

# Agri-Photovoltaics (Agri-PV) from BayWa r.e.

Sustainable food & energy from one area.





# Agri-PV from BayWa r.e.



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BayWa Group and  
Agri-PV Products

2

BayWa r.e. Agri-PV  
References



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# BayWa Group and Agri-PV Products



# Our five pillars in the field of solar project planning

## Ground-mounted PV systems

Improvement of biodiversity through highly standardized solar parks



Subsidy-free



## Rooftop-PV

Double use of the roof areas in new buildings and in existing buildings



## Carport-PV

Double use of commercial parking space



## Floating-PV

Conversion of unused water areas into energy sources



## Agri-PV

Sustainable agriculture and energy in one area



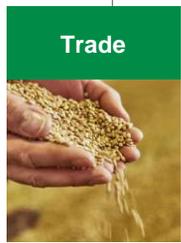
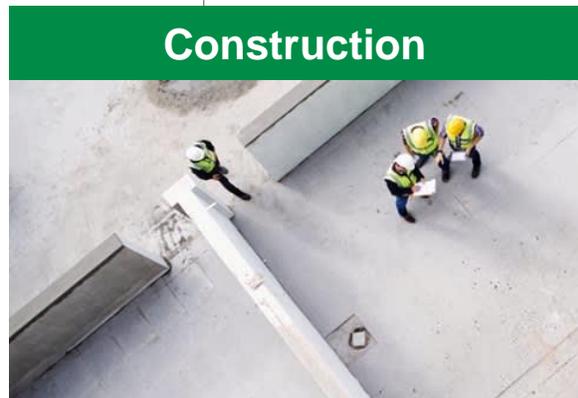
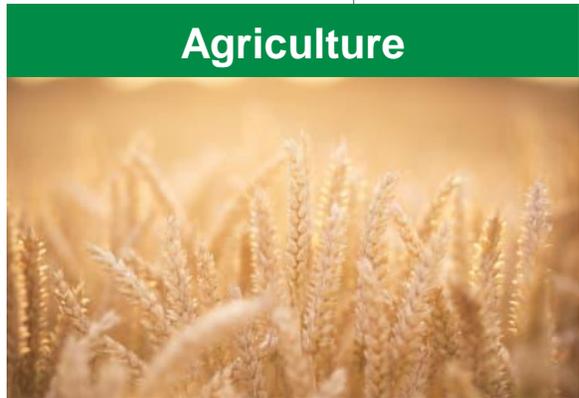
Rooftop-, Carport-, Floating- and Agri-PV relieve the existing land use competition





# BayWa Group serves fundamental needs – BayWa r.e. is 100% focused on renewables

BayWa



Agri-PV: leveraging competence of three core segments



# BayWa r.e.'s first involvement in an Agri-PV plant in Germany

## Heggelbach

Lake Constance, Germany

### Key Facts:

- Installation in 2016
- Potato, celery, wheat, clover
- Battery storage
- Energy management system
- 2018: higher agricultural yields under Agri-PV due to hot and dry summer
- Scientific research project APV-RESOLA with Fraunhofer ISE
- Negative Price-Performance-Ratio for grain growing under Agri-PV

 APV 194 kWp  
 150kW/150 kWh  
 Netz

64%

Self-consumption

54%

Self-sufficiency rate



Quelle: BayWa r.e.



Source: University of Hohenheim



Source: University of Hohenheim



Source: University of Hohenheim



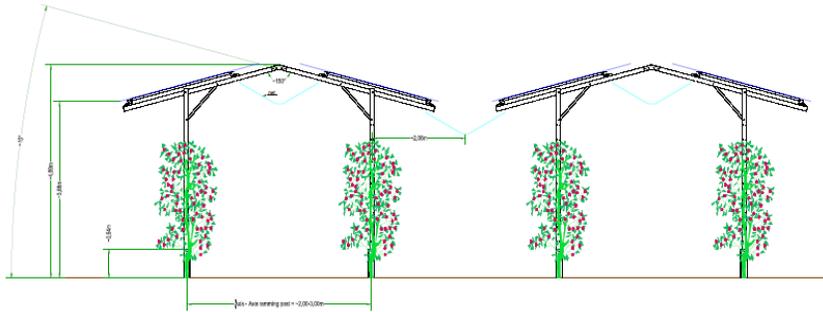
Source: University of Hohenheim



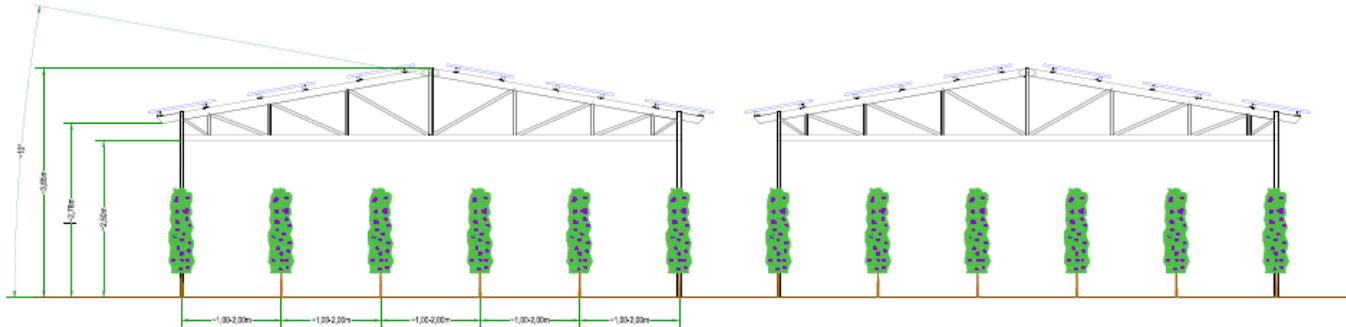
## BayWa r.e. Agri-PV products: Category I, double use of the agricultural area

Highly elevated, many synergy effects, agriculture under PV modules, e.g. special crops

■ Agri-PV: single-row system



■ Agri-PV: multi-row system – see also the following slide for strawberries

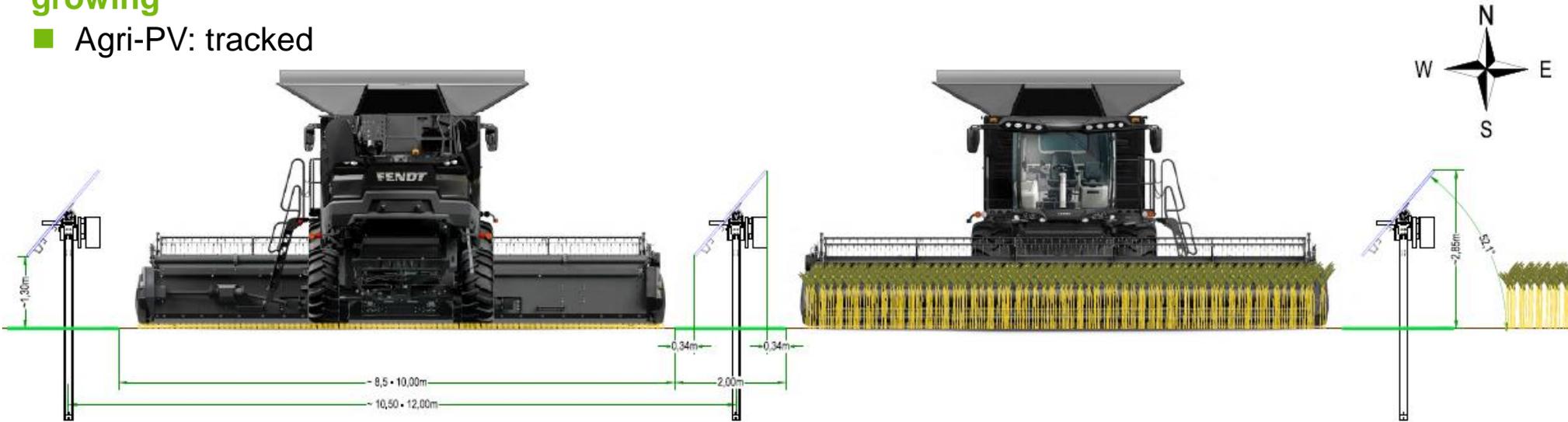




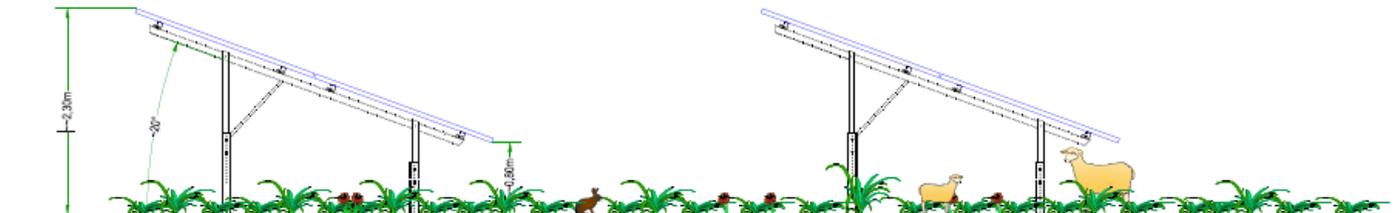
# BayWa r.e. Agri-PV products: Category II, parallel use of the agricultural area

Installed close to the ground, lower synergy effects, agriculture between PV modules, e.g. agriculture and vegetable growing

■ Agri-PV: tracked



■ Agri-PV: fixed-tilt





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## BayWa r.e. Agri-PV References



## 2. Agri-PV plant and 1st Fruitvoltaic-Raspberry Farm of BayWa r.e.

### Albers Fruit Farm

Babberich, Netherlands



#### Project overview

- 2,67 MWp over 31.000 raspberry plants
- 10.250 modules on 3,3 hectare
- Standardized complete solution
- Development of our own assembly structure and transparent panel design for optimal shade
- Double use of agricultural land
- Protection for the harvest from extreme weather events
- Eliminates the need for plastic wrap to protect the crop

**2.67**  
MWp

Total capacity

**10,250**  
modules

on 3,3 hectare

**31,000**

Raspberry plant



**AFTER**





# Results case study with raspberry (1/3)

## Albers Fruit Farm, 2020

### Comparison of foil protection system with Agri-PV: PAR monitoring concept

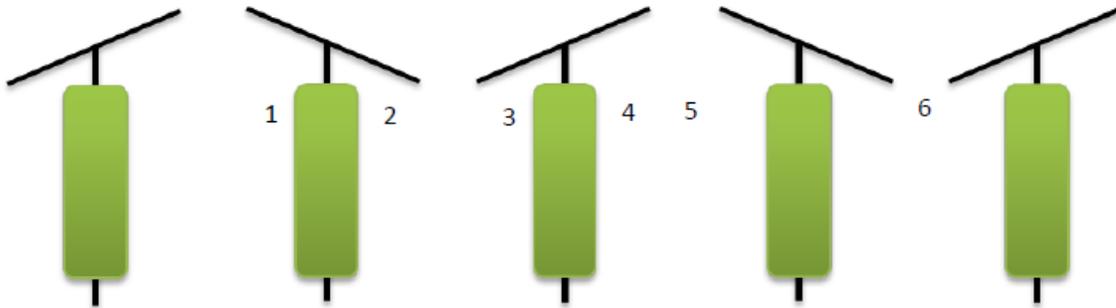


Figure 2. Measurement positions below the solar panel construction to measure light transmission.

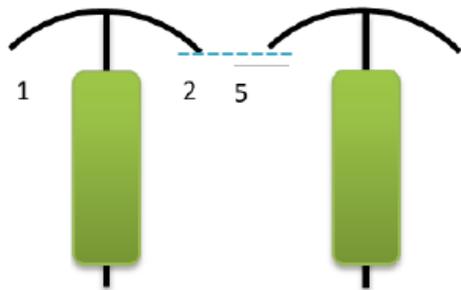


Figure 3. Measurement positions below the plastic construction. The blue dotted line represents a blue net which is applied during fruit maturation.

Source:  
Wageningen University/GroenLeven

■ Average light transmittance under Agri-PV: 56%



## Results case study with raspberry (2/3)

### Albers Fruit Farm, 2020

#### Comparison of foil protection system with Agri-PV: temperature

**Table 6** Temperature (°C) data

Standard			
	Average	Max	Min
Average	17.9	26.2	11.1
Maximum	29.7	43.0	21.0
Minimum	7.6	12.4	0.8
Solar panels			
	Average	Max	Min
Average	17.8	25.0	11.6
Maximum	27.3	38.3	20.9
Minimum	7.9	11.7	1.7

Source:  
Wageningen University/GroenLeven

- Lower temperature fluctuations under Agri-PV: fewer peaks, fewer lows
- Less heat stress under Agri-PV: almost 5 degrees less in maximum
- Farmer very satisfied with overall results many inquiries from farmers



## Results case study with raspberry (3/3) Albers Fruit Farm, 2020

### Comparison of foil protection system with Agri-PV: light transmission and yield



Figure 4. PAR sensor below solar panels



Figure 4. The measurement head of the LICOR LI6800 Photosynthesis measurement system, attached to a raspberry leaf.

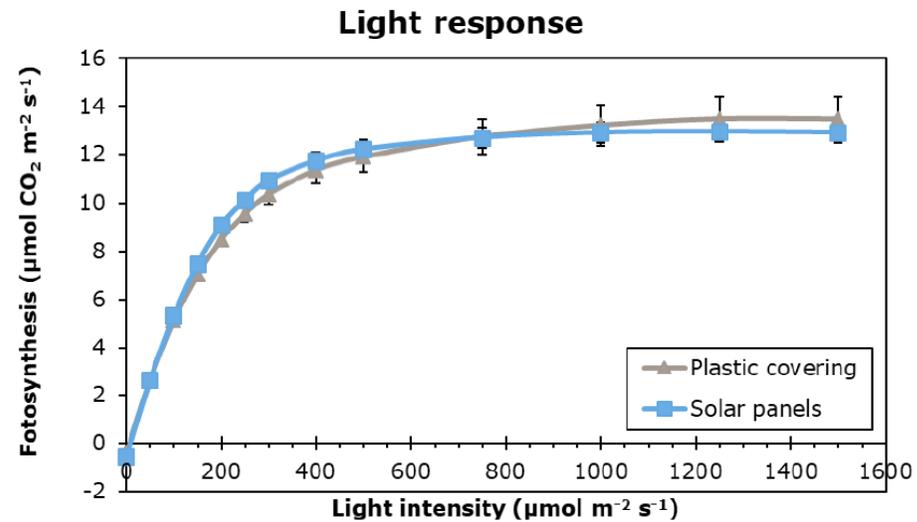


Figure 5. Light response curve of raspberry leaves to increasing light intensity. Error bars show standard error of the mean (n=4).

Source:  
Wageningen University/GroenLeven

- Very similar dependence on light intensity and photosynthesis
- approx. 3.5% less raspberry yield under Agri-PV compared to reference under foil protection system
- Improved land use efficiency by 10% because longer raspberry rows on the plot (and no investment costs, etc)
- Net approx. 6% raspberry yield increase with Agri-PV



### 3. Agri-PV plant of BayWa r.e. and 1<sup>st</sup> Fruitvoltaic-Currant-Farm

#### Kusters Fruit Farm

Wadenrijen, Netherlands



#### Project overview

- Standardized complete solution
- Development of our own assembly structure and own module design with transparency for optimal shading
- Double use of agricultural land
- Protection for the harvest from extreme weather events
- Eliminates the need for plastic roofs

**1.18**  
MWp

Total capacity

**4,552**  
modules

On 1,5 hectare

**4,500**

Currant plants



**AFTER**  
(Beginn of  
construction  
March, 2021)





# Experience from the Netherlands

## Three more berry pilot plants, 2020

Every business has its own needs



**blackberry**



**strawberry**



**blueberry**



Every project has its own main focus → All projects make a contribution to the sustainable development of the companies :

- more economical,
- more environmentally friendly,
- more socially acceptable





**r.e. think agricultu r.e.**

**Thank you.**

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# Agri-PV Homepage :

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