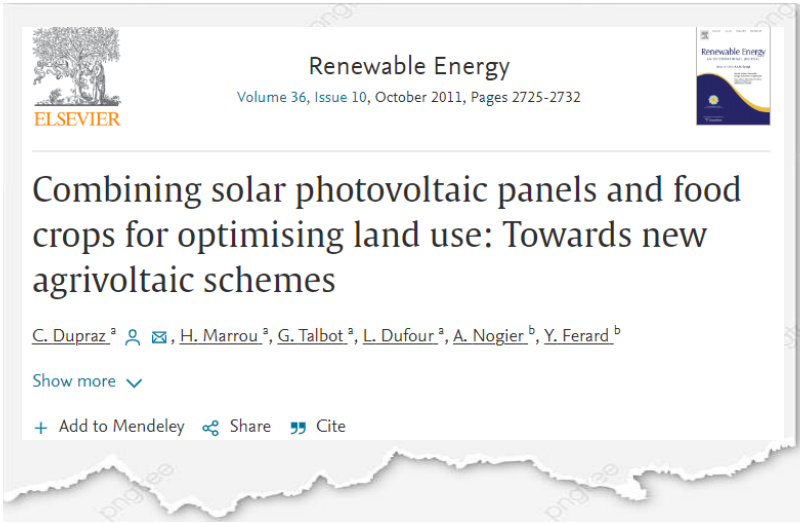
Introduction

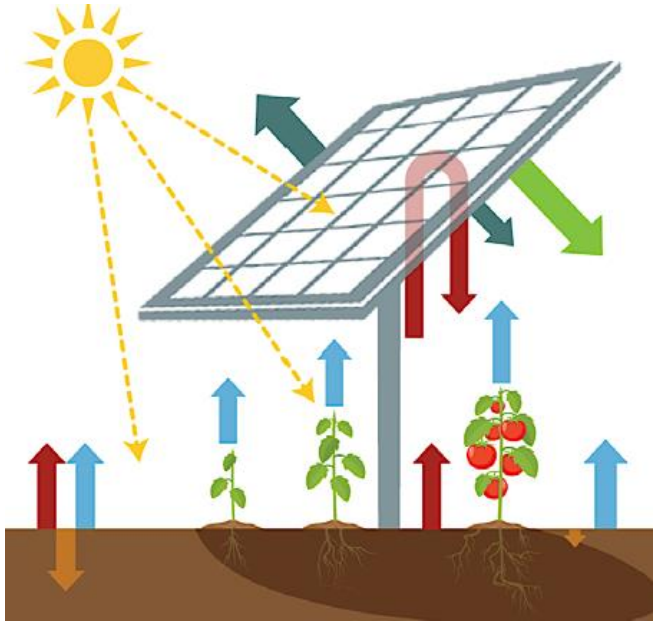
Definition and the origin of the term

Agrivoltaic / Agri-PV

[…] Solar plants using PV panels will therefore compete with agriculture for land. In this paper, we suggest that a combination of solar panels and food crops on the same land unit may maximise the land use. We suggest to call this an ***agrivoltaic system*** *[…]*

(Dupraz(1) *et al.*, 2011)



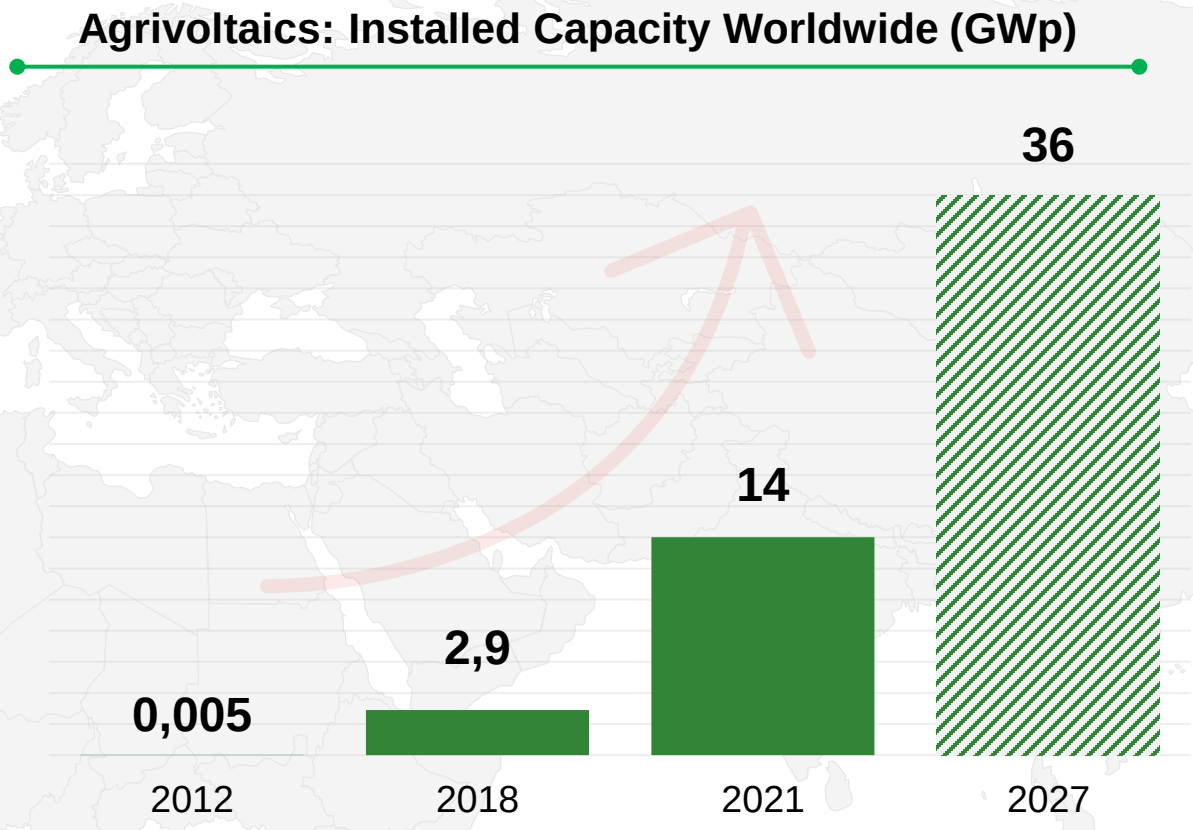


(1) Christian Dupraz - French National Institute for Agriculture, Food, and Environment (INRAE) | INRAE · Centre de Recherche de Montpellier
(2) Even though some attribute the origin of the term "agrivoltaic" to 1982, with the studies of Adolf Goetzberger, founder of the Fraunhofer Institute for Solar Energy Systems ISE..

Agrivoltaics Overview

Installations and future trends

- Agrivoltaic installations began in 2004 in Japan, exploring coexistence of agriculture and photovoltaic production. In 2013 Japan initiated the **first agrivoltaic support program**, followed by China, South Korea, France, and Germany.
- Global installed capacity was 5 MWp in 2012, rising to 2.9 GWp in 2018, and reaching **14 GWp** by the end of the decade, with China contributing 12 GWp.
- The first large-scale agrivoltaic system, covering 10 hectares, was established in 2015.



Data Processing Chart: Fraunhofer I.S.E. (2022) and DOE (2022) analysis.

Regulatory framework

From EU strategy to local legislation

Agenda 2030

At the international level, in September 2015, the UN adopted **Agenda 2030**, a sustainability plan that includes the development of agro-photovoltaic plants for renewable energy among its **17 action items**.

EU Biodiversity strategy

To support agrophotovoltaics, the European Commission **plans initiatives within the European Biodiversity Strategy**, aiming to accelerate the transition to a new sustainable food system

Climate ADAPT
SHARING ADAPTATION INFORMATION ACROSS EUROPE

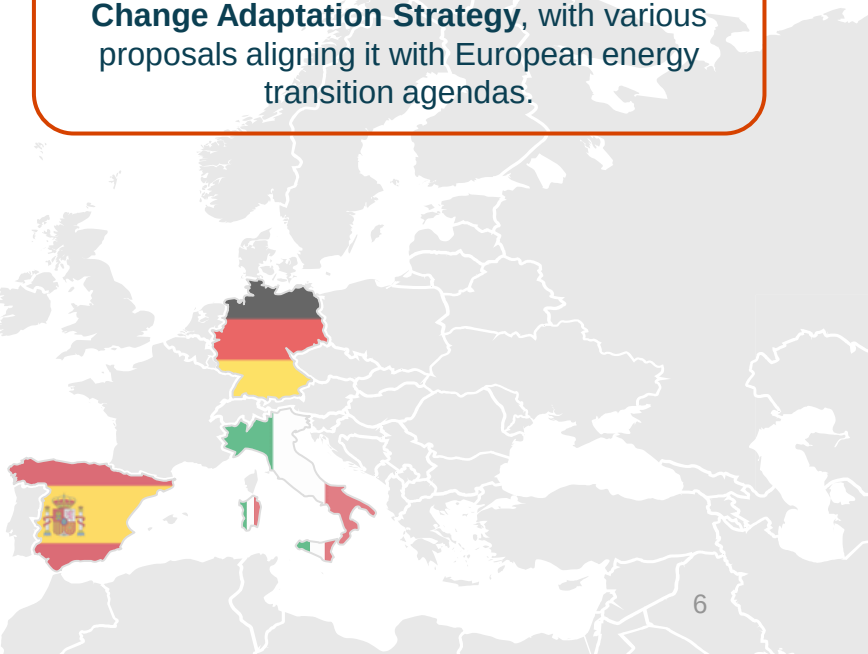
EU - ADAPT

The Commission has proposed integrating agri-photovoltaics into the upcoming **Climate Change Adaptation Strategy**, with various proposals aligning it with European energy transition agendas.

Support for agrivoltaics through renewable energy tendering. Definition of the agrivoltaic system since 2017. In 2020, new contracts were awarded for an additional agrivoltaic capacity of 80 MW.

Research activities at the Fraunhofer Institute for Solar Energy Systems ISE. Support for Agrisolar through innovation-focused tendering. Introduction of the first technical standard for agrivoltaic systems, DIN SPEC 91434:2021-05.

The PNRR allocates over 3 billion euros for Agrivoltaics. MiTE guidelines with requirements are introduced, along with the launch of the Sustainable Agrivoltaic Network.

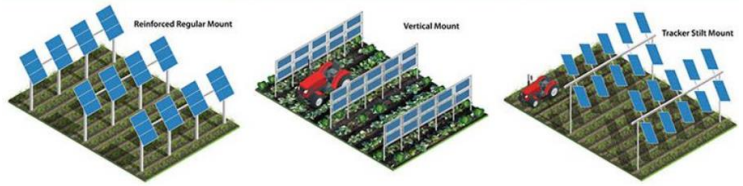


The Enel's model

Our view

Standard *(utility scale)*

Advanced *(innovation)*



Agrivoltaics model: **applicable for solar developers**

Optimization of the spacing of PV panels and utilizing available site space for integrated agriculture aims to maintain agricultural functionality while improving overall site quality.

The careful selection of crops and the correct planning of restoration measures, coupled with interventions during solar farm construction such as revegetation and visual impact mitigation, guarantee a **sustainable coexistence**, fostering both agricultural benefits and a sustainable model.

Benefits

Environment

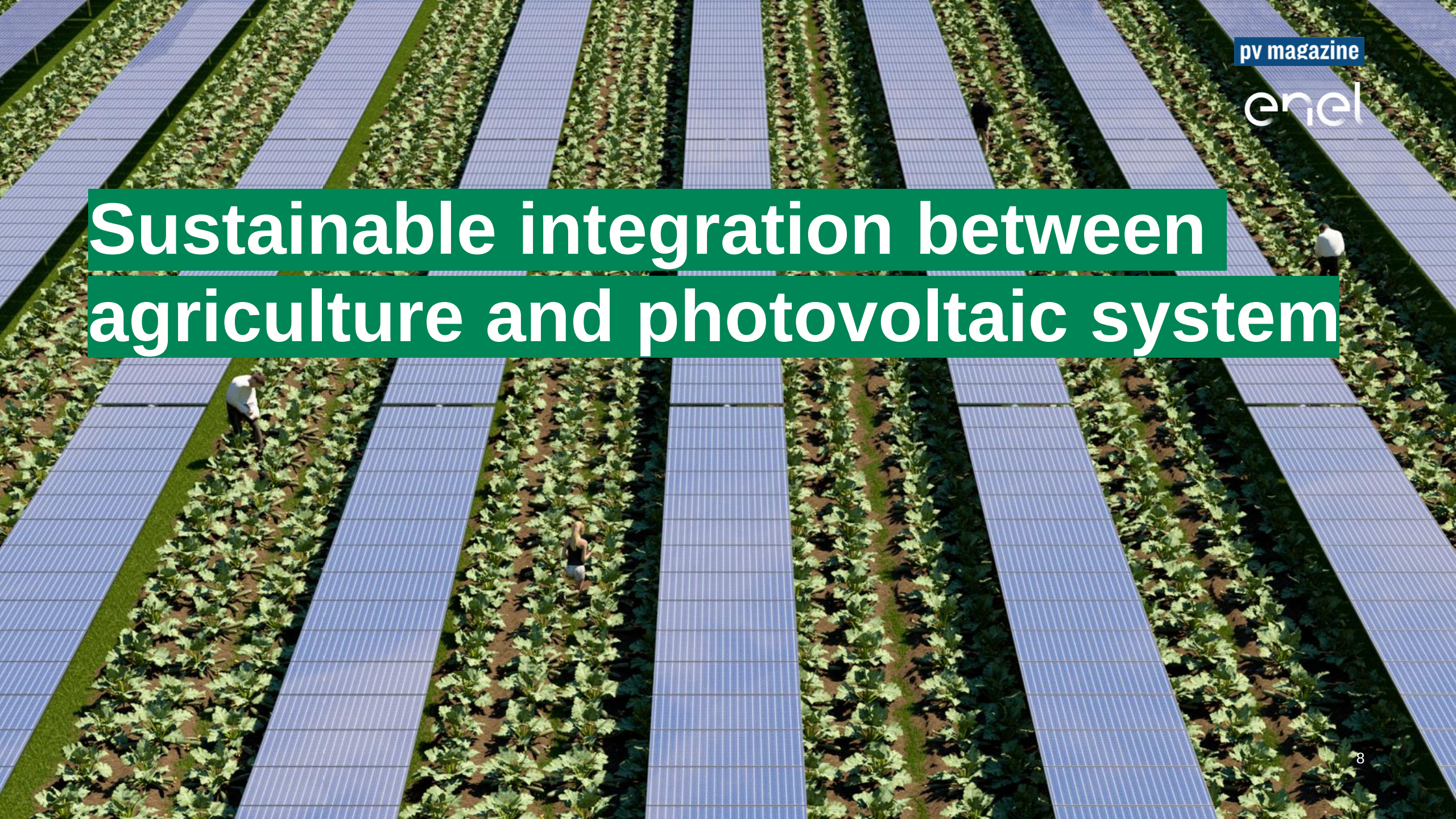
- Reduction of land occupancy
- Soil erosion control
- Restoration of soil quality and fertility
- Reduction of water consumption
- Habitat and food for insects, birds, small mammals
- Increase of the landscape diversification
- Increase of Pollinators

Solar developer

- Control of noxious invasive seeds
- Reduction of regular mowing
- Reduction of stormwater management costs
- Reduction of PV modules cleaning events

Local community

- Job creation by partnering with local farmers
- Increase of yield for farmers (plants under heat-stress)
- Integration with livestock farming
- Honey production
- Potential for Innovation applications (high-tech agriculture, monitoring sensors)
- Cooperation agreement, University NGO, Research centers

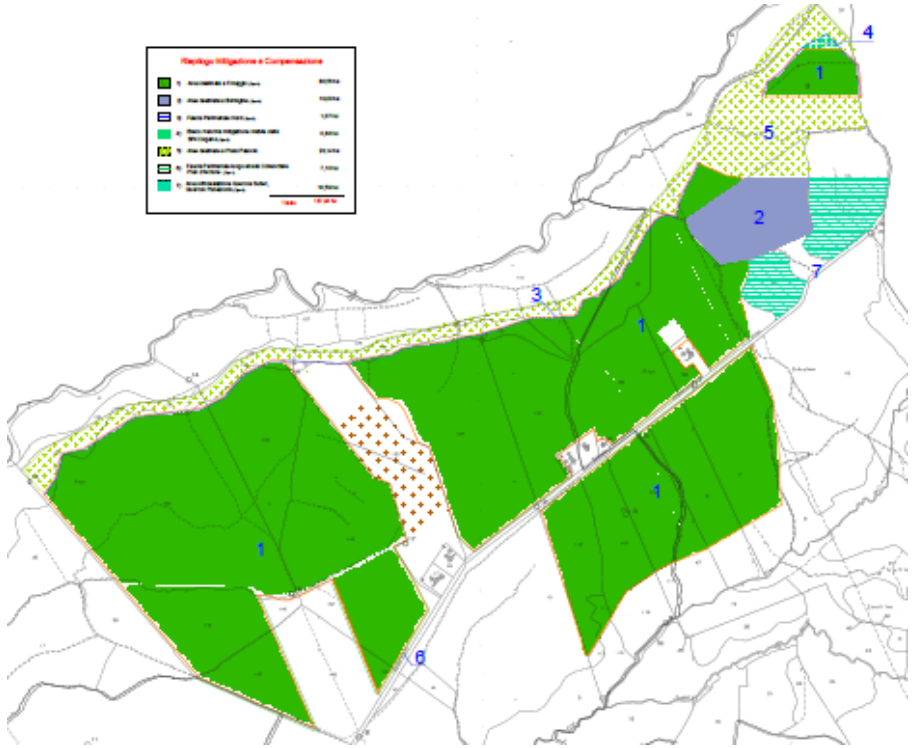


Sustainable integration between agriculture and photovoltaic system

Italy's largest agrivoltaic plant

Tarquinia Solar Plant

It will be built on land belonging to a local company that will collaborate with Enel Green Power to integrate the plant with agricultural activities: in particular, **fodder and borage** will be grown in the vacant areas between the rows of panels and the overhead power line buffer strips, while **olive trees** will be planted in the perimeter strips.



Technology	Status	Capacity	Energy output (per year)	CO_2 emissions avoided	Power supplied
Solar photovoltaic	Under construction	170 MW	280 GWh	130,000 tons per year	111,000 households per year

Solar Flax Harvest in Spain

Las Corchas Solar Plant

The three-hectare solar field in Carmona, Seville, now not only hosts innovative projects but marks a milestone—the inaugural solar flax harvest.

…and not only agricolture

Grass Management by the Sheep grazing

more than

19 projects

where the activity is taking place in the last 5 years

The coexistence of agriculture (livestock farming) and photovoltaics offers **several benefits**, both to local communities (establishing good relationships with farmers) and livestock (microclimate improvment, panel as shelter) and in terms of reduced OPEX costs and fire risk

Thanks for your attention

Ing. Martini Marco

Environmental Engineer ITA&RoE
Engineering & Construction
Enel Green Power S.p.A

Email: marco.martini@enel.com

pv magazine Webinar
Agri-PV: Let’s talk about technology, finance and **regulation**

January 18, 2024

Agenda Agri PV presentation

	Topic
1	About JUWI
2	Agri-PV in JUWI
3	Market Update Italy
4	Agri-PV integration scheme
5	Case study Italy

1

A strong group

As an MVV company, we are part of one of Germany's leading energy groups

1,300
employees throughout the world

18
offices in 11 countries throughout the world

8.2
million tonnes of CO_2 saved per year

100
percent subsidiary of MVV Energie AG

6,550
employees throughout the world

355
million euros investment volume

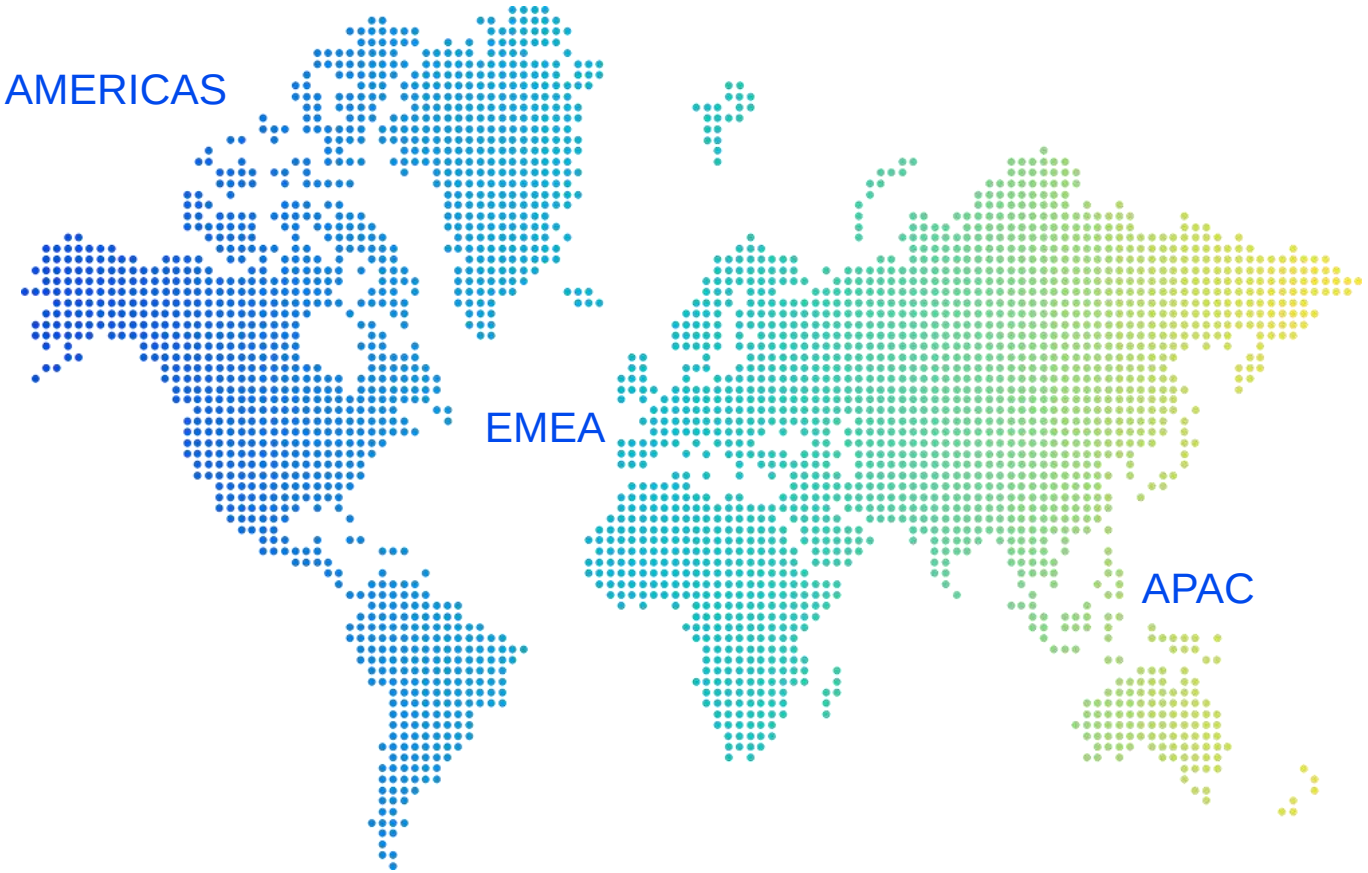
4.2
billion euros of sales FY 2021

2040
climate-positive with the Mannheim model

1

Our Track Record

Facts and figures



Solar power

- > 2,000 systems, free-standing and roof-mounted
- approx. 5.3 billion kWh annual output
- approx. 3,850 MW total capacity

Wind power

- > 1,250 wind turbines at about 200 locations
- approx. 6.1 billion kWh annual output
- approx. 3,000 MW total capacity

Hybrid

- 20 projects
- approx. 130 MW solar
- approx. 35 MW wind
- approx. 170 MW total capacity

2

Agri-PV in JUWI
With the best of both worlds

Italy

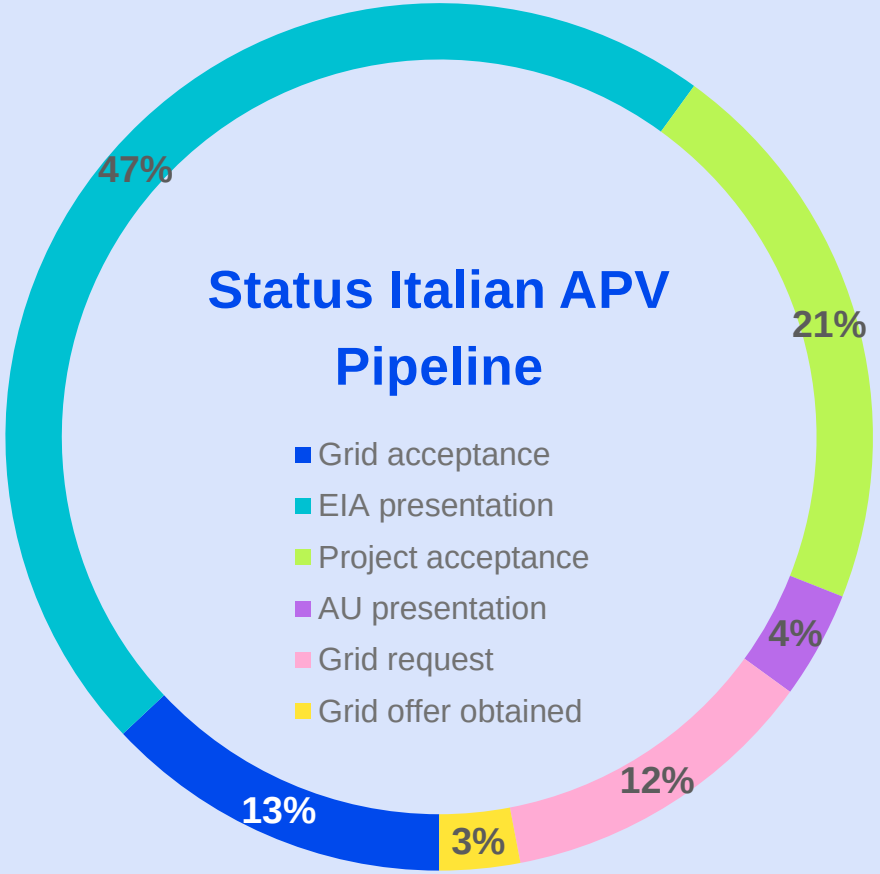
Italy is our focus market for Agri-PV with a substantial project pipeline of > 250 MW under development

Germany

General conditions are less favorable, we are evaluating first pilot and test projects to optimize future applications

Global

Monitoring of JUWI markets with positive outlooks in Japan and South Africa.



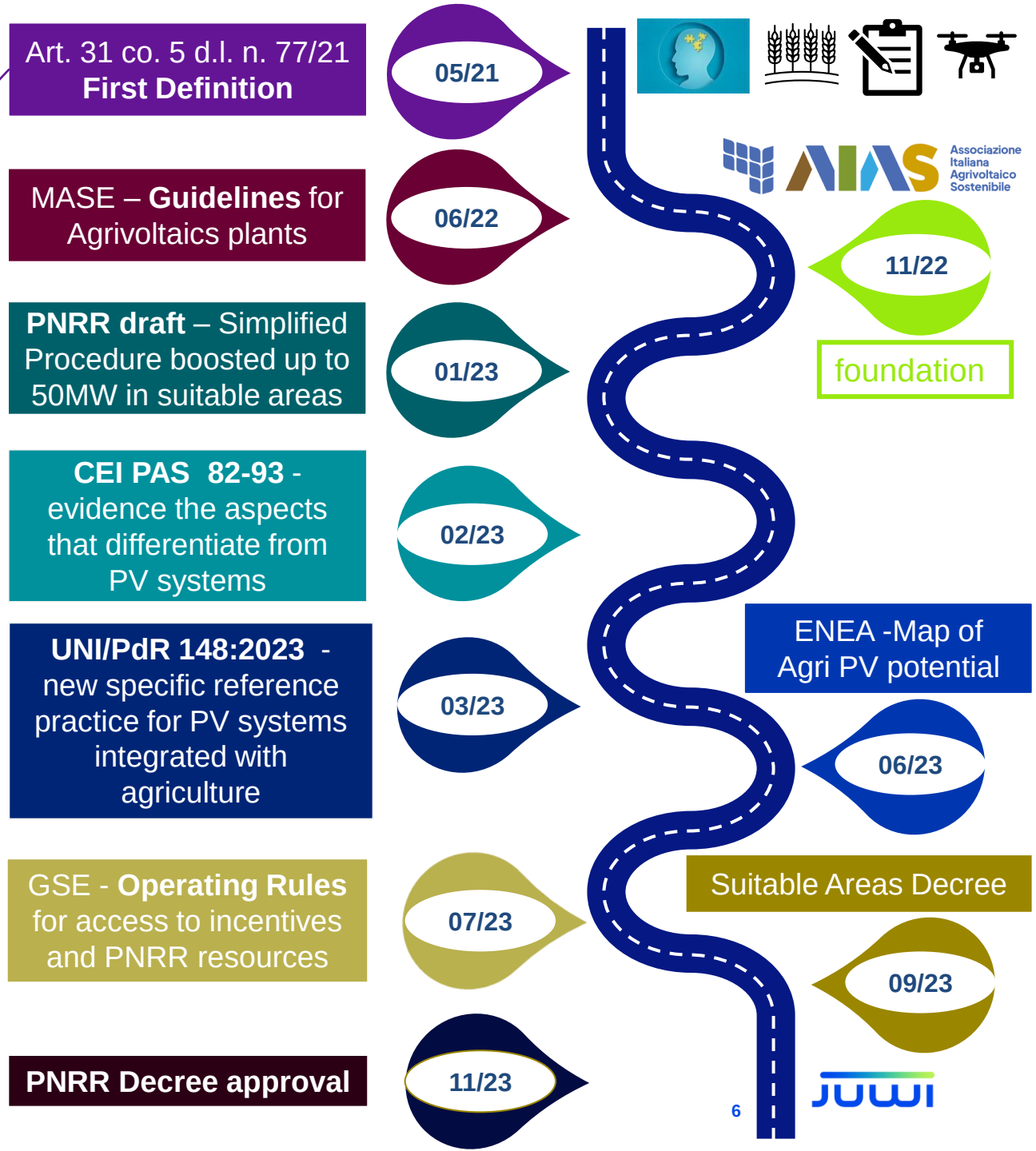
3

Agri PV Italy

Market Update Italy

Policy

- Art. 65 co. 1- quarter and quinquies d.l. n. 1/12
  - **APV systems are eligible for public funding**
- PNRR (recovery and resilience plan)
  - **€ 1.1 billion allocated for** the implementation of **APV** (up to **40% of eligible investment costs**).
  - **incentive electricity tariffs** (estimated budget of **€ 560 million**) paid during the operational phase of the projects (20 years).
  - **1.04 GW** of agrivoltaic systems installations **expected by 30 June 2026**.
  - The text has been **approved** in Strasburg in **November 23**.
- «D.L. Energia» n. 17/22: Agri PV up to 20MW
  - **simplified authorization process (PAS)**
  - **No environmental procedure (VIA) in suitable areas**



4

The Italian APV guidelines

Legislation complexity

MINIMUM REQUIREMENTS

A - Design and Construction:

A1 – Min. area for agricultural activity*

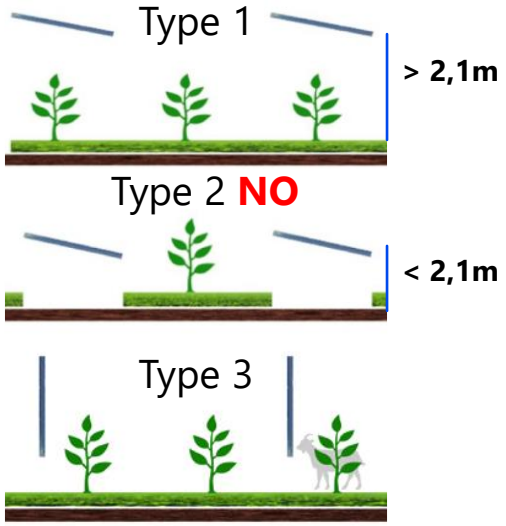
A2 - % of total area covered by modules (LAOR)

B – Operation & Maintenance:

B1 - Continuity of agricultural activity**

B2 -Minimum electrical yield***

C - Innovative integrated solutions:



D - Monitoring system:

D1 - Water management****

D2 - Continuity of agricultural activity*

E - Monitoring system:

E1 - Recovery of soil fertility

E2 - The microclimate

E3 -Resilience to climate change

"Agrivoltaic" (+ D.2) = PV system built in agricultural area

"Advanced Agrivoltaic"= access incentives on electricity tariffs.

pre-conditions for PNRR contributions

* Classification of agricultural activities and calculation of different type of agricultural areas defined by CEI PAS 82-93
** Methods for estimating agricultural production introduced by CEI (Annex A) and calculation defined by UNI/PdR 148:2023 (annex B)
*** Calculation and input defined by CEI and UNI
**** no clear definition of estimating methods or calculation (reference to DM 31/07/2015 of Ministry of Agricultural and Food Policies Forestry)

4

The Italian APV guidelines

Legislation complexity

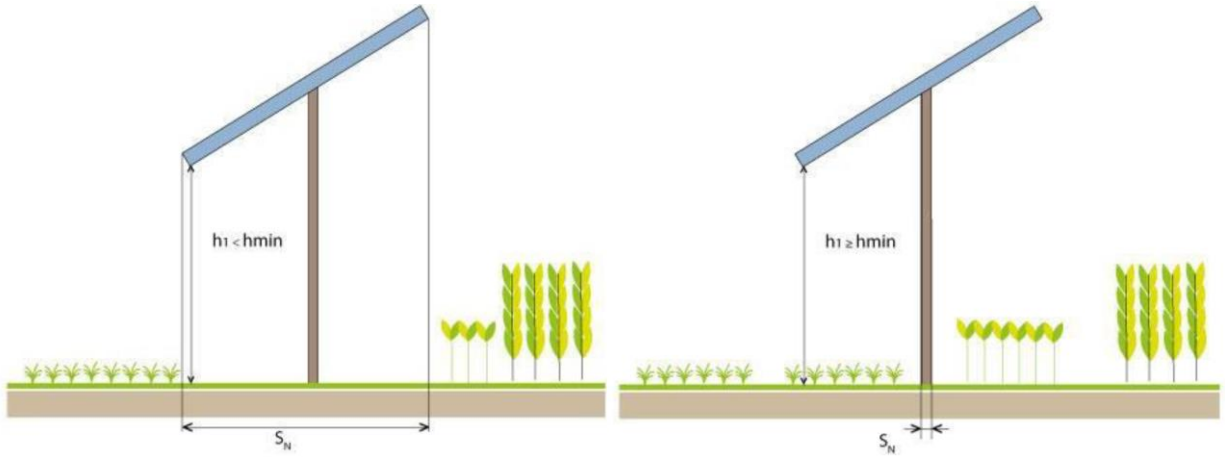
CEI PAS 82-93

COMITATO ELETTROTECNICO ITALIANO

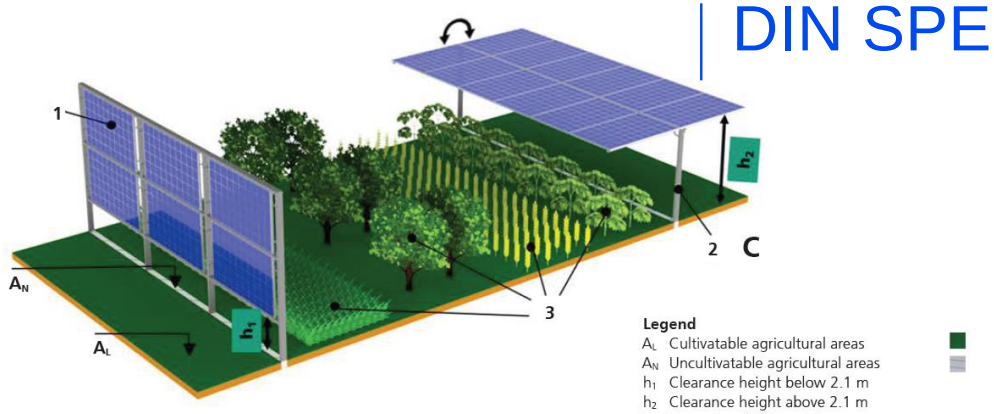
- safety requirements
- **Sn** – not agricultural area
- Many aspects to be defined in a future edition

UNI/PdR 148:2023

- Characteristics for integration with agriculture and the landscape (Annex C)
- Integration of agricultural activities with the management of APV plants
- Impacts on the territory, on the community (Annex D) and the responsible actors
- Technical requirements: the **agricultural yield** (Ra) and the **Land Equivalent Ratio** (LER).
- The Monitoring of APV systems and recommendations (Annex B)



DIN SPEC 91434



Legend

A_L	Cultivatable agricultural areas
A_N	Uncultivatable agricultural areas
h_1	Clearance height below 2.1 m
h_2	Clearance height above 2.1 m
1	Examples of PV modules
2	Mounting structure
3	Examples of crops

4

The APV integration scheme

Agri – PV Project management

Origination

- Check agricultural activities (abandoned vs. Operational)
- Classification Base vs Advanced APV

Start Authorization

- **C**rop **S**cience **I**nvestigation
- Conclusions for initial APV design

Planning and Purchasing

- Ensuring the **continuation of agricultural activities** for at least 30 years
- Risk reduction for bankability (warranties, insurance, H&S…)

Finance & Sales

- Identify Investor, enter EPC and O&M contract
- evaluate impact from agricultural activities and herbicides/fertilizers

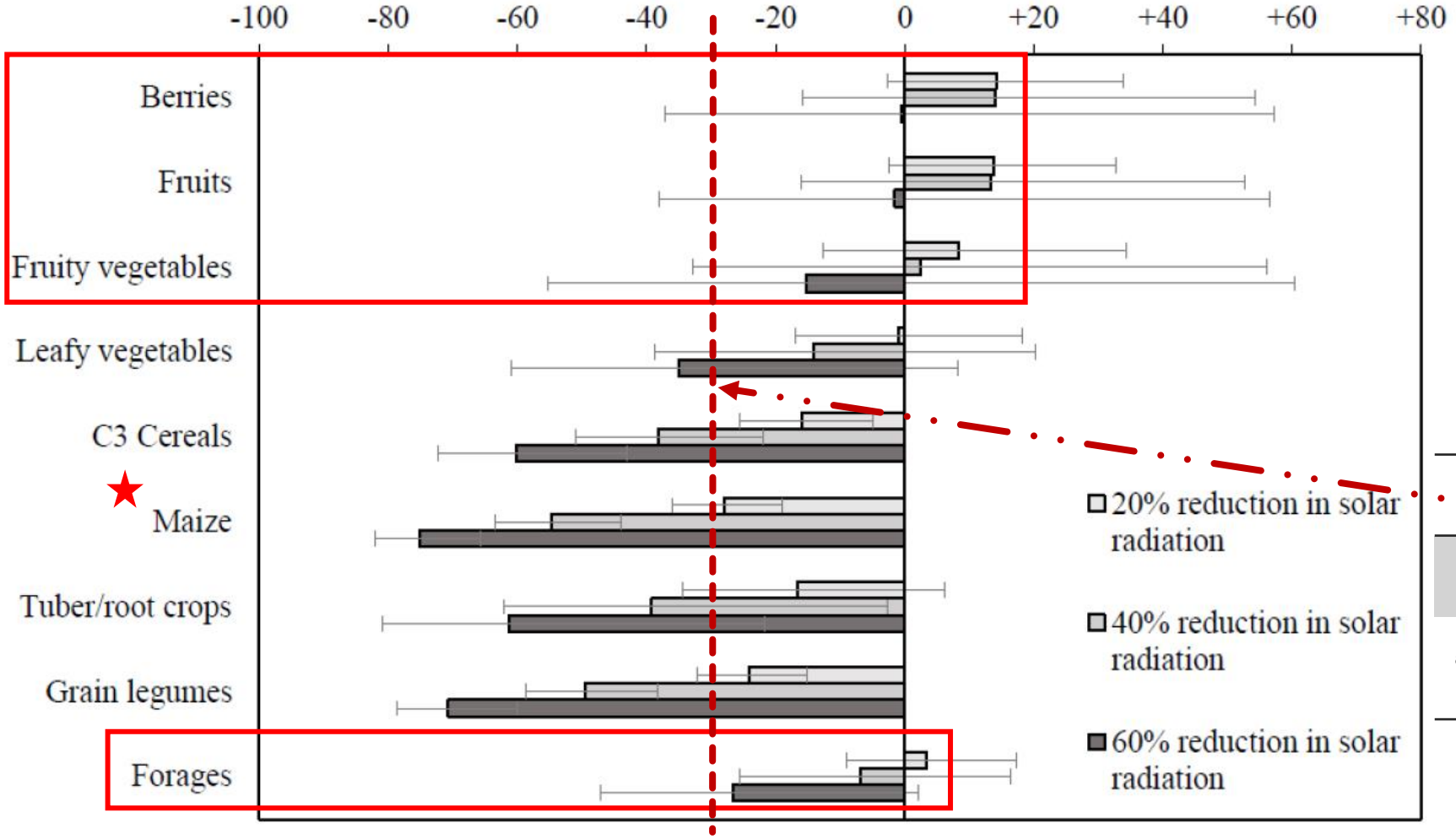
Construction and OP&M

Coordination with agricultural activities

5 Case study Italy - New approach of PV design

Shading impact on crop yield by Fraunhofer ISE

Yield change compared to unshaded control (%)



MINIMUM REQUIREMENTS

- **B – Operation & Maintenance:**
  - **B1** - Continuity of agricultural activity**
  - **B2** -Minimum electrical yield***
- **C - Innovative integrated solutions:**
- **D - Monitoring system:**
  - **D1** - Water management****
  - **D2** - Continuity of agricultural activity*

- fruits + berries react increasing the yield
- Regarding vegetables, a distinction must be made between fruity and leafy ones
- Legumes, tuber/root crops, C3 cereals and maize* seems to be not tolerant to shadow - Yield losses to be expected
- **Forges** (> 6 million ha or ~ 50% of the utilized agricultural area "SAU" in Italy) **??**

Standard	DIN SPEC 91434	Guide lines MiTE	AFNOR Label	Guide lines NEDO	UNI/PdR 148:2023
Minimum production target %	>66%	n.a.	>90%	>80%	**>70%**
agricultural yield (Ra)	Based on the last 3 y production	n.a	Based on permanent control area	average past and annual yield	Based in DIN SPEC and AFNOR

Table 1 - Regulatory references and guidelines for the development of agrivoltaic systems. Source: UNI/PdR 148:2023

★ Proof. S.Amaducci (AgriVoltaics Industry Forum Europe 2023, November 28-29 Strasburg)- Optimisation of an Agrivoltaico system for industrial crops: the case study of maize in the Po Valley: **In Italy maize behaves as a shade tolerant crop**.

5 Case study Italy - New approach of PV design

Light simulation in different configurations by Fraunhofer ISE

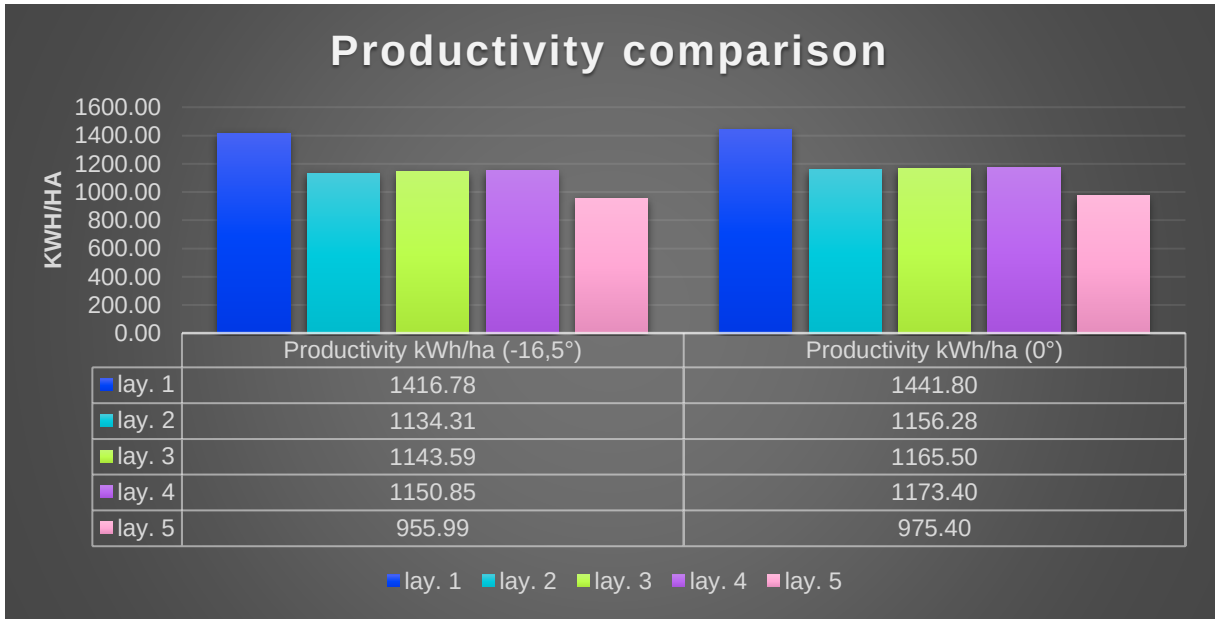
lay. 1	lay. 2	lay. 3	lay. 4	lay. 5		lay. 1	lay. 2	lay. 3	lay. 4	lay. 5
		azimuth (°)						azimuth (°)		
		-16.5						0		
		pitch (m)						pitch (m)		
11		14		17		11		14		17
		height (m)						height (m)		
3	2.5	3	3.5	3		3	2.5	3	3.5	3

pitch (m)	11	14			17
height (m)	3	2.5	3	3.5	3
delta kWh/ha	25.01	21.98	21.91	22.55	19.40
%	1.77%	1.94%	1.92%	1.96%	2.03%

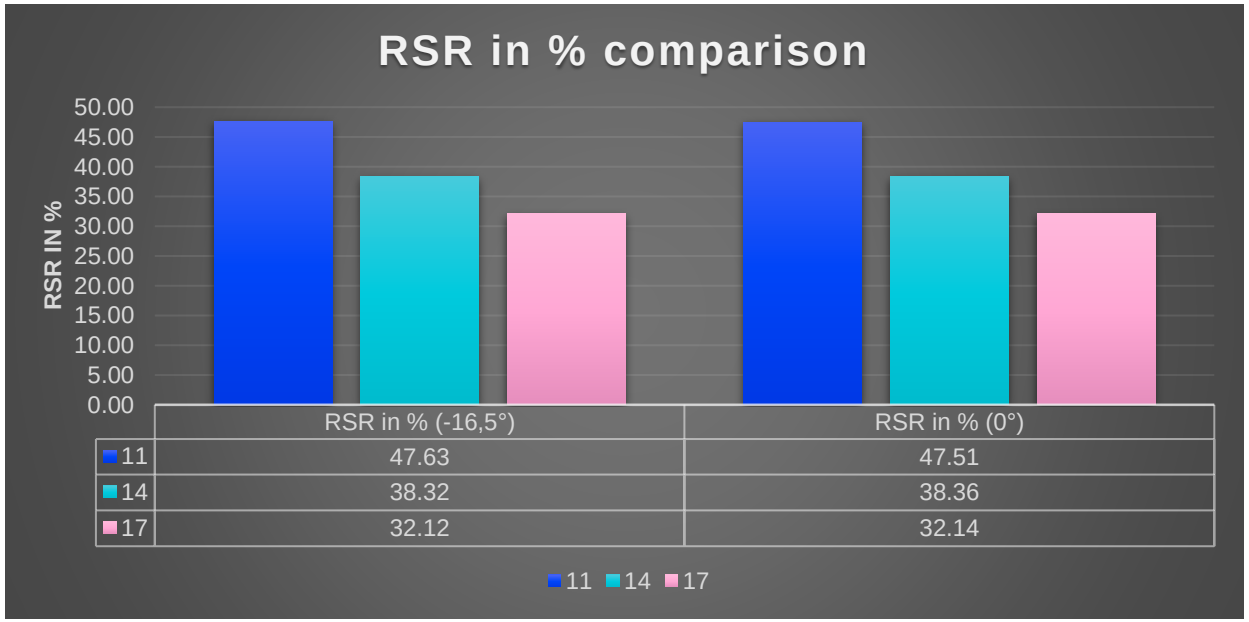
from 575W module in the designing phase to 610W in the construction phase (+5,7%). ↑ pitch or ↓ n° of panels

5 Case study Italy – Light simulation and results by Fraunhofer ISE

Yield change compared to different configurations



	Productivity kWh/ha (-16,5°)	Productivity kWh/ha (0°)
lay. 1	1416.78	1441.80
lay. 2	1134.31	1156.28
lay. 3	1143.59	1165.50
lay. 4	1150.85	1173.40
lay. 5	955.99	975.40



	RSR in % (-16,5°)	RSR in % (0°)
11	47.63	47.51
14	38.32	38.36
17	32.12	32.14

Energy

Productivity ↓ when the pithch ↑;

Productivity ↑ when the height ↑ (rear side);

Productivity Azimuth (0°) > azimuth (-16,5°);

The loss of productivity should be calculated in terms of economic values and compared with the «gain» of the agricultural yield;

RSR

RSR in both azimuth configuration is comparable;

Different RSR are to be considered in relation with the shadow tolerance, (previous slide);

The actual agricultural activities and their continuity should be considered in order to choose the optimum layout.

Thank You

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