



## **New features and latest developments in PVsyst**

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# Overview

- **String mismatch tool**
- **SolarEdge optimizers**
- **Multiple orientations management**
- **Thin object shadings**
- **IAM definitions, Module surface**
- **Pumping Systems**
- **Unlimited Trackers / Bifacial Tracking**
- **Lithium Ion batteries**

# New String Mismatch Tool

## Mismatch losses in PVsyst

Mismatch causes:

- Shading
- Module variations (incl. ageing)
- Temperature gradients
- Non-uniform Wire length

Detailed hourly calculation

Fixed mismatch factor  
(has to be estimated)

Module variations impact mainly on current  
(mismatch within one string)

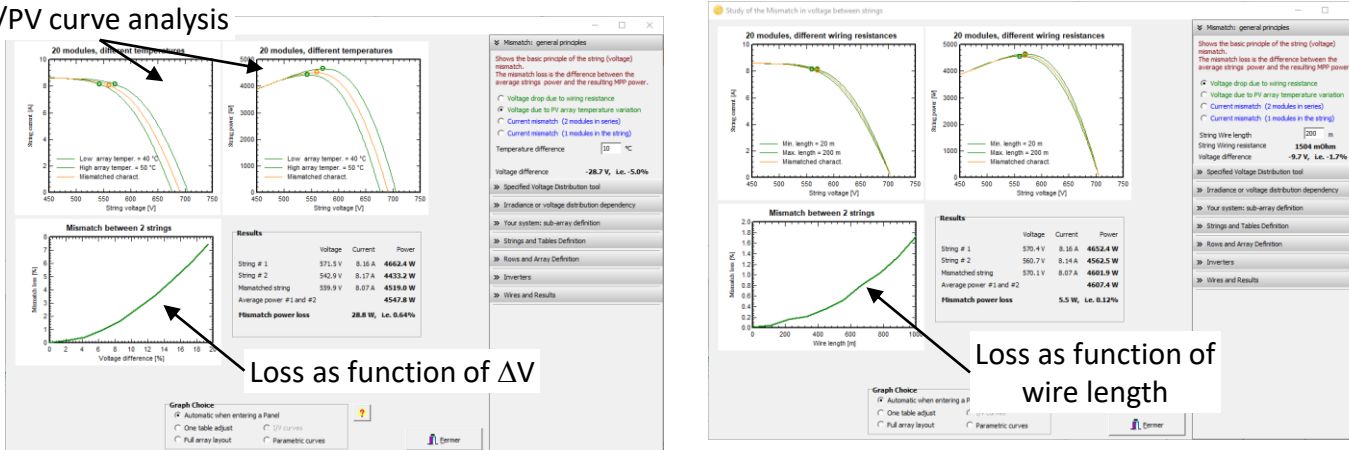
Temperature and wiring variations impact  
mainly on voltage  
(mismatch in between strings)

The new tool allows to estimate the mismatch losses in between strings (voltage)

Question: What are the possible benefits of string inverters compared to central inverters?

## General comparison of voltage mismatch and current mismatch

IV/PV curve analysis



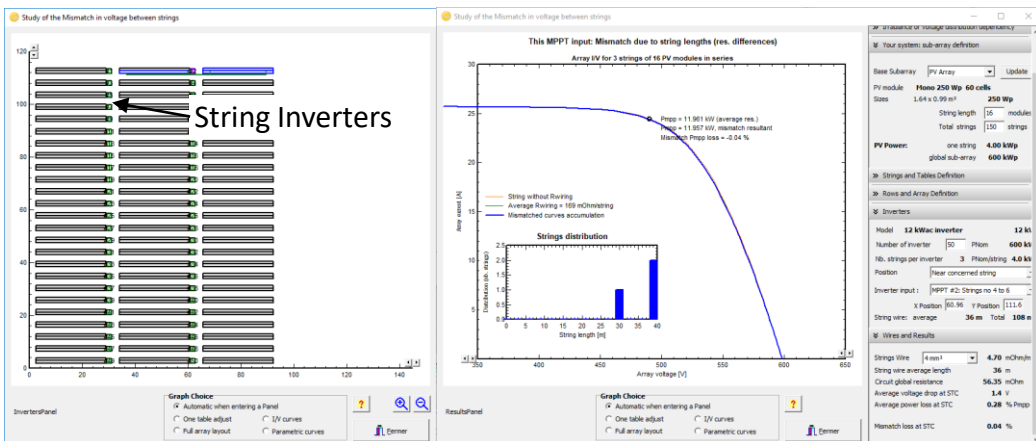
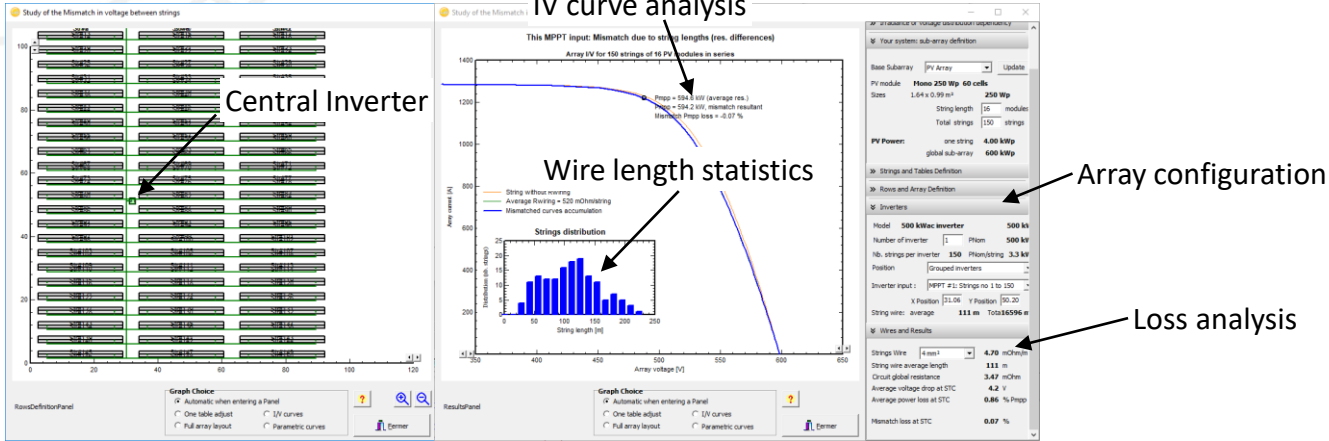
Loss as function of  $\Delta V$

Loss as function of wire length

Voltage mismatch losses are generally much smaller than current mismatch losses

# New String Mismatch Tool

Compare different wiring layouts



# SolarEdge optimizers

## More flexible configuration of SolarEdge architecture

Example:

Configuration with 4 inverters, 5 orientations, 3 string lengths

Inverter definitions for SolarEdge systems

InvertersInputsTab | Strings with mixed orientations or optimizers

**Existing sub-arrays**

Sub-array #	N Opt ser/parall	Nb. inv. inputs	Model	Status
Sub-array #1	20	3	1 SE33.3K	OK
Sub-array #2	13	6	1 SE33.3K	OK
Sub-array #3	20	3	1 SE33.3K	OK
Sub-array #4	13	9	1 SE33.3K	OK
Sub-array #5	19	8	2 SE33.3K	OK

**Design parameters**

Reinitializes Inverter List

Max. number of strings: 9

Nominal PNom ratio: 1.35

Show sub-arrays

Show nb. optimizers in series

**Inverters input specification**

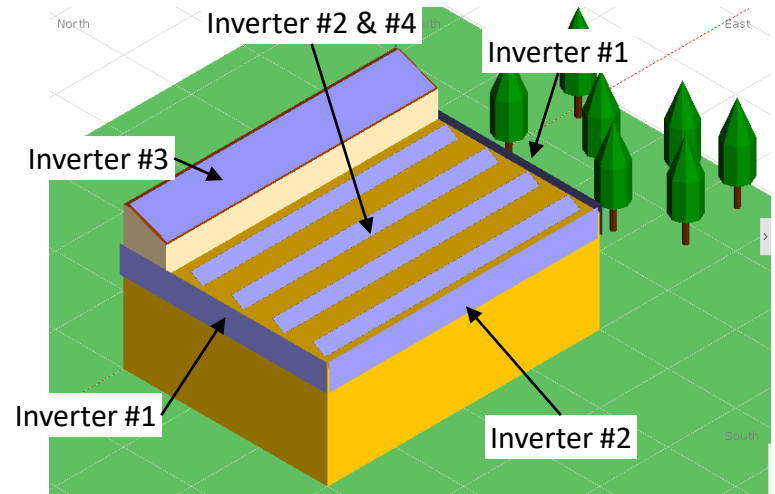
Inverter #	Model	String#1	String#2	String#3	String#4	PNom PV	PNomRatio	
Inverter #1	SE33.3K	Sub-array #1	Sub-array #1	Sub-array #1	Sub-array #3	25.88 kW	0.78	✖
Inverter #2	SE33.3K	Sub-array #2	Sub-array #2	Sub-array #2	Sub-array #2	29.10 kW	0.87	✖
Inverter #3	SE33.3K	Sub-array #4	Sub-array #4	Sub-array #4	Sub-array #4	30.58 kW	0.92	✖
Inverter #4	SE33.3K	Sub-array #5	Sub-array #5	Sub-array #5	Sub-array #5	30.82 kW	0.93	✖

NManualModif = 25

✖ Annuler    ✓ OK

**Inverter list** (points to Inverter #1)

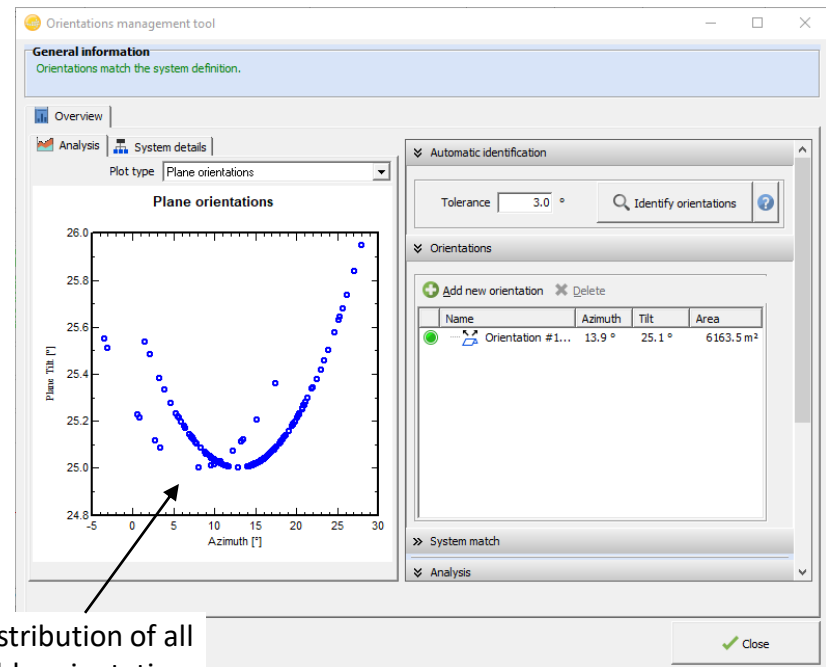
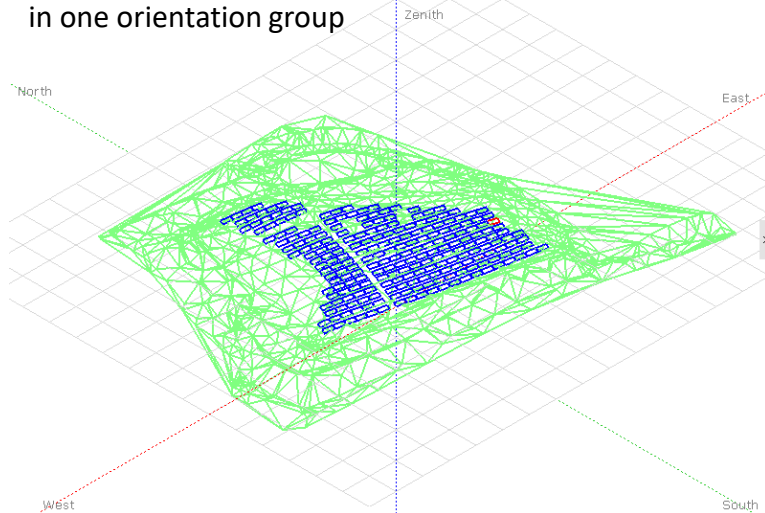
**Individual string assignment** (points to Sub-array #4 in String#2)



# Multiple Orientations Management

PV modules with many different orientations may be grouped into 1-8 average orientations

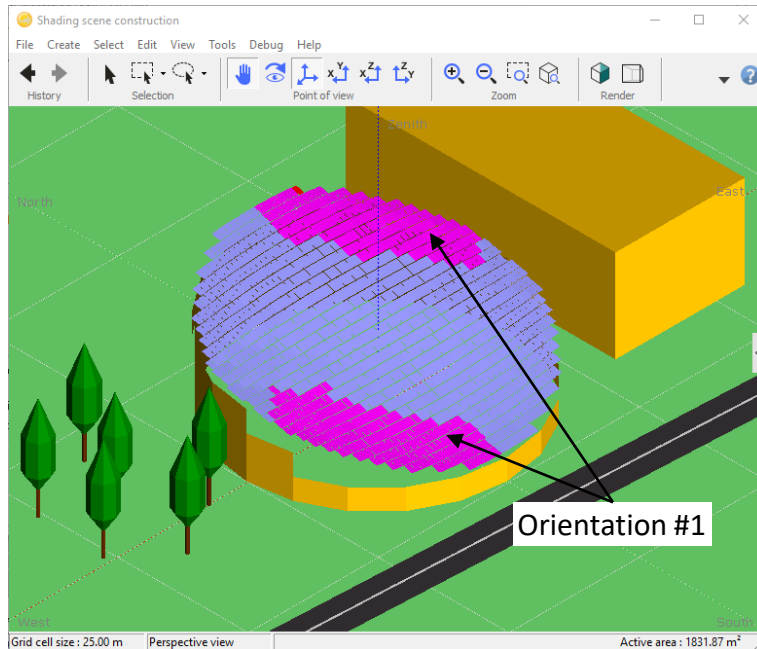
Example 1:  
Irregular topology with all tables averaged  
in one orientation group



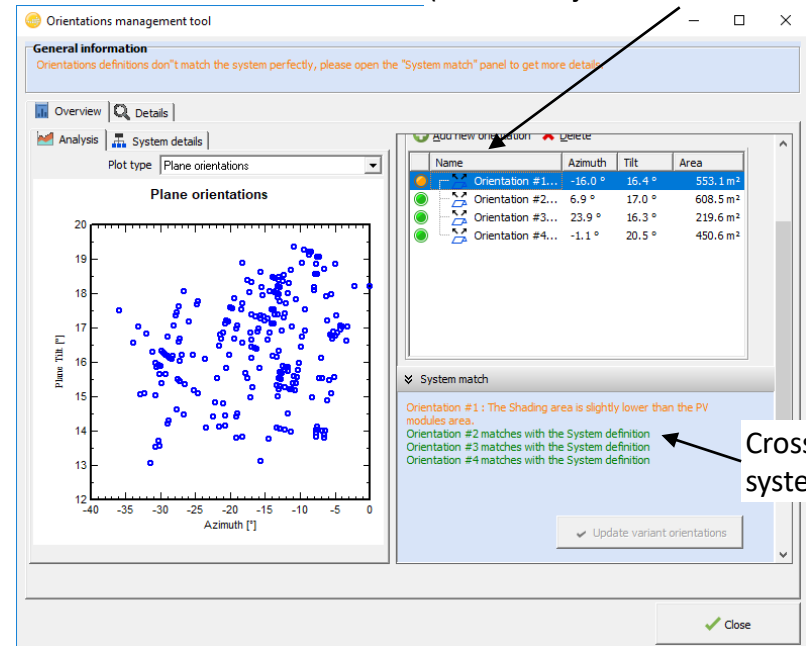
Distribution of all  
table orientations

# Multiple Orientations Management

Example 2:  
Non-flat roof that was automatically grouped



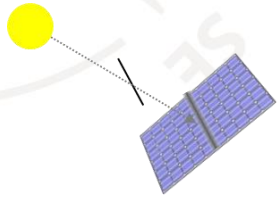
Orientations were automatically grouped into 4 average orientations (manual adjustments are still possible)



Cross-check with system definition

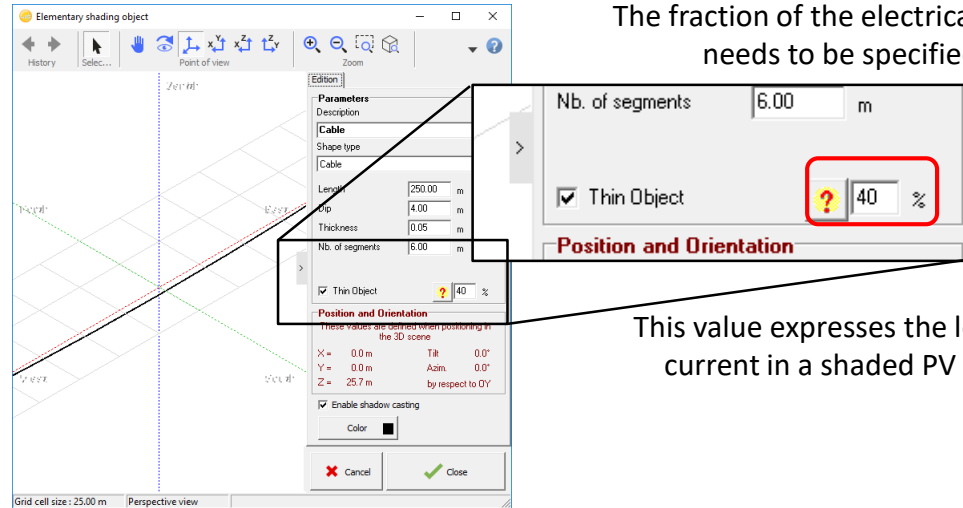
# Thin object shading

Thin objects do not cast sharp shades



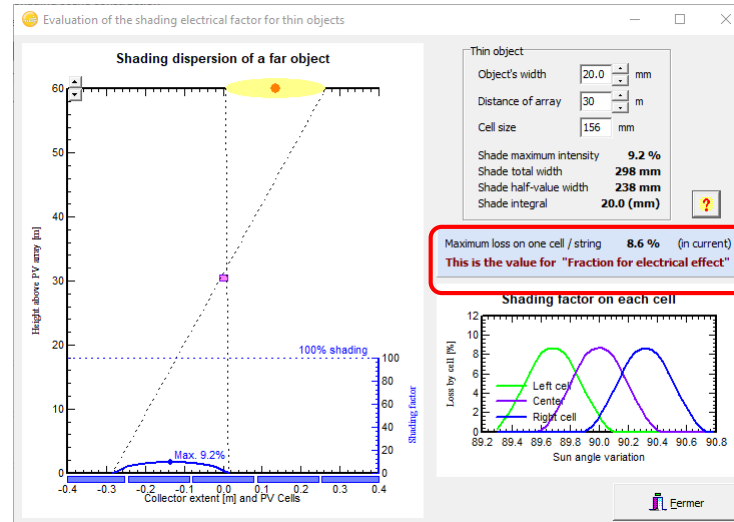
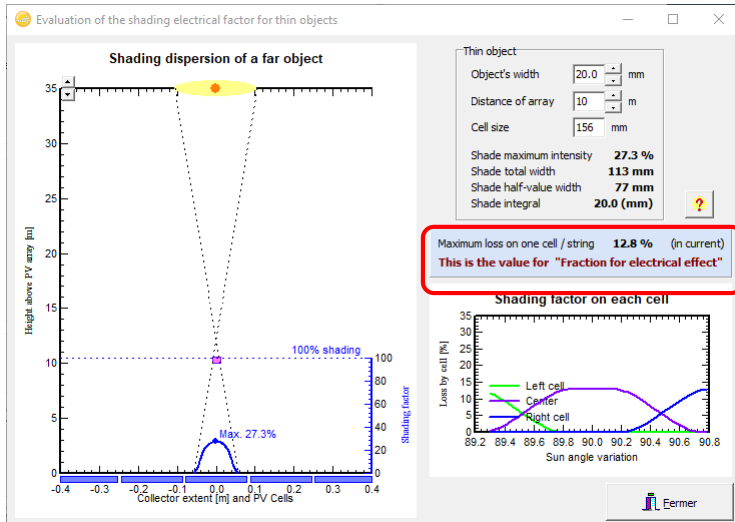
If width of shadow > cell width  
the electrical shading effect will be reduced

The fraction of the electrical effect  
needs to be specified



This value expresses the loss of  
current in a shaded PV cell

The new tool allows to estimate the Fraction of Electrical Effect





# IAM definitions, Module surface

IAM: Incidence Angle Modifier

Describes the angular reflection properties of the PV module surface

In the past, the PVsyst default was to use the ASHRAE model (empirical)

New: IAM default function is given according to PV module front surface

The screenshot shows the 'Definition of a PV module' window with the 'Incidence Angle effect' tab selected. The 'Front Surface' dropdown is set to 'AR coating'. The 'Points' table is as follows:

	Inc. Angle	IAM
1	0.0	1.000
2	30.0	0.999
3	50.0	0.987
4	60.0	0.962
5	70.0	0.892
6	75.0	0.816

The graph on the left shows the IAM function, which is constant at 1.0 until approximately 60 degrees, then decreases to 0 at 90 degrees.

The surface material defines the IAM function

The IAM function is now modeled according to Fresnel refraction laws.

User-defined profiles are still possible

# Pumping Systems

Pumping system definition, Variant "Irrigation system, 100 m3/day Winter + Spring, Head = 80 m"

**Pre-sizing suggestions**

Average daily needs:	Requested autonomy: 4.0 day(s)	Suggested tank volume: 400 m <sup>3</sup>
Head min: 80.0 meter/W	Accepted missing: 5.0 %	Suggested Pump power: 9.1 kW
Head max: 83.1 meter/W		Suggested PV power: 11.5 kWp (nom.)
Volume: 59.9 m <sup>3</sup> /day		
Hydraulic power: 2660 W (very approximative)		

**Pump definition** SubArray Design

**System information**

Chosen pump	PS9K C-SJ17-11	Technology	Centrifugal Multistage	Head	HeadRange
Max. power	9500 W	Flow Rate			

**Select the PV module**

Available Now

Generic: 250 Wp 26V Si-mono Mono 250 Wp 60 cells Since 2015 Typical

Approx. needed modules: 1 Sizing voltages: Vmpp (60°C) 25.7 V Voc (3°C) 40.4 V

**Select the control mode and the controller**

Control mode: MPPT-AC inverter

All Manufacturers: 15 kW MPPT-AC inverter SD700 Solar Pumping 15 kW Power Electronics Cc

Number of controllers: 1

**PV Array design**

**Number of modules and strings**

Mod. in serie: 20 (should be: between 18 and 20)

Overload loss: N/A Pnom ratio: N/A Nb modules: 40 Area: 65 m<sup>2</sup>

**Operating conditions:**

Vmpp (60°C)	514 V
Vmpp (20°C)	627 V
Voc (3°C)	809 V
Plane irradiance	1000 W/m <sup>2</sup>
Impp	16.4 A
Isc	17.3 A
Isc (at STC)	17.3 A

The controller power is slightly oversized.

Max. operating power at 1000 W/m<sup>2</sup> and 50°C: 8.9 kW

Array's nom. power (STC): 10.0 kWp

Buttons: System overview, Annuler, OK

Water Needs and Hydraulic Pressure / Head, Variant "Irrigation system"

Comment: New PV system

Pumping Hydraulic Circuit | Water needs and Head definitions

**Pumping System Type** Lake or River to Storage

**Lake or River characteristics**

Level depth (with respect to ground level)	80.0 m
Pump depth (cannot be higher than 4-5 meter above the lake level)	83.0 m

**Storage Tank**

Volume	700.0 m <sup>3</sup>
Diameter	35.43 m
Water full height	0.71 m
Feeding altitude	2.00 m
Bottom alimentation	<input type="checkbox"/>

**Hydraulic Circuit**

Pipe choice: DN65 (2"1/2)

Piping length: 200 m

Number of elbows: 0

Other friction losses: 0.00

**Diagram:** Feeding level, Ev. Ground pump (Close to pumping level), Pumping level, Immersed pump (recommended)

**Graph:** Head [meter/W] vs Flowrate [m<sup>3</sup>/h]. Legend: Total with friction loss, Altitude diff. OUT-IN

Buttons: Cancel, OK

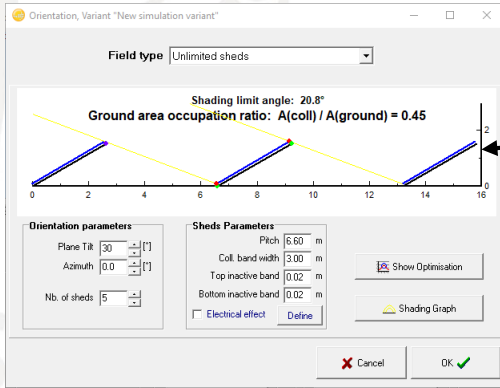
New dialogue for pumping systems  
In line with dialogues of grid-tied and standalone systems

The simulation of pumping systems was reviewed and adapted also to larger systems (few 100 kW)

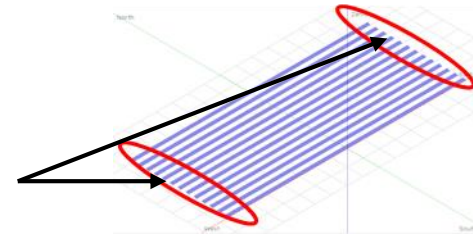
# Unlimited Trackers / Bifacial Tracking

## 2-dimensional approach for long rows

PVsys 'Unlimited Sheds' model  
for long rows with fixed tilt

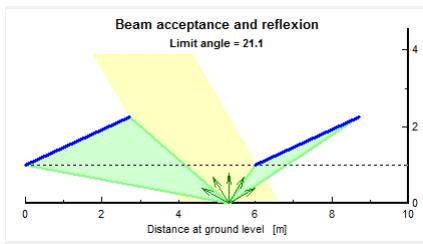


2-dimensional model  
neglects border effects of the rows

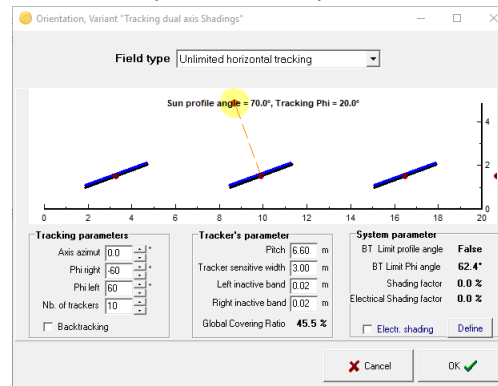


Bifacial model  
for fixed tilt sheds  
available (since V6.6.0)

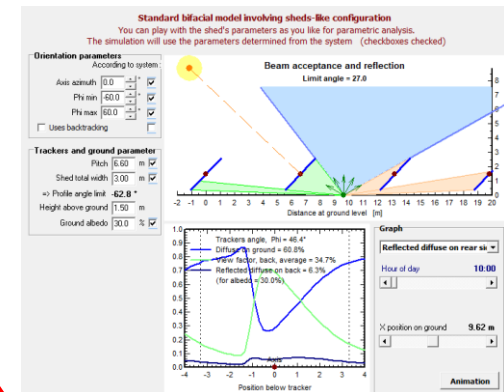
Unlimited trackers:  
first step towards  
horizontal bifacial tracking model  
(since V6.6.7)



+



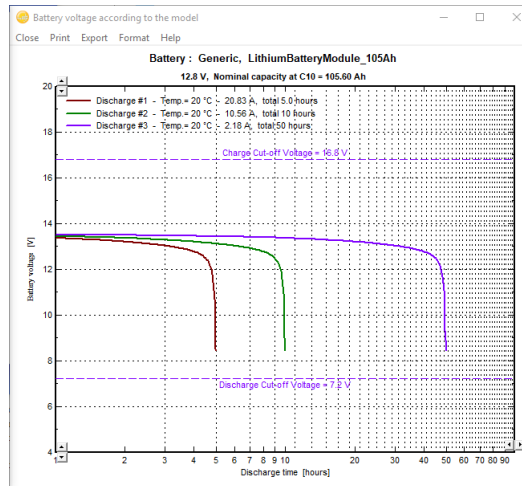
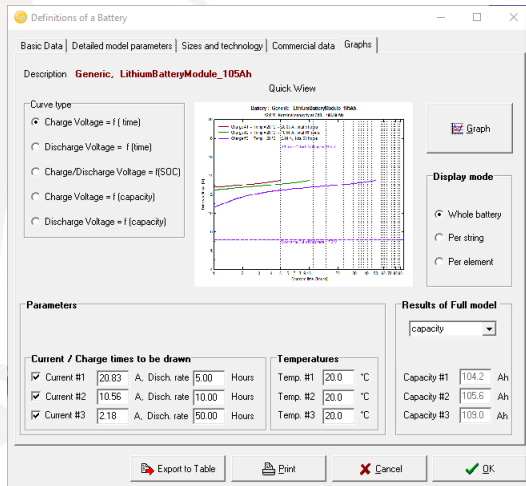
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Bifacial tracking  
for horizontal axis  
close to publishing

# Lithium Ion batteries

## Model for Li-Ion Batteries



## Composition Hierarchy

Main Category	Cells		Modules		Cabinets&Racks		Containers
CategoryLevel	1	1	2	2	3	3	4
Category	Cylindrical cell	Pouch cell	Battery module	Rack mount module	Cabinet	Rack	Container
Base element	cell	cell	cell	cell	Battery module	Rack mount module	Rack
Photo							

Allows to build easily large battery packs out of smaller components

In a next step it will be possible to combine battery storage with grid-tied systems



# Summary and Outlook

- New features in current PVsyst Version
  - String mismatch tool
  - More possibilities for SolarEdge optimizers
  - Improved multiple orientations management
  - Tool to study thin object shadings
  - IAM definitions, Module surface
  - Larger Pumping Systems became possible
  - Simplified calculation for single horizontal axis trackers
- New features in upcoming versions
  - Bifacial Tracking for horizontal axis
  - Lithium Ion batteries
  - Grid-tied PV systems with battery storage