

KASSIM

A versatile tool for education and research

Wageningen University & Research



KASSIM: A model-based educational tool



Helps students understand complex processes such as

- Impact of screens on crop temperature
- Heating demand based on outside weather
- Transpiration effects under high humidity conditions

Using the KASPRO model as simulation engine, including

- Different covering materials and screens
- LED lighting, air treatment
- Climate control similar to practise

Web-based user friendly app for all educational levels

Funded by LTO Glaskracht and the Dutch Ministry

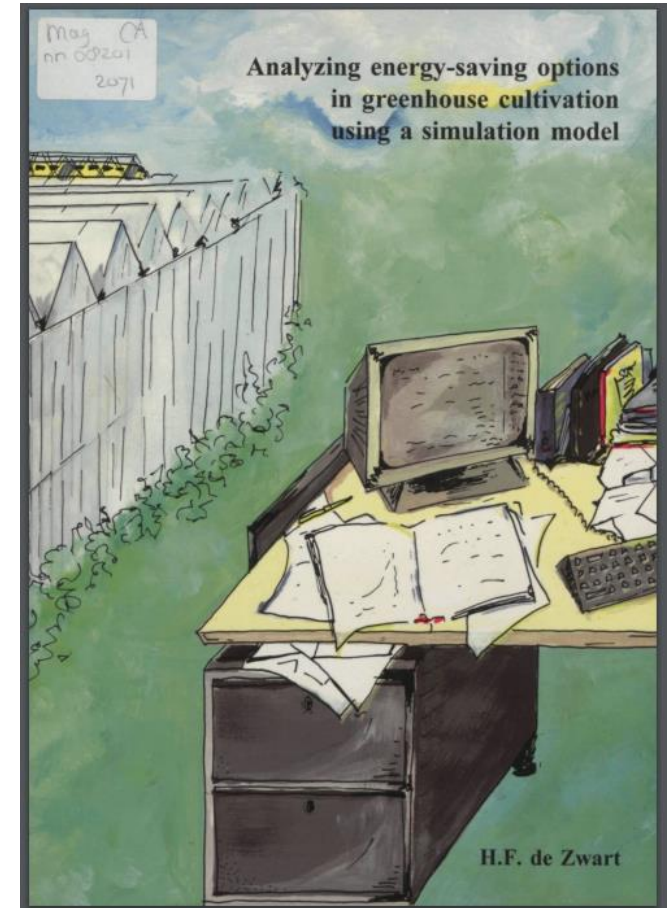
KAPRO as simulation engine

Simulate greenhouse climate, crop growth and energy consumption of greenhouses

In relation to the outside climate, equipment, cultivation, and climate controller settings.

Developed by Wageningen Research (De Zwart, 1996)

Build upon >25 years of research, technical developments and practical experiments



KASSIM → how does it look

The screenshot displays the KASSIM web interface. On the left is a control panel with an 'UPDATE' button and a 'difference' checkbox. Below this are sections for 'Weather and location', 'Greenhouse', 'Crop', 'Setpoints', 'Screens', 'Illumination', and 'Air treatment'. The 'Weather and location' section shows settings for Bleiswijk (The Netherlands) on 05-05-2025 at 12:12, with a partly cloudy sky, 475 W/m² global solar radiation, 19.3 °C temperature, 49.3% humidity, and 0.2 m/s wind speed. The 'Greenhouse' section includes fields for U-value, Tr dir, and Tr hem. The 'Crop' section shows temperature, transpiration, and gross photosynthesis rates. The 'Air' section shows air temperature, transpiration, and CO2 concentration. The 'Illumination' section shows PAR and Tr PAR. The 'Air treatment' section shows temperature and W/m². The right side of the interface features a 3D simulation of a greenhouse with a gabled roof, showing solar radiation, temperature, and transpiration rates across different components like the roof, floor, and crop layers. The simulation is powered by Wageningen University & Research.

UPDATE difference

Weather and location

Location: **Bleiswijk (The Netherlands)**

Date and time (dd-mm-yyyy): **05-05-2025** 12:12

Cloudiness: **Partly cloudy**

Global solar radiation: **475** W/m²

Temperature: **19.3** °C

Humidity: **49.3** %

Wind speed: **0.2** m/s

Greenhouse

U-value: W/m²/K

Tr dir: %

Tr hem: %

Crop

Temperature: °C

Transpiration: g/m²/h

Gross phot.: g/m²/h

Air

Temperature: °C

Transpiration: g/m²

CO₂: ppm

Illumination

PAR: umol/m²/s

Tr PAR: %

Air treatment

Temperature: °C

W/m²: W/m²

KASSIM is a single web-page with on the left an input panel with weather conditions and greenhouse configuration. On the right there is an image showing the greenhouse climate for the current settings

powered by **WAGENINGEN UNIVERSITY & RESEARCH**

Greenhouse configuration and weather

The screenshot displays the KASSIM software interface. At the top left, a green 'UPDATE' button is circled in red. Below it, a 'Weather and location' panel shows various weather parameters. To the right, a 'Greenhouse' panel lists configuration options. In the center, a 'Setpoints' table is visible. On the far right, a partial view of a simulation graph is shown.

Weather and location

Location	Bleis
Date and time (dd-mm-yyyy)	05-05-12:11
Cloudiness	Partl
Global solar radiation	475
Temperature	19.3
Humidity	49.3
Wind speed	0.2

Greenhouse

Greenhouse area	
Covering material	
AR coating	
White wash reduction	
Leakage infiltration	
Number of pipes per m	
Pipe diameter	
Greenhouse orientation	
CO2 dosing capacity	

Setpoints

Setpoint heating	18	°C
Setpoint ventilation on T	21	°C
Setpoint ventilation on RH	100	%
Setpoint CO2	800	ppm
Min. vents lee side	0	%
Min. vents wind side	0	%
Max. vents lee side	100	%
Max. vents wind side	100	%
Min. pipe temp. supply	0	°C
Max. pipe temp. supply	90	°C
P-band ventilation on T	5	°C
P-band ventilation on RH	5	%
Windward trail	50	%

Simulation Graph (partial)

Tr dir	%
Tr hem	%
Air	°C
	%
	g/m³
	ppm

Among the input parameters are the geographical location and time, which determine the solar position, and the weather variables like temperature, humidity and cloudiness. Also greenhouse parameters, such as covering material, leakage infiltration and heating system. Based on the heating and ventilation setpoints, KASSIM calculates the required pipe temperatures and window openings. If everything is set, a simulation is started with the UPDATE button

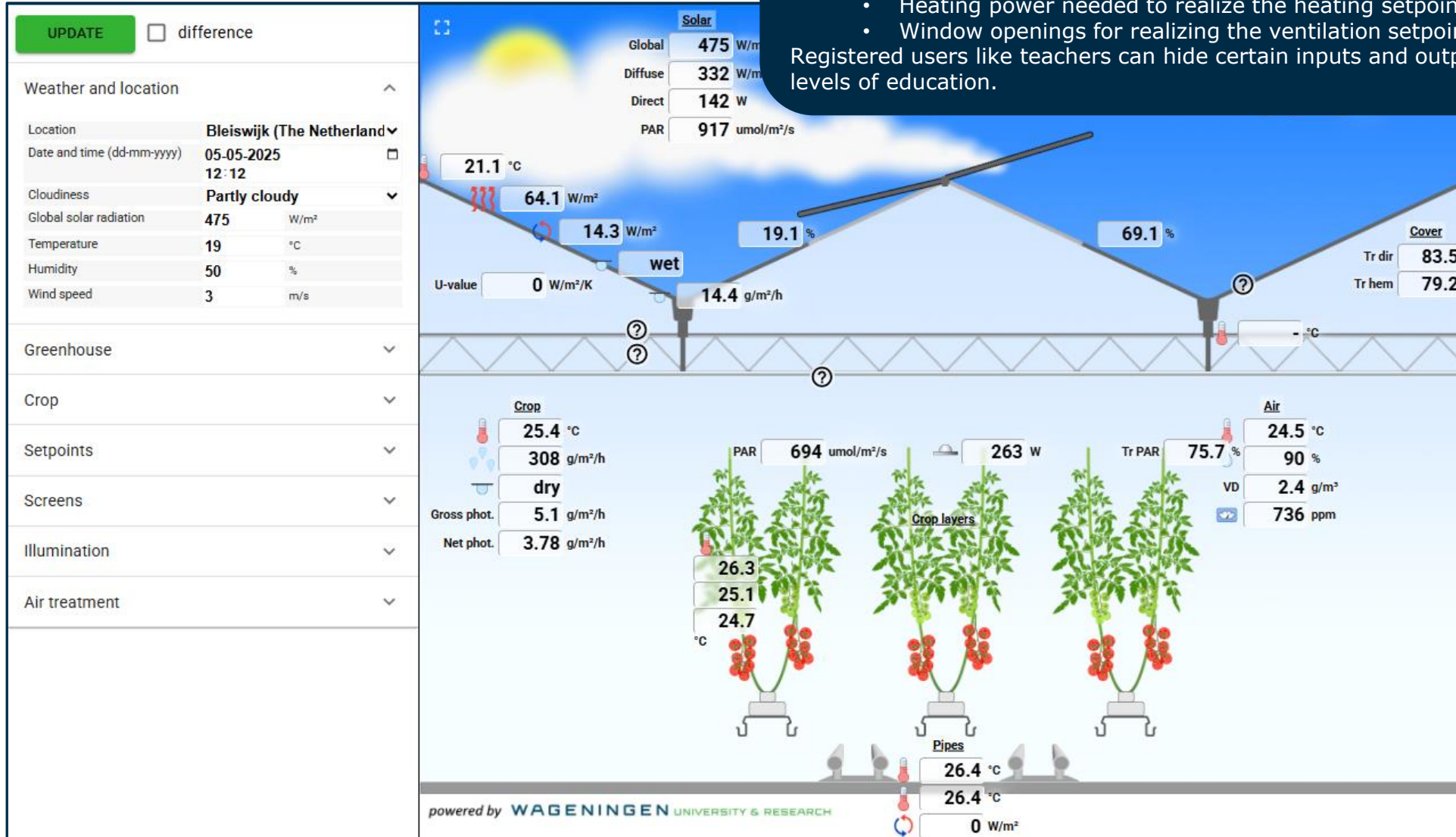
Simulation results

Then the model will take a second to simulate until a steady stated situation is reached, which represents the greenhouse climate for the input conditions.

Users can inspect phenomena such as:

- Crop status → photosynthesis, transpiration and if possible condensation at leaves
- Ventilation → air exchange rate, exchange of sensible and latent heat and vapour and CO₂
- Sensor data → PAR levels on leaf layers, net radiation, humidity
- Heating power needed to realize the heating setpoint
- Window openings for realizing the ventilation setpoint

Registered users like teachers can hide certain inputs and outputs to avoid complexity for lower levels of education.

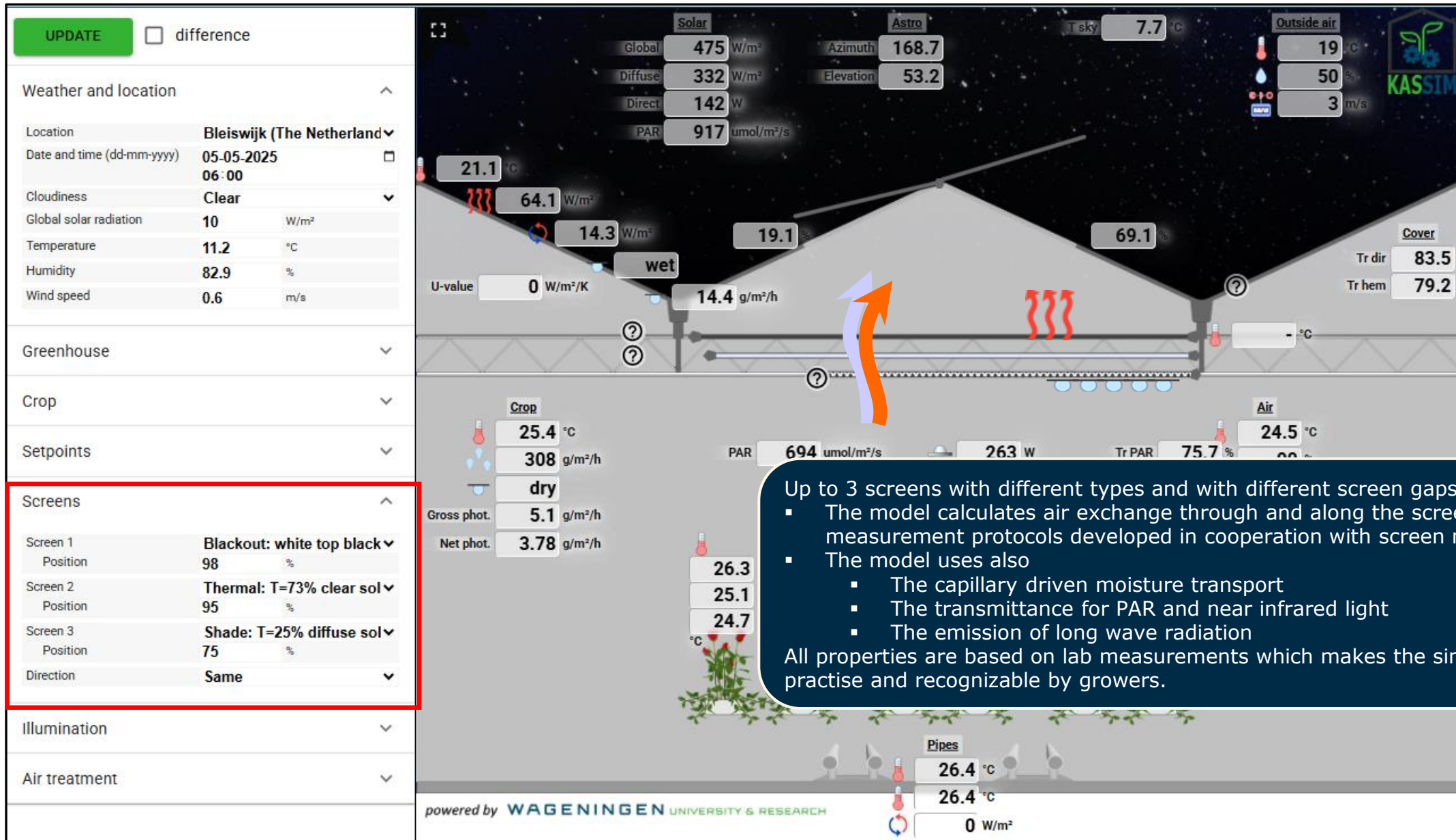


Different crop types available - phalaenopsis

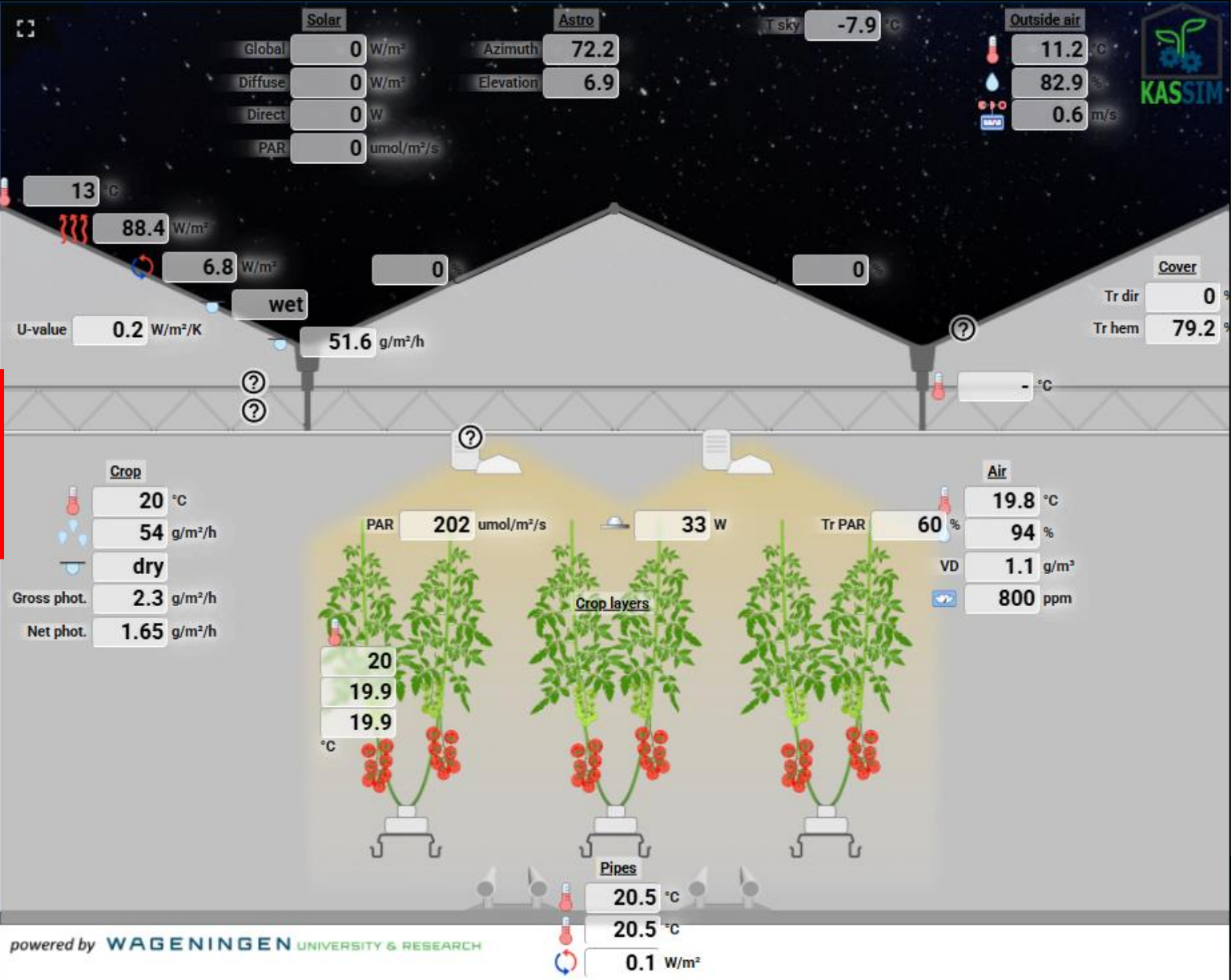
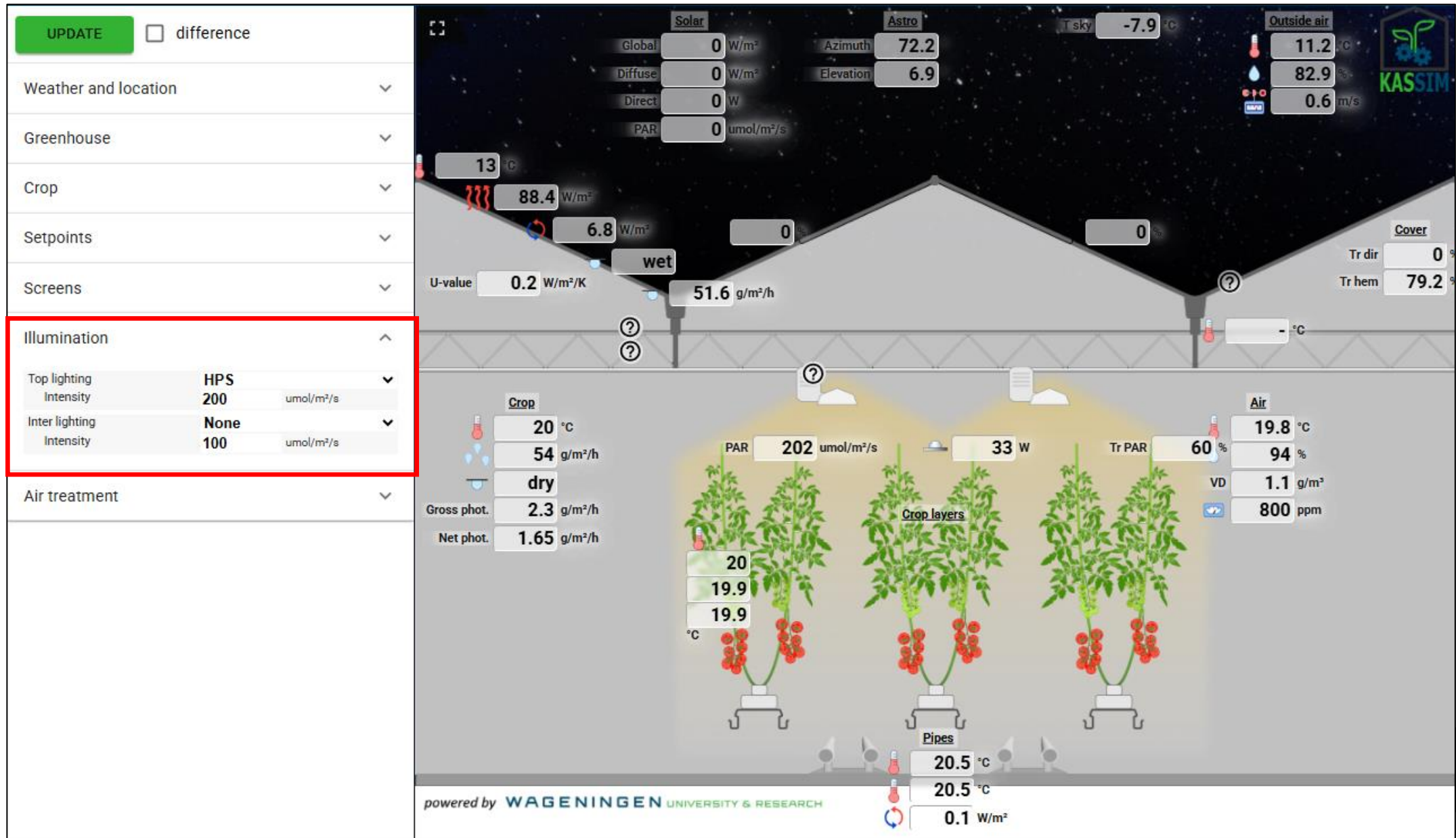
The screenshot displays the KASSIM software interface. On the left, a sidebar menu lists various settings: UPDATE, difference, RANGE RUN, Weather and location, Greenhouse, Crop (circled in red), Crop type, Setpoints, Screens, Illumination, and Air treatment. A dropdown menu is open under 'Crop', listing various plant types: None, Tomato, Rose, Gerbera, Cucumber, **Phalaenopsis** (highlighted), Alstroemeria, Anthurium, Fresia, Lettuce, Ficus, Petunia, and Sweetpepper.

The main interface features several control panels: Solar (Global and Diffuse radiation in W/m^2), Astro (Azimuth and Elevation), T sky (sky temperature in $^{\circ}C$), Outside air (temperature, humidity, and wind speed), and Ventilation (Flow in $m^3/m^2/h$ and W/m^2). A 3D visualization of a greenhouse is shown, with a callout box stating: "Transpiration and photosynthesis based on research and calibrated with practical experiments". The bottom right panel shows Air (temperature, humidity, and VPD) and Pipes (flow in W/m^2) settings. The bottom of the interface shows a row of six potted Phalaenopsis orchids.

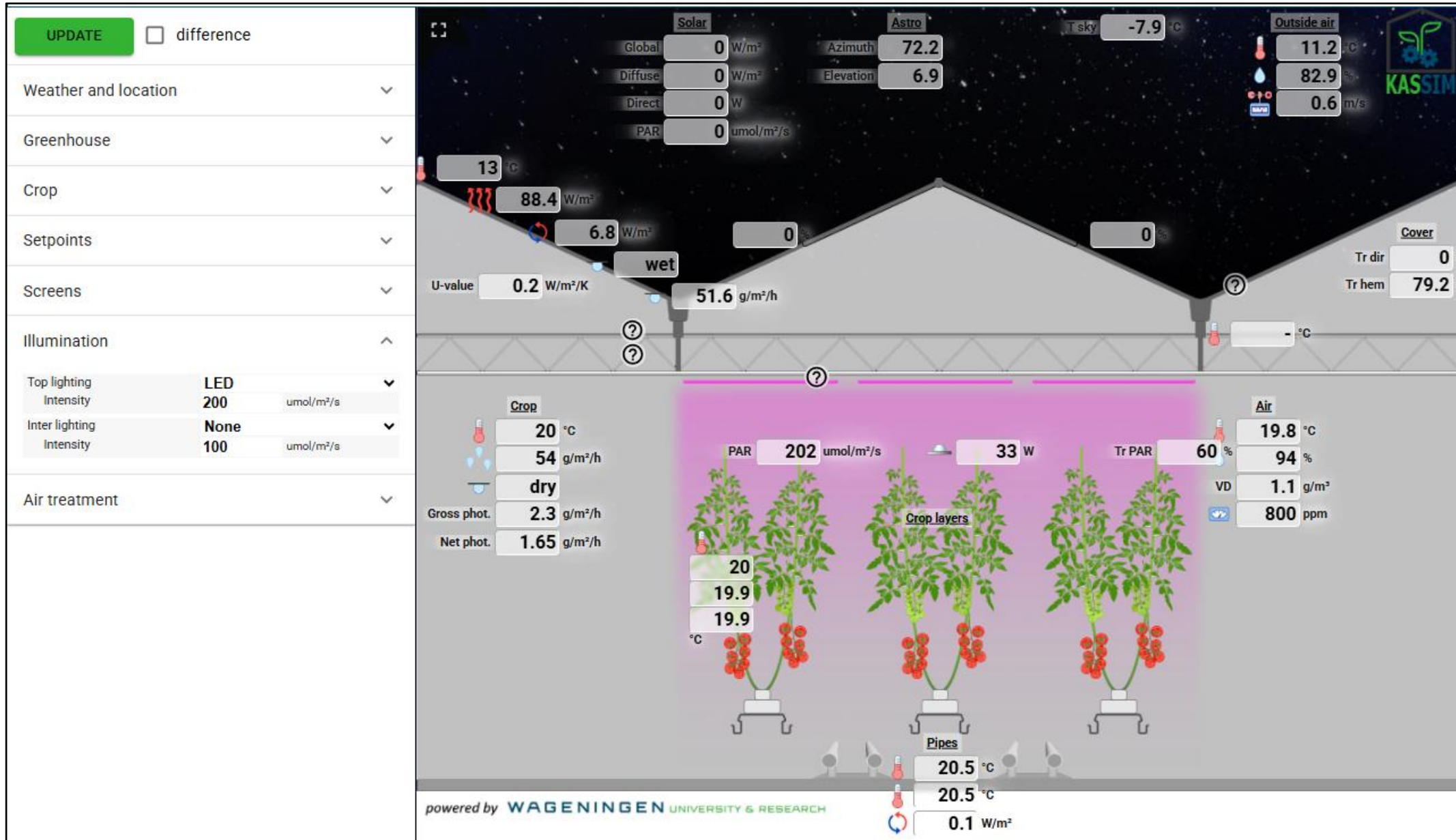
Up to 3 screens of different types



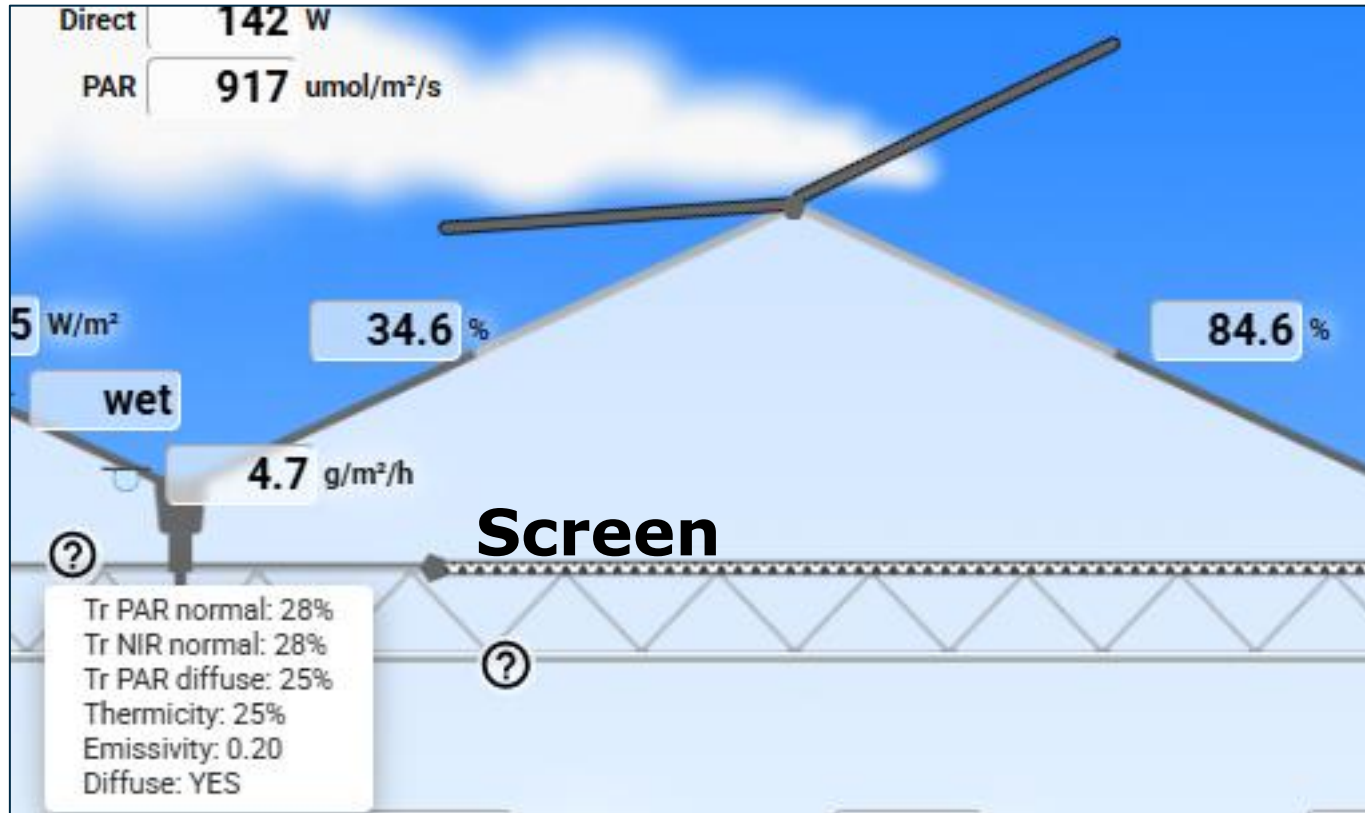
Illumination: traditional HPS



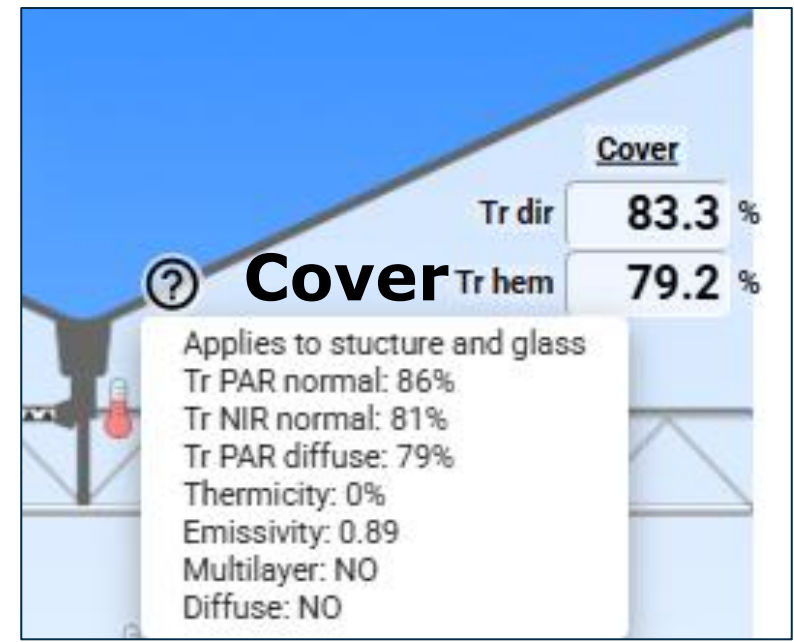
Illumination with LED



Properties of screens and cover



The output window shows also some question mark icons. These show the underlying properties of the selected screens and cover, which are mostly based on measurements of the Light laboratory of Wageningen Research, which is accredited for the NEN2675 norm for measuring greenhouse glass and screens.



“Range run” option

The screenshot shows a control interface with a settings panel on the left and a main display area on the right. The settings panel includes:

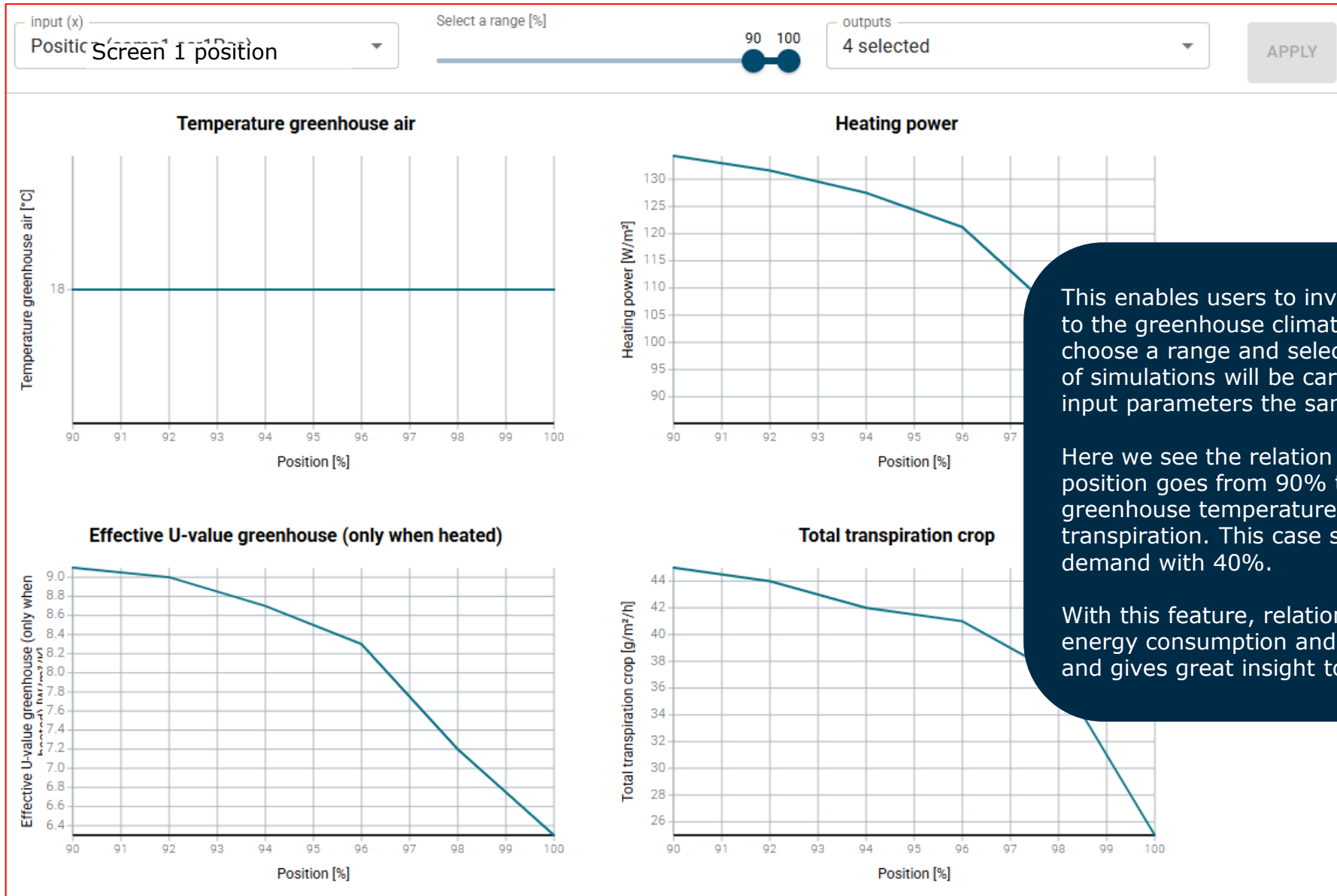
- UPDATE** (green button)
- difference
- RANGE RUN** (blue button, circled in red)
- Weather and location** section:
 - Location: **Bleiswijk (The Netherland)** (dropdown)
 - Date and time (dd-mm-yyyy): **01-06-2018 00:00** (calendar icon)
 - Use meteo data:
 - Cloudiness: **Clear** (dropdown)
 - Global solar radiation: **0** W/m²
 - Temperature: **5** °C
 - Humidity: **50** %
 - Wind speed: **3** m/s
- Crop** (dropdown)
- Setpoints** (dropdown)

The main display area on the right shows a night sky background with a grey structure below it. At the bottom of the display, there are input fields for:

- Crop** (with a thermometer icon) in °C
- SWR abs.** in W/m²

There are also three question mark icons in the display area.

Range run - Screen gap

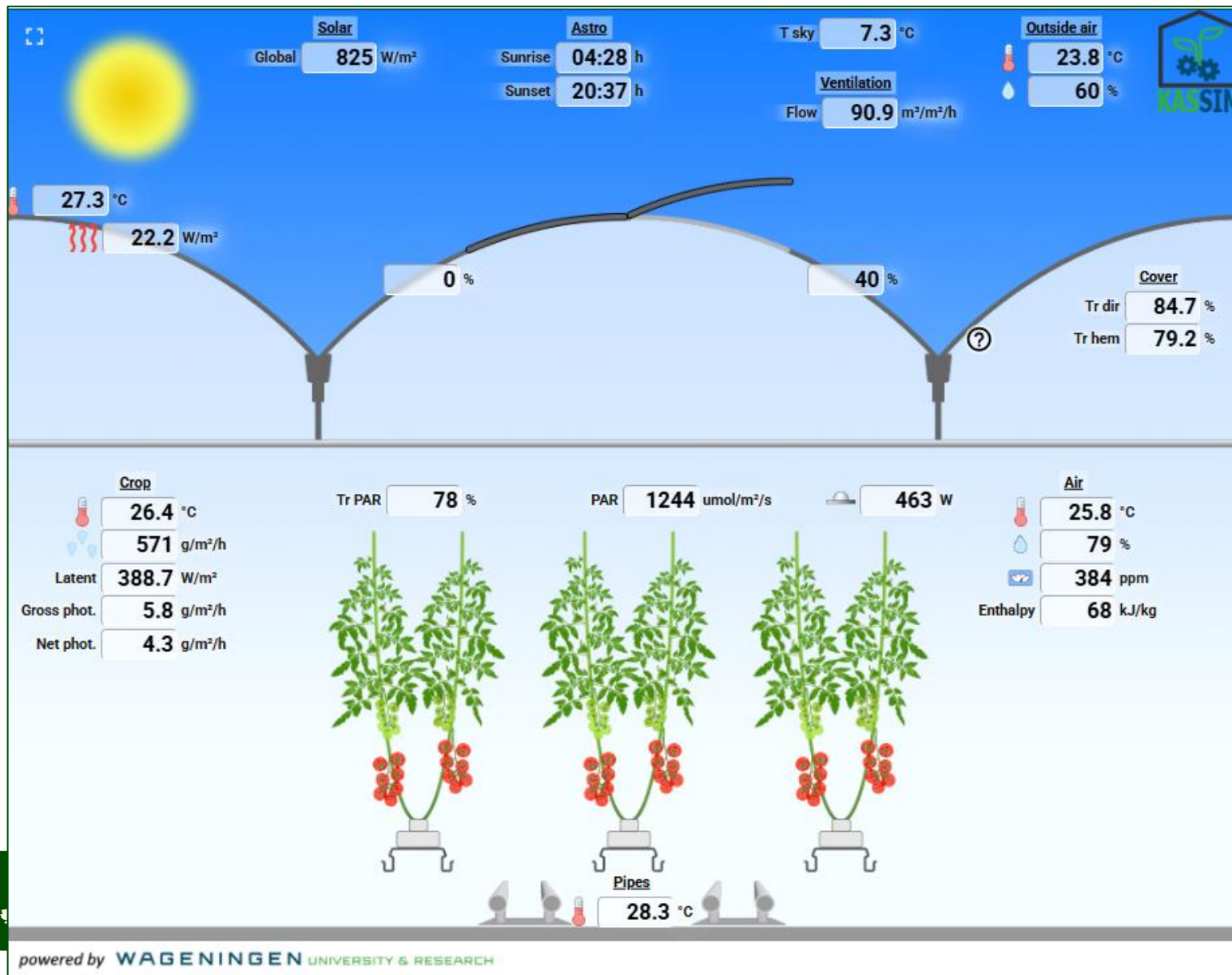


This enables users to investigate the sensitivity of input parameters to the greenhouse climate. Users can select a parameter from a list, choose a range and select up to 4 simulation outputs. Then a series of simulations will be carried out within this range, keeping all other input parameters the same

Here we see the relation between the screen gap, where the screens position goes from 90% to 100% closed, related to the the greenhouse temperature, heating power, effective U-value and crop transpiration. This case shows that a 10% gap increases the heat demand with 40%.

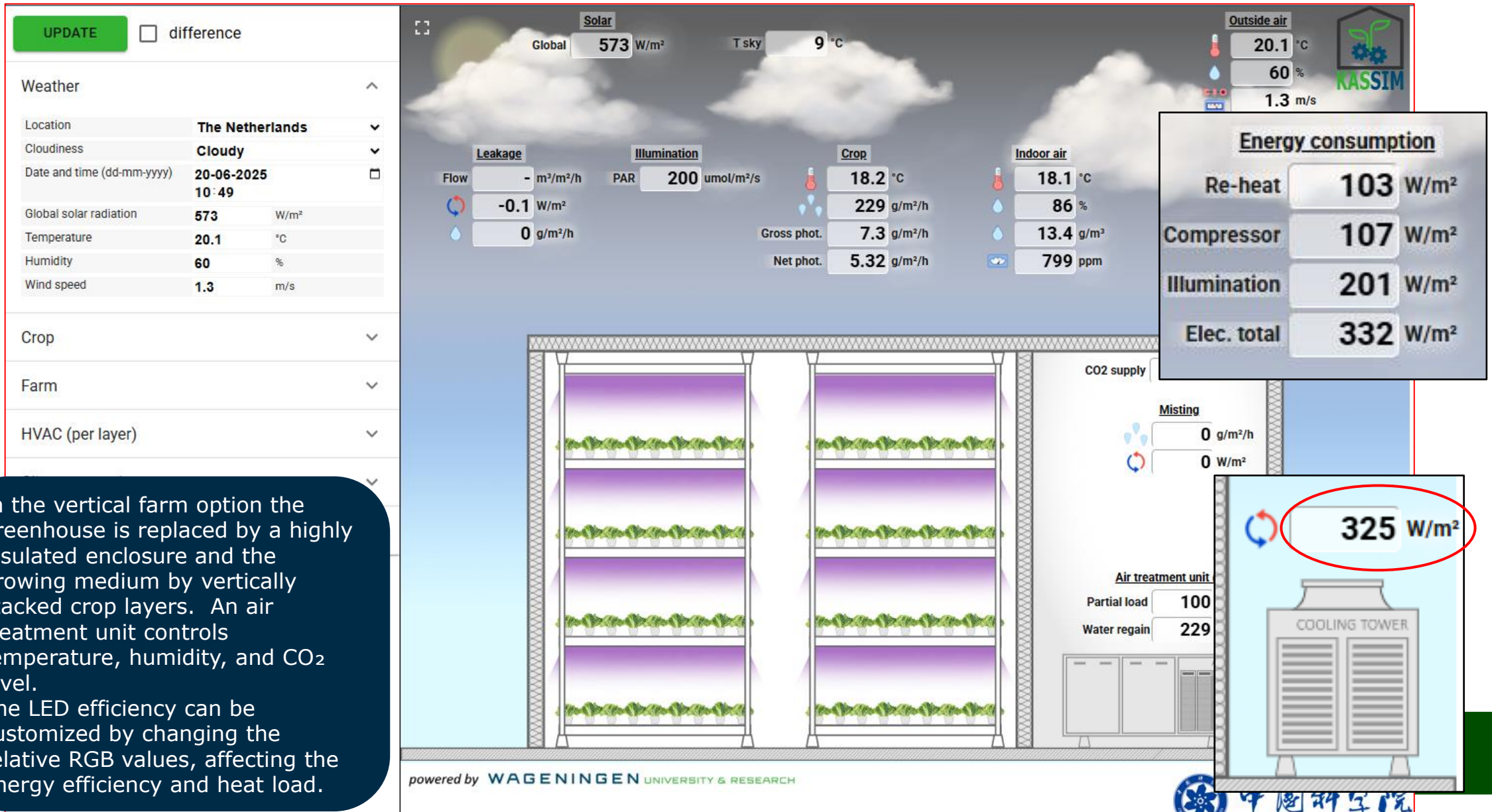
With this feature, relations between inputs and the resulting climate, energy consumption and crop response, can be identified very easily and gives great insight to students.

Low tech greenhouses



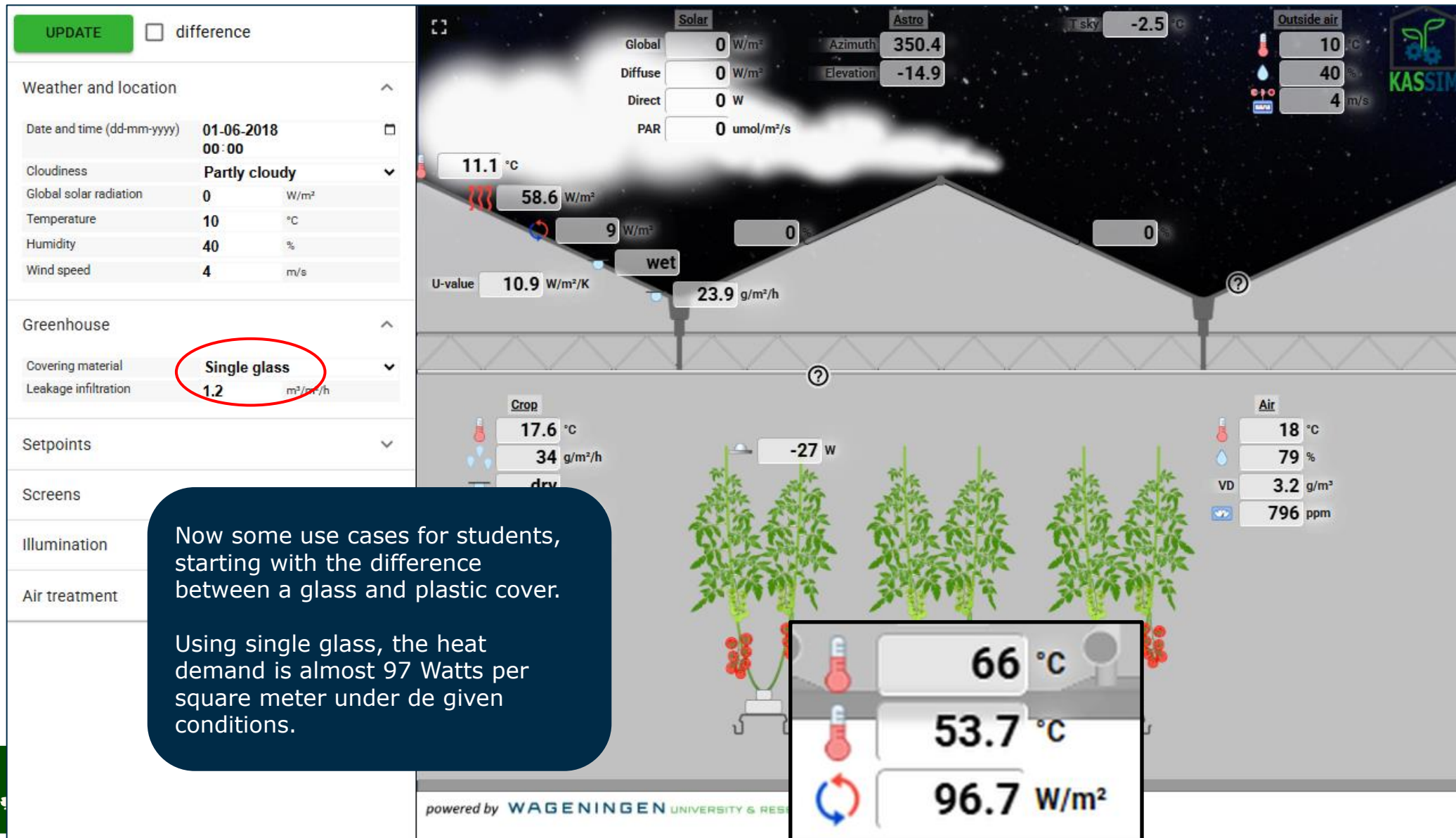
Next to the standard Venlo glasshouse, KASSIM can also simulate a multi-tunnel plastic greenhouse with side wall ventilation. These have no screens or illumination, have limited control and have a single or double polyethylene cover. Of course, the corresponding geographical locations like Almeria, are available.

Vertical farm

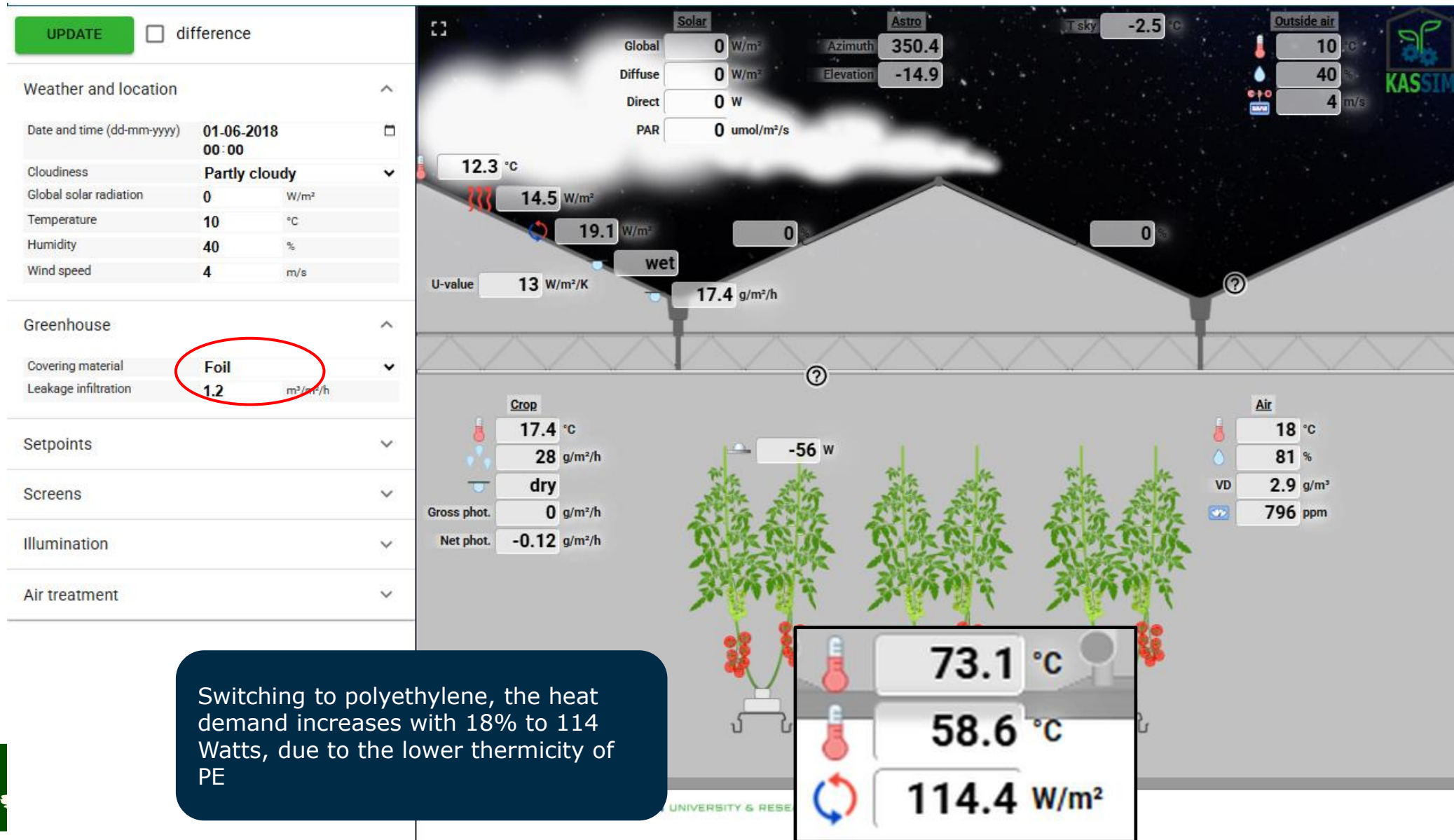


In the vertical farm option the greenhouse is replaced by a highly insulated enclosure and the growing medium by vertically stacked crop layers. An air treatment unit controls temperature, humidity, and CO₂ level. The LED efficiency can be customized by changing the relative RGB values, affecting the energy efficiency and heat load.

Use cases –glass versus PE cover

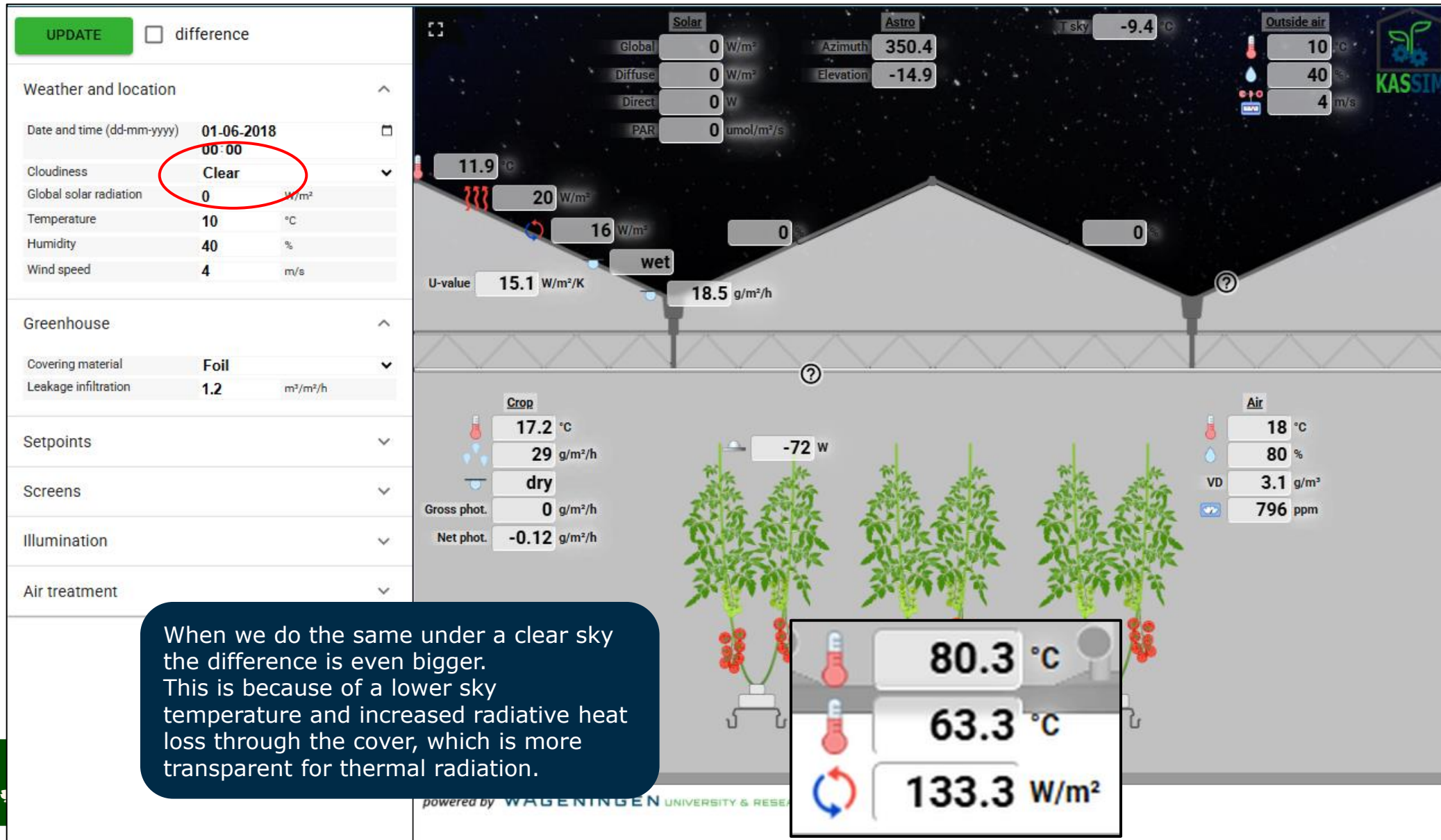


Same conditions, PE → 18% more heating



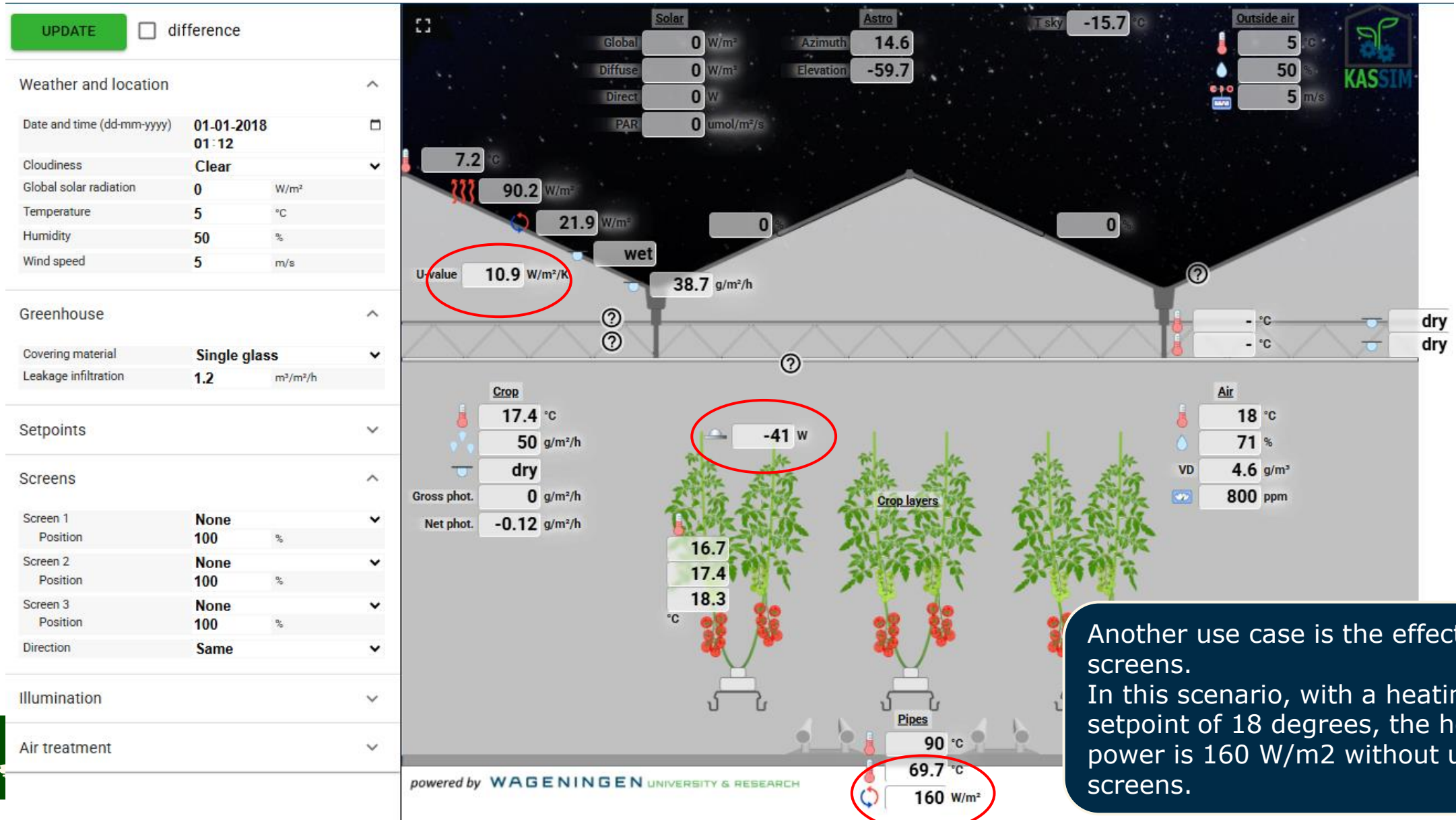
Switching to polyethylene, the heat demand increases with 18% to 114 Watts, due to the lower thermicity of PE

Clear sky → 37% more heating



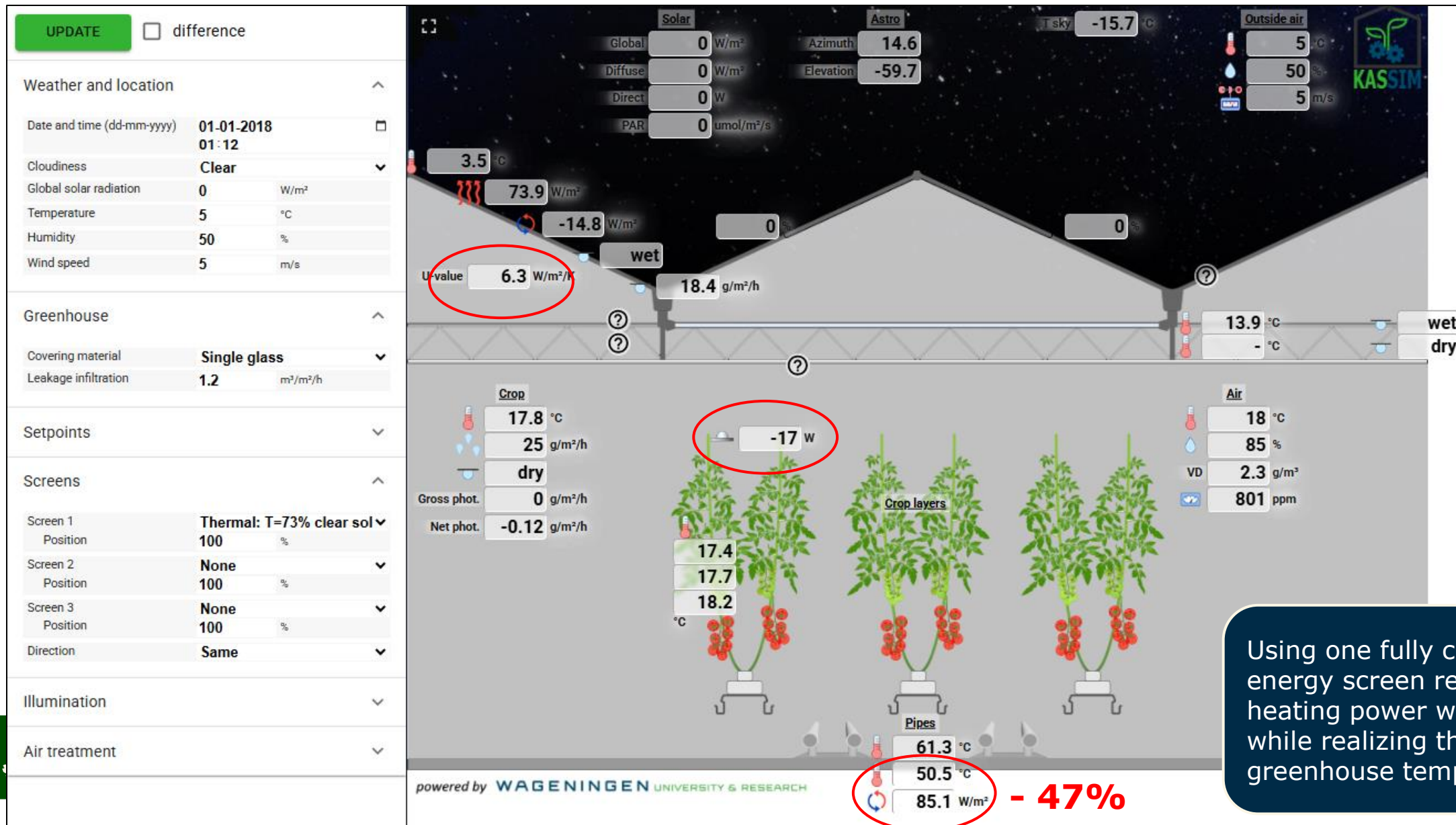
When we do the same under a clear sky the difference is even bigger. This is because of a lower sky temperature and increased radiative heat loss through the cover, which is more transparent for thermal radiation.

The effect of screens – no screen



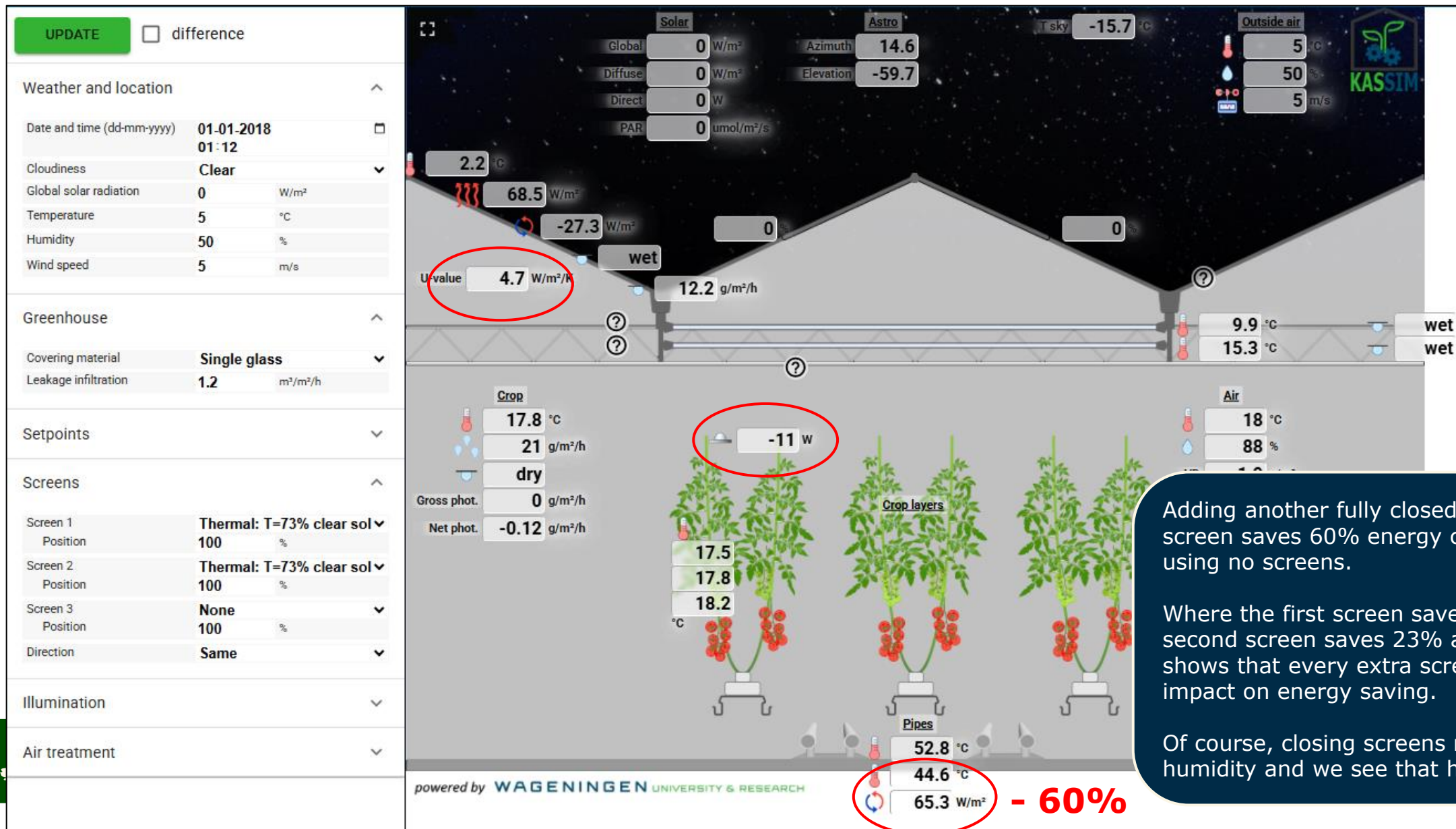
Another use case is the effect of screens. In this scenario, with a heating setpoint of 18 degrees, the heating power is 160 W/m² without using screens.

One energy screen → 47% less heating




Using one fully closed energy screen reduces the heating power with 47%, while realizing the same greenhouse temperature

Two energy screens → 60% less heating



Waterstromenmodel (WSM)



[To the app](#)

[Apply for an account](#)

With the Waterstreams model (WSM), the water usage from various sources, discharge of nitrogen and phosphates can be calculated for a hydroponic cu simulates the discharge, the investments required to reduce effluent and em emission regulations. It also provides insights into the impact of the quality c water, and the expansion of storage tanks. The WSM was developed for gree funded by the 'Kennis op Maat' program and the Foundation for Applied Wa *N.b. registration offers the option to save scenarios and is only available for Du*
[Click for more information](#)

Greenhouse Energy Guide




[To the app](#)

The rec political grower comm tool Gr The Gr Club of [Click fo](#)

More information about KASSIM and other apps can be found on the app portal of Wageningen Research Greenhouse horticulture.

to tec of the al gree pmen wards and fir n is or

Kassim



KASSIM

[High tech complex](#)

[High tech basis](#)

[Low tech](#)

[New: Vertical farm](#)

[Apply for an account](#)

Kassim is an interactive learning tool that provides a clear overview of the en horticultural greenhouse. A powerful simulation model, developed for scientfic rese calculates all relevant variables based on the weather, greenhouse climate settings a to the principles of 'Het Nieuwe Telen'.
 Kassim has been developed for green education and the greenhouse horticulture se Nederland, and the Ministries of Economic Affairs and Agriculture, Nature and Food *N.b. registration offers the additional option of customizing the complexity and is only available for teachers working in Dutch education. Processing a registration can take some days.*
[Click for more information](#)

Kassim The Game

Kassim the Game is an online serious game in the field of energy-efficient and cost-effective cultivation of crops in greenhouses.



info.kassim@wur.nl