

Photovoltaic System Simulation Software

# Solar Pro

Operation manual for field standing

# Introduction

Photovoltaic System Simulation Software

# Solar Pro®

High accuracy simulation software,  
acknowledged by the world

## features

### 1. Accurate simulation of shadow effects

Only a partial shadow of the module will significantly reduce the amount of power generated by the system. "Solar Pro" provides accurate simulations that take into account the effects of shadows on a modular basis.

### 2. For complex system designs

You can freely set the installation method such as flat or wall installation, tilt of the array, installation direction, etc. Even in complex systems, you can consider installation methods that maximize the amount of power generated.

### 3. Reflected light simulation

Solar Pro can be used for a wide range of applications, including simulating power generation and reflected light.

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## ★ Preliminary survey to improve calculation accuracy

- Inverter model
- Model of the module
- Module layout and distance of one block
- Information such as the layout plan, measured distance, and interval
- Single-Wire Connection Diagram

The above information enables more accurate simulations.



Figure 1

## 1. Create new

Then you start Solar Pro, click the New button in the upper left of the screen (Figure 1).

The "Wizard"(Figure 2) window is displayed.

This time, a simulation is performed using an image to be used as a base picture, click Cancel to close the window.

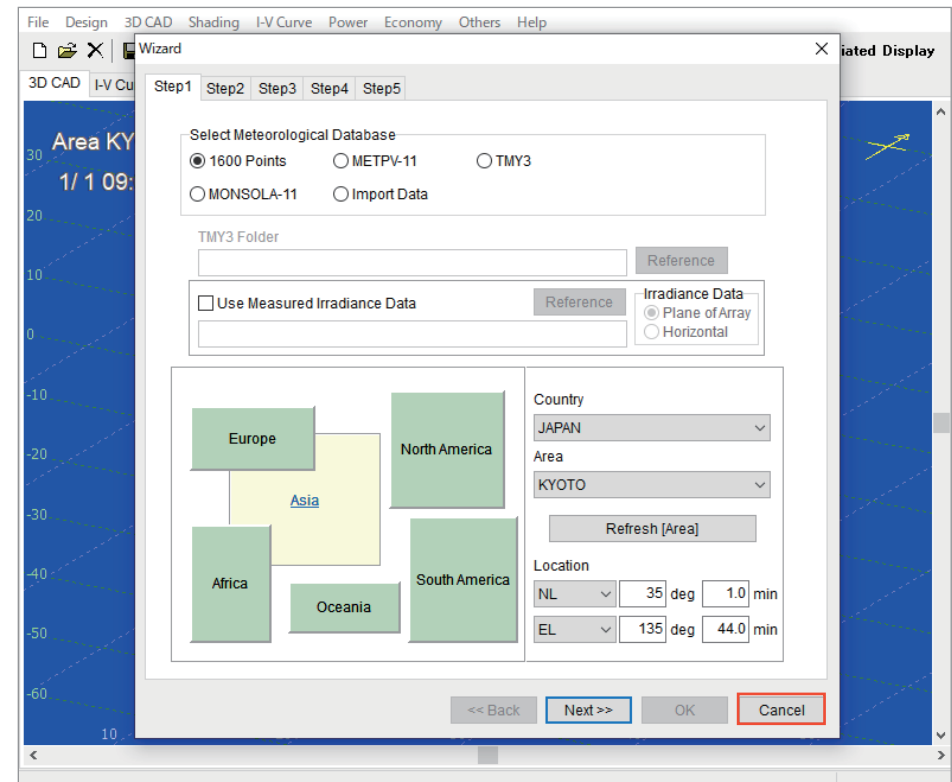


Figure 2

## 2. Import image

Prepare image data such as aerial photographs and construction schedule images to be used as base picture. If you select "3D CAD", "Map" (Figure 1) from the menu bar, the "Map" (Figure 2) window opens. Click "Image File" to import the image you want to use. Next, the image setting screen (Figure 3) is displayed, set scale.

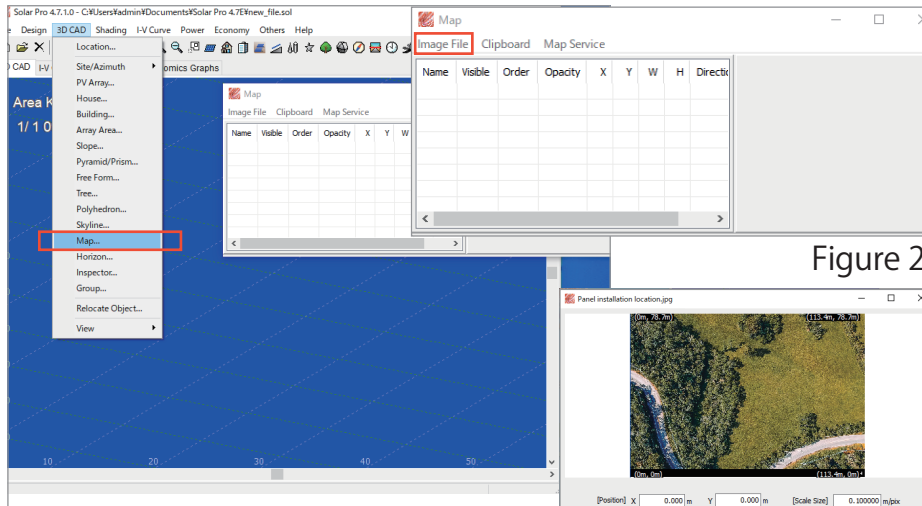


Figure 1

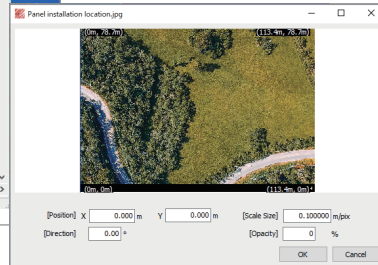


Figure 3

Figure 2

Right-click on the image and select "Scale Setting" (Figure 4). Set two reference points (Figure 5) by left-clicking, enter the distance, and click OK (Figure 6). Set opacity, etc. (Figure 7) and click OK to open the "3D CAD" window.

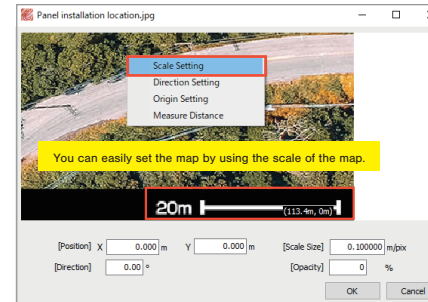


Figure 4

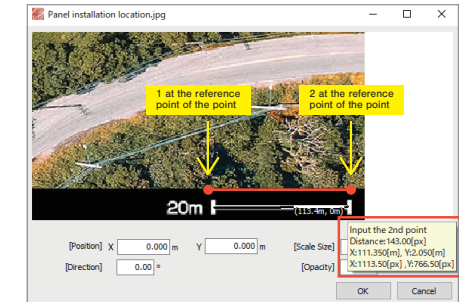


Figure 5



Figure 6



Figure 7

### Point 1 - Setting and operating of images -

The following changes and operations can be performed.

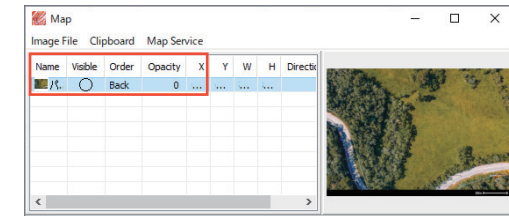
- Position: Coordinates displayed on 3D CAD window
- Scale Size: Resizing
- Direction: Rotating image
- Opacity: Opacity of image
- Mouse Wheel: Scaling Image
- Right drag: Shifting image



### Point 2 - "Map" settings -

The following changes can be made.

- Double-click to set the image.
- Visible: Click to show or hide
- Order: Set the stacking order of images (Back: Background, Fore: Foreground)
- Opacity: Use the slider to change
- [delete] Key: Delete image





## Point - 3D CAD operations -

On 3D CAD window, you can use the mouse as shown below.

### Mouse operation

- Left drag: Rotate the line of sight starting at the center of the screen
- Right drag: Shift the viewpoint
- Mouse wheel: Expansion/reduction
- [Alt] Drag from upper left to lower right while holding down the key: Range selection

### Shortcut Keys

**F4** : Change the point/date display at the upper left of the screen

**F5** : Switching Modules color (String, Inverter)

**F6** : Move to Origin

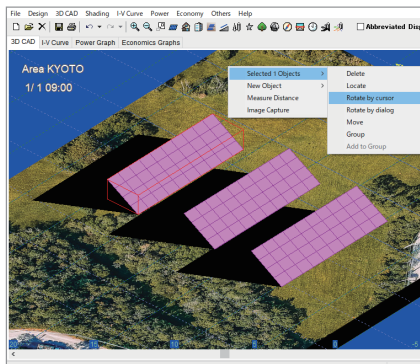
**F7** : Scale up

**F8** : Scale down

### Rotate an Object

Select the object and right-click it "Selected 1 Objects", "Rotate by cursor", you can rotate by clicking twice.

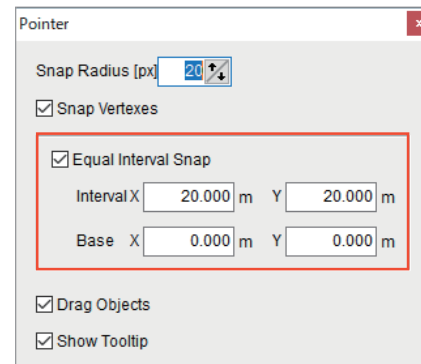
\*The rotation axis is set by the first click, and the rotation reference is set by the second click.



### Point snap setting

By selecting menu bar "3D CAD", "View", "Pointer", you can set the snap (stick together).

To arrays by using equally spaced snaps useful when you want to arrange them evenly.



## 3. Arrangement of PV arrays

You will arrange solar modules.

Right-click on 3D CAD window (Figure 1) and select "New Object", "PV Array".

This generated an array (Figure 2).

Double-click to display "PV Array" window.

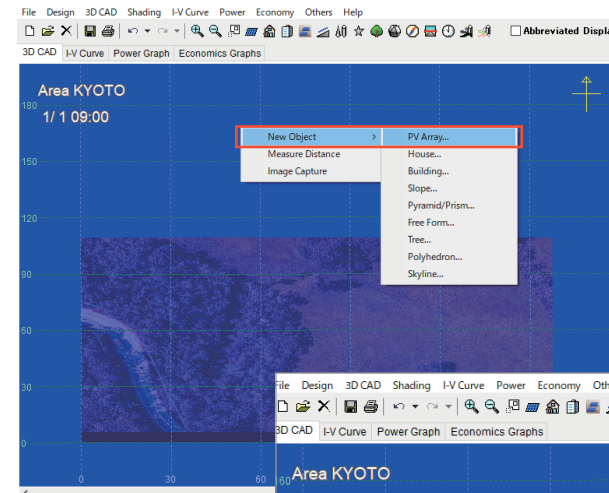


Figure 1

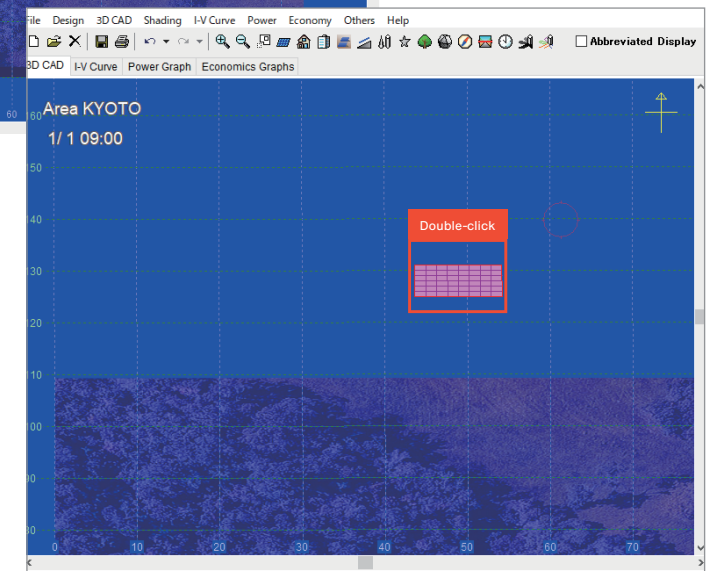


Figure 2

### 3. Arrangement of PV arrays

Enter information per block (Figure 1).

Enter the information you surveyed in advance and click OK.

If details have not been decided, "Tilt" enter "30" provisionally and click OK.

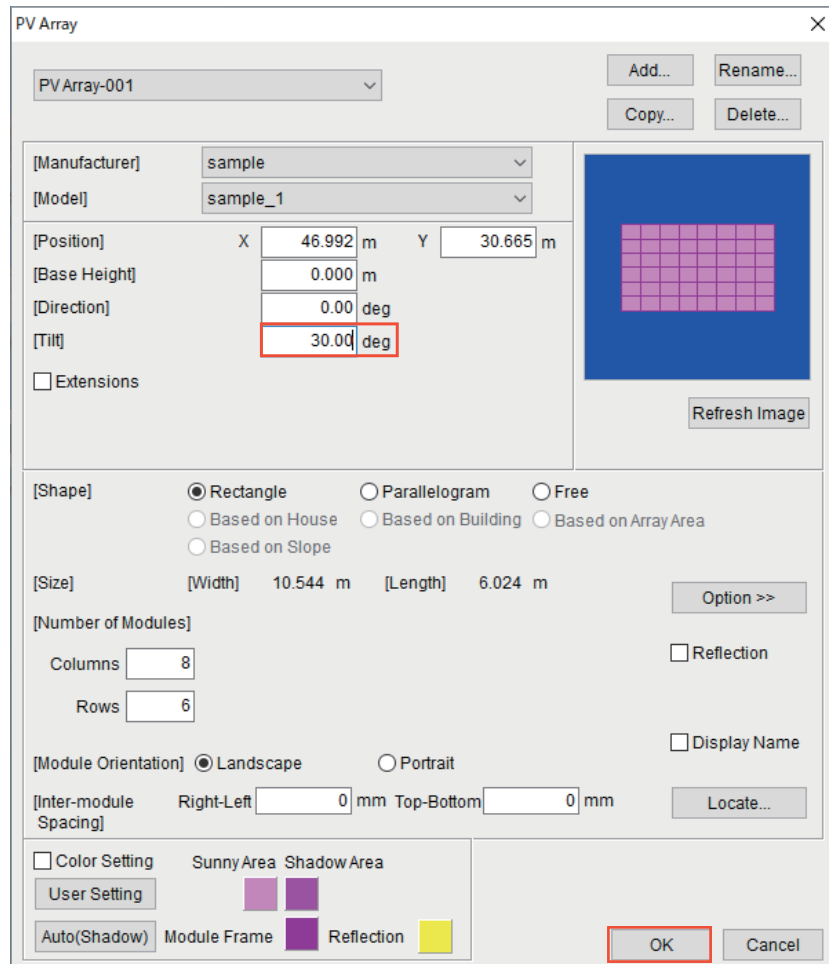


Figure 1

### 4. Duplication of PV arrays

Duplicate the array (Figure 2) with the information entered.

Copying can be performed by clicking an array to select it (red frame), and then dragging and dropping it while holding down "Ctrl". Close to the edges of arrays snaps (adsorption) and you can cleanly arrange them (Figure 3).

In this way, arrange the required number of arrays.

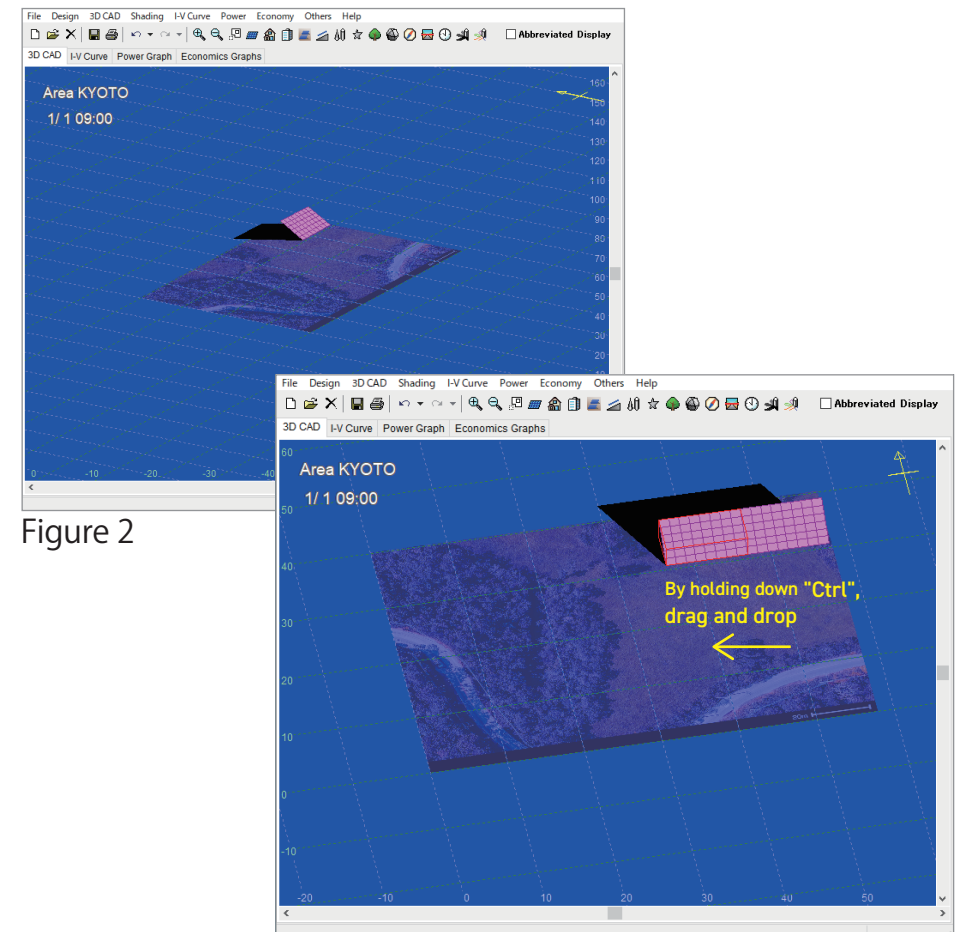


Figure 2

Figure 3

## 5. Wiring configuration

After the array has been placed, configure the connections.

Select the menu bar "I-V Curve", "Electrical Assembly" (Figure 1).

On "Electrical Assembly" (Figure 2) enter "Inverter", "Parallel(Max)", "Series(Max)" and click "Auto Connection".

\*Make sure that the total circuit configuration matches the number of installed modules.

To set the Inverter model, you can do this from the "Inverter Setting", check "Advanced", "Inverter Setting".

After completing the settings, click OK.

If you configure the wiring, the module will be colored (Figure 3).

If it does not change, you can press the [F5] key to switch the color between string and every inverter.

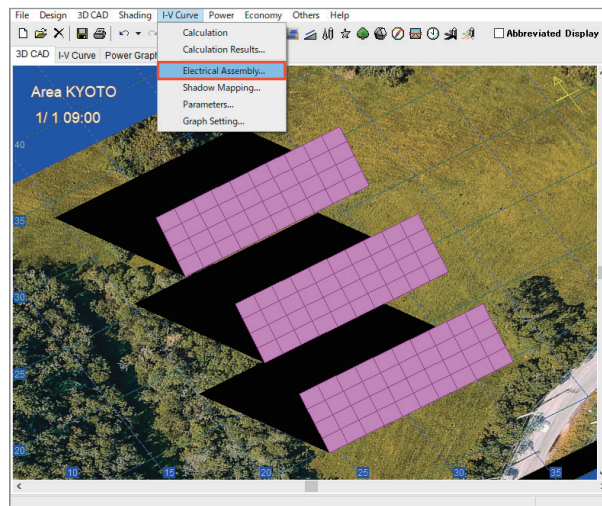


Figure 1

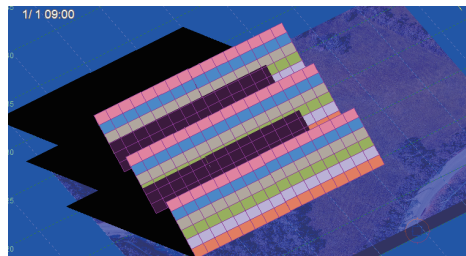


Figure 3

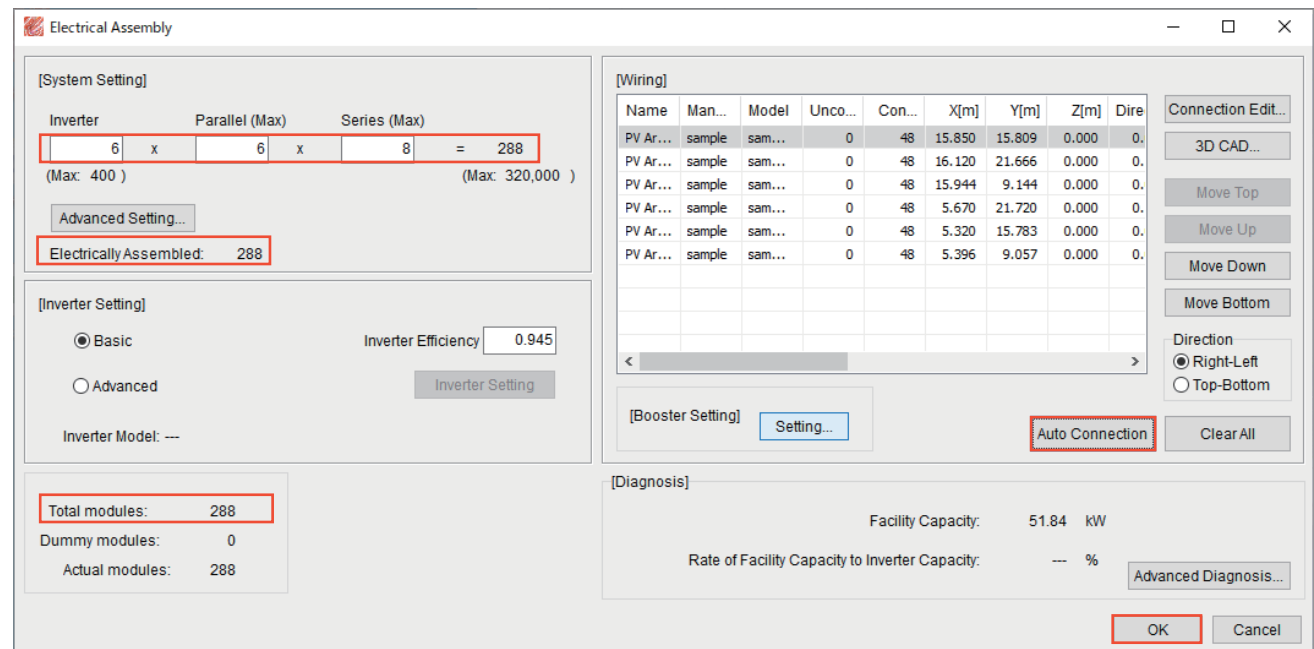


Figure 2

## 6. Cost setting

After completing the wiring configuration, perform a simulation. Select the menu bar "Economy", "Cost Setting" (Figure 1).

In "Cost Setting" (Figure 2), you can input the initial cost and examine the profitability.

As an example in the "Amount" of "Construction Cost", enter "100,000" and click OK.

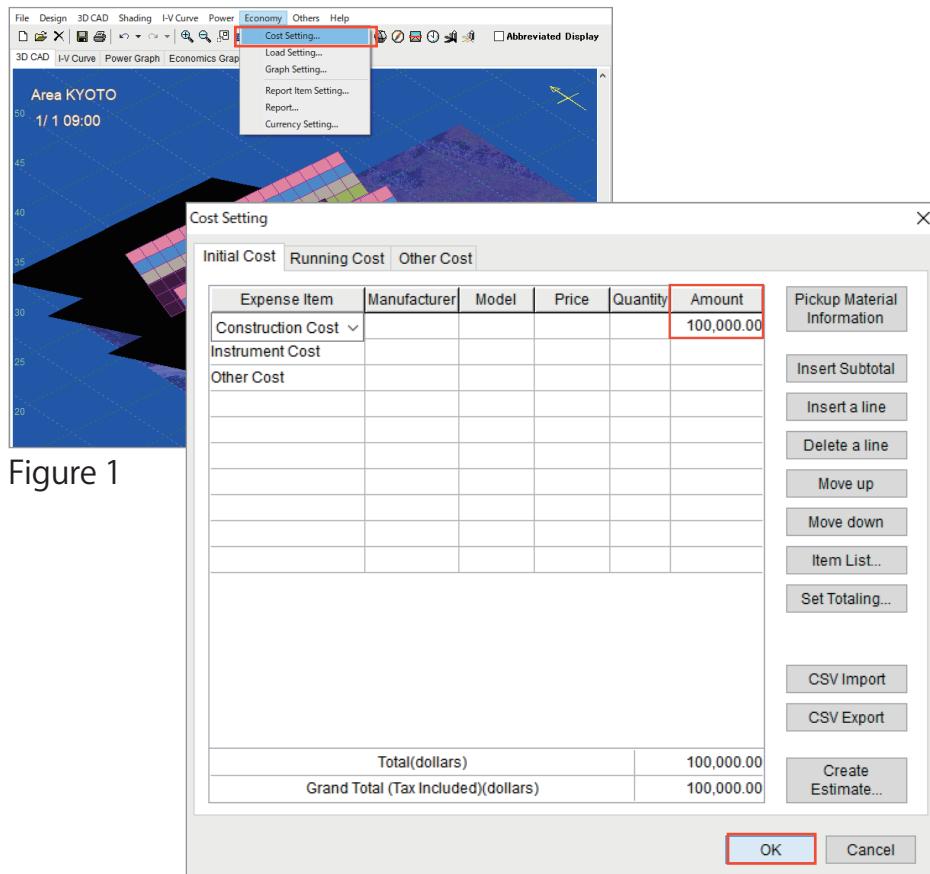


Figure 1

Figure 2

## 7. Calculate power generation

Next, select on the "Power", "Calculation" on the menu bar (Figure 3), click "Start" in the "Calculation" window (Figure 4). During calculation, animations such as shadows and I-V characteristics are displayed (Figure 5).

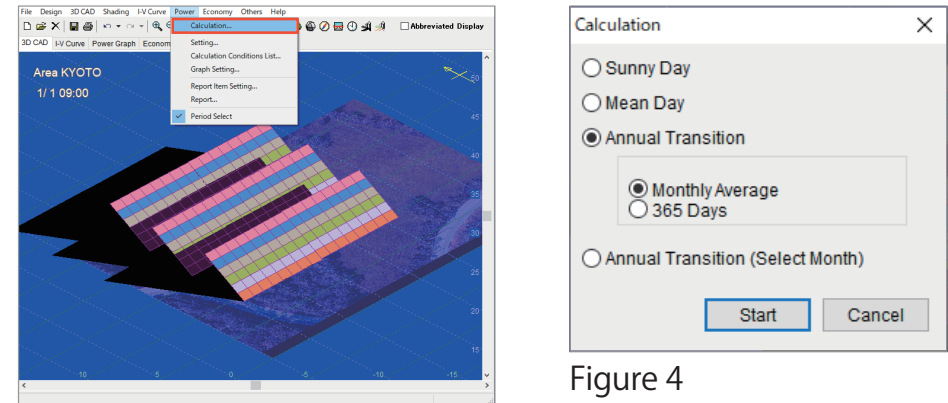


Figure 3

Figure 4

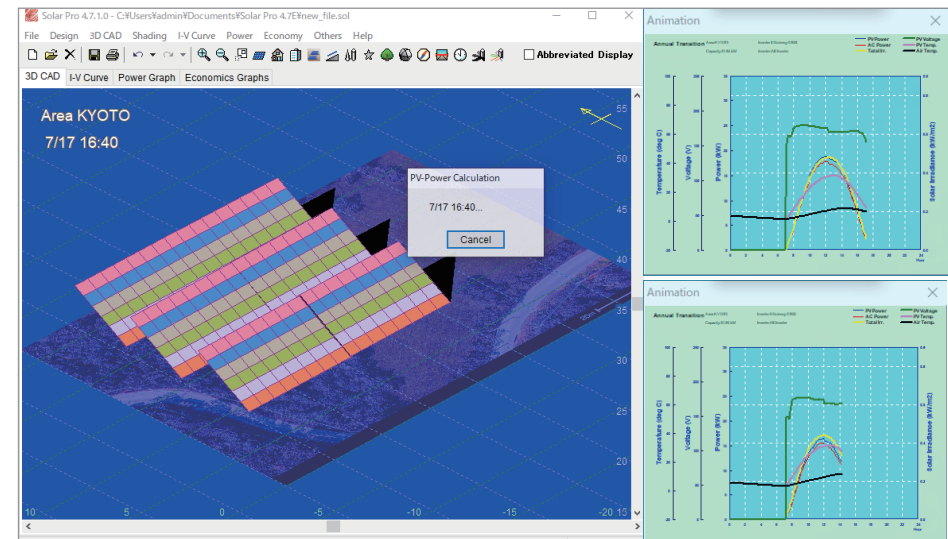


Figure 5



## 8. Power graph

When the calculation is completed, select "Power Graph" (Figure 1). Then "Power Graph" (Figure 2) is displayed, you can check the amount of power generated previously calculated. It is also possible to check by day or by every inverter.

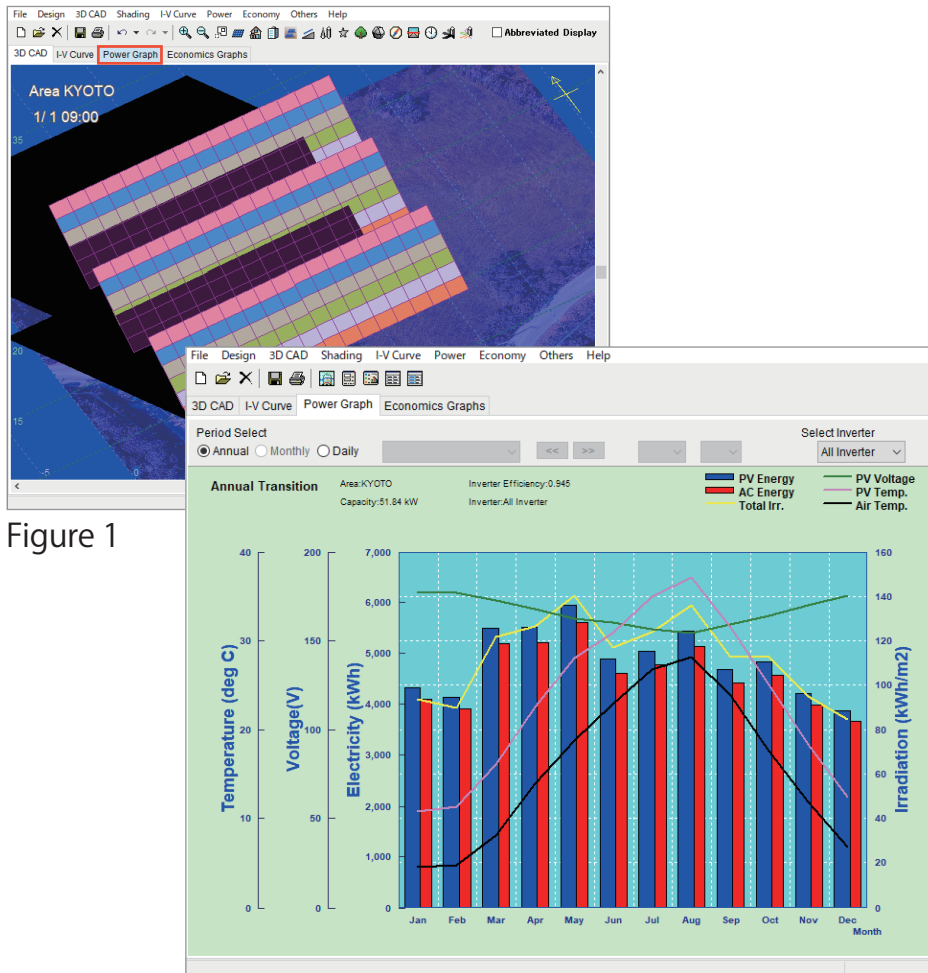


Figure 1

Figure 2

## 9. Economics graph

Then, select "Economics Graphs"(Figure 3), "Total Savings"(Figure 4). This graph shows how many years you can pay back.

\*Each graph can be output to a report etc. from the menu bar "File".

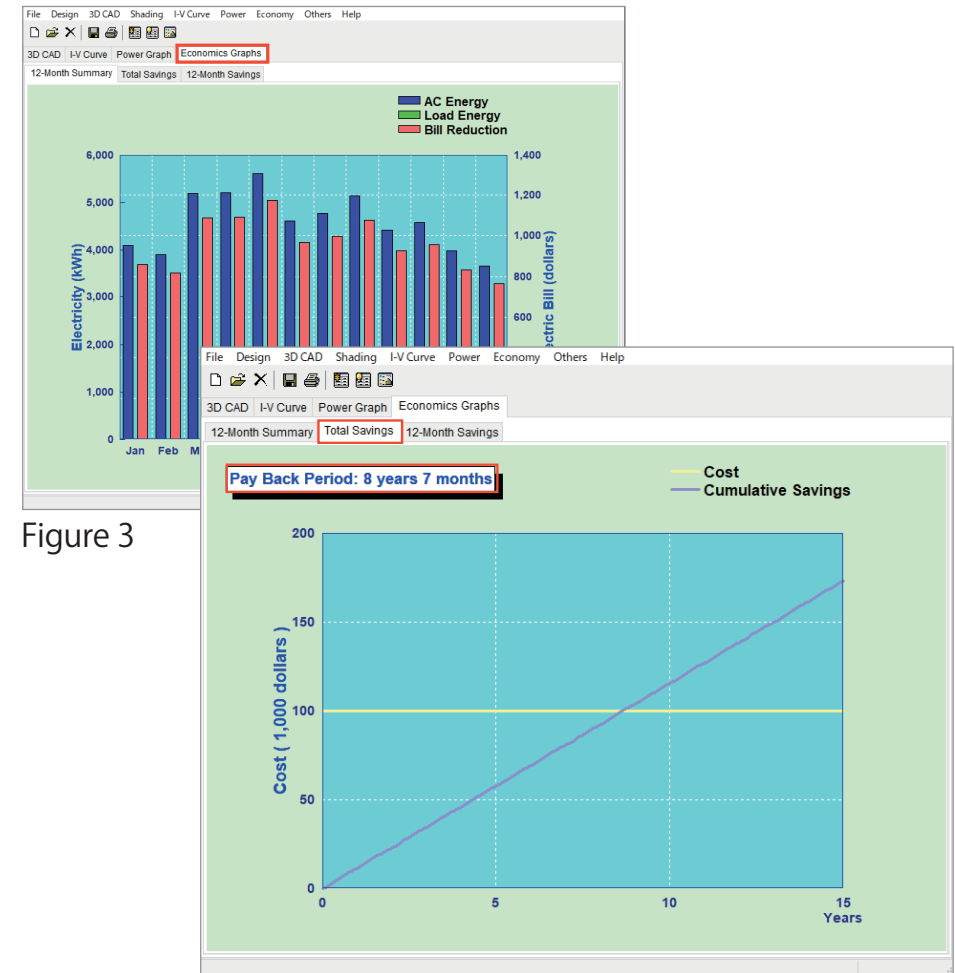


Figure 3

Figure 4

## ★Application①-Design on tilt

As an application, we will introduce simulations on tilting lands. First, prepare a PV array for calculation.

Next, the object to be tilted is added. **Right-click** on the screen, **Select the "New Object", "House"** (Figure 1) to create an object (Figure 2).

**Double-click** the object to change the settings (Figure 3).

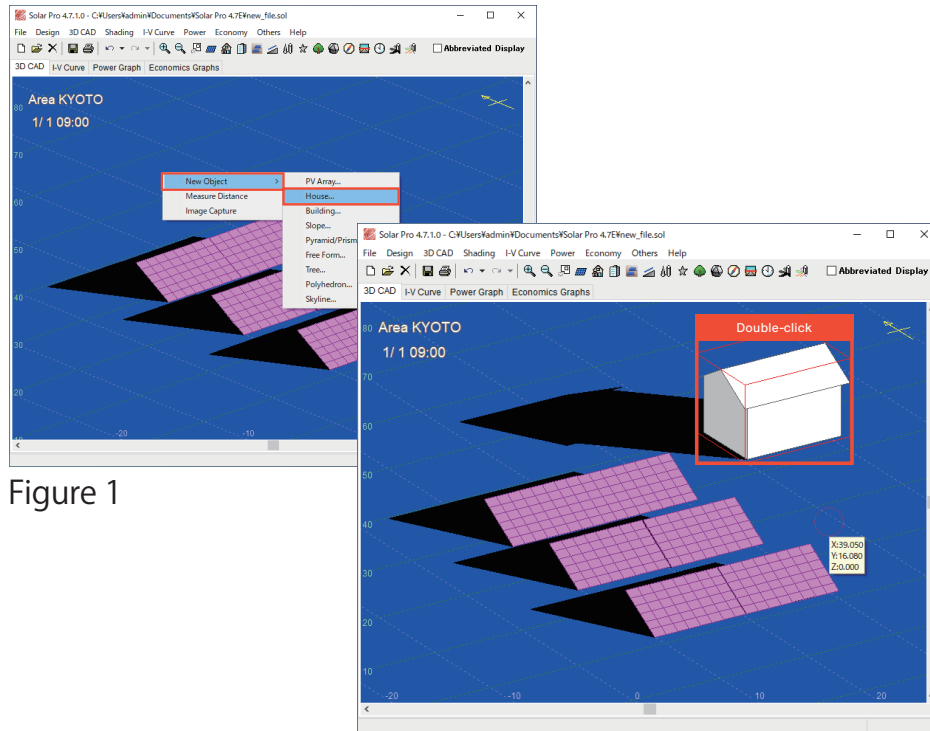


Figure 1

Figure 2

### 💡 Point - Stacking order of images -

In the "Image" window (see page 3) for designing on tilt using the base picture, setting the order to foreground is useful because you can display an image in front of an object.

As an example, **set as shown below and click OK.**

[Shape] Shed	[Width (W)] 100 m	[Depth (D)] 50 m
[Height] 0.1m	[Eave1] 0m	[Eave 2] 0m
[Tilt] 20 deg		

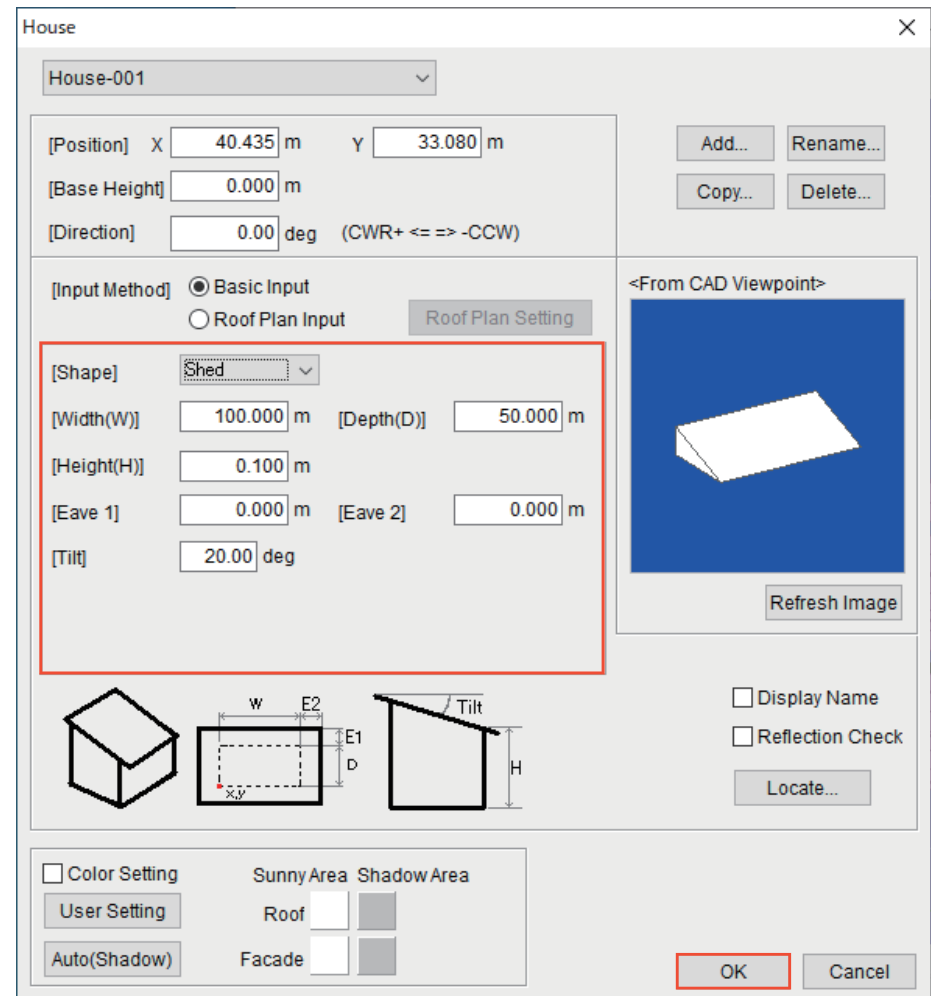


Figure 3



## ★Application ①-Design at tilt land (Array layout method)

Locate the arrays, so that they are buried in objects (Figure 1) and select the "3D CAD", "Inspector" (Figure 2) in the menu bar.

If you enter "50\*" for "Z Position" in the "Inspector" (Figure 3) window, the buried array floats up.

\*Enter the value that causes the array to be higher than the tilt object.

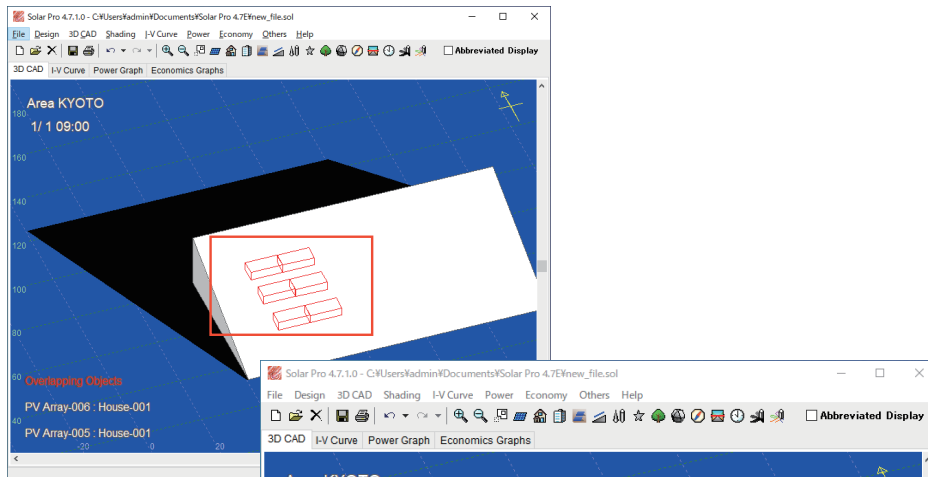


Figure 1

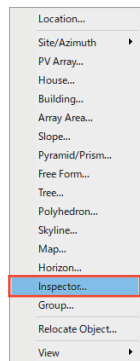


Figure 2

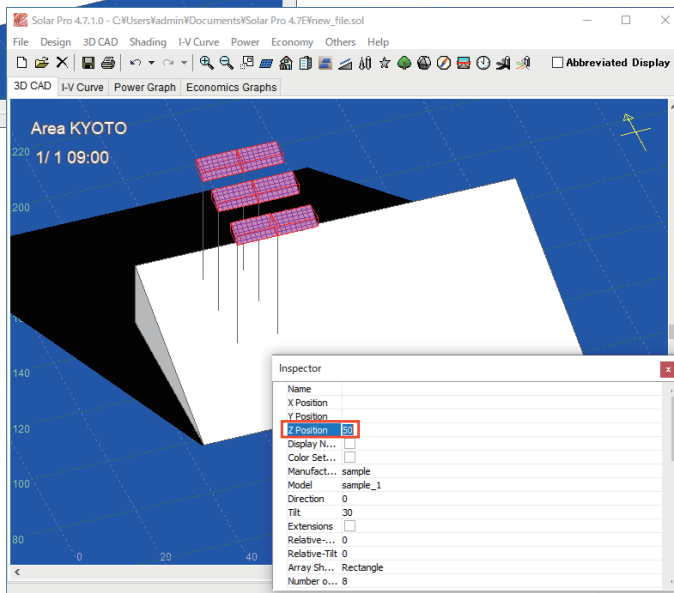


Figure 3

Next, right-click on the display and select the "Selected 6 Objects", "Locate" (Figure 4) to arrange the arrays according to the tilt (Figure 5).

The following page introduces how to set the direction and angle of the array.

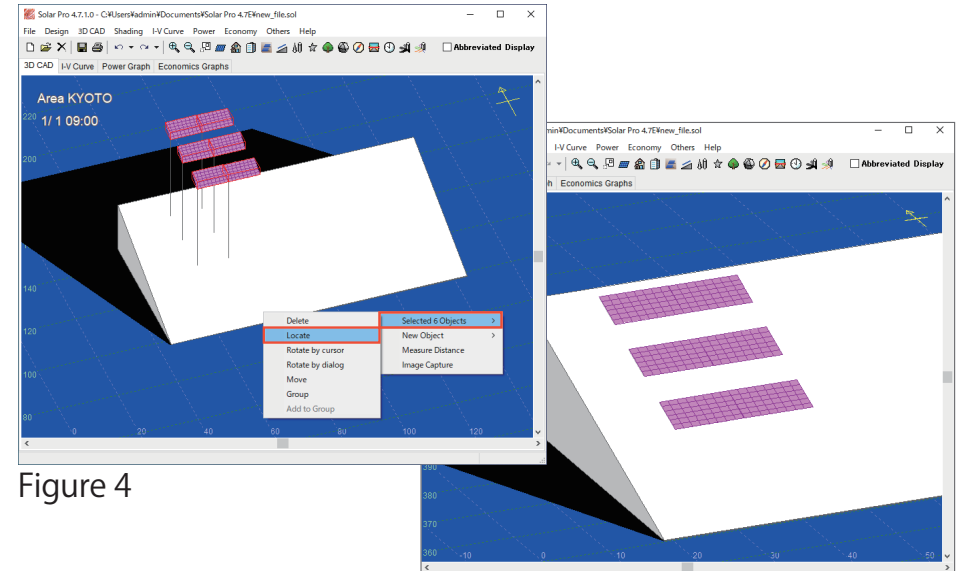


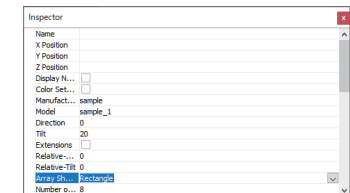
Figure 4

Figure 5

### Point - Inspector -

#### Changing multiple objects at once

Allows you to make settings for the selected object. This is useful when you want to change the orientation or angle of multiple arrays at the same time.



## ★Application ①-Design at tilt land (Angle Setting of Array)

Assume that a south-facing array is installed on a west-facing tilt. Return to "Before Arrays Arranged" by "Ctrl + Z". Double-click the tilt object and set the direction to "90" deg (Figure 1) to create a westward tilt (Figure 2). If you "Locate" as it will automatically adjust in tilt direction (Figure 3). Therefore, set the direction and angle in the "Inspector".

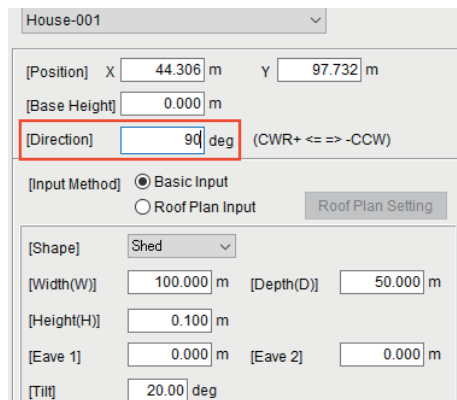


Figure 1

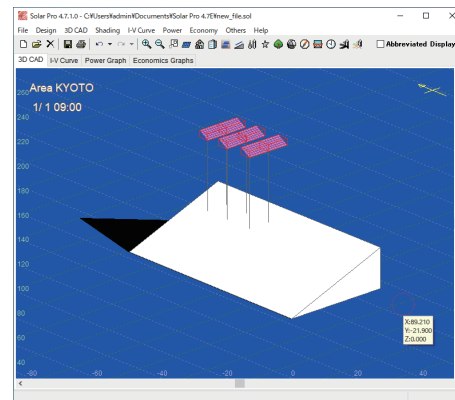


Figure 2

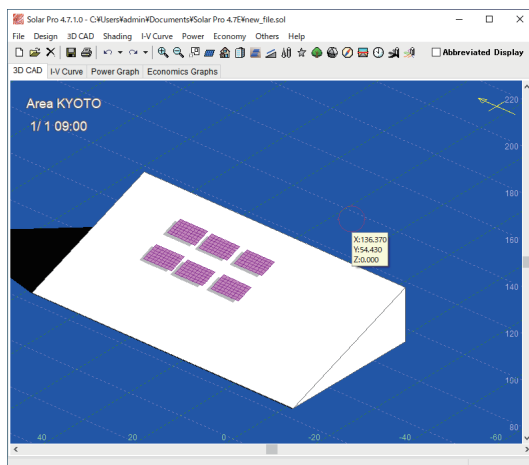


Figure 3

Select "3D CAD", "Inspector" in the menu bar, open the "Inspector" window, and enter as shown below (Figure 4).

[Expansions]  [Relative] -90 [Relative - Tilt] 30

An array with a 30 degree tilt is placed in the south direction (0 degrees) (Figure 5). After that, follow the procedures in "5.Wiring configuration" (see page 6).

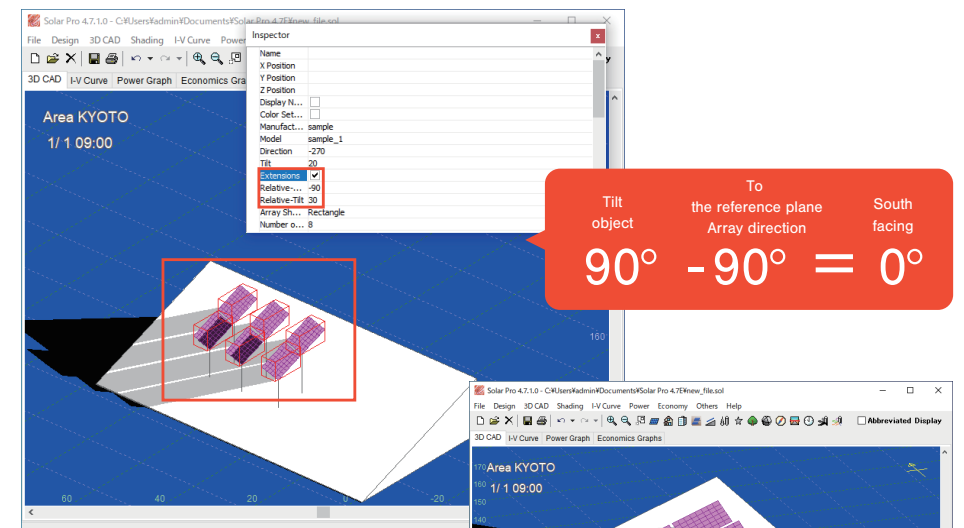


Figure 4

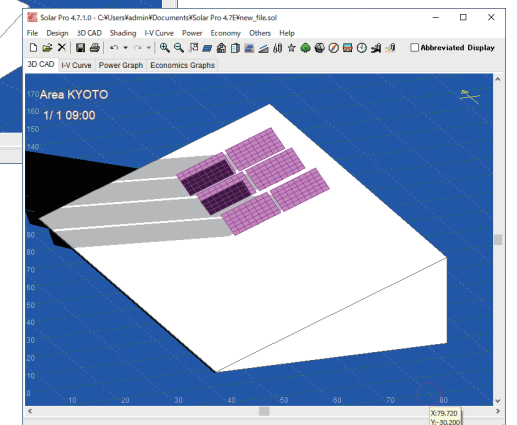


Figure 5

## ★Application ②-Setting angle of array for purpose

In the Application Part ②, two patterns are introduced:

"When the angle of the tilt and the angle of the array is determined"  
and "When the direction and the tilt of the array are determined".

First, we will explain the common procedures.

Rotate the tilt object direction by "-45 deg" (Figure 1) to prepare one array (Figure 2). By double-clicking the array, Click "Locate" (Figure 3) to display the "Relocate Object" window (Figure 4).

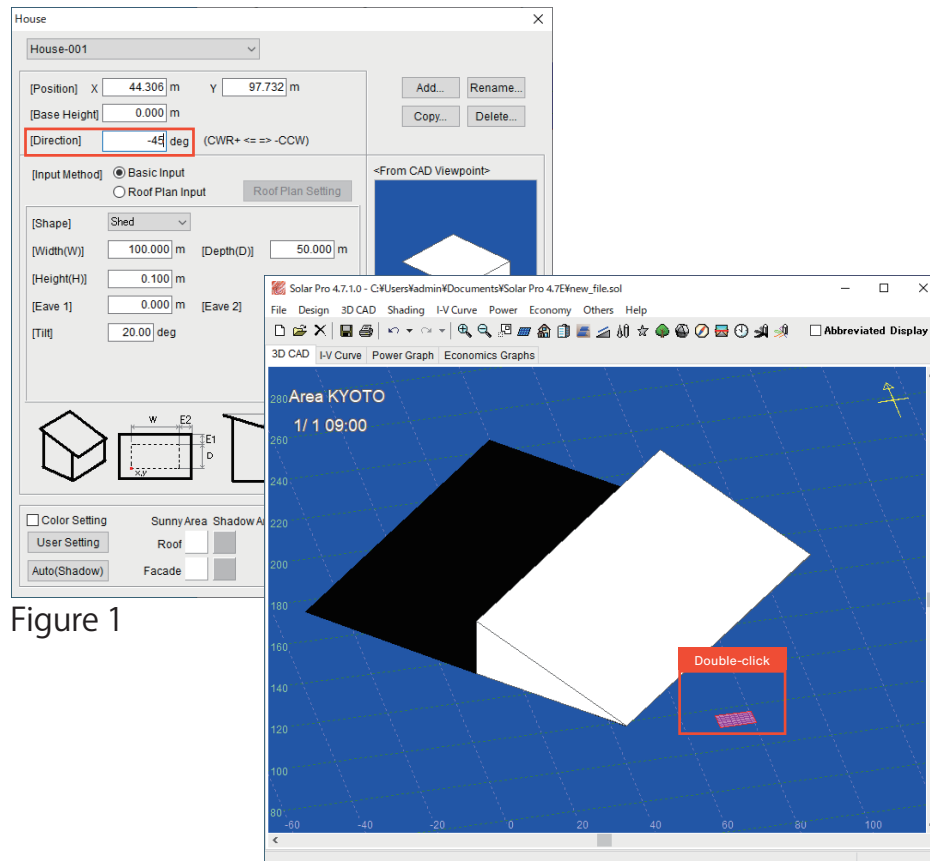


Figure 2

Left-click where you want to locate the array.

The angle of the array is automatically adjusted to the tilt.

Right-click and "Finish Placing".

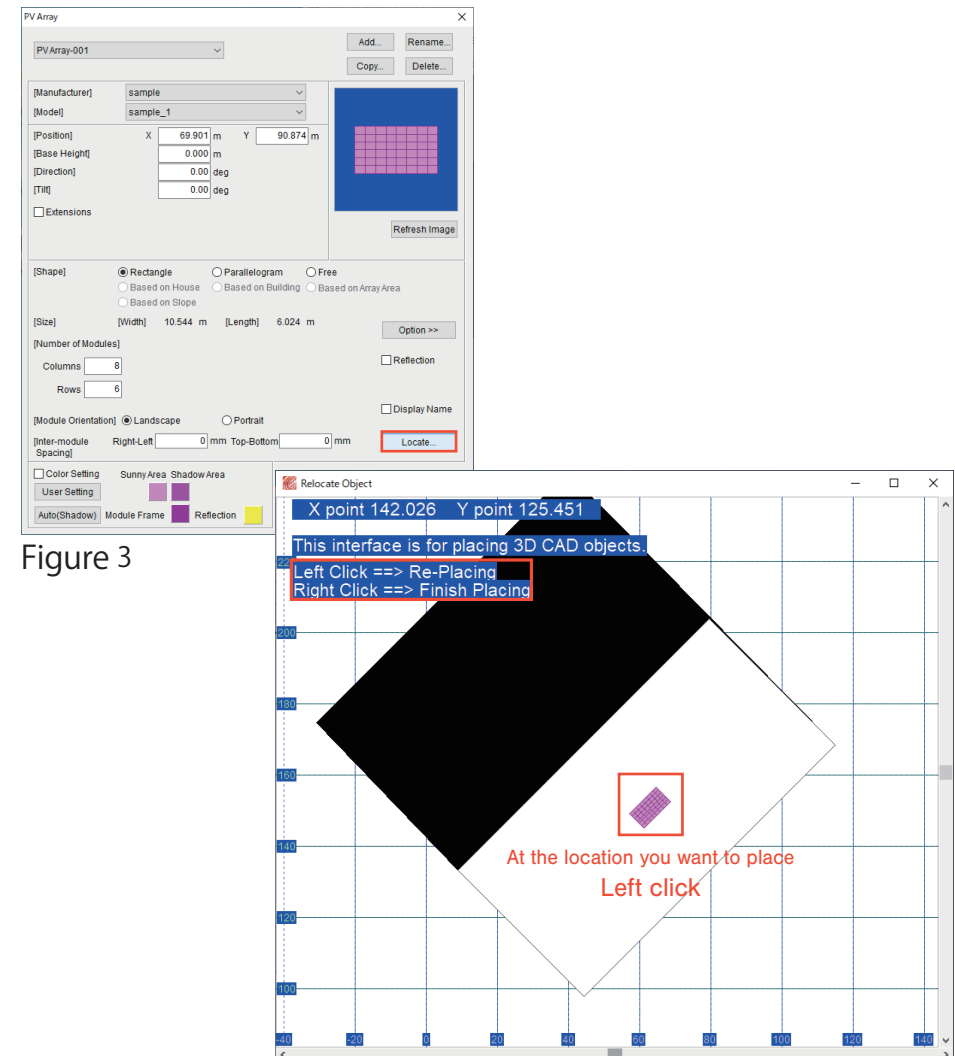


Figure 3

Figure 4

## ★Application②-Setting angle of array for purpose(Method 1)

Method 1: When the tilt and the angle of the array are determined

Example: Rotate the array 90 degrees relative to the tilted land (-45 degrees) and make the tilt 30 degrees.

Select "Extensions" in PV Array setting.

Then, the item name is changed and added (Figure 1).

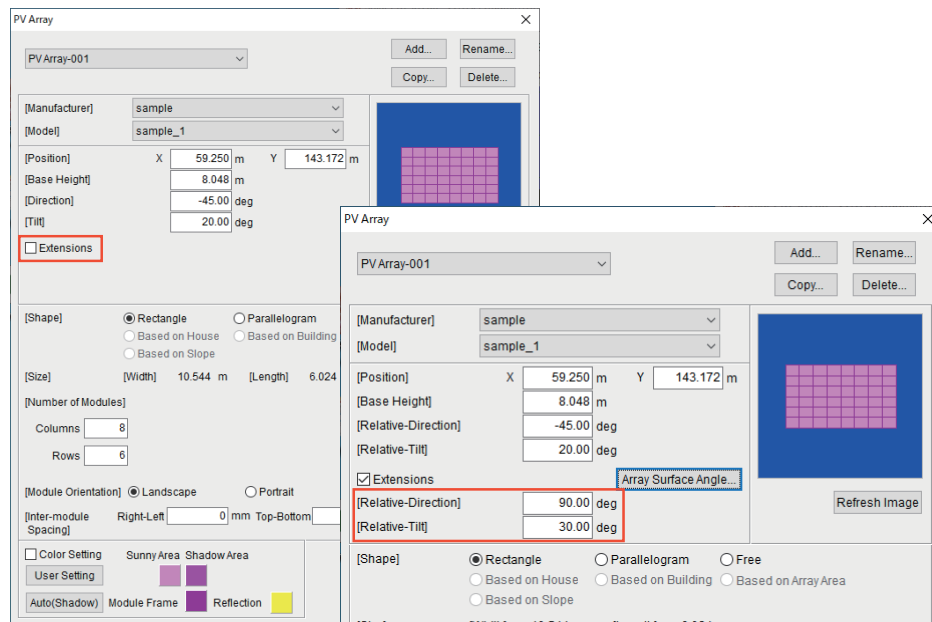


Figure 1

Figure 2

Enter as shown below and click OK (Figure 2).

[Relative - Direction] 90 deg      [Relative - Tilt] 30 deg

Then, the object is rotated by 90 degrees with respect to the tilted object (-45 degrees), an array with a tilt angle of 30 degrees is displayed (Figure 3). If you want to do in multiple arrays, use the Inspector (see page 11).

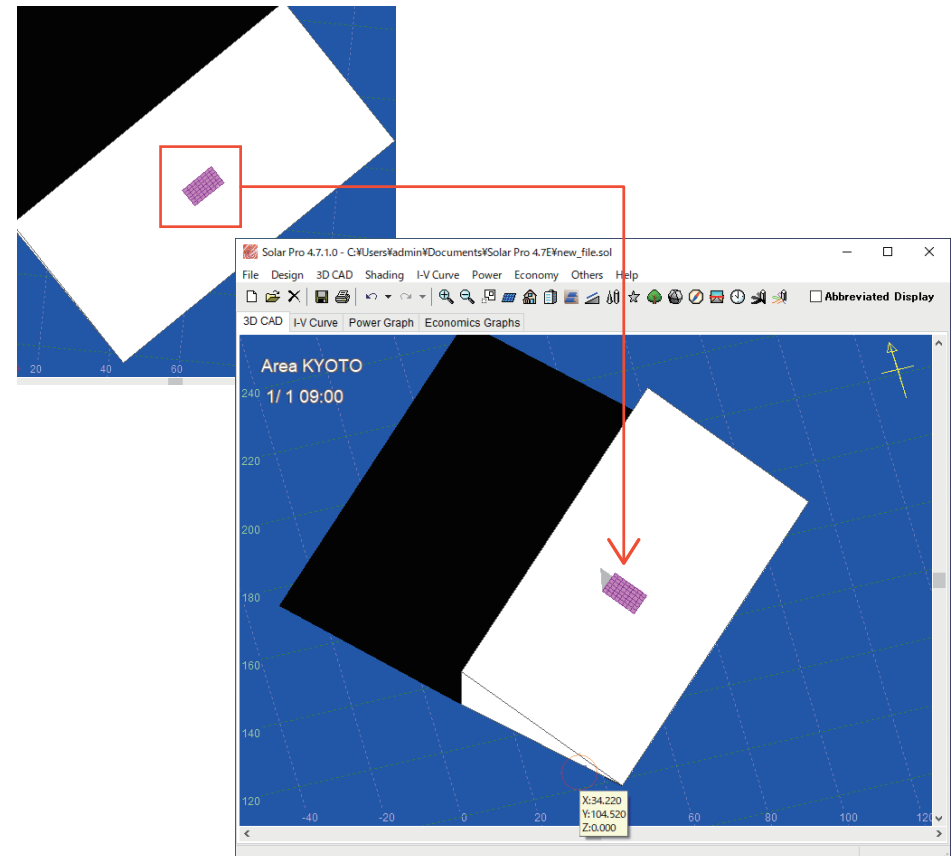


Figure 3

## ★Application ②-Setting angle of array for purpose(Method 2)

Method 2: When the direction and tilt of the array are determined

Example: Locate a 30-degree-tilt array facing south (0 degrees)  
at a tilted land (-45 degrees)

Select "Extension" in PV Array setting, and click "Array Surface Angle"  
(Figure 1) to open the "Array Surface Angle" window (Figure 2).

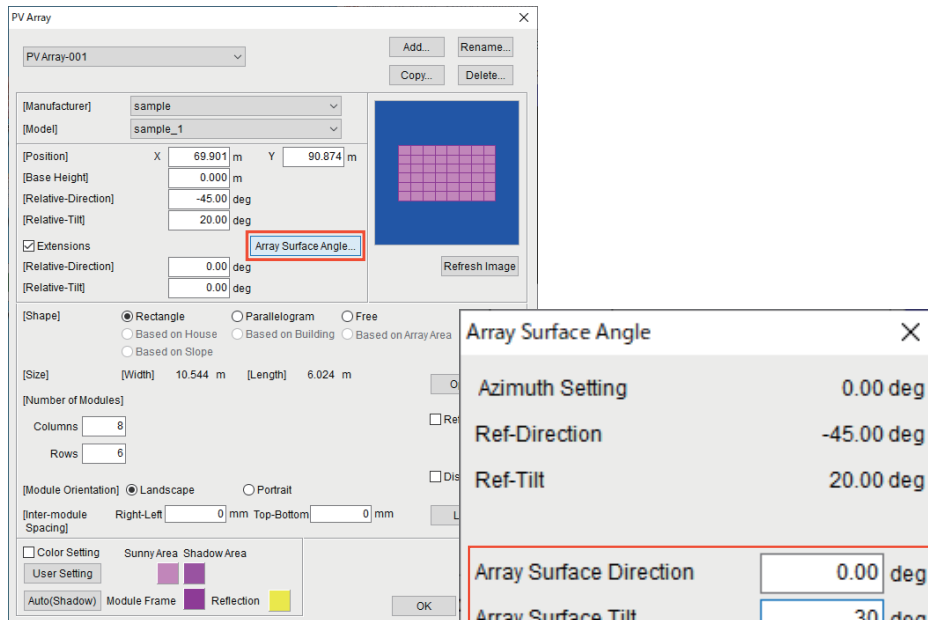


Figure 1

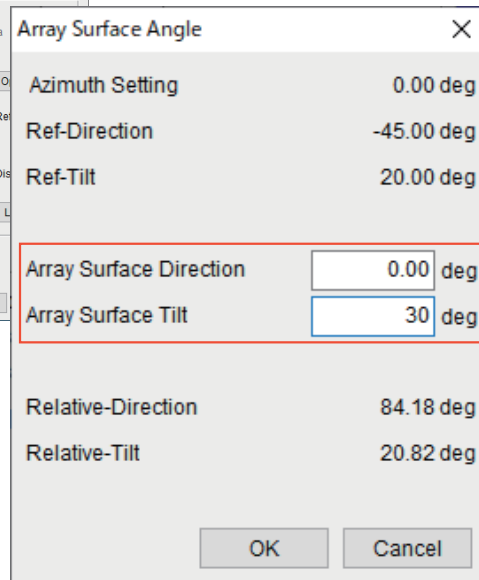


Figure 2

Enter as shown below and click OK.

【Array Surface Direction\*】 0 deg

【Array Surface Tilt】 30 deg

\*due south = 0 degrees / due west = 90 degrees / due east = -90 degrees / due north = 180 degrees

Since 【Relative - Direction / Tilt】 are automatically calculated (Figure 3),  
Click OK and check the "3D CAD" window (Figure 4).

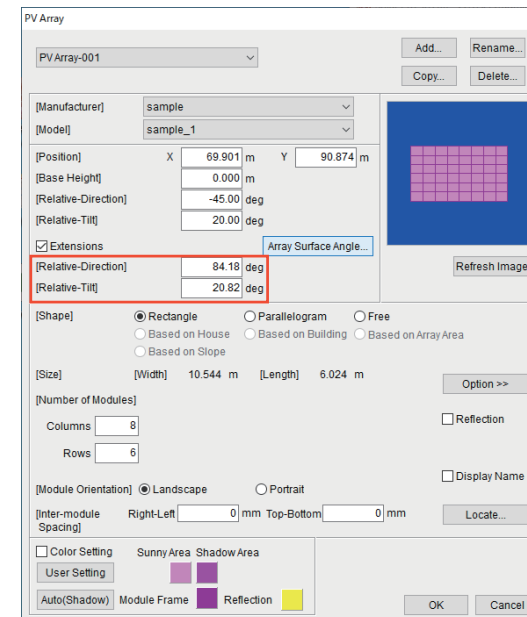


Figure 3

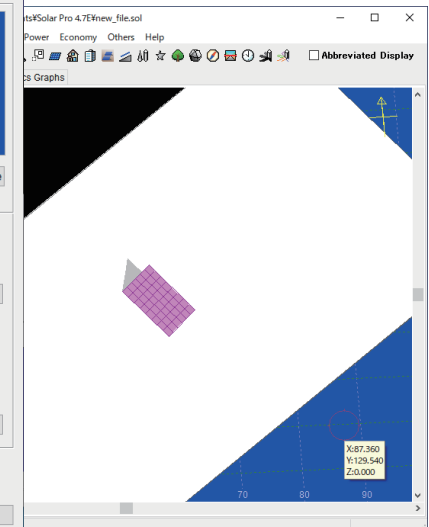


Figure 4

**Point** - How to specify directions and tilts in multiple arrays -

This method also uses the Inspector. However, since the "Array surface angle" cannot be set, note the automatically calculated number in Figure 3 and enter "Relative - Direction / Tilt" in inspector.

Direction	-45
Tilt	20
Extensions	<input checked="" type="checkbox"/>
Relative-...	84.18
Relative-Tilt	20.82

Inspector

# ★Application②-Setting angle of array for purpose(Summary)

## Method 1: When the tilt and the angle of the array are determined

This is how to set the angle with respect to the house.

Array setting in Method 1 (left) of Figure 1-2

[Relative-Direction]	-90.00 deg
[Relative-Tilt]	20.00 deg
<input checked="" type="checkbox"/> Extensions	Array Surface Angle...
[Relative-Direction]	90.00 deg
[Relative-Tilt]	30 deg

PV array setting

Array setting in Method 1 (right) of Figure 1-2

[Relative-Direction]	-20.00 deg
[Relative-Tilt]	20.00 deg
<input checked="" type="checkbox"/> Extensions	Array Surface Angle...
[Relative-Direction]	90.00 deg
[Relative-Tilt]	30.00 deg

PV array setting

Direction	-90
Tilt	20
Extensions	<input checked="" type="checkbox"/>
Relative-...	90
Relative-Tilt	30

Inspector

Direction	-20
Tilt	20
Extensions	<input checked="" type="checkbox"/>
Relative-...	90
Relative-Tilt	30

Inspector

## Method 2: When the direction and tilt of the array are determined

This is a method to set the direction and tilt of the array regardless of the direction or tilt of the tilted land.

Array setting in Method 2 (left) of Figure 1-2

Array Surface Direction	0.00 deg
Array Surface Tilt	30.00 deg
Relative-Direction	120.64 deg
Relative-Tilt	35.53 deg

Array plane angle

Array setting in Method 2 (right) of Figure 1-2

Array Surface Direction	0.00 deg
Array Surface Tilt	30.00 deg
Relative-Direction	49.64 deg
Relative-Tilt	12.97 deg

Array plane angle

Direction	-90
Tilt	20
Extensions	<input checked="" type="checkbox"/>
Relative-...	120.64
Relative-Tilt	35.53

Inspector

Direction	-20
Tilt	20
Extensions	<input checked="" type="checkbox"/>
Relative-...	49.64
Relative-Tilt	12.97

Inspector

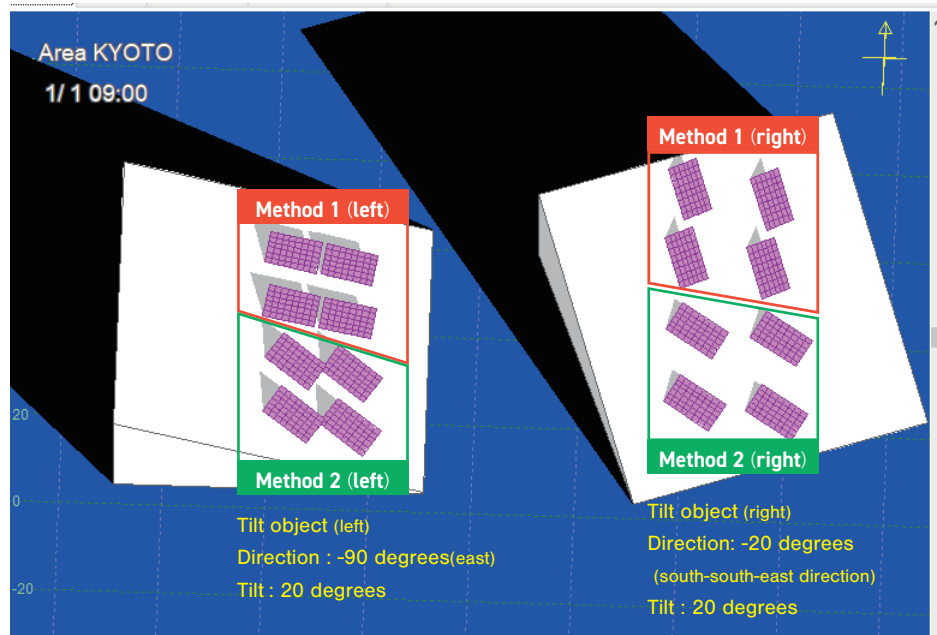


Figure 1

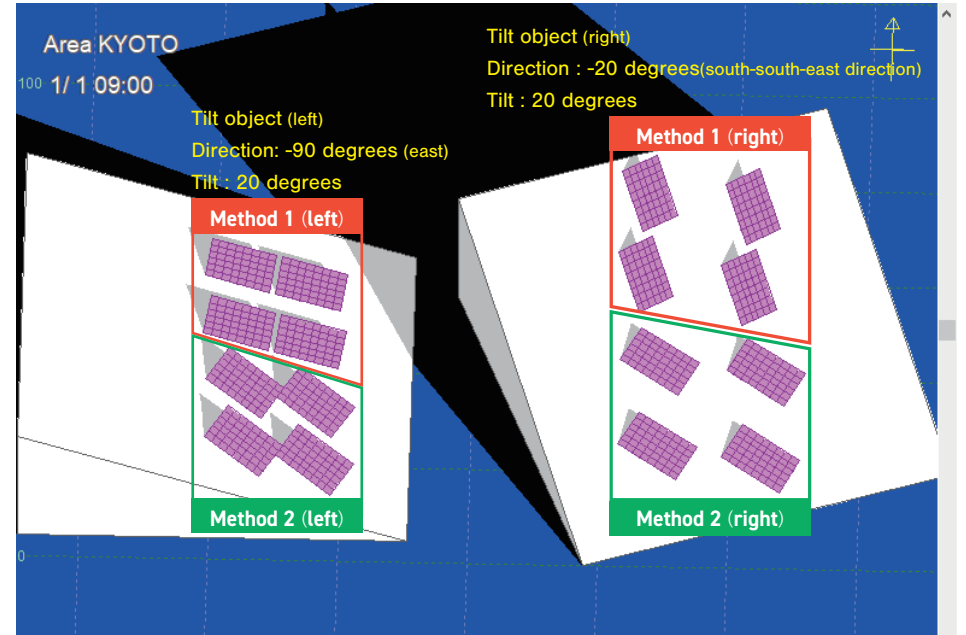


Figure 2



Photovoltaic System Simulation Software

# Solar Pro

High accuracy simulation software, acknowledged by the world

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Product specifications are as of March 2021. The specifications may change without prior notice.