



# Integrated greenhouse design for all climates

## Wageningen UR Greenhouse Horticulture

A good greenhouse design must be attuned to the requirements of the crop, the climate of the location, the company's infrastructure and the latest legislation and regulations. Together with our industrial partners, Wageningen UR Greenhouse Horticulture develops newly integrated greenhouse solutions. We advise our clients in relation to developing a complete greenhouse design – or parts of it – including the structure, installations and outer covering material, depending on the cultivation requirements.

### Concepts

Our employees are experts in the field of horticulture, physics, material technology and architecture. Customer-oriented solutions are developed by means of a thorough and dependable approach. Using unique capabilities and innovative thinking, fully integrated solutions are developed in cooperation with our industrial partners. Naturally, we like to contribute to the national and international publicity generated by the pioneering projects with which we are involved:

- Closed greenhouse concept
- Semi-closed greenhouses (Airco greenhouse)
- Solar greenhouses: Low energy greenhouses without use of fossil fuels
- Greenhouses as an energy source in Bergerden
- Procult: Protected culture in the (sub)tropics
- Floating greenhouses
- Greenhouse in the city, Greenhouse in Energy-grid, The Social Greenhouse, Emission-free Greenhouses and the Biological-Cycle Greenhouse
- Watery: Closed water cycled greenhouse for semi-arid areas



### Modelling the greenhouse climate

The greenhouse climate and the temperature progression and distribution are important parameters in designing a greenhouse. Using Computer Fluid Dynamics software (CFD), the airflow pattern and the temperature progression become clear. In varying the shape, size and location of the greenhouse, an optimal greenhouse design can be created that is adapted to the local climate, even in (sub)tropical regions.

Using our self-developed climatemodel KASPRO, which simulates a virtual greenhouse, predictions are made concerning the hourly energy consumption (use). These are based on the properties of the greenhouse, the covering materials, the cultivation conditions and the ambient climate.

### Light in the greenhouse

Using our extensive knowledge of transparent cladding materials, we calculate the entire greenhouse's light transmission for our customers – including the construction parts that intercept light. A sizeable database is used for this purpose that includes measurements of the properties of various greenhouse covering and screening materials.

### Strength and safety

By performing strength calculations based on European Union (EN 13031-1) standards, the safety of the greenhouse structure in relation to the covering materials is proven. The institute also analyses three dimensional structures including flexible sheets and cables.

#### For more information:

Silke Hemming, [silke.hemming@wur.nl](mailto:silke.hemming@wur.nl), +31 317 48 69 21

Wageningen UR Greenhouse Horticulture  
P.O. Box 20, 2665 ZG Bleiswijk, The Netherlands  
[www.glastuinbouw.wur.nl/uk](http://www.glastuinbouw.wur.nl/uk)



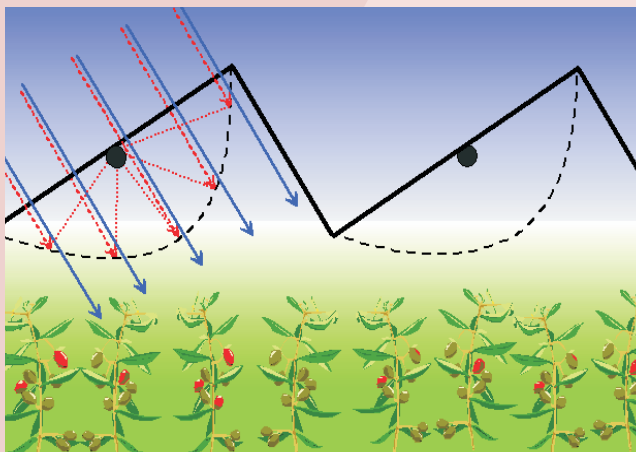
### Greenhouses for the tropics

For plastic film greenhouses in the tropical lowlands of Indonesia, the basic principle was to keep the interior temperature as low as possible. This was accomplished by maximum ventilation and applying special plastic film to reflect the Near InfraRed (NIR) radiation. Furthermore, the greenhouse was produced in such a way that the insects are kept out – making a more healthy food production possible in these tropical lowlands.

Partners: Wageningen UR, Rovero Systems BV, Plasthill BV, PT East West Seed Indonesia, Research Institute for Vegetables (RIW), Bogor Agricultural University (IPB).

Financing: Senter BIT, LNV Hortin, private industry.

Goal: To introduce protected cultivation in tropical lowlands.



### Electricity generating greenhouses

In designing energy generating greenhouses, the emphasis still lies on systems that supply low-grade forms of energy (i.e. warmth). The electricity generating greenhouse is aimed at catching the radiation that is not being used for crop growth and converting it into high-grade power. The project is oriented towards creating a properly functioning prototype, after which – in the case of proven success – a supplemental course will follow, scaled to real-life circumstances.

Partners: Wageningen UR, Bosman Kassenbouw.

Financing: EOS regulation Senter/Novem, Dutch Ministry of Agriculture, Product Board for Horticulture.

### Airco greenhouse

The Airco greenhouse has a unique air cooling system combined with atomisation. The first greenhouse in the Netherlands with this system is at a tomato grower in Ens. The windows have to be opened less often compared to conventional greenhouses, allowing the cultivation conditions to be better attuned to the crop's needs. This leads to obvious and substantial cost savings in comparison with other (semi)closed greenhouse concepts. The greenhouse climate can be monitored via website ([www.aircokas.nl](http://www.aircokas.nl), in Dutch).

Partners: Wageningen UR, Hoogendoorn Automatisering, LTO Groeiservice, LetsGrow.com.

Goal: Conditioned cultivation, climate control based on plant reactions.

