PROJECT DESCRIPTION

***insolagrin@Ringoes* – EnergySun**

Construction Project 1.83 MW

26.06.2023

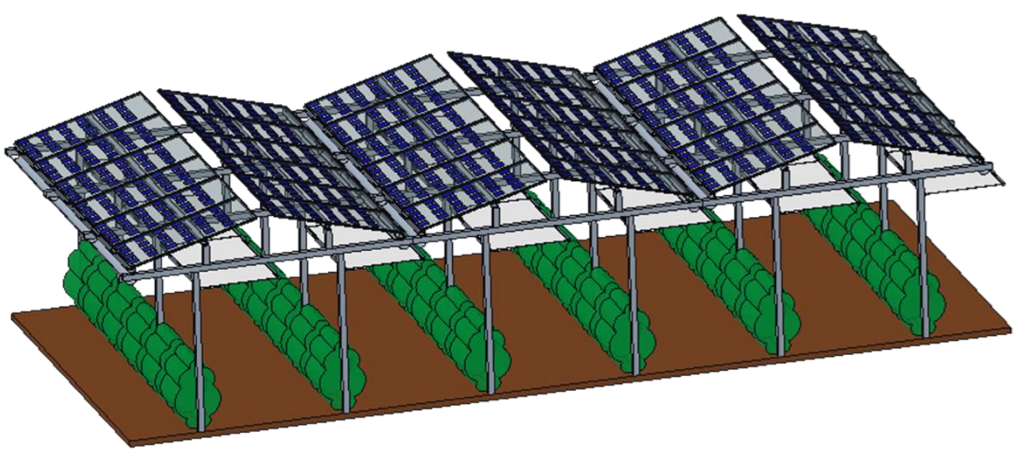


TABLE OF CONTENTS

1 INTRODUCTION

The insolagrin@Ringoes project is an agrivoltaic research and experimentation facility. This document describes the first project of 1.83 MW on 4.7 acre (1.92 ha).

The insolagrin agrivoltaic solution protects crops from bad weather, as well as excess heat thanks to a dynamic adjustment of the amount of light transmitted to the plants. The light not transmitted to the plants is transformed into electricity.

Installation area	**1.92**	hectare
Installed power	**1’830**	kWp
Expected electrical production	**1’434**	MWh/year
Project Budget (without extra Options, BOS and Grid connection)	**2.50**	USD/Wp
Total Project Budget (without extra Options, BOS and Grid connection)	**4.6**	Mio USD

The general conditions are detailed in chapter 10.

2 LOCATION

2.1 Location

The project is located in Ringoes in the state of New Jersey. The surface available for the implementation of the agrivoltaic project is situated in two separated fields and represents 1.92 ha or 4.7 acre (see Situation Plan) altogether. On this surface, a power of 1.83 MWp can be installed.

Figure 1 : Location and plots for the solar installation project,
coord. GPS : 40.434267, -74.856281

2.2 Allocation Plan

The plot 1008_16.01_27_Q0057 is in an agricultural development area and has no preservation status.

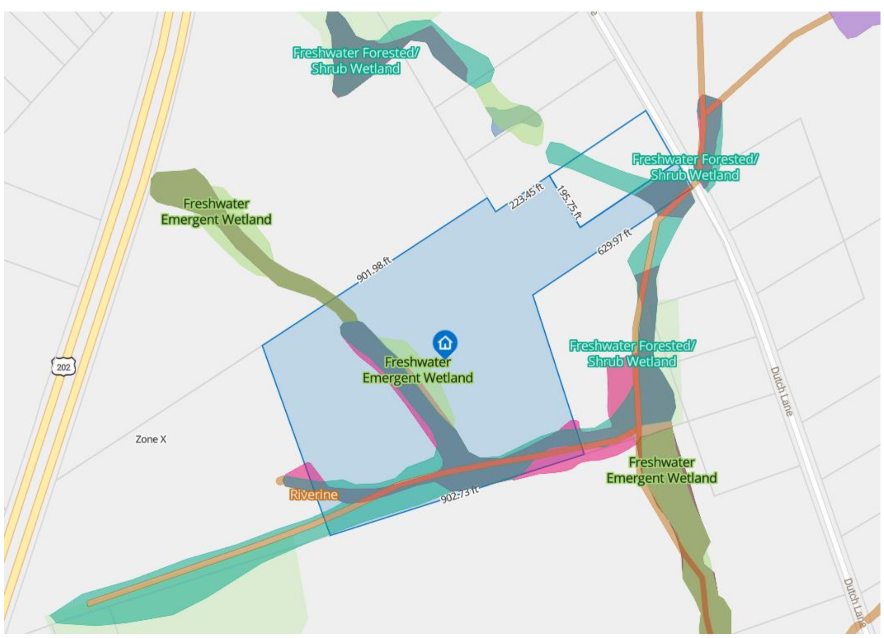


Figure 2 : Cadaster extract (Block 16.01, Lot 27)

2.3 Topography and earthworks needs

Both fields below have an average slope of approximately 3.5% in East-West, 2% in North-South direction, respectively, with little local variation. No general leveling of the ground is expected, but local adjustment might be needed.

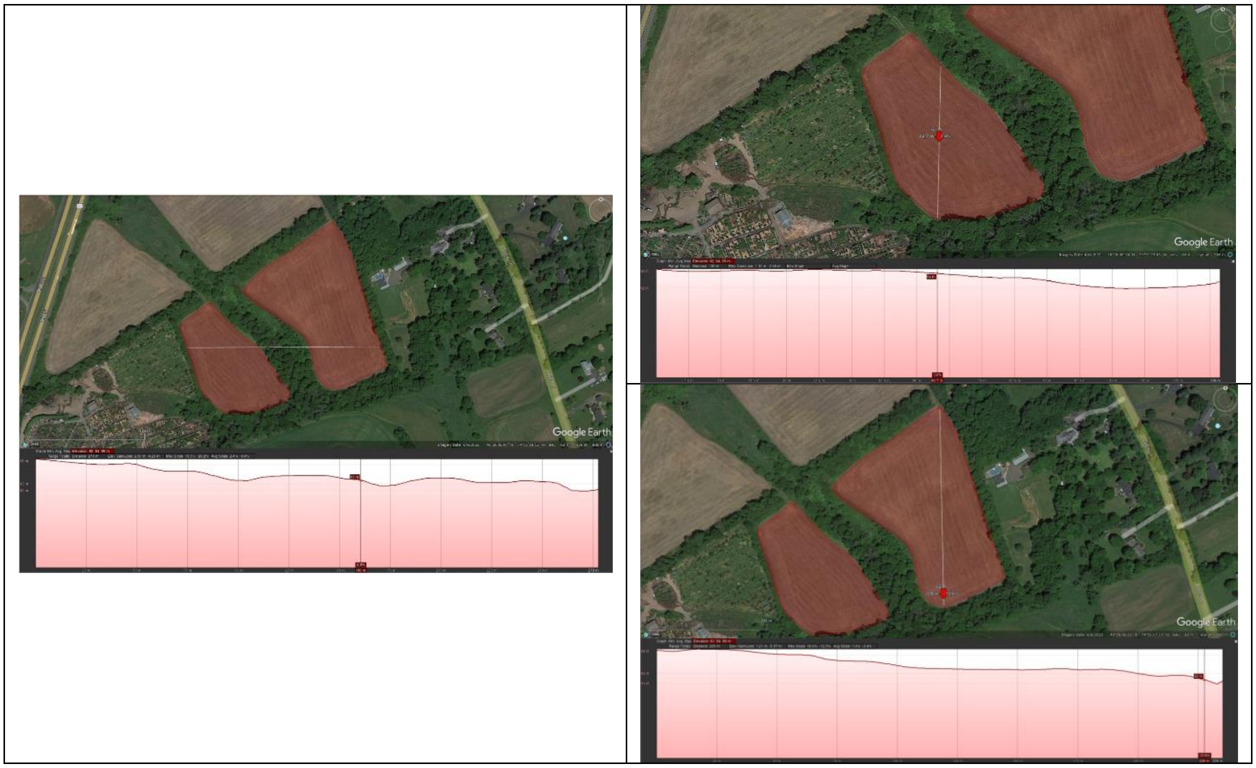


Figure 3: Slope across East-West (right) and North-South (left) on both fields

EnergySun will need to provide the exact topography and soil data to Insolight for the detailed design of the structure. Local slope variations of the plot profile should remain within an acceptable range of ± one (1) foot. Otherwise, those variations might require additional earthworks and thus impact the costs of the installation.

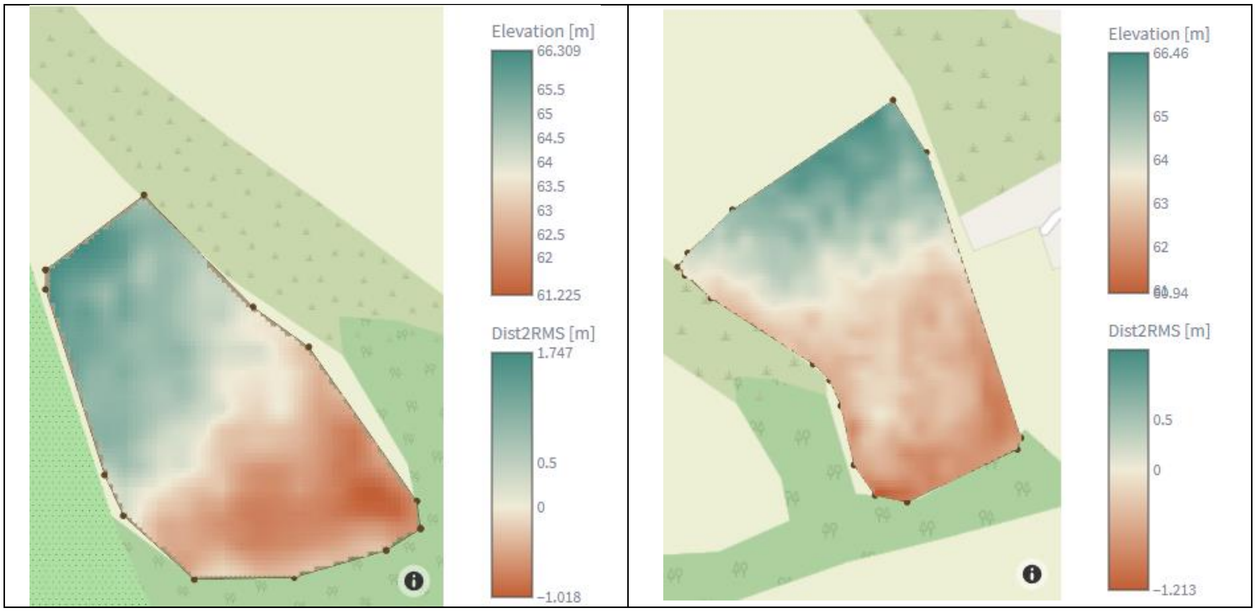


Figure 4: Topography of both fields in [m] for the 1.83 MW installation

2.4 Implementation of the installation

Part of the land cannot be covered by the installation (wetlands, etc.). Thus, though the fields are bigger, only part of them are available for the installation itself. The measurement for the ground surface of the installation for an installed power of 1.83 MWp are resumed in the table below:

	Surface [ha]	Surface [acre]	Installed Power [kWp]	Nbre of Modules [-]
Plot 1	*1.4*	*3.5*	-	
Plot 2	*2.5*	*6.1*	-	
Total	**3.9**	**9.6**	**-**	
Agri-PV plot 1	*0.78*	*1.9*	*617*	*2'054*
Agri-PV plot 2	*1.14*	*2.8*	*1'213*	*4'040*
Total Agri-PV	**1.92**	**4.7**	**1'830**	**6'094**

Figure 5: Implementation of the installation (n.b. refer to permitting plans for exact implementation)

3 CONSTRUCTION PROJECT

This chapter presents the technical drawings of the installation.

Note: plans are currently at Feasibility level and thus subject to possible variations. A shelter for a transformer will be needed for the 1.83 MWp.

3.1 3D rendering of a section of three (3) chapels

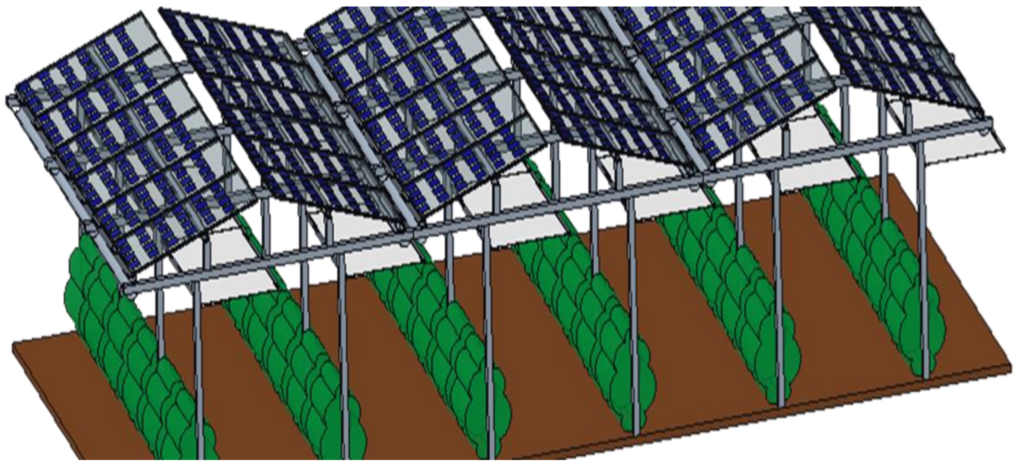


Figure 6: Partial 3D rendering of the installation.

3.2 Construction plans

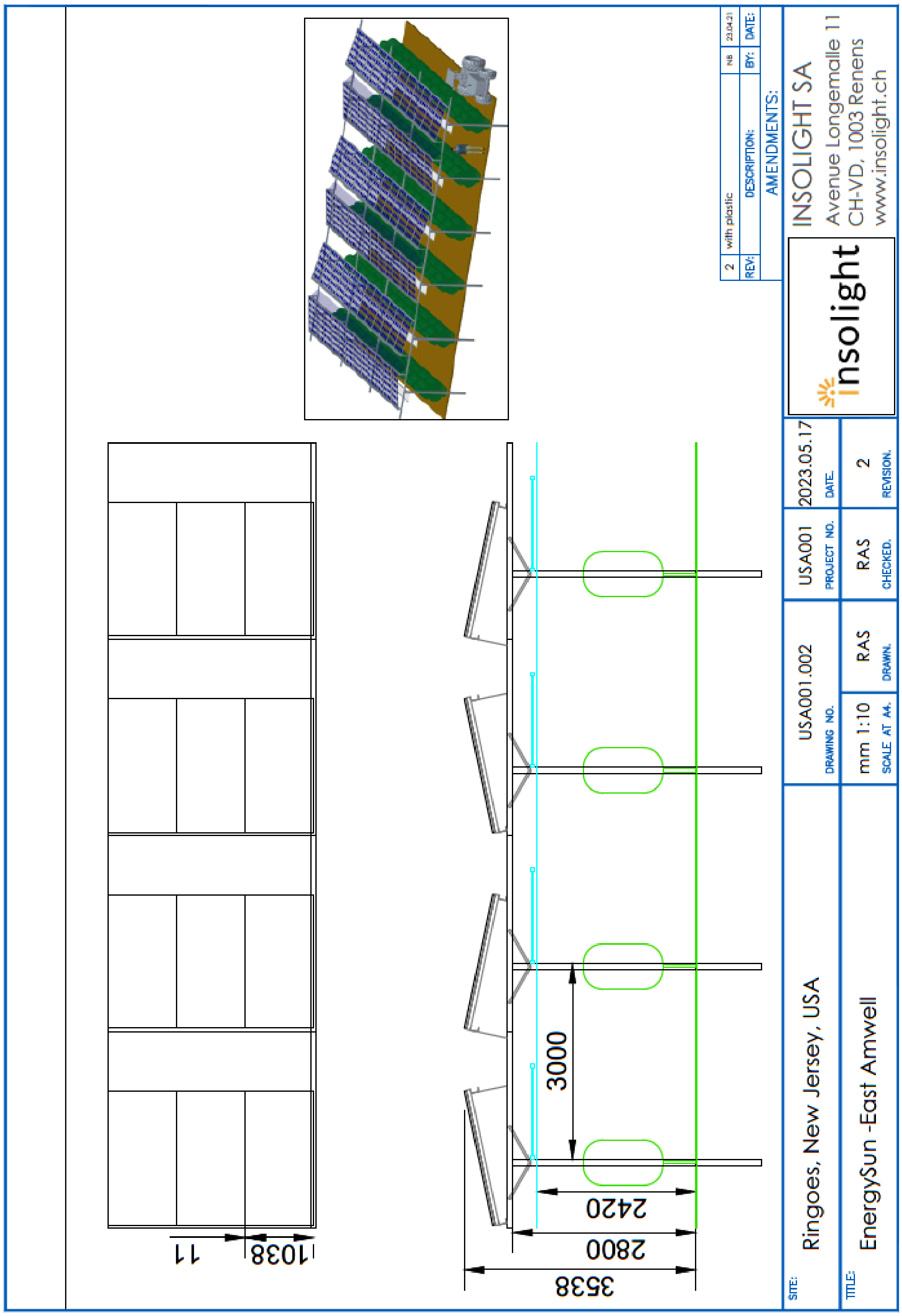
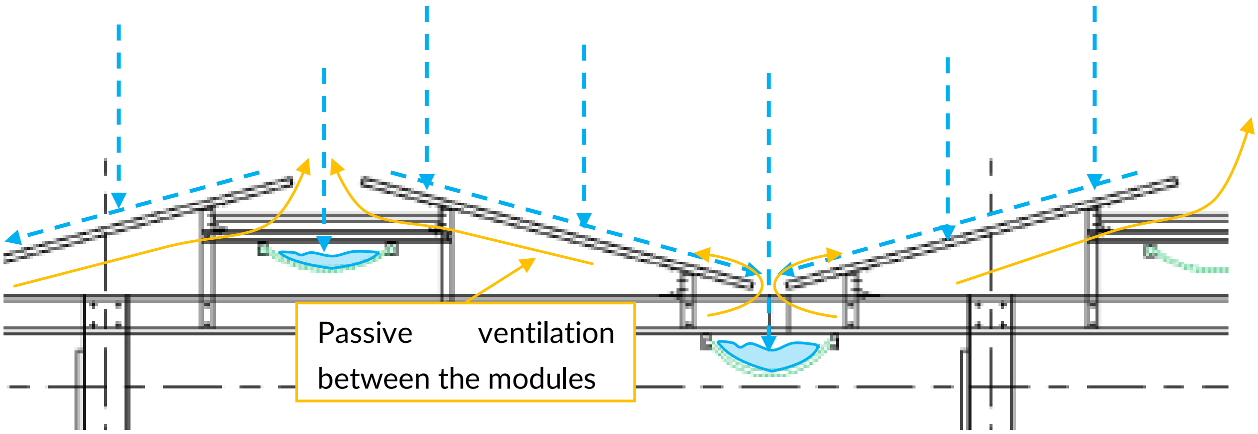


Figure 7 – Installation schematic

3.3 Rainwater management and passive aeration

With the standard structure, the water flowing along the panels will drop between the rows. Rainwater gutters can be integrated to the structure. In addition to collecting rainwater, it protects the structure itself.



4 CULTIVATION

To simulate the light transmission of the installation, an example of a raspberry summer cycle has been chosen.

The vegetative period for raspberries at the given location extends typically from the beginning of May to June and the harvest until the end of August. Outside of this cycle, there is no need for the light to reach the ground, thus electricity production can be maximized.

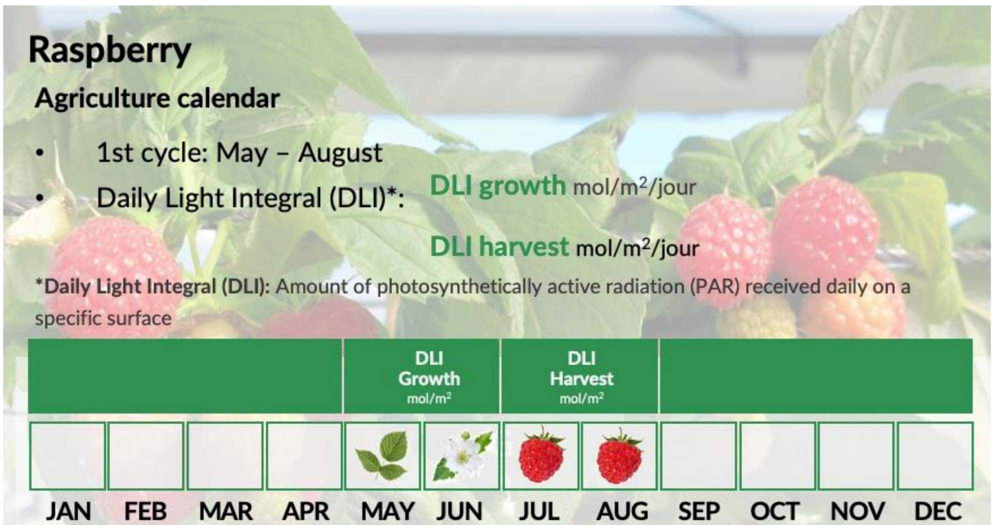
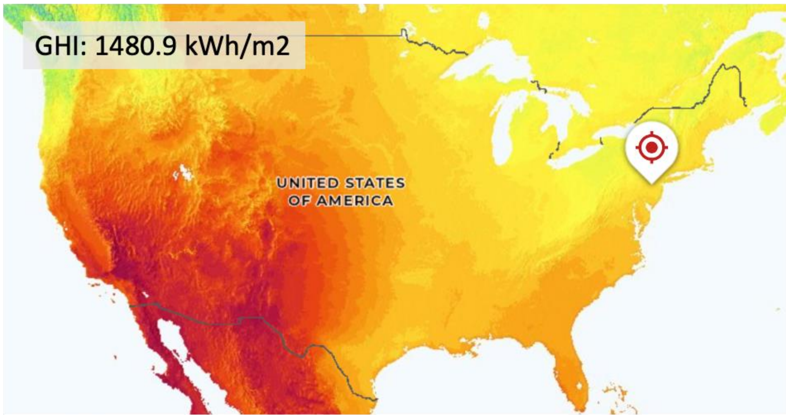


Figure 7: Cultivation schedule and light requirements

5 PERFORMANCE SIMULATIONS

5.1 Solar Irradiance

Global annual horizontal irradiance in Ringoes, New Jersey, USA: GHI 1’481 kWh/m2/year



*GHI: Global Horizontal Irradiance

Figure 8: Irradiance Map

5.2 Light Transmittance

The graph below indicates the range of adjustable light available below the installation. The retractable screen and thus the light transmitted below the installation is adjusted in real-time. It also moves to protect crops against climatical events such as heatwaves and frost.

The red curve corresponds to the chosen cultivation scenario, the gray curve to a comparison with a classic plastic tunnel.

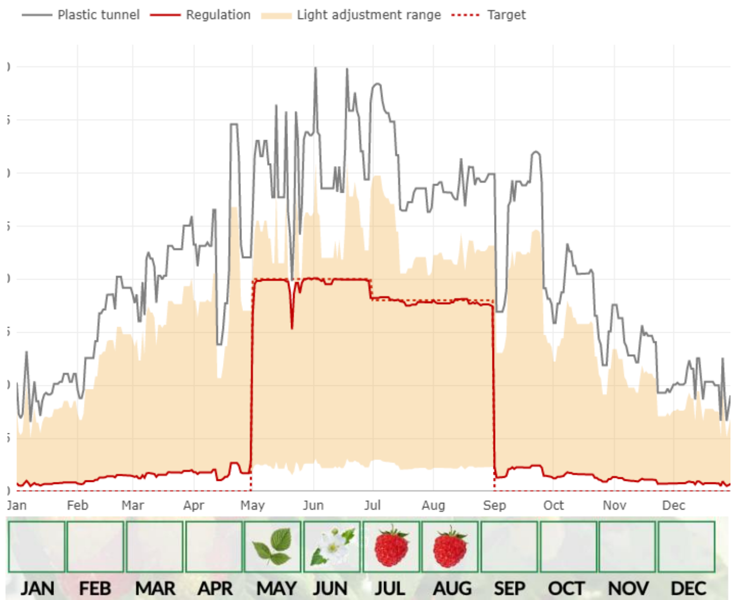


Figure 9: Amount of light transmitted to the plants

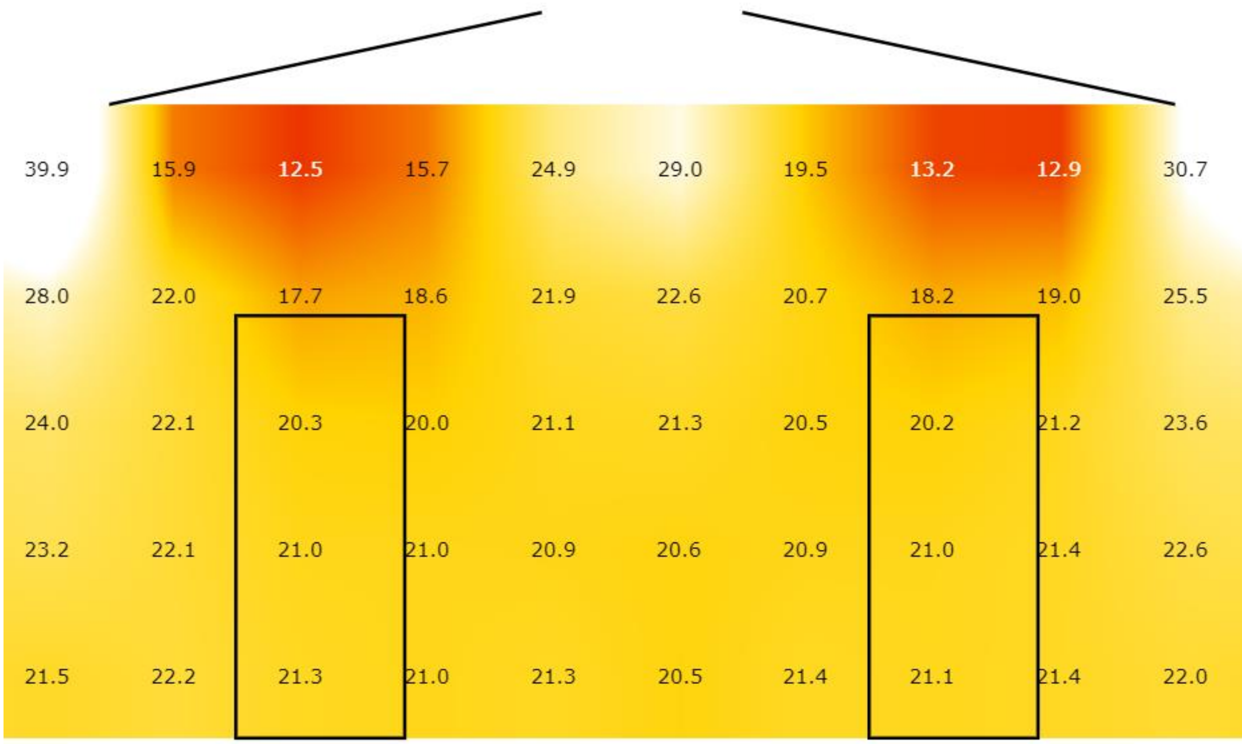


Figure 10: Daily Light Integral average availability in East Amwell under insolagrin from May to August

5.3 Electricity Production

The graph below shows the amount of electricity produced each month for a typical meteorological year. The blue bars indicate the expected production with the selected cultivation scenario.

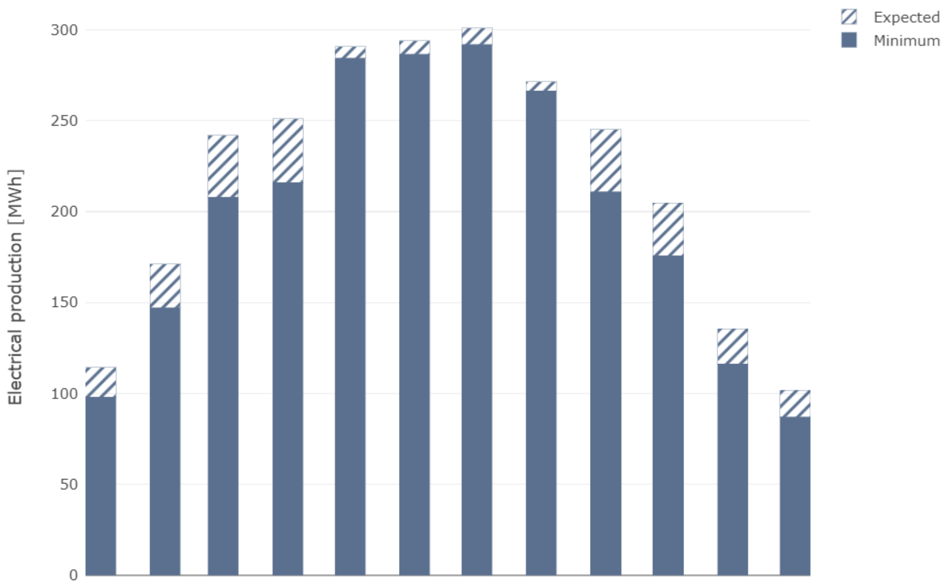


Figure 11:– Monthly electrical production for 1.83 MWp installed

Agri-PV installation size	**1.92 / 4.7**	ha /acre
Installed power	**1’830**	kWp
Expected electrical performance	**1’434**	kWh/kWp
Expected electricity production	**2’623**	MWh/year

6 ROLES & RESPONSIBILITIES

Activity	EnergySun Farms	Insolight
Design & Engineering		X
Geotechnical analysis	X	
Permitting: construction and grid connection	X	
Procurement of modules and structure		X
Procurement of BOS components (Inverters, cables, etc.)	X	
Preparation of the terrain (earthwork and preparation of water evacuation if necessary)	X	
Construction: structure & modules		X
Electrical installation of PV system (cabling of modules and inverters)	X	
Installation of the control system for dynamic shading (electrical cabinet, sensors, cabling, etc.)		X
Power storage and other special electrical work	X	
Grid connection and transformer	X	
Electrical certification according to local norms	X	
Software initialization		X
Operation (electricity + agriculture)	X	
Piloting support		X

7 SUPPLY CHAIN AND ORIGIN OF MATERIALS (SOURCED BY INSOLIGHT)

Material	Origin
Module	Option 1: Cambodia
	Option 2: USA
Structure	Europe
Screen System	Europe
Screen cloth	Europe
Sensors (PAR, temperature, and humidity)	Europe/Asia
Control system	Components: global Assembly: Switzerland

8 BUDGET AND PROVISIONAL OPERATING ACCOUNTS

Included in this budget:

- Materials: Modules and structure and dynamic shading system
- Preliminary budget for the construction of the structure and installation of the modules
- Installation and initialization of the dynamic shading system
- Preliminary budget of transport for structure

Not included in this budget:

- Ground preparation and ground works
- Electrical components of PV system (cables, inverters, storage system, etc.)
- Cabling of modules and inverters
- Grid connection

	Price			
	TOTAL USD	**TOTAL USD/m2**	**TOTAL USD/Wp**	**Responsible**
INSOLAGRIN System: Structure & Screen System & Control System (EXW USDOPE) Modules - Cambodia (DDP New Jersey)	USD 2'915'000	USD 151.82	USD 1.59	
***Transport (Structure, Screen & Control System)*	USD 65'000	USD 3.39	USD 0.04	
***Construction (Preliminary estimate without quote)*	USD 748'800	USD 39.00	USD 0.41	
Project Management	USD 147'000	USD 7.66	USD 0.08	
****TOTAL Insolagrin Installation excl. Options**	**USD 3'875'800**	**USD 201.86**	**USD 2.12**	Insolight
Water collection system gutter steel	USD 147'000	USD 7.66	USD 0.08	
Water tightness at ridge with foil	USD 65'000	USD 3.39	USD 0.04	
Extra cost modules USA - Auxin (EXW California)	USD 487'750	USD 25.40	USD 0.27	
TOTAL OPTIONS	**USD 699'750**	**USD 36.45**	**USD 0.38**	Insolight
TOTAL Agrivoltaic Installation (Without Electrical Components and Grid Connection)	**USD 4'575'550**	**USD 238.31**	**USD 2.50**	

***Budget without validated quotes from subcontractors*

9 PRELIMINARY TIMELINE

+Months from ordering	Activity
	Project description (incl. design, performance simulations, budget estimates) Contracts Permitting
0 (End of summer of 2023)	Construction and grid connection permits obtained
+1	Detailed designs validated
+2	Materials procured
+7	Materials delivered on site
+8	Construction
+9	Installation constructed and “agricultural” commissioning
?	“Electrical” commissioning

10 MAIN TERMS AND CONDITIONS

Terms	Details
Production description and services	• Insolagrin System • Piloting services
Price	• Price Insolagrin System (excluding inverters, cables, cabling and grid connection) as defined in the Budget section. • Agronomic piloting services: free for first project

Payment conditions	• Payment:
	  ○ 30% at order
	  ○ 60% at material deliveries
	  ○ 10% at installation start-up

Delivery conditions	• Expected 6 month between order (first payment) and Insolagrin system construction
Ownership	The client is the owner of the full installation
Rights of the Producer	• Can adjust the transparency manually • Possibility to ask Insolight to adjust the piloting system anytime • Access to the monitoring platform of the agronomic parameters
Obligations of Insolight	• Technical support to adjust piloting algorithm up to 50h/year • Insure access to monitoring platform • If a damage occurs at the installation, Insolight will support in solving the problem as soon as possible and coordinate with potential subcontractors
Rights of Insolight	• Insolight employees can access the site anytime • Insolight gets access to agricultural results of the installation • Insolight can communicate freely on the projects and its results
Warranties	• According to subcontractor specifications
Dismantling	Dismantling the agrivoltaic installation is under the responsibility of the client
Data	Data produced by the installation belong to Insolight
Applicable law	Switzerland

11 ANNEX PRODUCT DESCRIPTION

PRODUCT DESCRIPTION

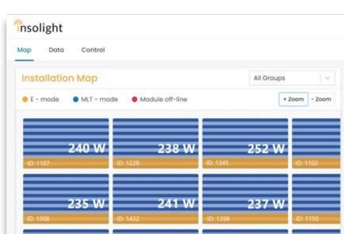
A dynamic agrivoltaic solution

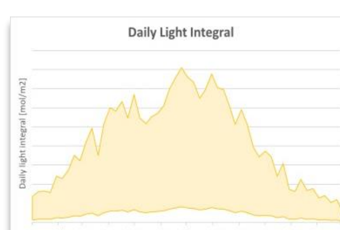
INSOLAGRIN IS…

…a solution to protect crops and generate renewable energy

…using a pilotable optical layer for adjustable shading

…piloted to optimize crops' growth and electricity production.

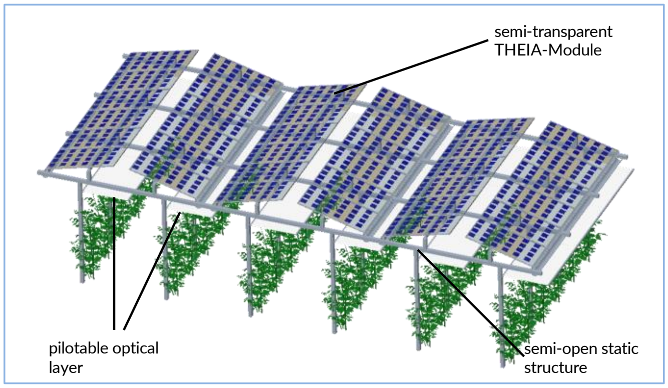


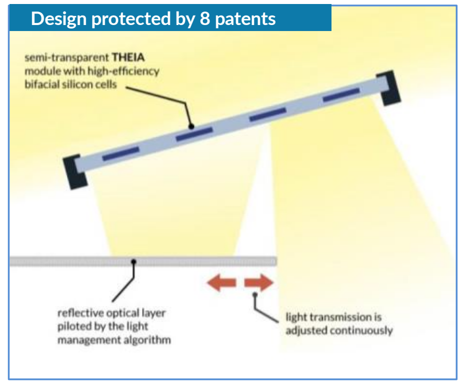


PRINCIPLE OF OPERATION

insolagrin is a dynamic agrivoltaic solution on a static structure. Its unique smart-translucency feature is made possible by a patented opto-mechanical system, comprising 3 innovative components:

- THEIA, a semi-transparent photovoltaic module with high-efficiency bifacial solar cells.
- A pilotable optical layer to selectively transmit or reflect sunlight towards the THEIA modules.
- A centralized piloting system to continuously adjust light transmission based on agronomic requirements.





Under ***insolagrin***, light transmission can be tuned continuously and instantaneously from 15 to 75% to ensure optimal crop growth conditions and maximize electricity production.

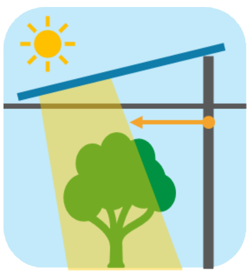
Minimal **light transmission**

Maximal **light transmission**

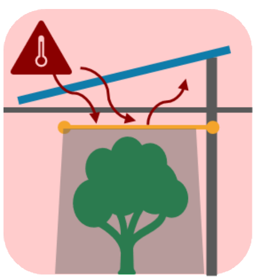
AGRONOMIC BENEFITS

Dynamic light adjustment is just one of the many agronomic benefits that ***insolagrin*** provides. The unique combination of a high degree of coverage with the translucent THEIA modules, and a multi-purpose pilotable optical layer, contribute to improve climate resilience.

THEIA modules provide a high degree of coverage, **protecting crops from rain, snow or hail**. Rainwater can be collected by gutters for irrigation.



The optical layer is piloted continuously to deliver **precise amounts of light** to the crops, ensuring optimal conditions for photosynthesis, and providing control on the time of harvest.



The optical layer **keeps crops in the shade during heat waves**, reducing evapotranspiration rates and irrigation requirements.

The optical layer can be deployed automatically at night to reduce infrared cooling and **protect crops against frost**.

Openings on the top of the structure enable passive ventilation by a "chimney" effect, **decreasing relative humidity** and the associated risk of disease.

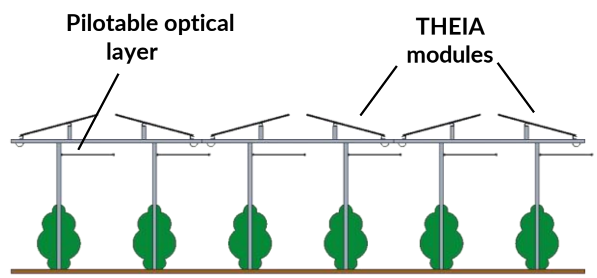
INTEGRATION

insolagrin adapts to various crop growing practices, from semi-open structures to Venlo-type glasshouses, with symmetric or asymmetric roofs. The table opposite provides typical values for the main structure parameters. The solution is customized for each project in collaboration with our construction partners, based on growers requirements.

TYPICAL FIGURES		
Power density per hectare	kWp/ha	600-850
Structure height	m	2-5
Module tilt	°	15
Inter-row spacing	m	2.5-3.5
Hail resistance (hail diameter)	mm	20-30
Maximum snow and wind loads	Pa	1500-2500

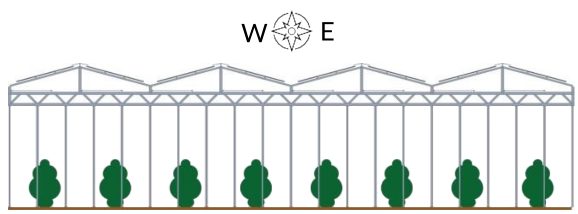
Example of integration in semi-open structure

Symmetric structure with THEIA modules on east- and west-facing roof sections, with a ground coverage ratio of 85% and a roof inclination of 15°. Openings between rows of modules allow for passive ventilation by a "chimney" effect. The structure is anchored to the ground by push or screw anchors, without concrete slab.



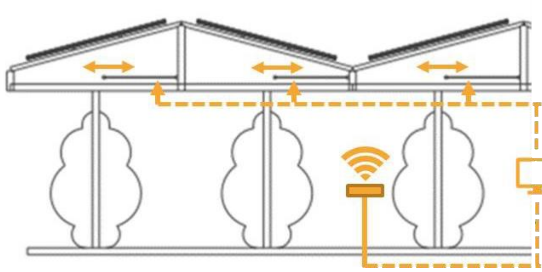
Example of integration in Venlo greenhouse

Symmetric Venlo greenhouse with THEIA modules on east- and west-facing roof sections. The ground coverage ratio is ca. 80%, including windows for venting. The pilotable optical layers are deployed from gutter to gutter for optimal light homogeneity.



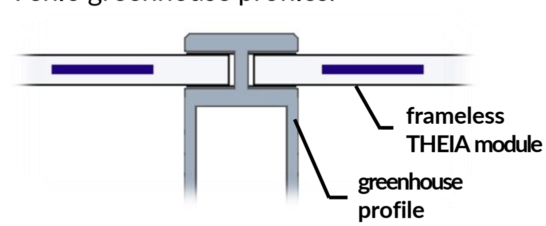
CENTRALIZED ACTUATION SYSTEM

The reflective optical layer of *insolagrin* is piloted by a centralized actuation system, based on the feedback of multiple sensors.



MODULE INTEGRATION

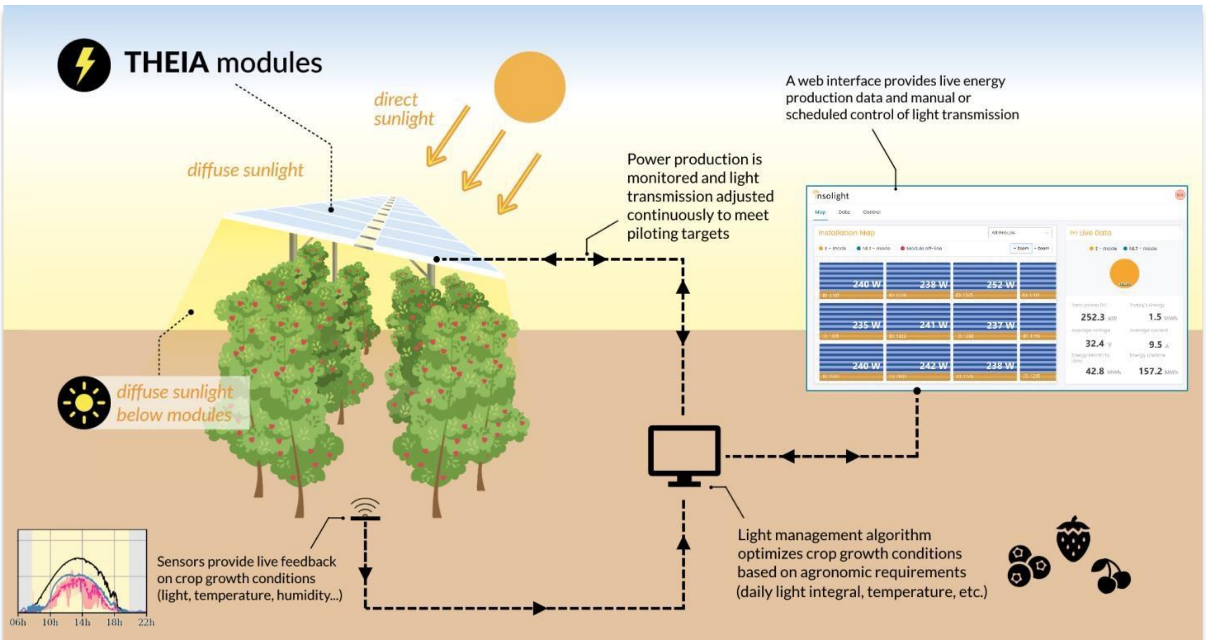
THEIA modules are available in both framed and frameless versions, to ensure compatibility with various mounting and clamping systems. The frameless version is designed for optimal integration in Venlo greenhouse profiles.



PILOTING SYSTEM

powered by insoinsights

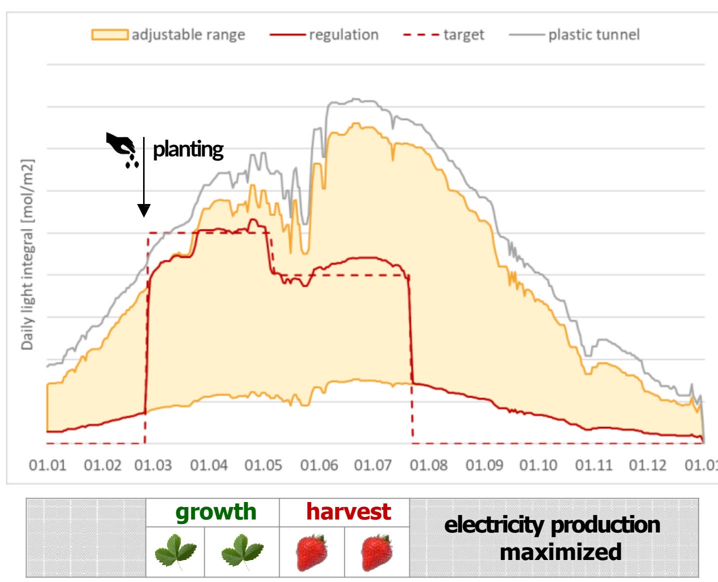
Electricity production and environmental data are continuously logged into our cloud-based acquisition system. Light transmission is piloted automatically based on live sensor feedback (irradiance, temperature, etc.), according to crop- specific algorithms developed and tested in collaboration with agronomic centers of excellence.



The light management algorithms ensure that ***insolagrin*** provides just the right amount of light to the crops during the growth and harvest periods, while maximizing electricity production the rest of the year. Dynamic shading also protects the crops from excess sunlight and high temperatures during the hottest hours of the day.

Example light regulation output for late strawberries in Aix-en-Provence (France)*. The plot illustrates the range of light adjustability provided by the system, compared to a plastic tunnel. During growth and harvest, the **daily light integral (DLI)** is dynamically regulated to optimal values according to pre-defined targets. Outside of the cultivation period, electricity production is maximized.

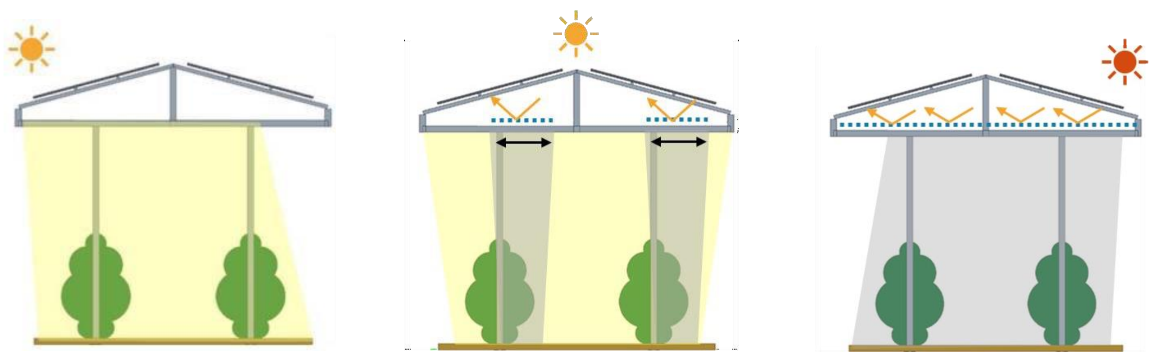
**Based on a typical meteorological year (TMY)*



LIGHT MANAGEMENT

The piloting system manages light transmission in order to achieve several objectives simultaneously:

- **Target precise daily light integral (DLI) values and instantaneous irradiance values (PPFD)**, taking into account the photosynthetic capacity of the plant over the course of the day.
- **Limit the rise in temperature of the plant** during the hottest hours of the day, by reflecting part of the incoming sunlight towards the backside of the THEIA modules.
- **Avoid wasting light** at the end of the day or between crop cycles, using excess sunlight to **produce renewable electricity.**



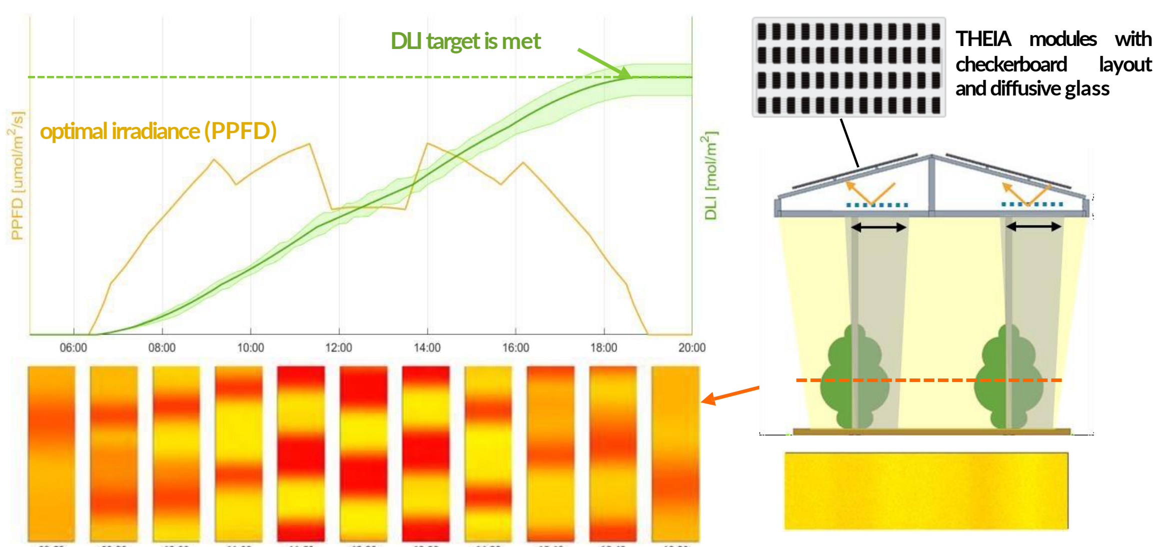
fully open, 60-75% transmission, diffuse and homogeneous light

partial shading mode, piloted to homogenize

fully closed, 15-20% transmission, diffuse and homogeneous light

Depending on ambient conditions, the pilotable optical layer can be deployed partially or fully, reflecting up to 80% of incident sunlight. In partial shading mode, the optical layer distributes light dynamically over the crops, in such a way to achieve daily light integral targets with excellent homogeneity, while maintaining irradiance (PPFD) and temperature under pre-defined limits.

simplified daily piloting example



light distribution patterns 1m above ground over the course of the day

homogeneous light distribution on the crops at the end of the day

Contact us to discuss your project

www.insolight.ch

Avenue de Longemalle 11
1020 Renens
Switzerland

info@insolight.ch