Specifications of Solar Pro

System Requirements	OS : Windows Vista / 7 / 8.1 / 10 CPU : More than Clock 1GHz Memory : More than 512MB Hard Disk : 500MB of available space Screen Resolution : More than 1,366×768 USB Port : USB 1.1 or higher	
Meteorological Data	Built-in Data	World 1,360 places MONSOLA-11
	Importable Data	Actual measured data meteonorm annual data SolarGIS (TMY data) NSRDB (SUNY 10-km gridded data) TMY 3 data METPV-11
Circuit Configuration	Cell Type	Mono-crystalline, Polycrystalline, Amorphous, Hybrid, HIT, CIS, CIGS
	Inverter	Up to 400 inverters
	Number of Modules	Up to 160,000 modules
	Max. Series-Parallel Module Number	Limitless within number of modules
Creatable Objects	PV Array (Up to 400 modules for each array), House, Building, Array Area, Pyramid, Prism, Truncated Pyramid, Free Form, Tree, Polyhedron, Skyline	

Laplace Systems

Photovoltaic System Simulation Software

Solar Pro™

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High accuracy simulation software, acknowledge by the world.

World's first full-scale simulation software

Solar Pro is a full-fledged simulation software released ahead of the world in 1997.
It achieves highly precise, module-level power and energy generation calculation by the integration
of instantaneous values taking into consideration the effects of solar radiation and shading.

State-of-the-art technology recognized by the world

It was introduced as state-of-the-art simulation software by "PHOTON",
Photovoltaic specialized magazine in Germany in 2001,after that we have continued
improvements constantly. Solar Pro has been widely used in the world.

Contributing to the dissemination of photovoltaic power generation

Solar Pro's technology has been highly appreciated by many public institutions.
We received Kyoto SME Excellence Technology Award in 2003, and were also elected as an accredited
project for Small Business Creative Activity Promotion Act and an Oscar certified company.

## Precise simulation considering the influence of shadows
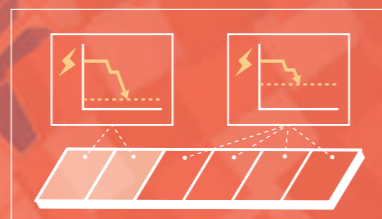
If the module is partially shaded, the power generation capacity of the entire
string decreases, and the power generation of the system decreases markedly.
Solar Pro will perform accurate simulation taking into consideration the
influence of shadows in module units.

Simple drawing function for complex system designs
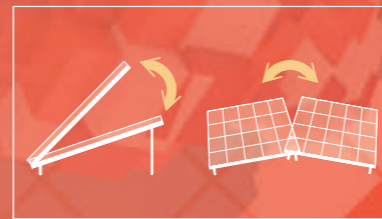
It corresponds widely to placement method such as flat putting and wall
setting, system of tracking type and mega solar etc.
Furthermore, it is possible to adjust the tilt of the photovoltaic array freely,
back and forth or right and left, and simulate the case where it is directed to
a direction different from the tilt of the roof or placed in a complicated place.

Reflected light simulation to prevent light damage beforehand
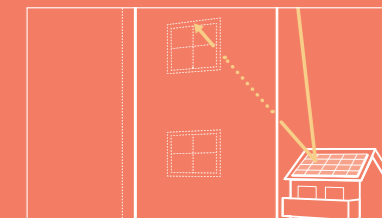
The glare of the reflected light of the solar panel became a social problem,
and consideration to reflected light became indispensable when examining
panel installation method. With Solar Pro, you can specify seasons and time
zones and see how the reflected light affects the surroundings.

Solar Pro's examples of use

Flexible layout design of solar panels

Many simulation software programs have restrictions on designing solar panel orientations and angles. With Solar Pro, you can perform simulations in any arrangement pattern, such as the entire wall of a building or a panel arrangement in a complicated slope.

For example, this complicated design...

1 Placing panels across the wall

2 Arranging 6 kinds of panels

3 Incrementally changing panel angles

4 Arrangement in which reflected light does not hit the surroundings

> Solar Pro can do!

1 Design the number of panels, the direction of installation, the pitch, etc., and fill the wall with countless panels

2 Considering the characteristics of each panel, design to maximize the amount of power generation.

3 We set the inclination angle finely for each panel and design so that each panel is hit by sunlight for a longer time.

4 Confirm the display and trajectory of reflected light on the 3D CAD drawing and pay attention to surrounding buildings and transportation facilities

Promotion and Sales activities

In addition to conducting simulations, Solar Pro can organize the cost of the designed equipment into an estimate, or you can create a customized report using the derived results.
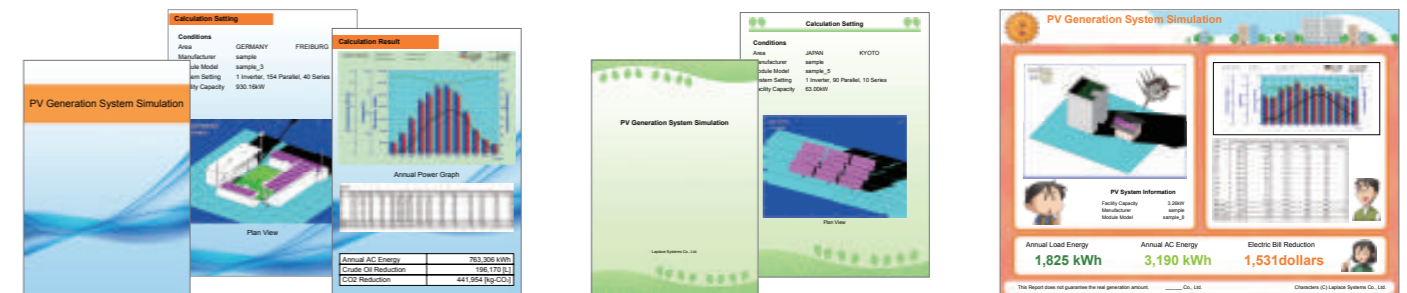
Cost Estimate

Users can create and print a project cost estimate that includes a bill of material for modules and inverters. Construction, Equipment, and other miscellaneous costs can also be added.

Reflect simulation contents
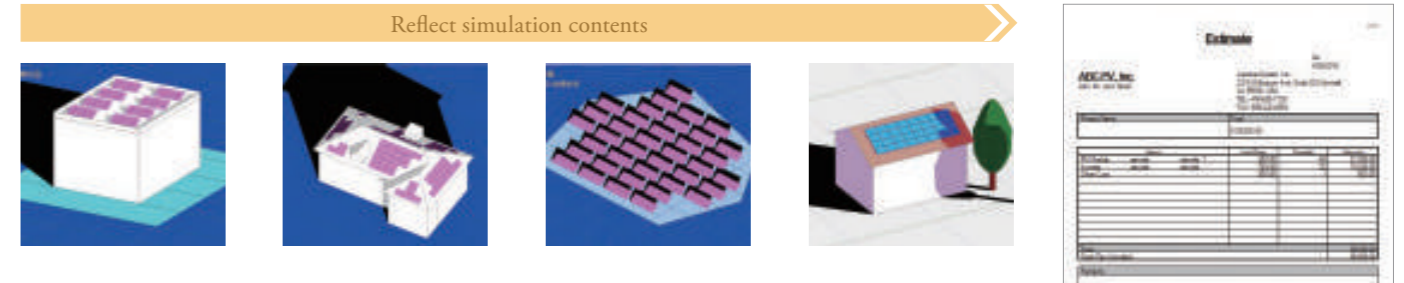
Create original reports   NEW

From detailed simulation results, you can freely arrange graphs and forms to create customized reports.

Education and Research

Solar Pro, which enables accurate simulation of various patterns, is also ideal for research and educational use of photovoltaic power generation. You can learn expert system designs easily by understanding motion of shadows and reflected light with animation.
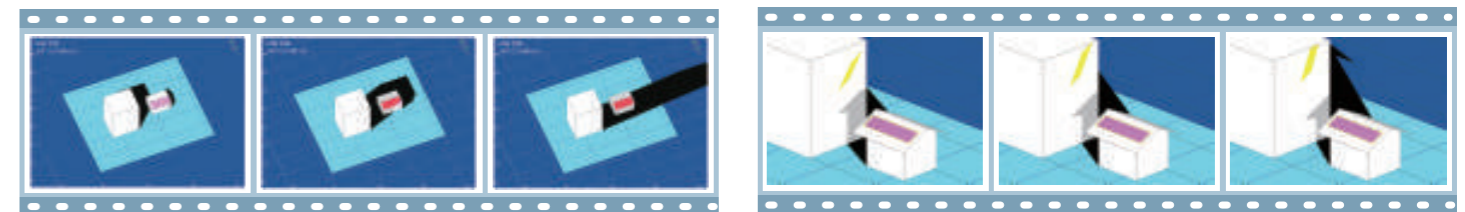
Confirm animation of shadow movement

Confirm movement of reflected light with animation

Function Guide

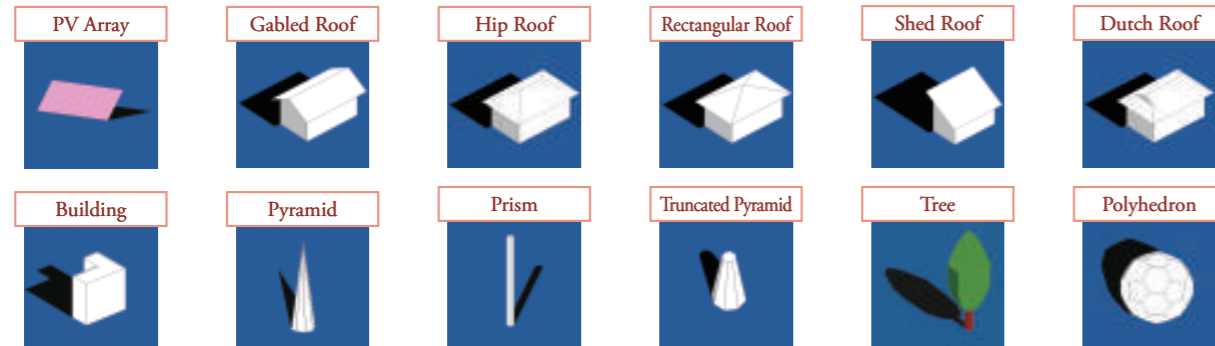## Enhanced design support function

Framing plan input function

You can design buildings and install PV modules efficiently with this function. You can also create buildings intuitively with mouse and read a DXF file as a draft to draw a roof. It is easy to set up under complicated conditions with disapproval area, dormer, chimney, and auto module installation functions.

Building	House	Solar cell installation area
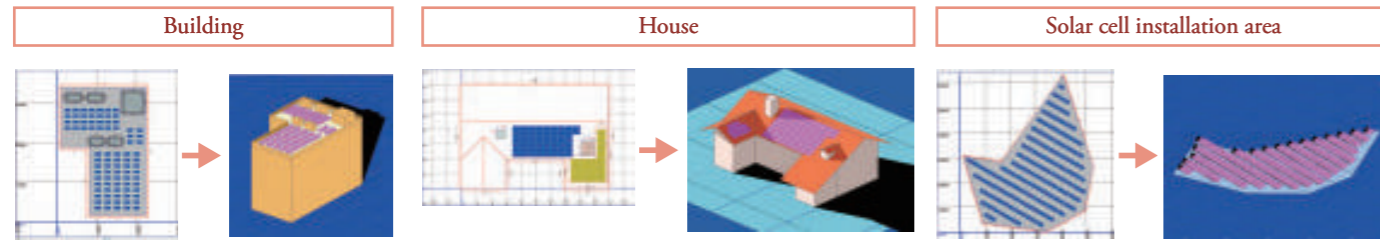
Choose Building Shapes

You can choose default building shapes such as buildings and houses which are close to their complete images.

PV Array	Gabled Roof	Hip Roof	Rectangular Roof	Shed Roof	Dutch Roof

Building	Pyramid	Prism	Truncated Pyramid	Tree	Polyhedron

Map Service

Insert Bing Maps images into 3D CAD interface to aid in precise design.Solar Pro can also import screenshots and other image files.
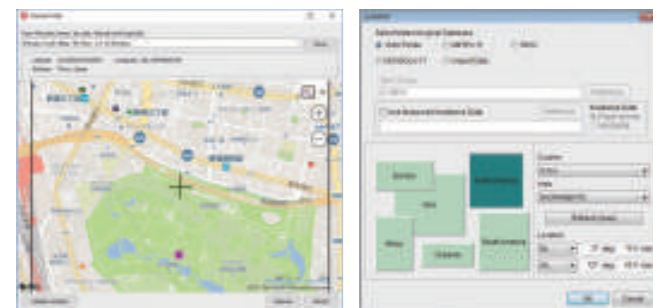
Simulation Wizard

Solar Pro has the useful wizard function for rough estimations so that users without any PV/architectural knowledge can operate PV power simulation without difficulty.Additionally, objects are able to be modified through the detailed setting menu. In case of covering solar panels over roofs and walls, setting is simple.

Increased variation of photovoltaic array tilt NEW

In addition to adjust the tilt of photovoltaic array back and forth, it can adjust the tilt right and left. The tilt of PV array also can be directed to a different direction from the tilt of the roof or simulated in a complicated place.

Fleely from front to back and from side to side
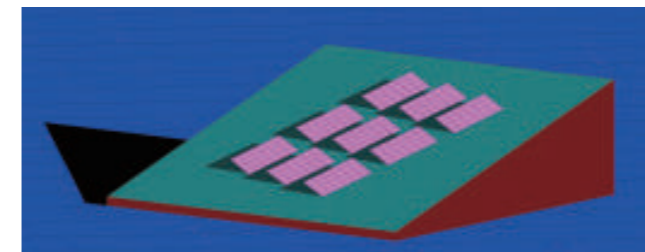
Optimum design NEW

Designed to simulate the array azimuth angle, panel orientation, and arrays spacing to maximize annual / daily electricity generation. Lead to more efficient design by realizing optimized design per parameter.

Automatic simulation of pattern with combinations of set values

Optimum setting pattern
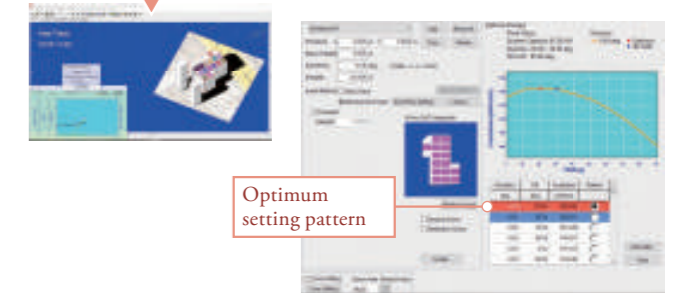
Comprehensive database to increase accuracy

Photon Module and Inverter Database

It has a variety of module and inverter data from the Photon database.

Photon

Various Weather Data

It can import various weather data such as Meteonorm annual data, SolarGIS (TMY data), NSRDB (SUNY 10-km gridded data), METPV-11, etc.

Function Guide

Various display functions

Shadow Movements

By inputting location (longitude and latitude), and date and time, you can see a shadow at the entered location and time. It also shows the continuous movements of shadows during the day by animation.

Shadow Trajectory

It shows all shadow trajectories within designated time interval. You can fully see shadow patterns in the time interval even when shadows inter-cross each other complicatedly.

Interlocked with Shadow Movement

Calculation and shadow movement on the CAD screen are interlocked so that you can see the shadow influence reflected on the graph.

At the moment when the shadow falls onto the surface, you can see that the generated electricity is lower with respect to the solar radiation intensity.

Inclined Irradiance

Generated Power
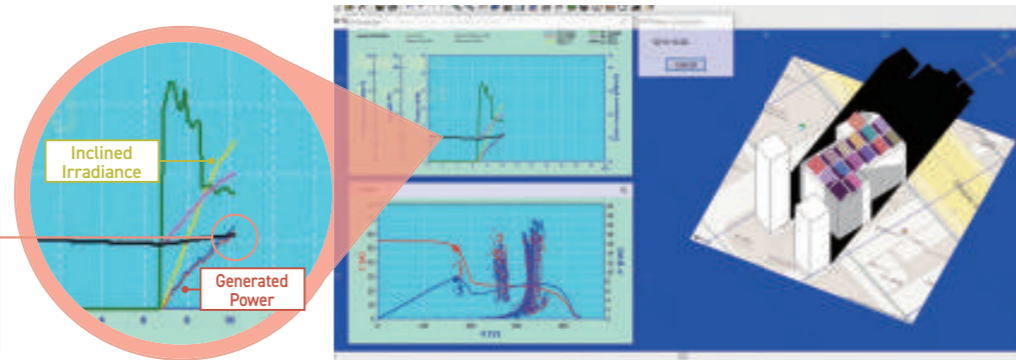
Reflected Light Movement

By inputting location (longitude and latitude), and date and time, users can see reflected lights. It also shows the continuous movements of reflected lights during a day by animation.
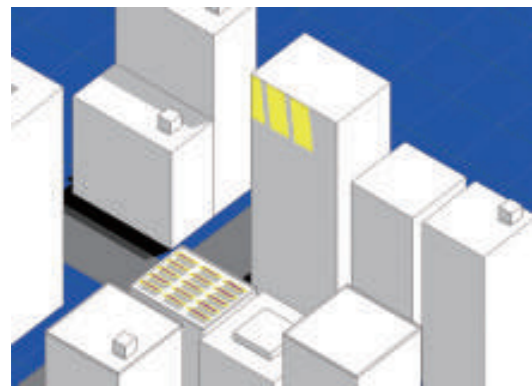
Reflected Light Trajectory

It shows all reflected light trajectories within designated time interval. You can see how reflected lights affect nearby buildings.
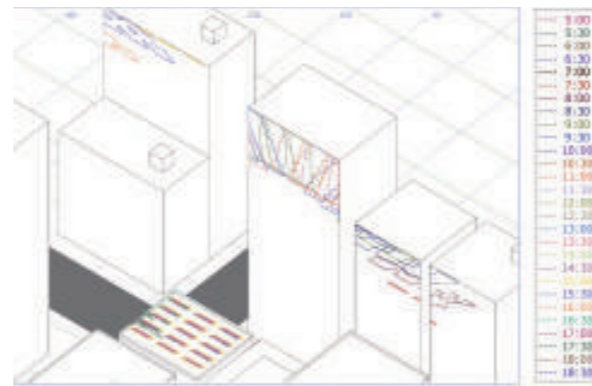
Image and video output NEW

Simulation results of shadows and reflected light can be output as images and videos.It is also possible to set titles and comments on videos.You can see images and videos of simulation results on personal computer, smartphone or tablet, so you can use it widely for presentations, PR, etc.

Prediction of power generation by highly scientific calculations based on instantaneous value

Integration of Instantaneous Calculations

Integrating instantaneous calculations of irradiance, instead of the simple calculation based on the annual irradiation amount, results in valid and precise calculation of generated energy. It supports arch type, tracking type and other special systems, too.
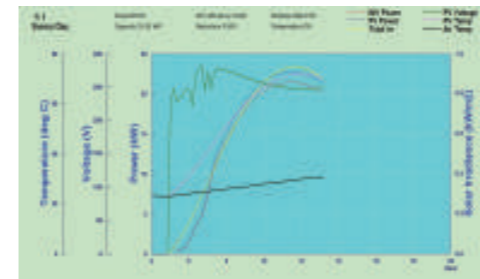
Calculation on I-V Characteristics Graph

By calculating PV system as a circuit combing the current equation per module, it shows a precise I-V curve which takes account of circuit linkage of each module.Various changes of I-V curves resulted from the deference of the shadow influence can be compared, therefore evaluation on environment where a system performs effectively.
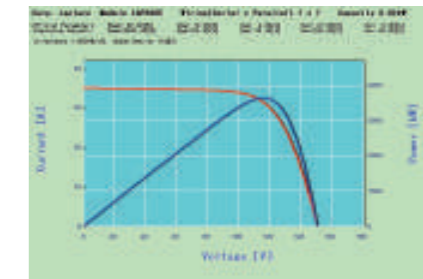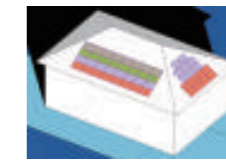
Module connection setting

You can design module connections. Modules are colored to visualize strings and inverter connections on the 3D CAD screen. It is possible to connect across arrays and multiple inverters.
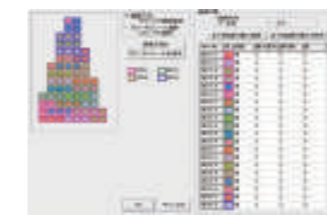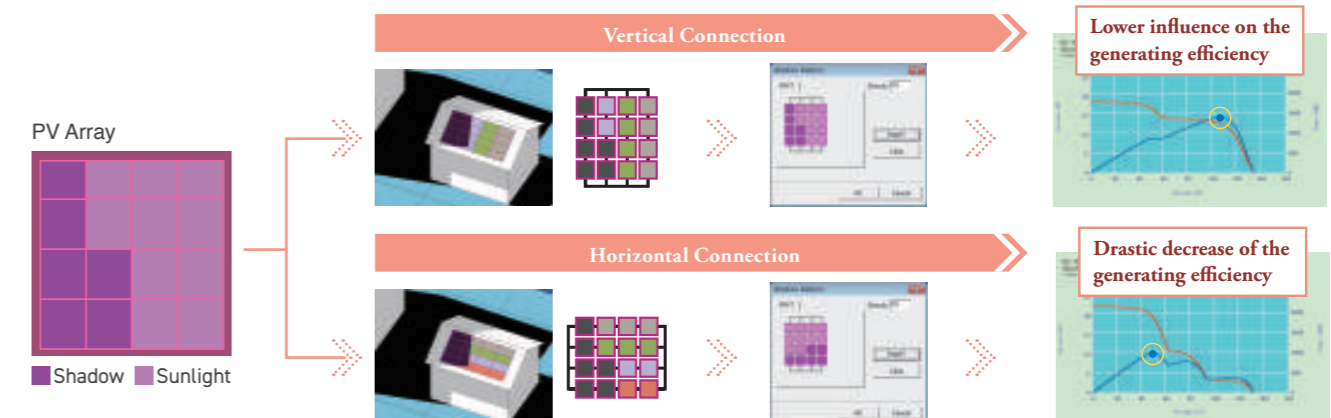
Setting Screen   Colored by Inverters   Colored by Strings

Interlock between Module Connection and Shadow Figure

You can find module connections relatively unaffected by shadows with designing them in a different direction. As fig. 1 shows, in case the shadows are falling on the PV arrays similarly, the generated power is largely different depending on a way of module connection.

PV Array

Vertical Connection

Lower influence on the generating efficiency

Horizontal Connection

Drastic decrease of the generating efficiency

Shadow   Sunlight

Simulation principle of Solar Pro

Solar Pro integrates the instantaneous value of the generated electric power and leads to highly accurate results.

1 year energy generation graph

There are detailed calculations and simple calculations for yearly calculations.
You can also select the calculation interval in units of 1 minute.

Enable highly accurate and scientifically grounded calculations by integrating instantaneous values instead of calculating from annual accumulated solar radiation.
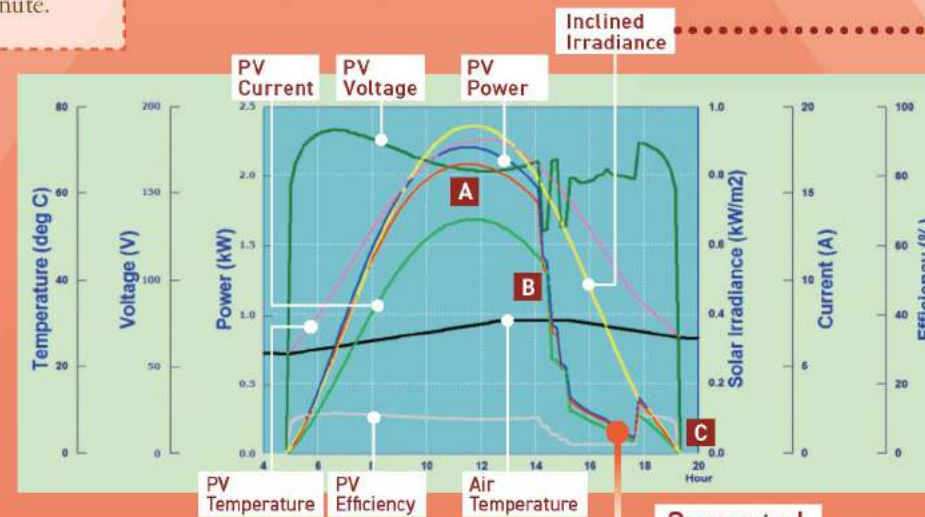
The solar radiation incident on the PV array is calculated using direct irradiance, scattered light, and ground reflected light. This allows you to determine the total amount of solar radiation (tilted surface solar radiation) received by the PV array, whatever orientation the PV array is installed in.

3

1 day energy generation graph

PV Current · PV Voltage · PV Power · Inclined Irradiance · PV Temperature · PV Efficiency · Air Temperature

A Temperature Influences
Rise in PV temperature during daytime shows decrease in voltage. It is one of the unique characteristics of Solar Pro to analyze the influence by temperature at the voltage base.

B Shadow Influences
This graph shows electric decreasing voltage, electric current, and electric power. It can reflect the calculation of shadow changing momentarily.
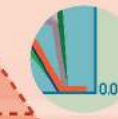
C Operating Conditions on Inverters
It reflects inverter's setting such as operate, stop, action on capacity-over.

Plot the maximum power point obtained from the IV curve as generated power.

2

Calculation on I-V Characteristics Graph

Draw an IV curve from a combination of electric current and voltage and find the maximum power point.

I-V curve
An I-V curve graph is a basic graph displaying performance of PV modules. In Solar Pro, a possible combination of electric current and voltage is calculated precisely by altering load resistance accordingly.

P-V curve
A P-V curve consists of electric power and electric voltage.

Generated Power

Maximum Power Point
It is the point where modules are able to deliver maximum power which determines operating voltage and current.
*Maximum Power Point per inverter, string, and module can be calculated.

Solve simultaneous equations for the number of modules and find the combination of electric current and voltage.

1

Calculation per Module

Calculate the current equation taking into consideration the state of sunshine and shadow for each module.

A combination of electric current and voltage is derived according to the situation such as the installation condition of each module and the type of module, and is represented as an IV curve. Therefore, it is possible to calculate accurately even in complicated situations such as different installation conditions and modules in different wiring configurations.

calculation : $I = I_{ph} - I_0[exp\{C(V+I\,R_s)\} - 1] - (V+I\,R_s)/R_p$
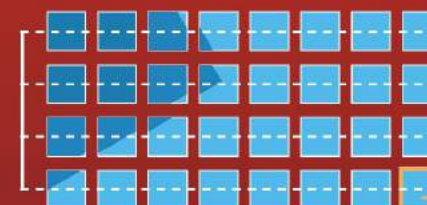
It reflects the state and connection of modules one by one.

Consider the effects of shading on all modules in a string, not just the one being shaded.