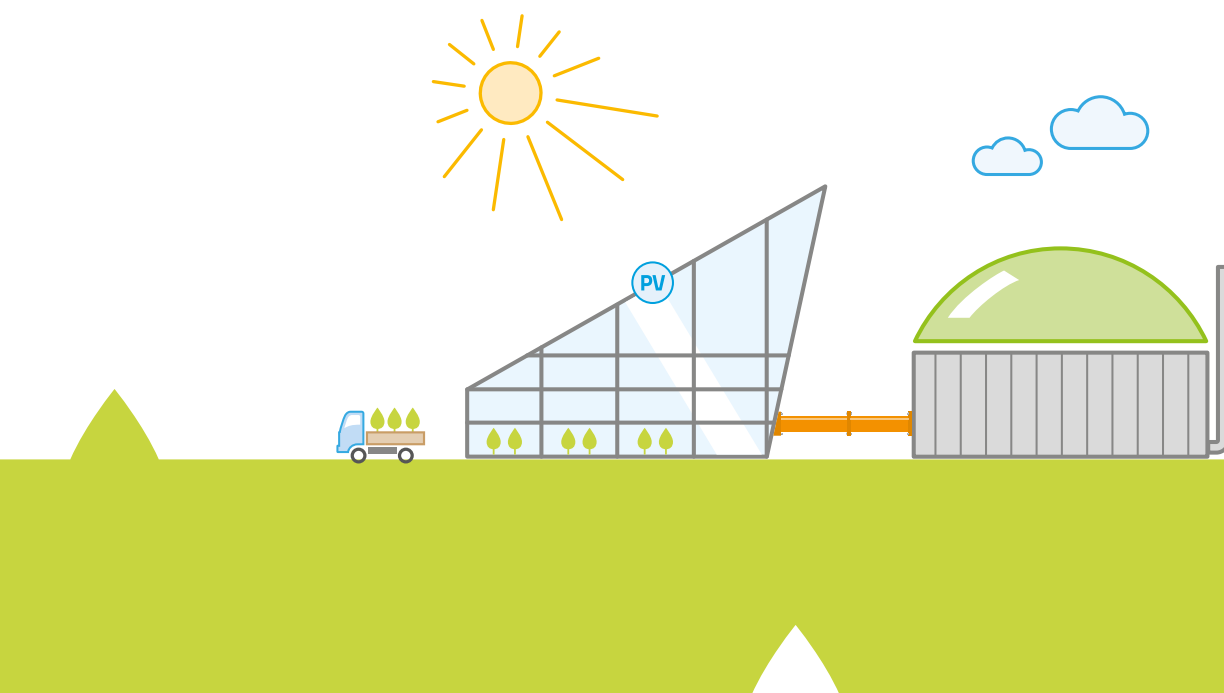


# Boost your energy harvest!

— Greenhouse innovation for biogas operators



**CULTIVECO**

POWERED BY GRAMMA GREENHOUSE

# CULTIVECO

Thus your success grows and thrives.

\_\_\_ As an operator of a biogas plant you are facing the challenge to prove a useful excess heat concept. If there are no or too few off-takers available, an alternative is needed to benefit from the CHP-bonus. At the same time it is of interest to you as a farmer to cultivate effectively and develop new crops.

**Both objectives can be combined effectively thanks to CULTIVECO.**

With the patented "GRAMMA Effective PV-Greenhouse" concept we provide a special solution tailored to the agricultural sector, from which you can benefit in multiple ways: a greenhouse with a solar roof, heated by the waste heat of your biogas plant instead of fossil fuels.

**Synergy instead of competition – a path to the future of farming**

The functional integration of our PV greenhouse reveals new potential for the agricultural sector. With CULTIVECO we manage to harmonize the agriculture and energy industries to use available surfaces in an optimized and sustainable manner. \_\_\_

## The principle

Single system, threefold value generation

- 1** You can use the greenhouse **growing surface** yourself or rent it out. Its stable climate guarantees high yields, even for sensitive species such as tomatoes (see Case Study on the right). In addition there is an increasing demand for locally and sustainably produced foods.
- 2** Part of the roof is used for photovoltaics. The **produced electricity** is primarily self-consumed in the biogas plant, replacing conventionally purchased electricity, whose price is constantly increasing. Electricity which is not self-consumed can be fed into the grid as an additional source of income.
- 3** The size of the greenhouse will be tailored to the output of your plant, so you can **use the waste heat adequately**. Thus, you will get your CHP-bonus and enjoy regulatory grand-fathering.



## On fertile soil.

This is how your investment pays off

\_\_\_ The waste heat utilization alone ensures a solid return. In addition, gains are created from agricultural use as well as power generation – latter due to the development of increasing electricity prices. All in all, you generate attractive additional revenues without risk because: CULTIVECO as a general contractor is standing by for you.

See here, how quickly our innovative system will be profitable:

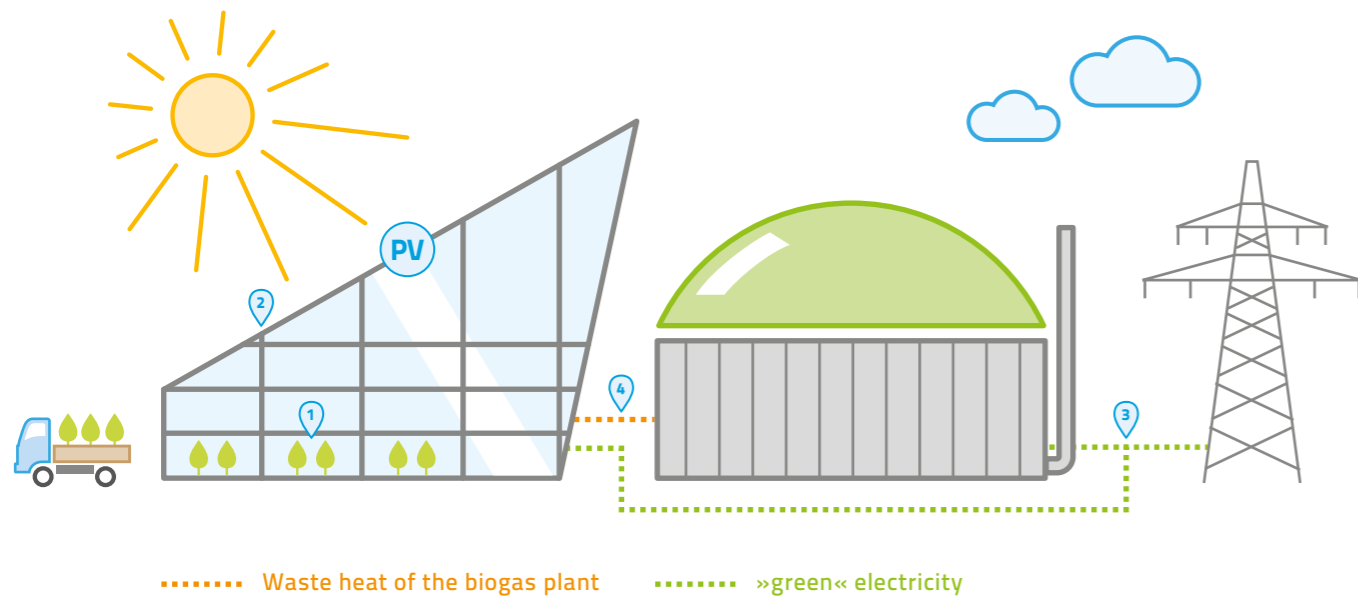
	Key	Cost/key	Statement
<i>Calculation of profitability for a „GRAMMA Effective PV Greenhouse „with 1000 sqm agricultural and 540 sqm PV module surface in combination with a 400 kW biogas plant</i>	Amount to be invested	250 000 € - 350 000 €	depending on the equipment
	Total IRR	12% - 15%	without leverage
	Payback-period	5 - 6 years	of course, greenhouse and PV system have a useful life of about 20-30 years
	Income agricultural use	5 000 € - 10 000 €/year	depending on the greenhouse usage concept

## Plenty of sunshine:

Case Study "Cismarfelde"

\_\_\_ At a dairy and corn farm with an attached biogas plant in the Grömitz district Cismarfelde, a 400 sqm "GRAMMA Effective PV Greenhouse" for growing organic tomatoes of varieties Sparta and Berner Rose was built in 2013.

Due to the organic standards they are grown in soil instead of a substrate and are subsequently sold through local direct marketing. The Baltic Sea region is tourist-orientated and thus a high demand for regional, high-quality food can be observed, which is also reflected in tomato sales. Far from offering the "sun fruit" only as a fresh ingredient, farmer Eike Steensen is thinking one step further. "With the heat from the biogas plant it is not a problem to dry the tomatoes." Other projects include the production of aromatic sauces and spicy chutneys. Thus, the "GRAMMA Effective PV Greenhouse" in Ostholstein has proven to be both profitable and adaptable to demand trends and it shows that the concept is bearing fruit even in the north of Germany. \_\_\_



# The Function

## Naturally, well-thought-through

— Not doing things by halves – this is the basis for the unique “GRAMMA Greenhouse” concept. At present, our PV greenhouse technology is the only one available that allows a dual production of electricity and agricultural products, without having to compromise the results of either activity.

This means that the agricultural production and quality is as high as in a conventional greenhouse – while at the same time producing a significant electricity yield. An absolute novelty in the market.

- 1 Optimal growing conditions mean stable harvests and thus an additional source of income. The arrangement of the plant rows – north-south instead of east-west – ensures excellent light conditions.
- 2 The design of the greenhouse allows to use part of the roof area for solar power generation – without disadvantageous shading effects which affect plant growth. In addition, the substructure already exists through the roof struts.
- 3 The production of the PV system covers partly the electricity needs of the biogas plant. By optimizing the timing of the electricity-intensive activities, it can be shifted to the time of the day when the PV system produces the highest output. Any energy surplus can be fed into the grid against payment.
- 4 The required temperature in the greenhouse is generated by the waste heat from the biogas plant instead of using fossil fuels. The prerequisite for the CHP-bonus is therefore fulfilled.

# Organically built:

## The modular system

— The basic version of “GRAMMA Effective PV Greenhouse” includes the functions described on the previous page. According to the individual farming concept it can be expanded by a modern infrastructure, which depends entirely on your wishes and requirements as operator:

- Automation technology
- Heatable growing tables
- Hydroponic culture
- CO<sub>2</sub> enrichment (from the biogas plant)
- LED lighting
- Use of heat pumps for further enlargement
- etc.

# Greenfield

## The technical design

— The sizing of your PV greenhouse depends on the waste heat potential of your biogas plant and in turn influences the available roof area, which can be used for installation of the PV system. Per square meter greenhouse ca. 100W PV power can be integrated with the use of conventional 250W modules.

Use our construction example to get an impression of the structure of the total system. —

System element	Performance / Size	Statement
Biogas plant heat minus own consumption is available	500 kW el	assuming that the entire waste
Greenhouse	1 000 sqm – 2 000 sqm	depending on location and usage concept
Acreage	800 sqm – 1 600 sqm	
PV system*	100 kWp – 200 kWp	when installing modules with 250 Watt

\* Depending on the maximum required power for self-consumption possibly lower power inverters can be installed in order to increase the effective production hours per year..

# TOWARDS THE SUN

## The solar surface

— The geometric construction of the greenhouse allows absolute flexibility regarding the solar module technologies and formats used. Thus, as operator you are not bound by fixed systems, but free to decide which solution at the current point of time is most convincing available in terms of cost and efficiency. This way the “GRAMMA Effective PV Greenhouse” permanently keeps pace with the technological development.

## Getting granular

### Certificates and Norms

The “GRAMMA Effective PV Greenhouse” is established in accordance with the European Greenhouse Norm 13031-1 and all relevant European building standards. This extends to the local norms with respect to static requirements.

Specifically in Germany, this includes the following norms

- DIN EN 1991-1-3 »Eurocode 1: Einwirkungen auf Tragwerke - Teil 1-3: Allgemeine Einwirkungen, Schneelasten; Deutsche Fassung EN 1991-1-3:2003 + AC:2009«;
- DIN EN 1991-1-3/NA »Nationaler Anhang - National festgelegte Parameter - Eurocode 1: Einwirkungen auf Tragwerke - Teil 1-3: Allgemeine Einwirkungen - Schneelasten«;
- DIN EN 1991-1-4 »Eurocode 1: Einwirkungen auf Tragwerke - Teil 1-4: Allgemeine Einwirkungen - Windlasten; Deutsche Fassung EN 1991-1-4:2005 + A1:2010 + AC:2010«;
- DIN EN 1991-1-4/NA »Nationaler Anhang - National festgelegte Parameter - Eurocode 1: Einwirkungen auf Tragwerke - Teil 1-4: Allgemeine Einwirkungen - Windlasten«;
- DIN EN 1993-1-1 »Eurocode 3: Bemessung und Konstruktion von Stahlbauten - Teil 1-1: Allgemeine Bemessungsregeln und Regeln für den Hochbau; Deutsche Fassung EN 1993-1-1:2005 + AC:2009«;
- DIN EN 1993-1-3 »Eurocode 3: Bemessung und Konstruktion von Stahlbauten - Teil 1-3: Allgemeine Regeln - Ergänzende Regeln für kaltgeformte Bauteile und Bleche; Deutsche Fassung EN 1993-1-3:2006 + AC:2009«;
- DIN EN 1993-1-8 »Eurocode 3: Bemessung und Konstruktion von Stahlbauten - Teil 1-8: Bemessung von Anschlüssen; Deutsche Fassung EN 1993-1-8:2005 + AC:2009«;
- DIN EN 13031-1 »Gewächshäuser - Bemessung und Konstruktion - Teil 1: Kulturgewächshäuser; Deutsche Fassung EN 13031-1:2001«.



## Our performance

### Starting from the root

— CULTIVECO has many years of experience as a general contractor in the field of renewable energies. So we accompany your project to success as well – from project development over planning and sizing, construction and technical installation to turnkey delivery.

In short: you get an operating system from a single source using the unique, patented “GRAMMA Effective PV Greenhouse” technology.

But not only plants, even technology needs care: So we are happy to look after you long term within in the framework of an optional maintenance contract. —

## Growth Accelerator

### Our Business Consulting

— In addition to our technical expertise, we support you if required with entrepreneurial advice by developing appropriate marketing strategies and distribution channels together with you.

Here our experience from numerous Best Practice projects comes to fruition, proving that the demand for healthy, local products is high – it just needs to be met! —



# Your contact

## Refreshingly direct

— Agricultural and energy expertise combine CULTIVECO into an innovative solution – economically and ecologically.

Caught your interest? Then we look forward to a fruitful dialogue:

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Please note that the construction of our  
Greenhouse is patented!

