

Soil Test GUI Manual

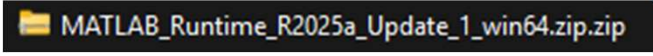
Date : 3rd December 2025

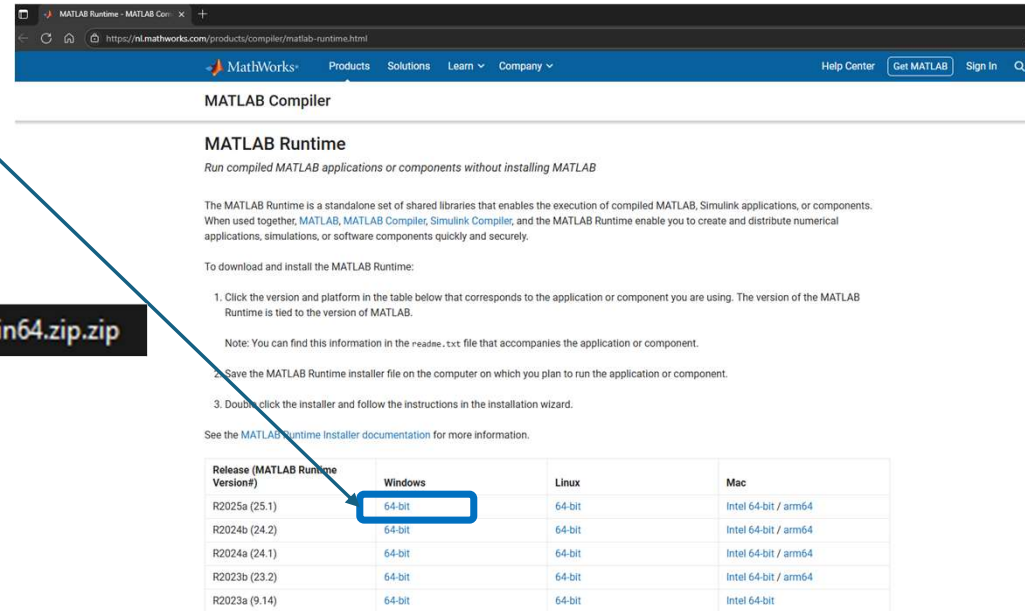
Software version : 5_5_34_soil_irradiance_test

Manual version: 2.0

Author: A. Binani

Before the start up

- Download the matlab compiler runtime version 25.1 (see the blue box in the image)
 - [MATLAB Runtime - MATLAB Compiler – MATLAB](#)
- Unzip the downloaded folder 
- Install the downloaded matlab compiler runtime version 25.1 by running the file “setup.exe”
- The weather data for the simulation is based on the city of Amsterdam. This is a typical meteorological year with 10-min time stamps.
- The albedo is set as 20%.
- To use a different city or time-period or different albedo please contact bigeye_team@tno.nl



MATLAB Compiler

MATLAB Runtime

Run compiled MATLAB applications or components without installing MATLAB

The MATLAB Runtime is a standalone set of shared libraries that enables the execution of compiled MATLAB, Simulink applications, or components. When used together, MATLAB, MATLAB Compiler, Simulink Compiler, and the MATLAB Runtime enable you to create and distribute numerical applications, simulations, or software components quickly and securely.

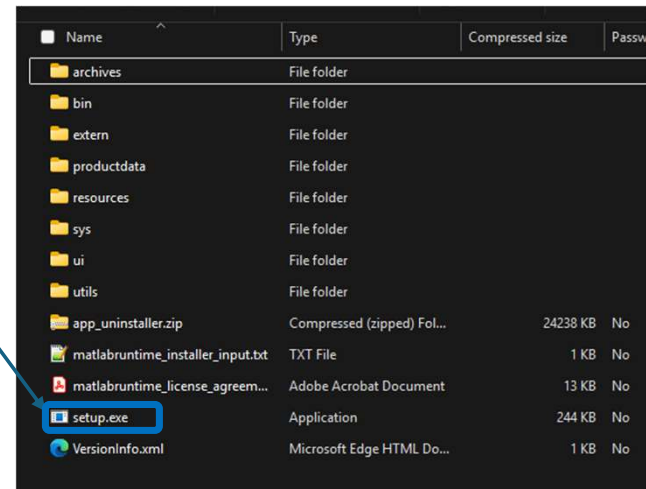
To download and install the MATLAB Runtime:

1. Click the version and platform in the table below that corresponds to the application or component you are using. The version of the MATLAB Runtime is tied to the version of MATLAB.
2. Save the MATLAB Runtime installer file on the computer on which you plan to run the application or component.
3. Double-click the installer and follow the instructions in the installation wizard.

Note: You can find this information in the `readme.txt` file that accompanies the application or component.

See the [MATLAB Runtime Installer documentation](#) for more information.

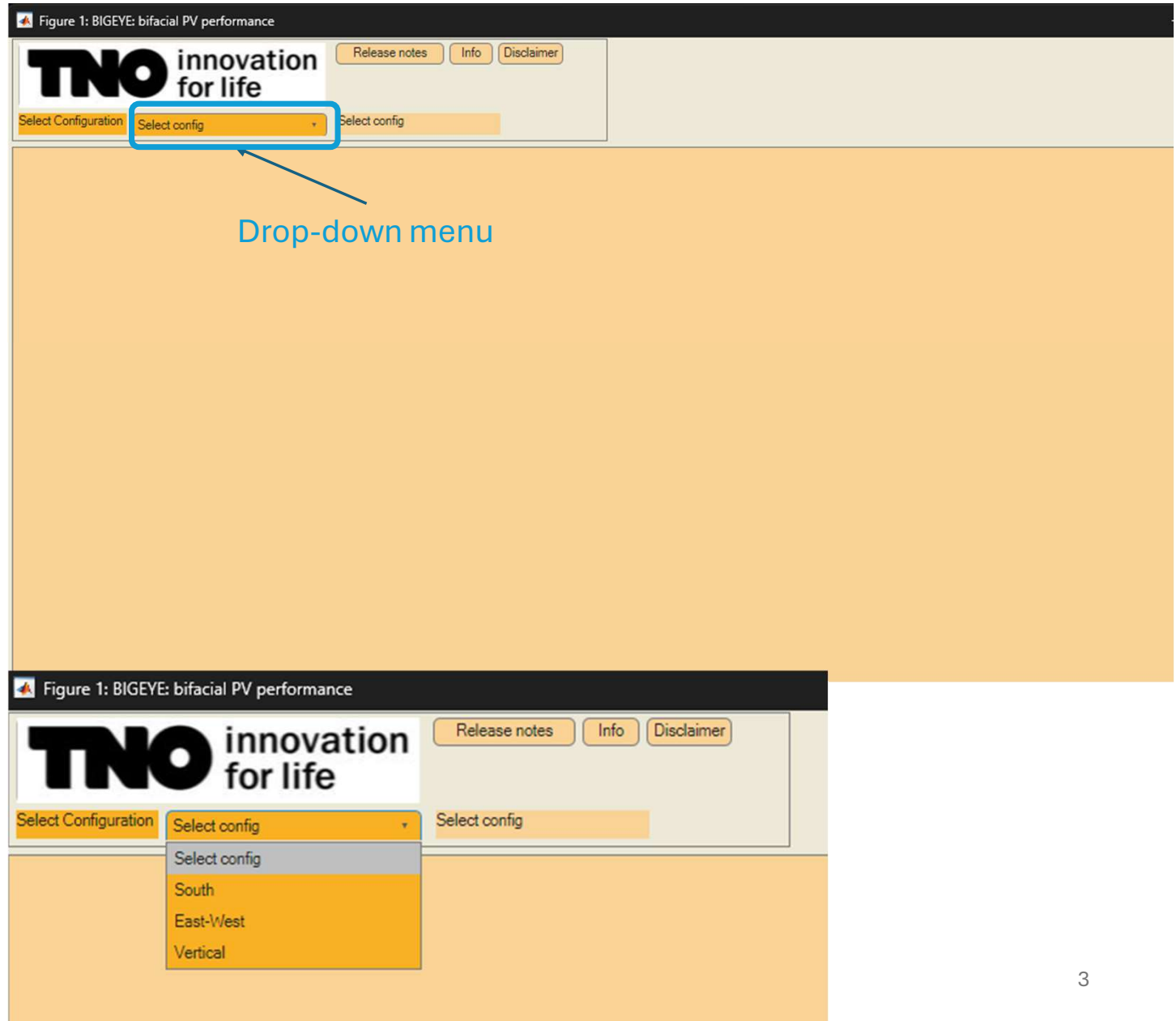
Release (MATLAB Runtime Version#)	Windows	Linux	Mac
R2025a (25.1)	64-bit	64-bit	Intel 64-bit / arm64
R2024b (24.2)	64-bit	64-bit	Intel 64-bit / arm64
R2024a (24.1)	64-bit	64-bit	Intel 64-bit / arm64
R2023b (23.2)	64-bit	64-bit	Intel 64-bit / arm64
R2023a (9.14)	64-bit	64-bit	Intel 64-bit



Name	Type	Compressed size	Passw
archives	File folder		
bin	File folder		
extern	File folder		
productdata	File folder		
resources	File folder		
sys	File folder		
ui	File folder		
utils	File folder		
app_uninstaller.zip	Compressed (zipped) Fol...	24238 KB	No
matlabruntime_installer_input.txt	TXT File	1 KB	No
matlabruntime_license_agreem...	Adobe Acrobat Document	13 KB	No
setup.exe	Application	244 KB	No
VersionInfo.xml	Microsoft Edge HTML Do...	1 KB	No

Start up

- The software will open in maximised mode as seen in the image.
- The startup takes a couple of minutes depending on the system resources.
- Currently there are three different configuration available in the drop-down menu, namely,
 - South
 - East-West
 - Vertical
- In the next pages we will look into the different configurations.



Select Configuration (South)

- The parameters panel for the “South configuration” appear on its selection.
- The left panel are the ones to be filled as per the solar park design. **(Fill every parameter for each configuration even if the default value is required)**
- The parameters under the “Calculated Parameters” are for checking the input parameters.
- The static image on the right shows a lateral view of the selected configuration with the visual definition of the parameters.
- The “output dir” button allows one to save the result pdf in a specific location.

Parameters to be filled

Checking parameters

Figure 1: BIGEYE: bifacial PV performance

TNO innovation for life

Release notes Info Disclaimer

Select Configuration South South

Parameters (South)

Parameters (South)	Calculated parameters
Module long side (m)	Ground coverage ratio (%) 0
Module short side (m)	D1 (m) 0
Module transparency (%)	D2 (m) 0
Module orientation	Max height, H_{max} (m) 0
Number of modules	
Gap between two long sides (m)	
Gap between two short sides (m)	
Pitch (m)	
Tilt angle (degrees)	
Ground clearance (m)	
Field orientation (degrees)	

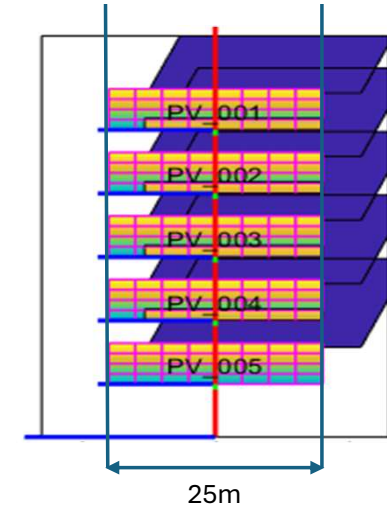
output dir C:\Users\binania\Downloads\Soil_irradiance_test

run soil irradiance test close plots

The diagram illustrates a lateral view of a bifacial PV panel. The panel is tilted at an angle relative to a horizontal dashed line representing the ground level. The tilt angle is labeled as 'Tilt angle'. The horizontal distance from the North side to the vertical projection of the panel's top edge is labeled 'Pitch'. The vertical height of the panel's top edge is labeled H_{max} . The horizontal distance from the vertical projection of the top edge to the South side is labeled 'D2'. The horizontal distance from the North side to the South side is labeled 'D1'. The vertical distance from the ground level to the bottom edge of the panel is labeled 'Ground clearance'. The panel is labeled 'PV'.

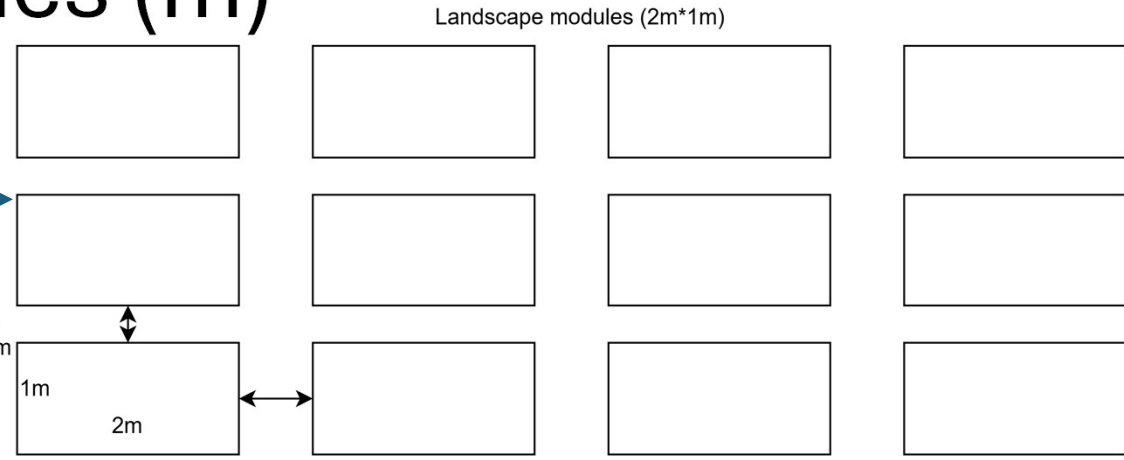
Details about the input parameters (South)

- **Module long side (m)** – The long side of the module in meters.
- **Module short side (m)** – The short side of the module in meters.
- **Module transparency (%)** – The transparency of the module in percentage. The allowed values are from 0 – 80 [0 for fully opaque modules ; 100 for only glass]
- **Module orientation** – The drop-down menu has two options; 1> Landscape, and 2> Portrait.
- **Number of modules** – This is the number of modules in the North-South direction. (For the other direction the PV shed is limited to 25m as seen in the image)
- **Gap between two long sides (m)** – This is the gap in meters between the two long sides of a PV table. (See the page 6 for visual explanation)
- **Gap between two short sides (m)** – This is the gap in meters between the two short sides of a PV table. (See the page 6 for visual explanation)
- **Pitch (m)** – The distance between the base of one PV shed to the base of the next PV shed. If the Pitch is not mentioned in the CAD file then see page 7 for its calculation and double check the D1 and D2 values in the GUI under “Calculated parameters”.
- **Tilt angle (degrees)** – The tilt angle of the module.
- **Ground clearance (m)** – The distance between the ground and the lower end of the PV shed.
- **Field orientation (degrees)** – The deviation of the PV park ground alignment with the North-South direction. It can range from -40° to $+40^{\circ}$. In the next page we will see the effect of field orientation.

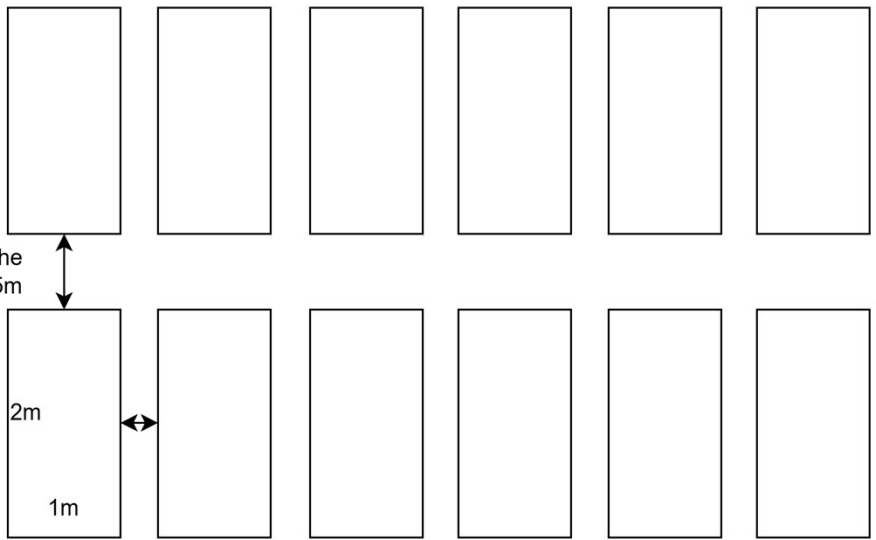


Gap between the long sides (m) & Gap between the short sides (m)

3L Design



Portrait modules (2m*1m)



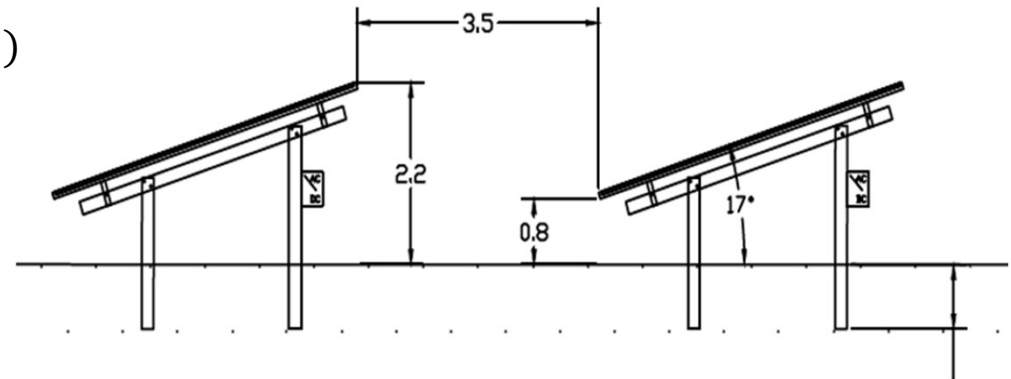
2P Design

Calculation from D2 values to Pitch

$$\text{Pitch} = D2 + ((\text{Max height} - \text{Min height})/\tan(\text{Tilt angle}))$$

In this example:

$$\text{Pitch} = 3.5 + ((2.2 - 0.8)/\tan(17))$$



Field orientation for sample input for South configuration

Field Orientation (Degrees) = 0

Figure 1: BIGEYE: bifacial PV performance

TNO innovation for life

Select Configuration: South

Parameters (South)		Calculated parameters	
Module long side (m)	2	Ground coverage ratio (%)	66.6667
Module short side (m)	1	D1 (m)	2.3739
Module transparency (%)	5	D2 (m)	2.1363
Module orientation	Landscape	Max height, H_max (m)	1.8353
Number of modules	4		
Gap between two long sides (m)	0		
Gap between two short sides (m)	0		
Pitch (m)	6		
Tilt angle (degrees)	15		
Ground clearance (m)	0.8		
Field orientation (degrees)	0		

Figure 2: Geometry overview and beam shade

Sun: azi=220.0,elev=10.0

Field Orientation (Degrees) = 15

Figure 1: BIGEYE: bifacial PV performance

TNO innovation for life

Select Configuration: South

Parameters (South)		Calculated parameters	
Module long side (m)	2	Ground coverage ratio (%)	66.6667
Module short side (m)	1	D1 (m)	2.3739
Module transparency (%)	5	D2 (m)	2.1363
Module orientation	Landscape	Max height, H_max (m)	1.8353
Number of modules	4		
Gap between two long sides (m)	0		
Gap between two short sides (m)	0		
Pitch (m)	6		
Tilt angle (degrees)	15		
Ground clearance (m)	0.8		
Field orientation (degrees)	15		

Figure 2: Geometry overview and beam shade

Sun: azi=220.0,elev=10.0

Field Orientation (Degrees) = -15

Figure 1: BIGEYE: bifacial PV performance

TNO innovation for life

Select Configuration: South

Parameters (South)		Calculated parameters	
Module long side (m)	2	Ground coverage ratio (%)	66.6667
Module short side (m)	1	D1 (m)	2.3739
Module transparency (%)	5	D2 (m)	2.1363
Module orientation	Landscape	Max height, H_max (m)	1.8353
Number of modules	4		
Gap between two long sides (m)	0		
Gap between two short sides (m)	0		
Pitch (m)	6		
Tilt angle (degrees)	15		
Ground clearance (m)	0.8		
Field orientation (degrees)	-15		

Figure 2: Geometry overview and beam shade

Sun: azi=220.0,elev=10.0

Select Configuration (East-West)

- The parameters panel for the “East-West configuration” appear on its selection.
- The left panel are the ones to be filled as per the solar park design.
- The parameters under the “Calculated Parameters” are for checking the input parameters.
- The static image on the right shows a lateral view of the selected configuration with the visual definition of the parameters.
- The “output dir” button allows one to save the result pdf in a specific location.

Parameters to be filled

Checking parameters

Figure 1: BIGEYE: bifacial PV performance

Parameters (East-West)

Module long side (m)	
Module short side (m)	
Module transparency (%)	
Module orientation	Select
Number of modules	
Gap between two long sides (m)	
Gap between two short sides (m)	
D1 (m)	
D2 (m)	
Tilt angle (degrees)	
Ground clearance (m)	
Field orientation (degrees)	

Calculated parameters

Ground coverage ratio (%)	0
Pitch (m)	--
Max height, H_max (m)	0

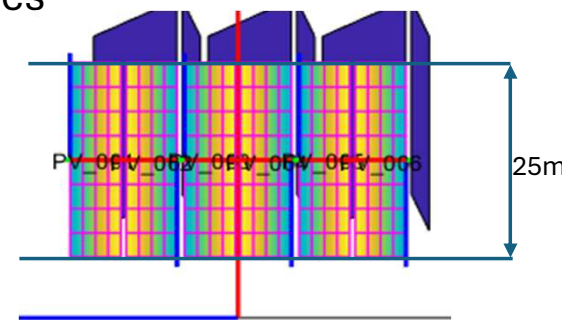
output dir: C:\Users\binaria\Downloads\Soil_irradiance_test

run soil irradiance test close plots

West East

Details about the input parameters (East-West)

- **Module long side (m)** – The long side of the module in meters.
- **Module short side (m)** – The short side of the module in meters.
- **Module transparency (%)** – The transparency of the module in percentage. The allowed values are from 0 – 80 [0 for fully opaque modules ; 100 for only glass]
- **Module orientation** – The drop-down menu has two option;1> Landscape, and 2> Portrait.
- **Number of modules** – This is the number of module in the East-West direction. (For the other direction the PV shed is limited to 25m as seen in the image)
- **Gap between two long sides (m)** – This is the gap in meters between the two long sides of a PV table.
- **Gap between two short sides (m)** – This is the gap in meters between the two short sides of a PV table.
- **D1 (m)** – The distance between the top gap of the adjacent PV sheds.
- **D2 (m)** – The distance between the bottom gap of the adjacent PV sheds.
- **Tilt angle (degrees)** – The tilt angle of the module.
- **Ground clearance (m)** – The distance between the ground and the lower end of the PV shed.
- **Field orientation (degrees)** – The deviation of the PV park ground alignment with the North-South direction. It can range from -40° to $+40^{\circ}$. In the next page we will see the effect of field orientation.



Field orientation for sample input for East-West configuration

Field Orientation (Degrees) = 0

Figure 1: BIGEYE: bifacial PV performance

TNO innovation for life

Select Configuration: East-West

Parameters (East-West)

Module long side (m)	2	Calculated parameters	
Module short side (m)	1	Ground coverage ratio (%)	91.1321
Module transparency (%)	5	Pitch (m)	8.7785
Module orientation	Landscape	Max height, H_max (m)	1.1946
Number of modules	4		
Gap between two long sides (m)	0		
Gap between two short sides (m)	0		
D1 (m)	0.3		
D2 (m)	0.6		
Tilt angle (degrees)	10		
Ground clearance (m)	0.5		
Field orientation (degrees)	0		

Figure 2: Geometry overview and beam shade

Sun: azi=220.0,elev=10.0

Field Orientation (Degrees) = 15

Figure 1: BIGEYE: bifacial PV performance

TNO innovation for life

Select Configuration: East-West

Parameters (East-West)

Module long side (m)	2	Calculated parameters	
Module short side (m)	1	Ground coverage ratio (%)	91.1321
Module transparency (%)	5	Pitch (m)	8.7785
Module orientation	Landscape	Max height, H_max (m)	1.1946
Number of modules	4		
Gap between two long sides (m)	0		
Gap between two short sides (m)	0		
D1 (m)	0.3		
D2 (m)	0.6		
Tilt angle (degrees)	10		
Ground clearance (m)	0.5		
Field orientation (degrees)	15		

Figure 2: Geometry overview and beam shade

Sun: azi=220.0,elev=10.0

Field Orientation (Degrees) = -15

Figure 1: BIGEYE: bifacial PV performance

TNO innovation for life

Select Configuration: East-West

Parameters (East-West)

Module long side (m)	2	Calculated parameters	
Module short side (m)	1	Ground coverage ratio (%)	91.1321
Module transparency (%)	5	Pitch (m)	8.7785
Module orientation	Landscape	Max height, H_max (m)	1.1946
Number of modules	4		
Gap between two long sides (m)	0		
Gap between two short sides (m)	0		
D1 (m)	0.3		
D2 (m)	0.6		
Tilt angle (degrees)	10		
Ground clearance (m)	0.5		
Field orientation (degrees)	-15		

Figure 2: Geometry overview and beam shade

Sun: azi=220.0,elev=10.0

Select Configuration (Vertical)

- The parameters panel for the “Vertical configuration” appear on its selection.
- The left panel are the ones to be filled as per the solar park design.
- The parameters under the “Calculated Parameters” are for checking the input parameters.
- The static image on the right shows a lateral view of the selected configuration with the visual definition of the parameters.
- The “output dir” button allows one to save the result pdf in a specific location.

Parameters to be filled

Checking parameters

Figure 1: BIGEYE: bifacial PV performance

Parameters (Vertical)

Parameter	Value
Module long side (m)	
Module short side (m)	
Module transparency (%)	
Module orientation	Select
Number of modules	
Gap between two long sides (m)	
Gap between two short sides (m)	
Pitch (m)	
Ground clearance (m)	
Field orientation (degrees)	

Calculated parameters

Ground coverage ratio (%)	0
Max height, H_{max} (m)	0

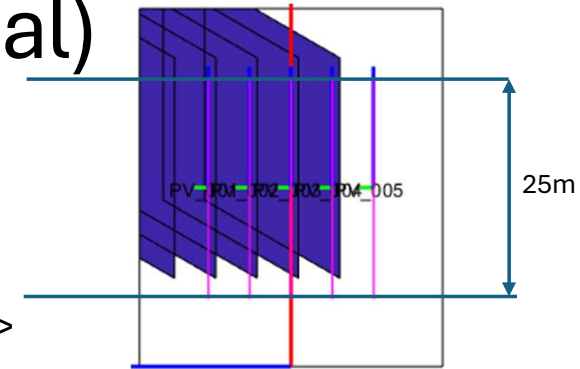
output dir: C:\Users\binania\Downloads\Soil_irradiance_test

run soil irradiance test close plots

Diagram labels: H_{max} , Pitch, Tilt angle = 90°, Ground clearance, West, East, PV

Details about the input parameters (Vertical)

- **Module Length (m)** – The long side of the module in meters.
- **Module Width (m)** – The short side of the module in meters.
- **Module Transparency (%)** – The transparency of the module in percentage. The allowed values are from 0 – 80 [0 for fully opaque modules ; 100 for only glass]
- **Module Orientation** – The drop-down menu has two option; 1> Landscape, and 2> Portrait.
- **Number of modules** – This is the number of module in the Vertical direction. (For the other direction the PV shed is limited to 25m as seen in the image)
- **Gap between two long sides (m)** – This is the gap in meters between the two long sides of a PV table.
- **Gap between two short sides (m)** – This is the gap in meters between the two short sides of a PV table.
- **Pitch (m)** – The distance between the base of one PV shed to the base of the next PV shed.
- **Tilt Angle (Degrees)** – The tilt angle of the module.
- **Ground Clearance (m)** – The distance between the ground and the lower end of the PV shed.
- **Field Orientation (Degrees)** – The deviation of the PV park ground alignment with the North-South direction. It can range from -40° to $+40^{\circ}$. In the next page we will see the effect of field orientation.



Field orientation for sample input for Vertical configuration

Field Orientation (Degrees) = 0

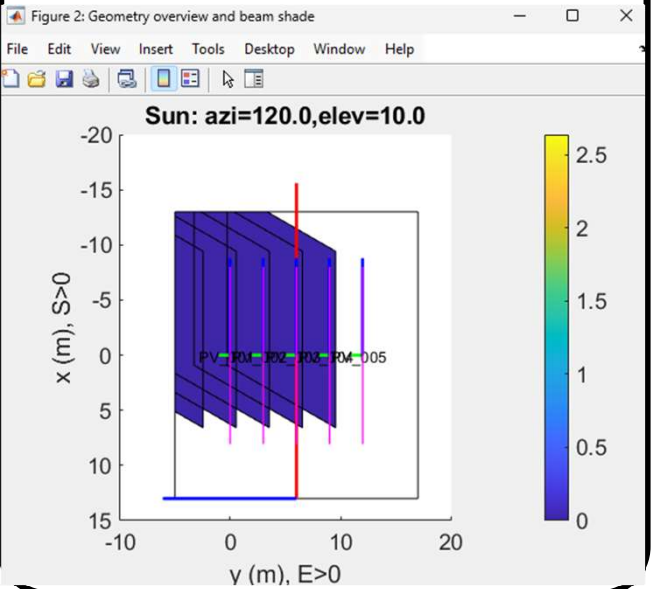
Figure 1: BIGEYE: bifacial PV performance

TNO innovation for life

Select Configuration: Vertical

Parameters (Vertical)

Module long side (m)	2	Calculated parameters	
Module short side (m)	1	Ground coverage ratio (%)	66.6667
Module transparency (%)	5	Max height, H_max (m)	2.5
Module orientation	Landscape		
Number of modules	2		
Gap between two long sides (m)	0		
Gap between two short sides (m)	0		
Pitch (m)	3		
Ground clearance (m)	0.5		
Field orientation (degrees)	0		



Field Orientation (Degrees) = 15

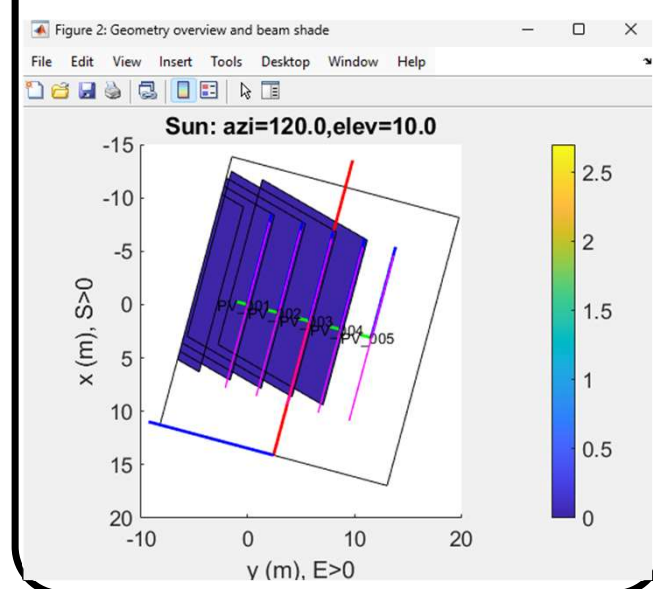
Figure 1: BIGEYE: bifacial PV performance

TNO innovation for life

Select Configuration: Vertical

Parameters (Vertical)

Module long side (m)	2	Calculated parameters	
Module short side (m)	1	Ground coverage ratio (%)	66.6667
Module transparency (%)	5	Max height, H_max (m)	2.5
Module orientation	Landscape		
Number of modules	2		
Gap between two long sides (m)	0		
Gap between two short sides (m)	0		
Pitch (m)	3		
Ground clearance (m)	0.5		
Field orientation (degrees)	15		



Field Orientation (Degrees) = -15

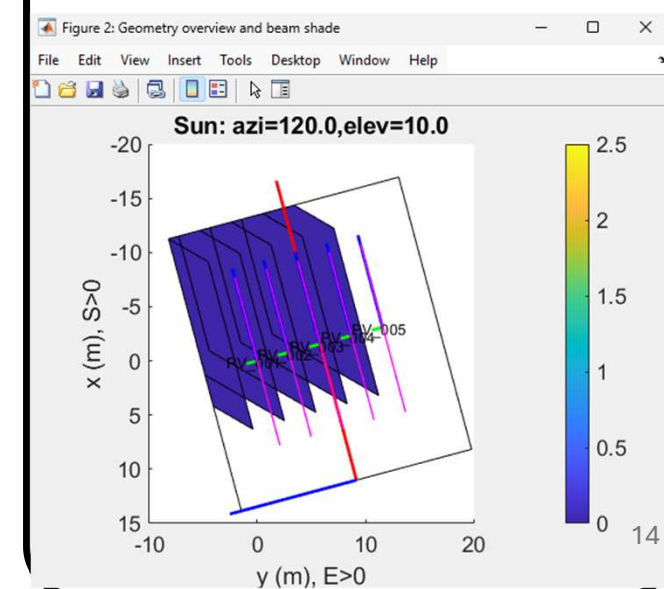
Figure 1: BIGEYE: bifacial PV performance

TNO innovation for life

Select Configuration: Vertical

Parameters (Vertical)

Module long side (m)	2	Calculated parameters	
Module short side (m)	1	Ground coverage ratio (%)	66.6667
Module transparency (%)	5	Max height, H_max (m)	2.5
Module orientation	Landscape		
Number of modules	2		
Gap between two long sides (m)	0		
Gap between two short sides (m)	0		
Pitch (m)	3		
Ground clearance (m)	0.5		
Field orientation (degrees)	-15		



Test run for South configuration

Steps:

1. Input all the parameters in the blue box.
 - a. Check the parameters in the orange box.
 - b. Select the “output dir” to save the pdf.
2. Click on the “run soil test” button (Dark green box) to start the simulation.
3. The “close plots” button will close all the plots that appear after the simulation is completed.

Figure 1: BIGEYE: bifacial PV performance

The screenshot displays the TNO innovation for life software interface. The top left features the TNO logo and navigation buttons (Release notes, Info, Disclaimer). Below this is a configuration selector set to 'South'. The main area is divided into 'Parameters (South)' and 'Calculated parameters'. The 'Parameters (South)' section contains a list of input fields, with a blue box highlighting the 'Module long side (m)', 'Module short side (m)', 'Module transparency (%)', 'Module orientation', 'Number of modules', 'Gap between two long sides (m)', 'Gap between two short sides (m)', 'Pitch (m)', 'Tilt angle (degrees)', 'Ground clearance (m)', and 'Field orientation (degrees)'. The 'Calculated parameters' section shows 'Ground coverage ratio (%)' at 66.6667, 'D1 (m)' at 2.3739, 'D2 (m)' at 2.1363, and 'Max height, H_max (m)' at 1.8353. At the bottom, there is an 'output dir' field with a file path, a 'run soil irradiance test' button (highlighted with a dark green box), and a 'close plots' button. To the right of the parameters is a diagram of a PV array. The diagram shows a horizontal axis from 'North' to 'South'. A PV panel is tilted at an angle. Key dimensions are labeled: 'H_max' (maximum height), 'Pitch' (distance between panels), 'D1' (distance from the North edge to the top of the panel), 'D2' (distance from the top of the panel to the South edge), and 'Ground clearance' (height of the panel above the ground). The PV panel is labeled 'PV'.

Parameters (South)	Value
Module long side (m)	2
Module short side (m)	1
Module transparency (%)	5
Module orientation	Landscape
Number of modules	4
Gap between two long sides (m)	0
Gap between two short sides (m)	0
Pitch (m)	6
Tilt angle (degrees)	15
Ground clearance (m)	0.8
Field orientation (degrees)	0

Calculated parameters	Value
Ground coverage ratio (%)	66.6667
D1 (m)	2.3739
D2 (m)	2.1363
Max height, H_max (m)	1.8353

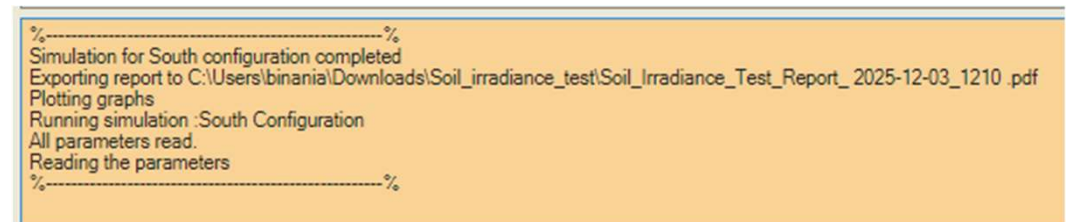
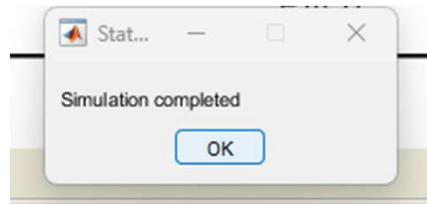
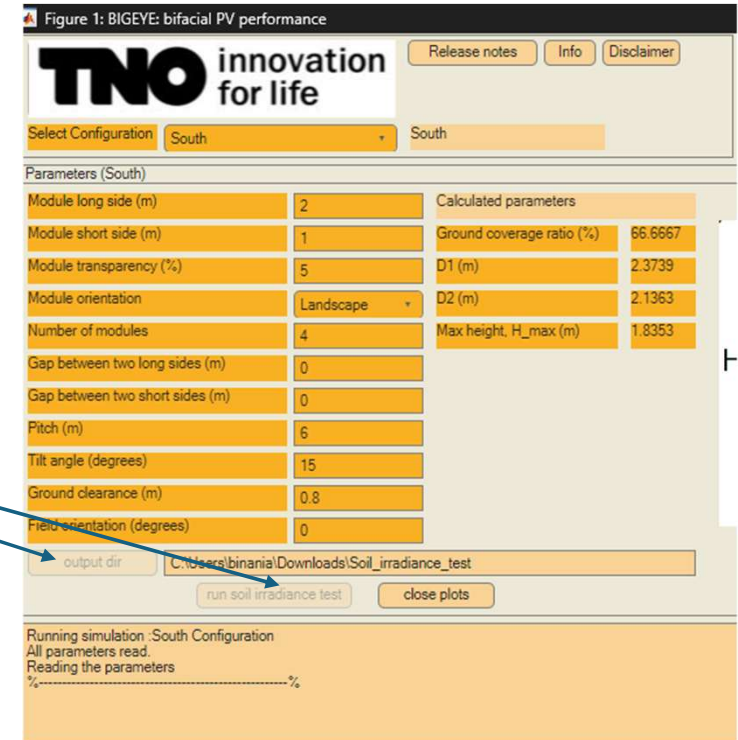
Test run for South configuration (Contd.)

Simulation in progress:

1. The “output dir” and “run soil test” buttons will be greyed out during the runtime.
2. A log is also displayed in the bottom. It reads bottom up.

Simulation completed:

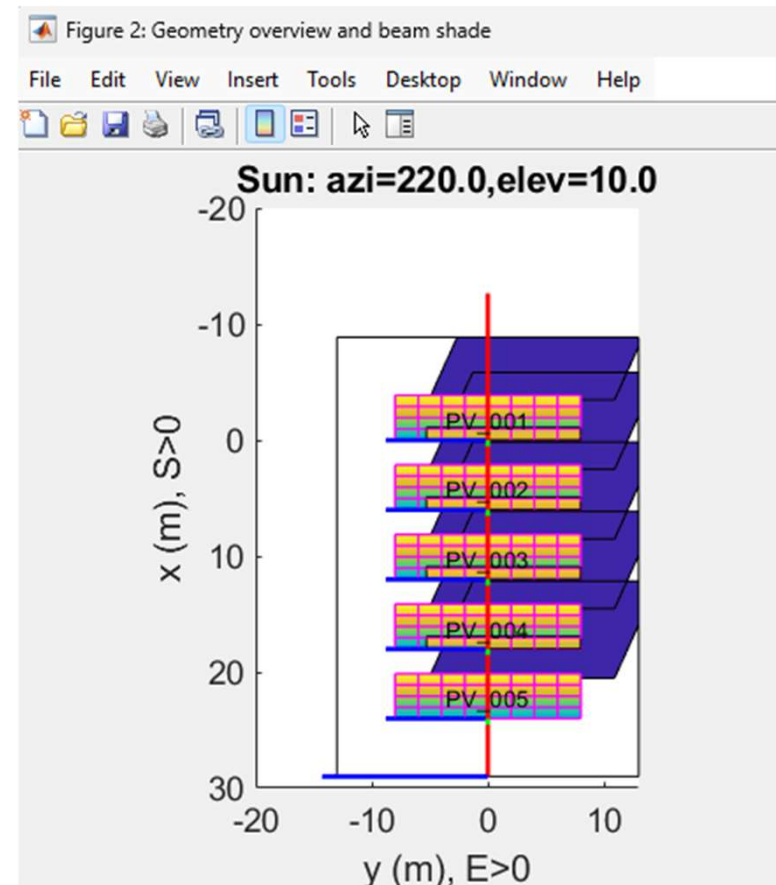
1. There will be three pop-up windows with the three different figures/plots.
2. Once the simulation is completed a pop-up window will indicate that the simulation is completed. Clicking on the “OK” will restore the “output dir” and “run soil test” buttons.



Test run for South configuration (Contd.)

First figure/plot:

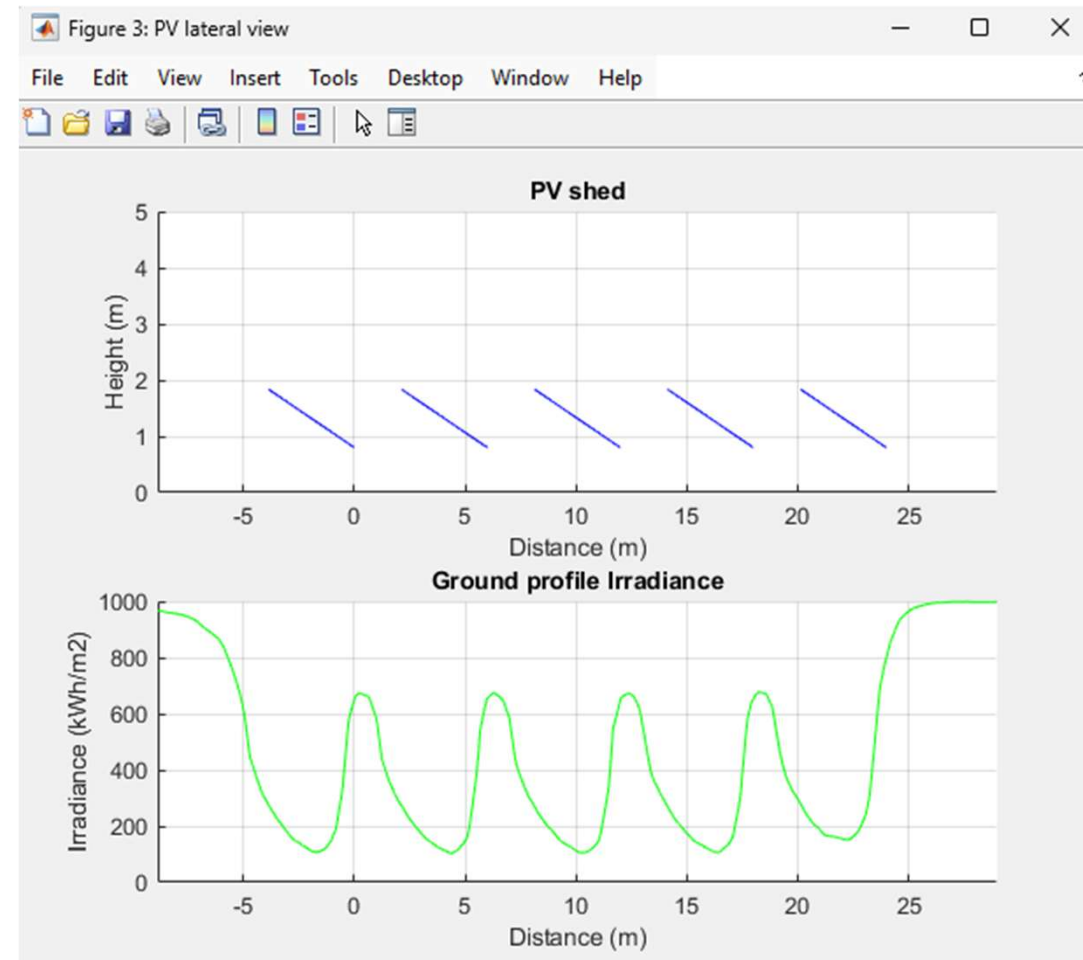
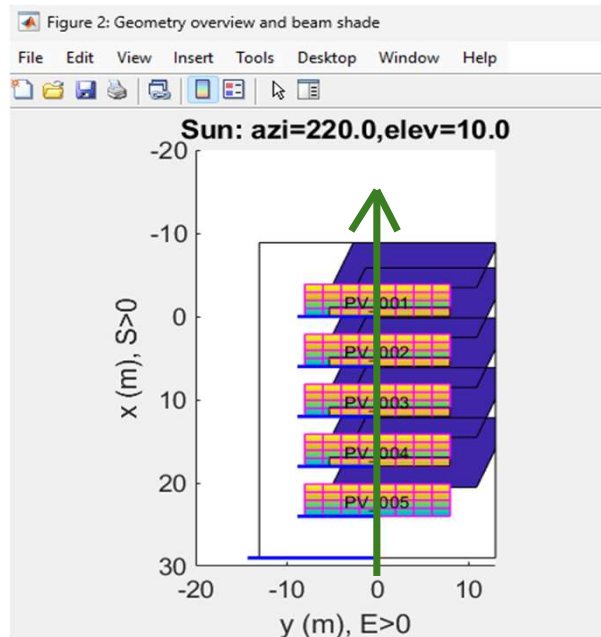
1. The first plot is the top-down view of the PV system.
2. The Sun's position is fixed at azimuth of 220 and elevation of 10 which cast the shadows on the ground as seen in dark blue.
3. The scale bar on the right indicates the height of different PV modules with respect to ground.
4. In this case the system is aligned with the North-South direction.



Test run for South configuration (Contd.)

Second figure/plot:

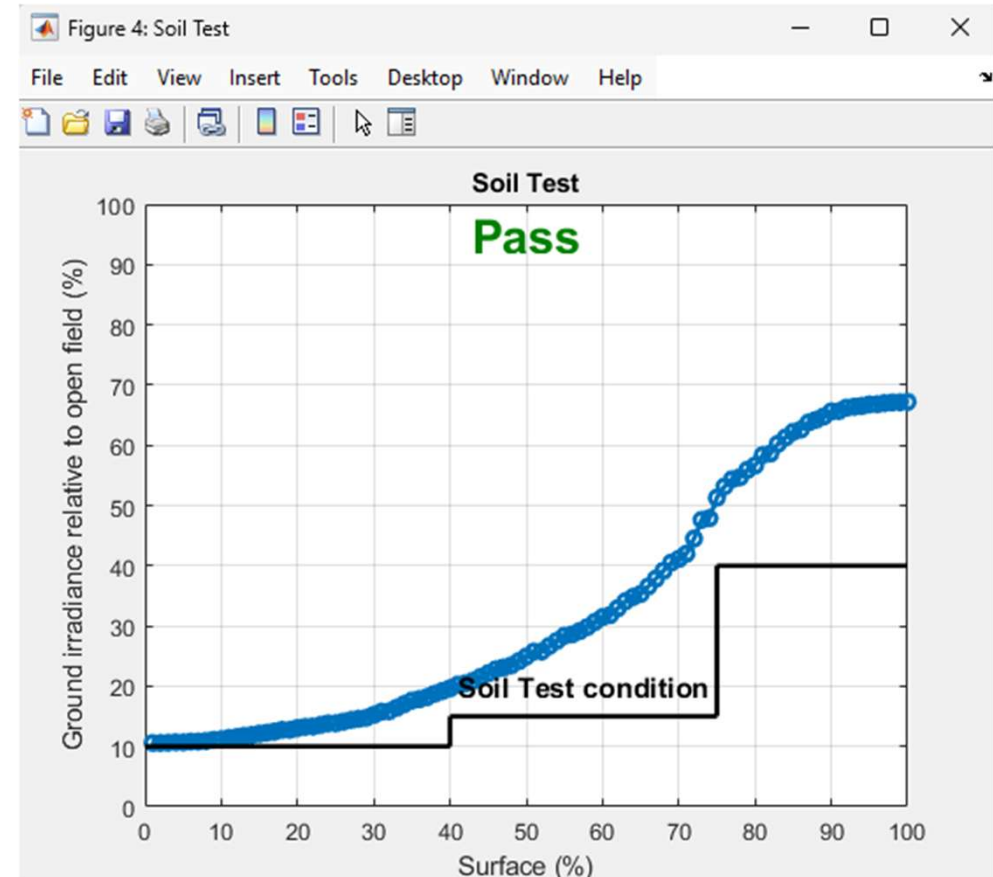
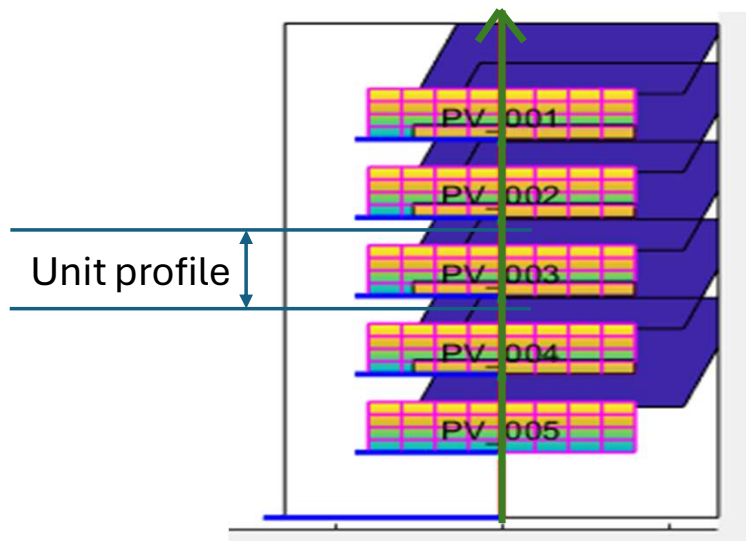
1. The second figure consists of two plots.
2. The top plot is the lateral view of the PV sheds.
3. The bottom plot is the sum of the irradiance falling on the ground profile (as indicated in "Figure 2 : Geometry overview and beam shade "by the green line).



Test run for South configuration (Contd.)

Third figure/plot:

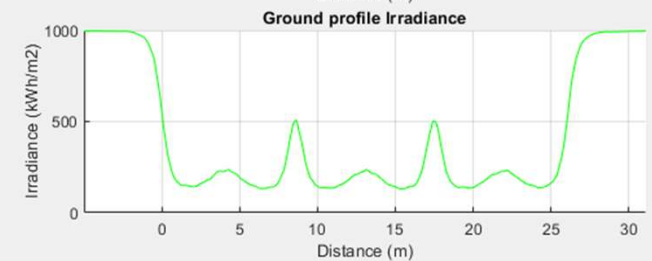
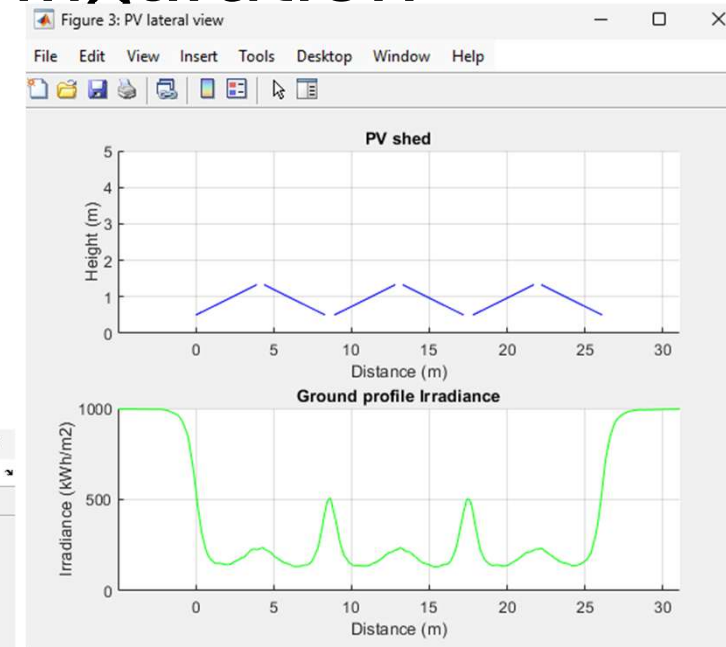
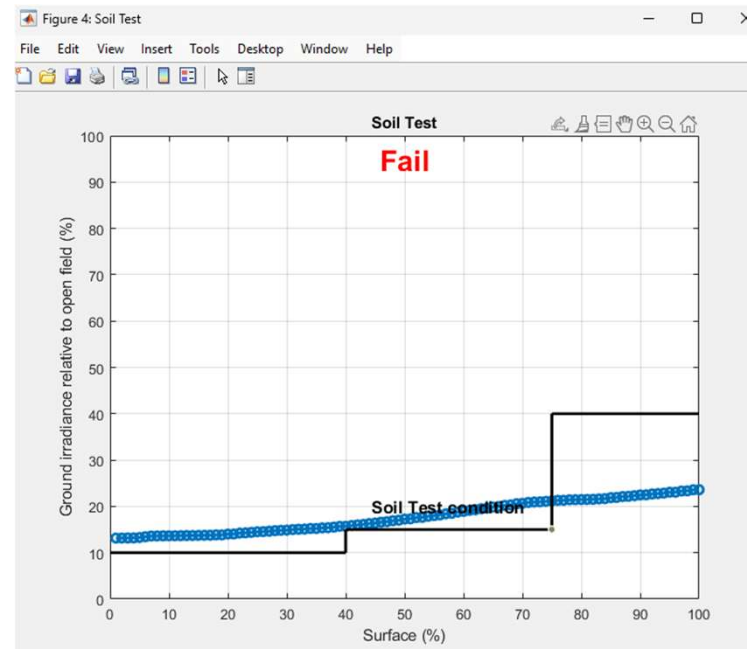
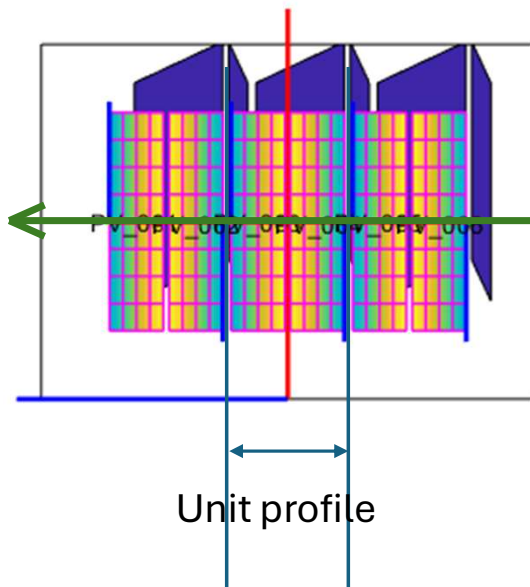
1. This plot is the soil test result.
2. The Text in the graph area indicates whether the design is a “**PASS**” or “**Fail**”.
3. The bold black lines in the form of steps are the soil test conditions.
4. The blue line with marker is the ground irradiance on the Unit profile of the design.



Soil Test result for East-West configuration

Third figure/plot:

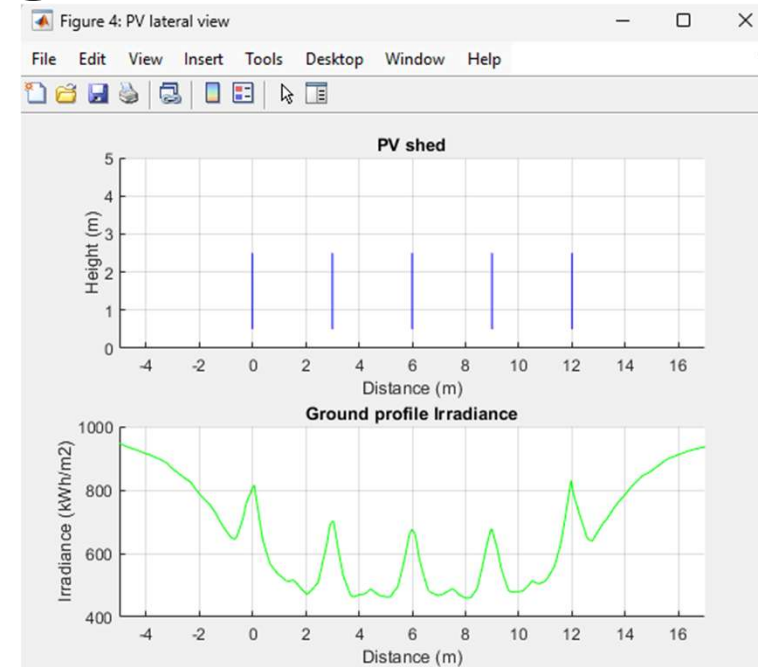
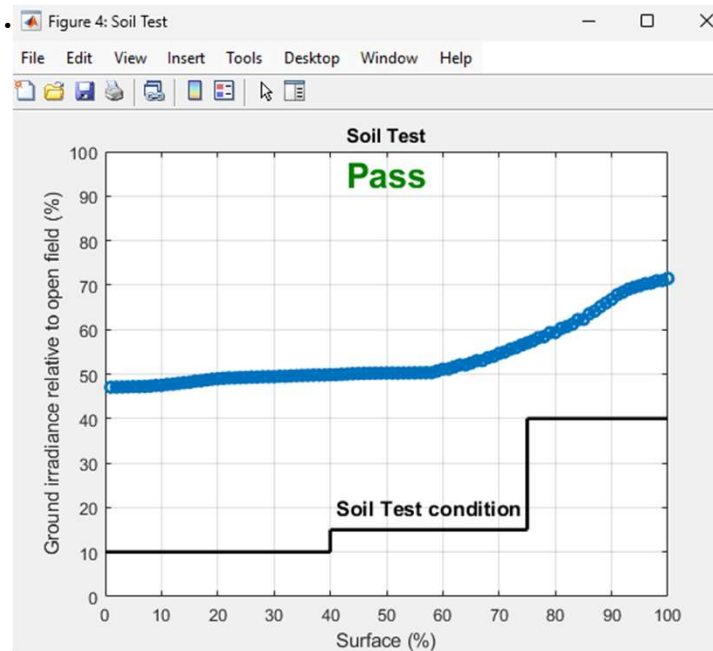
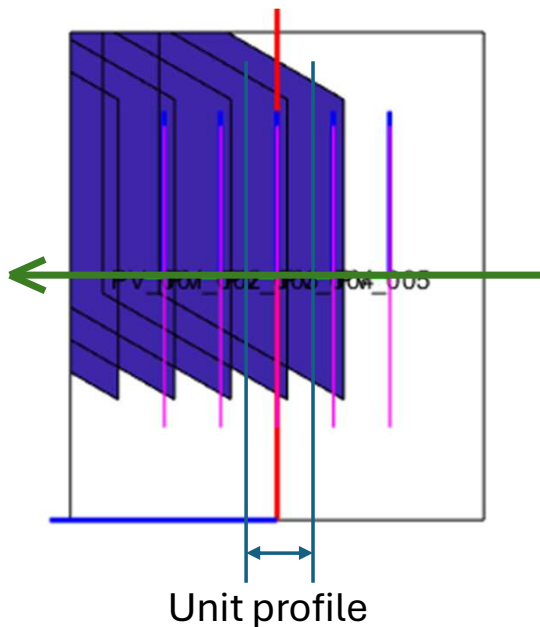
1. This plot is the soil test result.
2. The Text in the graph area indicates whether the design is a “**PASS**” or “**Fail**”.
3. The bold black lines in the form of steps are the soil test conditions.
4. The blue line with marker is the ground irradiance on the Unit profile of the design.



Soil Test result for Vertical configuration

Third figure/plot:

1. This plot is the soil test result.
2. The Text in the graph area indicates whether the design is a “**PASS**” or “**Fail**”.
3. The bold black lines in the form of steps are the soil test conditions.
4. The blue line with marker is the ground irradiance on the Unit profile of the design.



For more detailed information on Soil Test calculation please refer to the publication:

Evaluation method and module design for cost-effective compliance with irradiance guidelines to maintain soil quality in solar parks.

-Ilkay Cesar and Bas B. Van Aken

<https://doi.org/10.1051/epjpv/2025003>