

Stand alone pv system design using Pvsyst

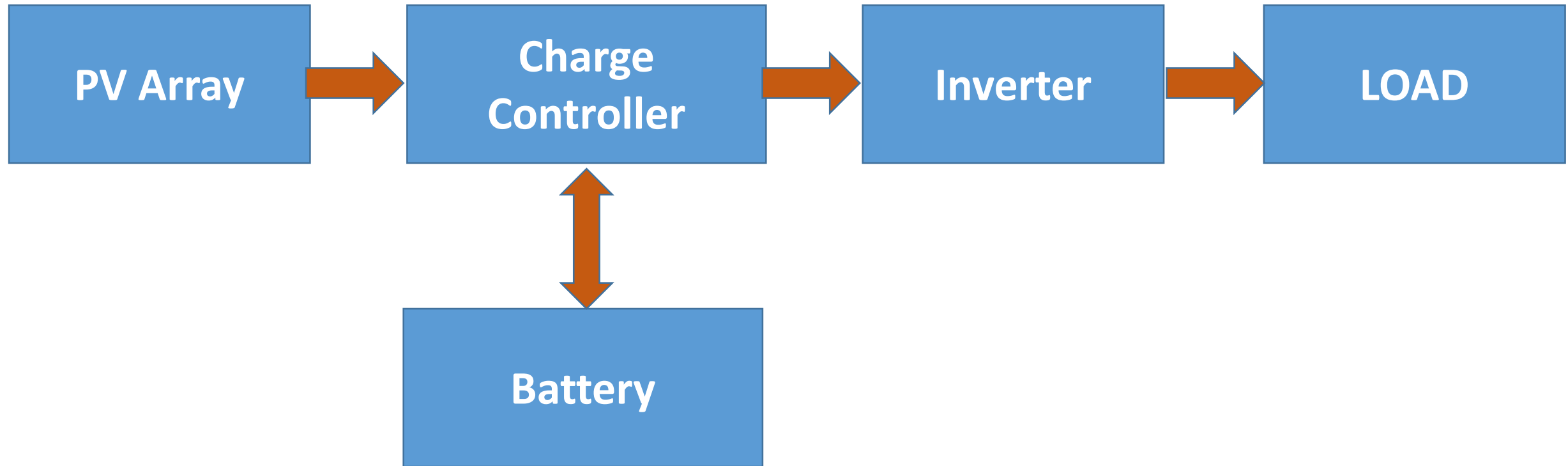


ห้องปฏิบัติการวิจัยเทคโนโลยีพลังงานแสงอาทิตย์,
Solar Energy Technology Laboratory (STL)

ศูนย์เทคโนโลยีอิเล็กทรอนิกส์และคอมพิวเตอร์แห่งชาติ
(National Electronics and Computer Technology Center (NECTEC))

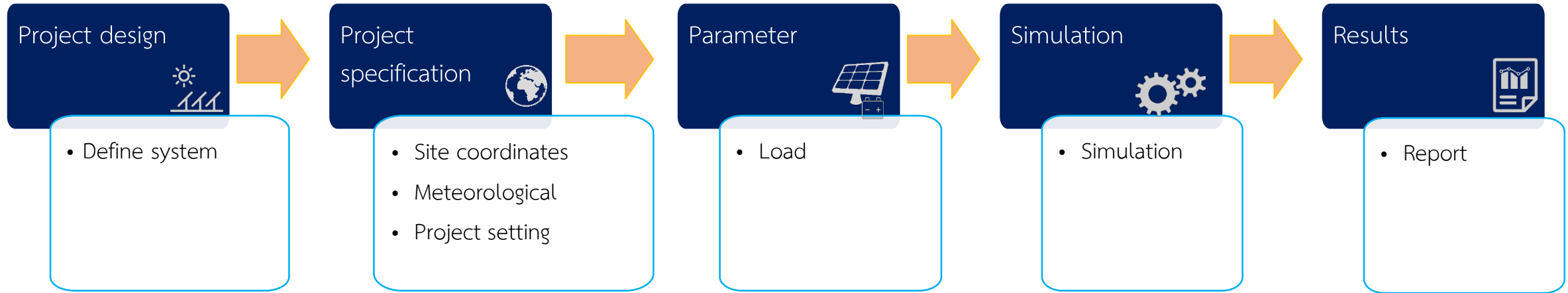
Pvsyst : Design Steps

PV Stand-alone systems

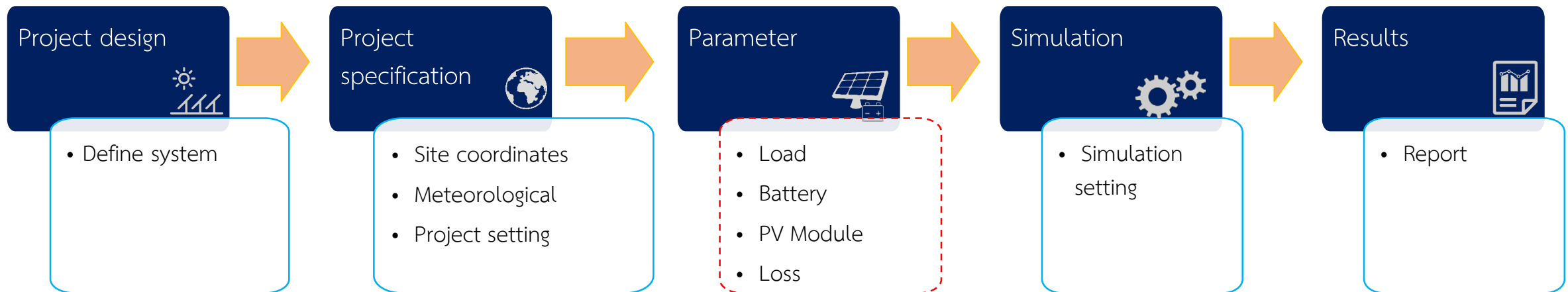


Pvsyst : Design Steps

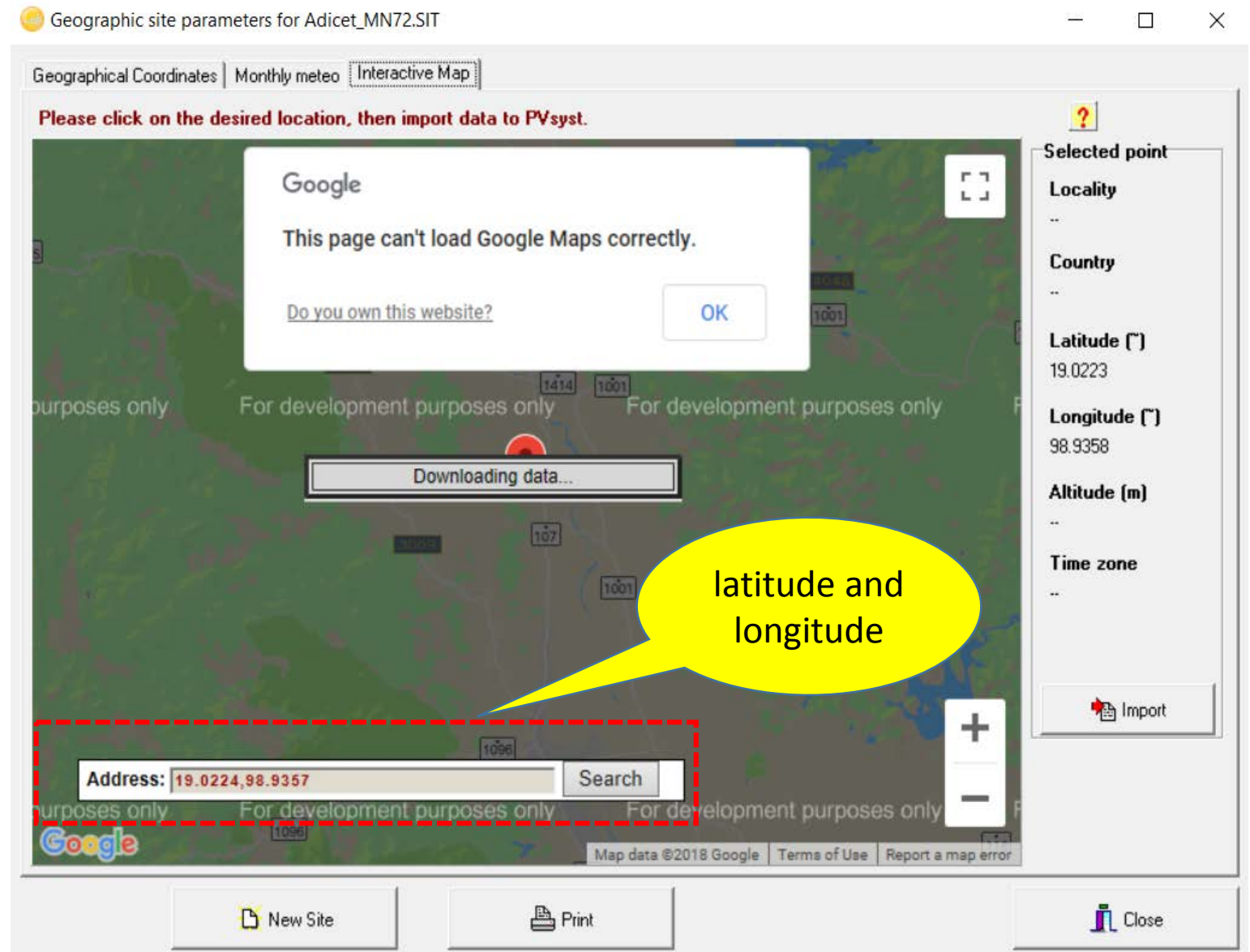
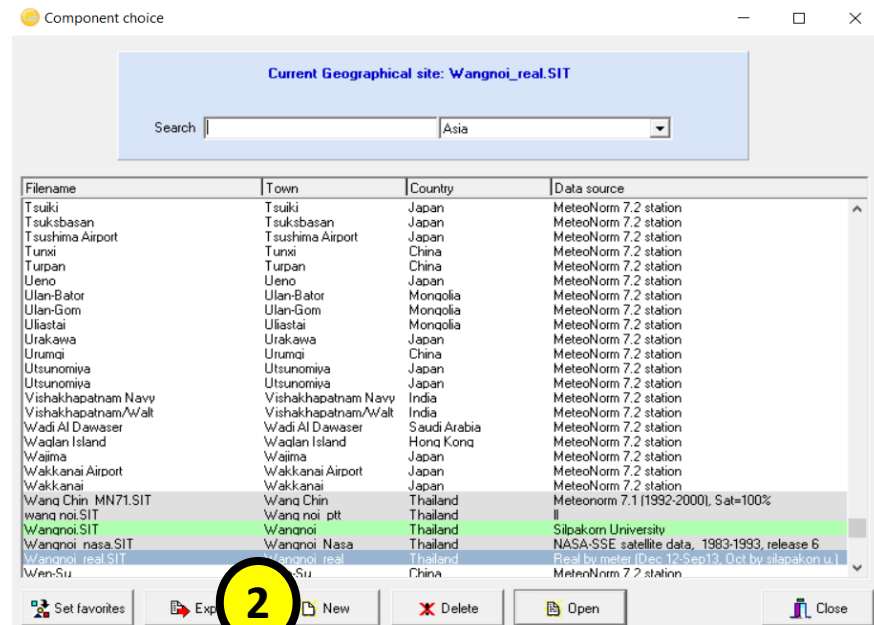
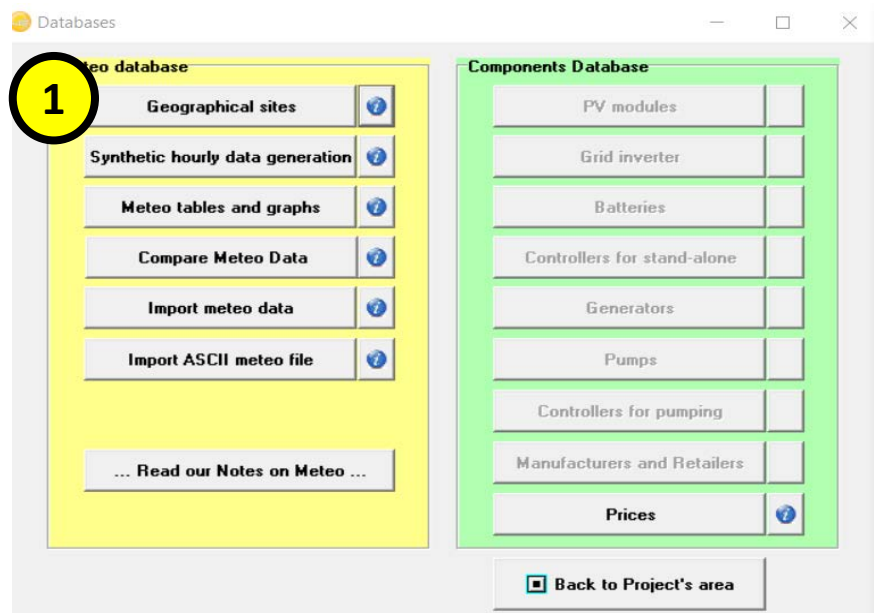
Preliminary design



Project Design



Pvsyst : Data bases



Pvsyst : Databases

Geographic site parameters for Adicet_MN72.SIT

Geographical Coordinates | Monthly meteo | Interactive Map

3 Location

Site name: Adicet

Country: Thailand Region: Asia

Get from coordinates

4 Geographical Coordinates

Sun paths

Latitude: 19.0224 [°] 19 1 20 (+ = North, - = South hemisph.)

Longitude: 98.9357 [°] 98 56 8 (+ = East, - = West of Greenwich)

Altitude: 381 M above sea level

Time zone: 7.0 Corresponding to an average difference

Legal Time - Solar Time = 0h 24m

Get from name

5 Meteo data Import

☒ Meteonorm 7.2
☐ NASA-SSE
☐ PVGIS TMY
☐ NREL / NSRDB TMY

Import

Tabular I/O (Excel)

Import
 Export line
 Export table

New Site Print Close

Geographic site parameters for Adicet_MN72.SIT

Geographical Coordinates | Monthly meteo | Interactive Map

Site: Adicet (Thailand)

Data source: Meteonorm 7.2 (1991-2000), Sat=100%

	Horizontal global irradiation	Horizontal diffuse irradiation	Temperature	Wind Velocity	Linke Turbidity	Relative Humidity
	kWh/m ² .mth	kWh/m ² .mth	~C	m/s	[-]	%
January	145.8	49.5	21.6	0.79	2.835	68.9
February	147.8	50.0	24.2	0.89	3.350	59.5
March	172.6	68.9	27.0	1.20	4.358	55.3
April	176.2	77.1	29.0	1.60	4.619	58.9
May	180.3	84.8	27.6	1.70	4.270	75.7
June	163.7	78.3	27.0	1.50	3.899	81.1
July	176.1	81.9	27.2	1.49	3.418	79.9
August	131.0	81.6	26.8	1.39	3.951	81.7
September	142.7	76.9	26.1	1.20	3.951	85.4
October	149.4	67.3	26.1	1.09	3.730	79.9
November	136.5	54.9	23.5	1.00	2.990	76.7
December	147.2	40.1	21.9	0.79	2.914	72.9
Year	1869.3	811.3	25.6	1.2	3.690	73.0

Horizontal global irradiation year-to-year variability 5.8%

6 Required Data

☒ Horizontal global irradiation
☒ Average Ext. Temperature

Extra data

☒ Horizontal diffuse irradiation
☒ Wind velocity
☒ Linke Turbidity
☒ Relative Humidity

Irradiation units

☐ kWh/m².day
☒ kWh/m².mth
☐ MJ/m².day
☐ MJ/m².mth
☐ W/m²
☐ Clearness Index Kt

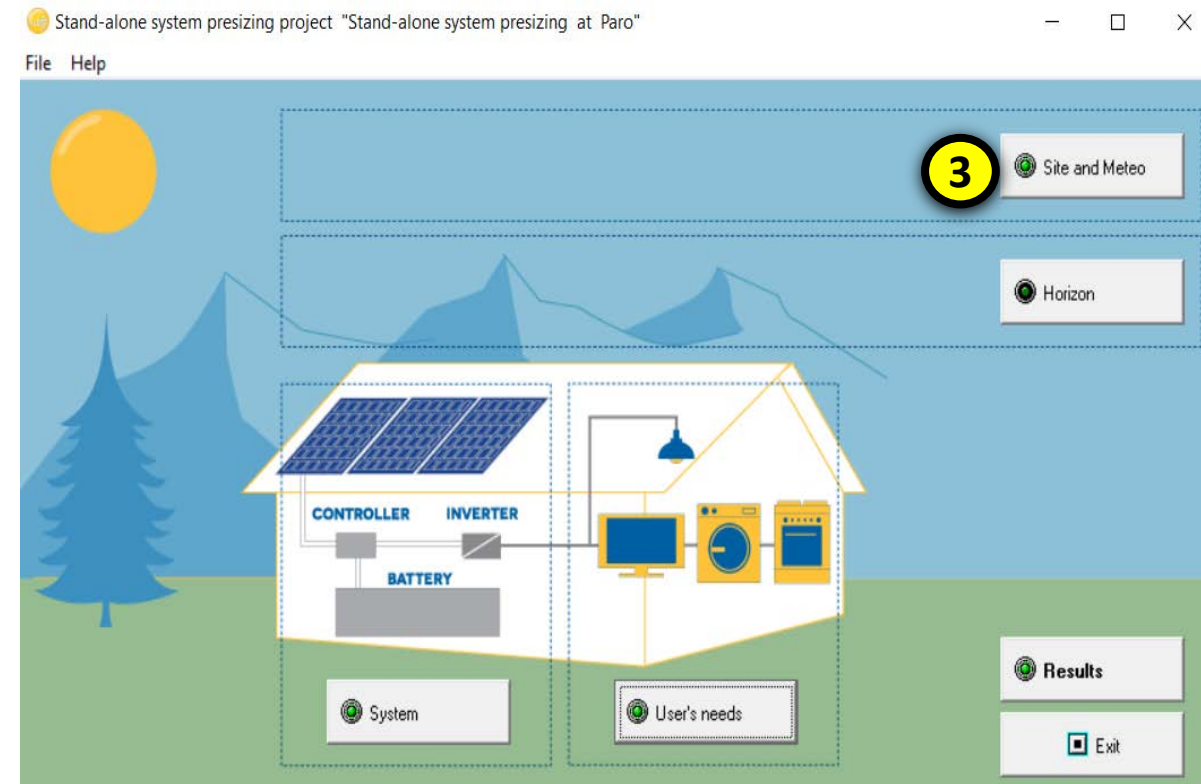
New Site Print Close

Pvsyst : Preliminary Design

Estimate Loads

Electric equipment	Power (W)	Number	Time (hr)	Energy (kWh)
LED	8	6	6	0.288
FAN	55	2	10	1.10
TV 21"	110	1	4	0.44
Computer	100	1	4	0.40
Fridge	70	1	24	1.68
Total Energy				3.908

Pvsyst : Preliminary Design



Pvsyst : Preliminary Design

Project's location

Project

4

Project name

Stand-alone system presizing at Adicet

Location

5

Country

Thailand

Site

Adicet

Meteonorm 7.2 (1991-2000), Sat=10(

5.1

Open site

Cancel

OK

Project name and Site coordinates

Geographic site parameters for Adicet_MN72.SIT

Geographical Coordinates

Monthly meteo

Interactive Map

Show map

Location

Site name

Adicet

Country

Thailand

Region

Asia

Get from coordinates

Geographical Coordinates

Sun paths

Latitude

Decimal

19.0224

Deg.

19

min.

1

sec.

20

(+ = North, - = South hemisph.)

Longitude

98.9357

(~) 98

56

8

(+ = East, - = West of Greenwich)

Altitude

381

M above sea level

Time zone

7.0

Corresponding to an average difference

Legal Time - Solar Time = 0h 24m

Get from name

Same Databases

Print

Close

8

Pvsyst : Preliminary design

Electric equipment

Stand-alone system pre-sizing - Daily use of energy

Definition of Daily Household consumptions, year

Consumptions | Hourly distribution

7

Daily consumptions

Number	Appliance	Power	Daily use	Hourly distrib	Daily energy
6	Lamps (LED or fluo)	8 W/lamp	6.0 h/day	OK	288 Wh
2	Fan	55 W/app.	10.0 h/day	OK	1100 Wh
1	TV	110 W/app.	4.0 h/day	OK	440 Wh
0	Fridge / Deep-freeze	0.00 kWh/day	0.0 h/day		0 Wh
0	Dish- & Cloth-washers	0.0 W aver.	0.0 h/day		0 Wh
1	Fridge	70 W/app.	24.0 h/day	OK	1680 Wh
1	Computer	100 W/app.	4.0 h/day	OK	400 Wh
Stand-by consumers		0 W tot	24 h/day		0 Wh
Total daily energy					3908 Wh/day
Total monthly energy					117.2 kWh/month

Appliances info

8

Consumption definition by

☒ Year ☐ Seasons ☐ Months

Week-end or Weekly use

☐ Use only during

7 days in a week

Model

Load Save

Cancel OK

Using time

6

8

7

Pvsyst : Preliminary design

Stand-alone system pre-sizing - Daily use of energy

Definition of Daily Household consumptions, year

Consumptions
Hourly distribution

7

Daily consumptions

Number	Appliance	Power	Daily use	Hourly distrib	Daily energy	
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0	Dish- & Cloth-washers	0.0 W aver.	0.0 h/day		0 Wh	
1	Fridge	70 W/app.	24.0 h/day	OK	1680 Wh	
1	Computer	100 W/app.	4.0 h/day	OK	400 Wh	
Stand-by consumers					0 W tot	24 h/day
					0 Wh	
<div>Appliances info</div>					<div>Total daily energy</div> <div>3908 Wh/day</div>	
					<div>Total monthly energy</div> <div>117.2 kWh/month</div>	

8

Consumption definition by

Year

Seasons

Months

Week-end or Weekly use

☐ Use only during

7

days in a week

Model

Load

Save

Cancel

OK

Daily use of Energy, Variant "New simulation variant"

Definition of Daily Household consumptions, year

Consumptions
Hourly distribution

9

Lamps (LED or fluo)

Fan

TV

Fridge

Computer

Daily global consumption

Model

Load

Save

Other profile

Cancel

OK

10.1

10.0

10

Pvsyst : Preliminary design

Stand-alone system pre-sizing - Daily use of energy

Save Domestic uses as ...

Description
User's needs: domestic uses

File name
f.LOD

Directory
C:\Users\Nectec\PV syst660_Data\Models

Ban Tohae_Project.LOD
 Ban Tohae_v2.LOD
 BanMaelaoa_Project.LOD
 KONG KOI_Project.LOD
 Load adicet.LOD
 Nectec_top.LOD
 school.LOD
 SolarMove-15fix.LOD
 TEST adiset.LOD
 Test.LOD

Consumption definition by ... Week end or Week days

☒ Year
☐ Season
☐ Month

Model

10.0 Save new consumption

Consumption distrib	Daily energy
	288 Wh
	1100 Wh
	440 Wh
	0 Wh
	0 Wh
	1680 Wh
	400 Wh
	0 Wh
	3908 Wh/day
	117.2 kWh/month

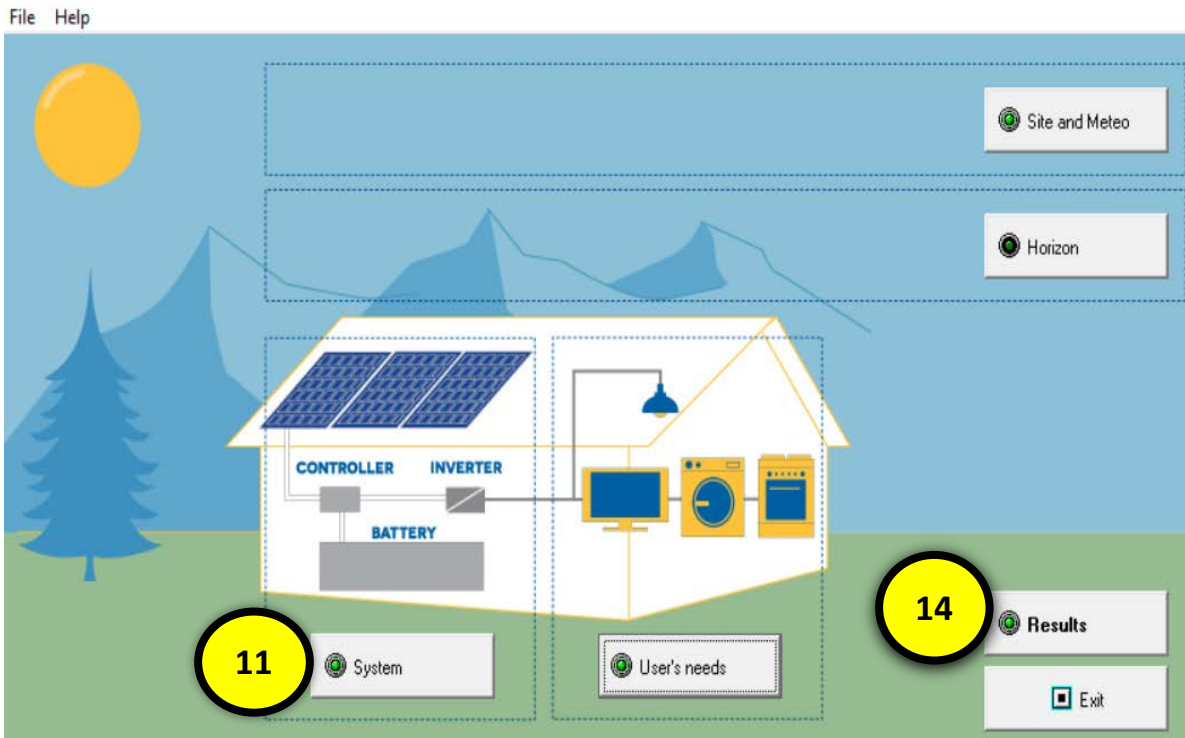
Component choice

Template_Big_SHS_2kWh_day.LOD : Enhanced SHS with fridge and little appliances, 2.2 kWh/day
 _Template_Household_10_kWh_day : Template, household 12 kWh/day
 _Template_SHS_400Wh_Day.LOD : Template SHS, 2 lamps + little TV/PC
 Ban Tohae_Project.LOD : User's needs: domestic uses
 Ban Tohae_v2.LOD : User's needs: domestic uses
 BanMaelaoa_Project.LOD : User's needs: domestic uses
 KONG KOI_Project.LOD : User's needs: domestic uses
 Load adicet.LOD : User's needs: domestic uses
 Nectec_top.LOD : User's needs: domestic uses
 school.LOD : User's needs: domestic uses
 SolarMove-15fix.LOD : User's needs: domestic uses
 TEST adiset.LOD : User's needs: domestic uses TEST adiset
 Test.LOD : User's needs: domestic uses

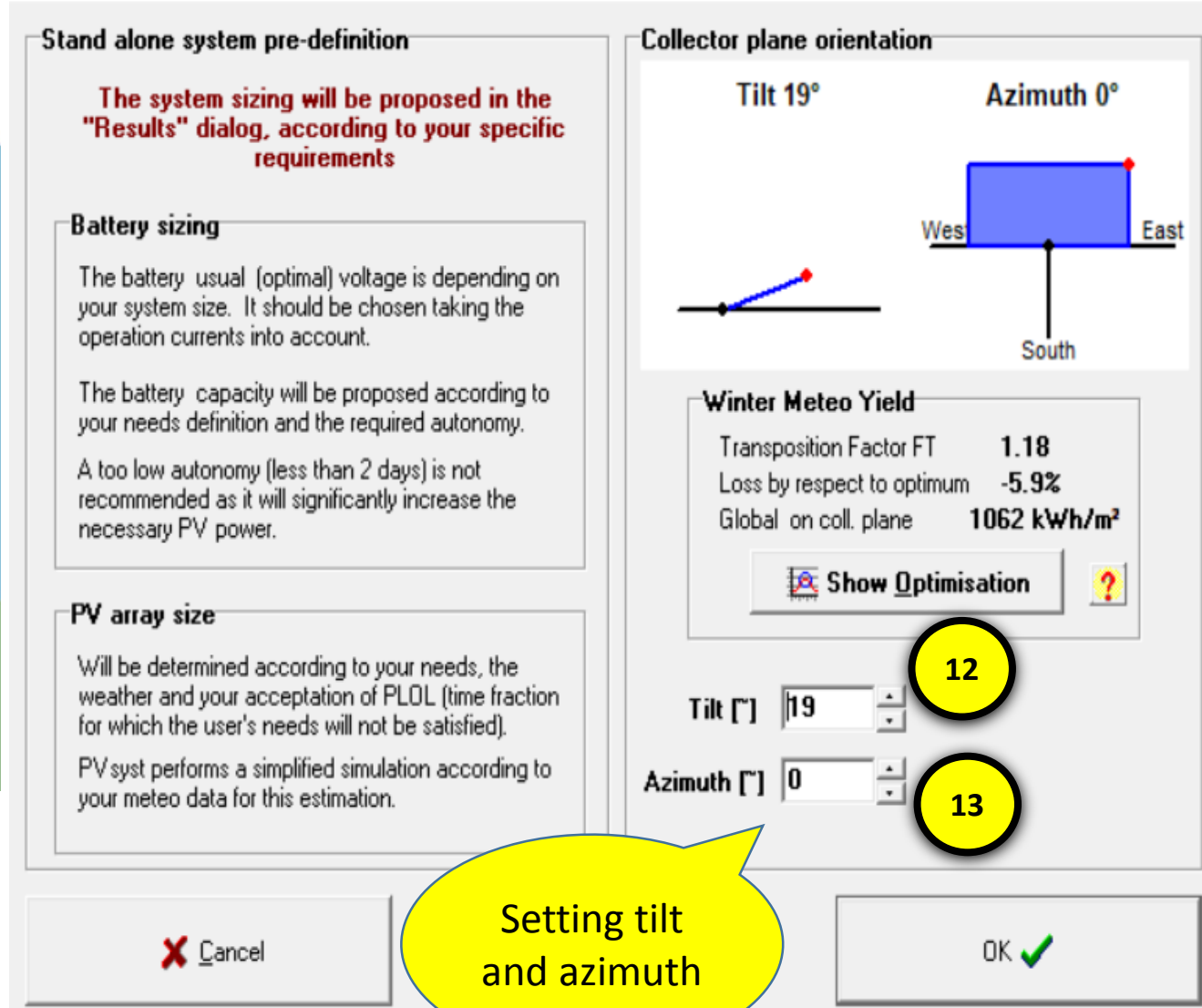
10.1 Load consumption

Pvsyst : Preliminary design

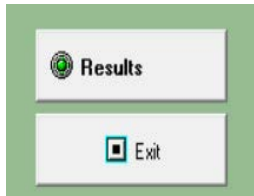
Stand-alone system presizing project "Stand-alone system presizing at Paro"



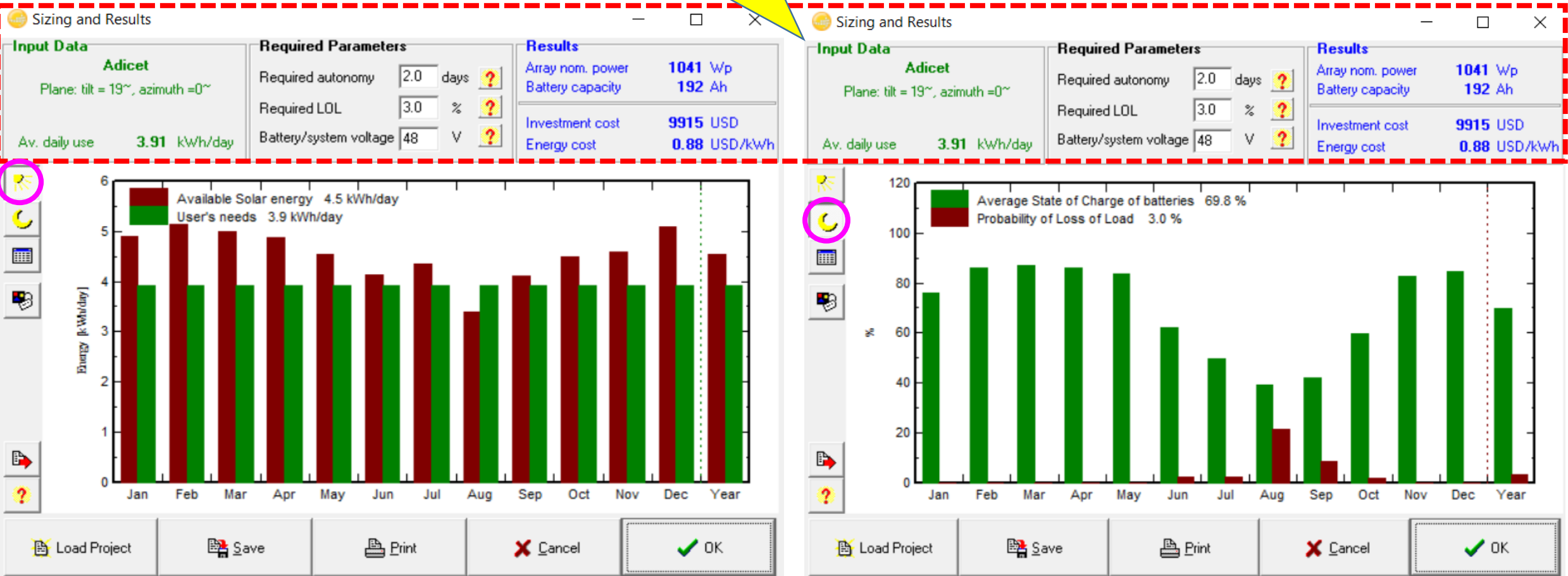
System Specification



Pvsyst : Preliminary design



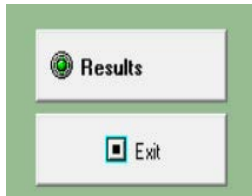
Result parameter at site
and power output



Day time

Night time

Pvsyst : Preliminary design



Sizing and Results

Input Data
Adicet
Plane: tilt = 19°, azimuth = 0°

Av. daily use **3.91** kWh/day

Required Parameters
Required autonomy 2.0 days ?
Required LOL 3.0 % ?
Battery/system voltage 48 V ?

Results
Array nom. power **1041** Wp
Battery capacity **192** Ah

Investment cost **9915** USD
Energy cost **0.88** USD/kWh

	Incid. kWh/m².day	PV avail. kWh	Demand kWh	Excess kWh	Missing kWh	SOC %	Pr. LOL %	Fuel liter
Jan.	5.9	151.6	121.1	14.3	0.0	76	0.0	0.0
Feb.	6.2	143.9	109.4	20.9	0.0	86	0.0	0.0
Mar.	6.0	155.1	121.1	19.4	0.0	87	0.0	0.0
Apr.	5.8	146.1	117.2	15.2	0.0	86	0.0	0.0
May	5.5	140.9	121.1	6.0	0.0	84	0.0	0.0
June	5.0	124.3	117.2	5.1	2.3	62	2.1	1.5
July	5.2	135.0	121.1	0.0	2.4	50	2.1	1.6
Aug.	4.1	105.4	121.1	0.0	22.0	39	21.5	14.6
Sep.	4.9	123.0	117.2	0.0	9.8	42	8.5	6.5
Oct.	5.4	139.4	121.1	1.3	2.3	60	1.8	1.5
Nov.	5.5	137.4	117.2	5.7	0.0	83	0.0	0.0
Dec.	6.1	157.9	121.1	20.6	0.0	85	0.0	0.0
Year	5.5	1660.0	1426.4	108.6	38.8	70	3.0	25.8

Load Project Save Print Cancel OK

Result monthly

Sizing and Results

Input Data
Adicet
Plane: tilt = 19°, azimuth = 0°

Av. daily use **3.91** kWh/day

Required Parameters
Required autonomy 2.0 days ?
Required LOL 3.0 % ?
Battery/system voltage 48 V ?

Results
Array nom. power **1041** Wp
Battery capacity **192** Ah

Investment cost **9915** USD
Energy cost **0.88** USD/kWh

Economic gross evaluation
Module cost 1274 USD
Battery cost 1688 USD
Regulator cost 818 USD
Transport/Fitting 6135 USD
Total investment 9915 USD

Annuities 796 USD/yr
Maintenance costs 422 USD/yr
Total Yearly cost 1218 USD/yr

Energy cost 0.88 USD/kWh

These values should only be considered as an order of magnitude. More precise evaluations will be available with detailed simulation.

Currency
USD - United States Do
[Rates](#)

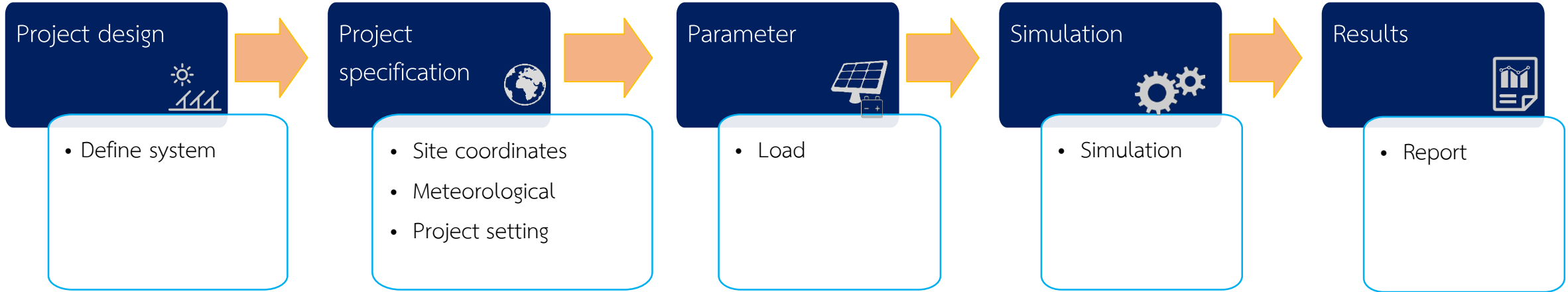
Loan
Duration 20 years
Rate 5.0 %
Ann. factor : 0.080
Edit costs ?

Load Project Save Print Cancel OK

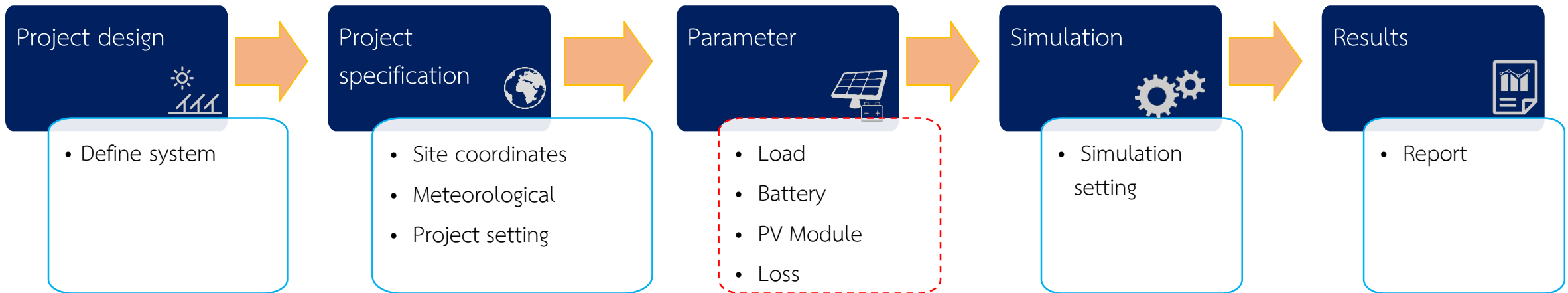
Result economic

Pvsyst : Design Steps

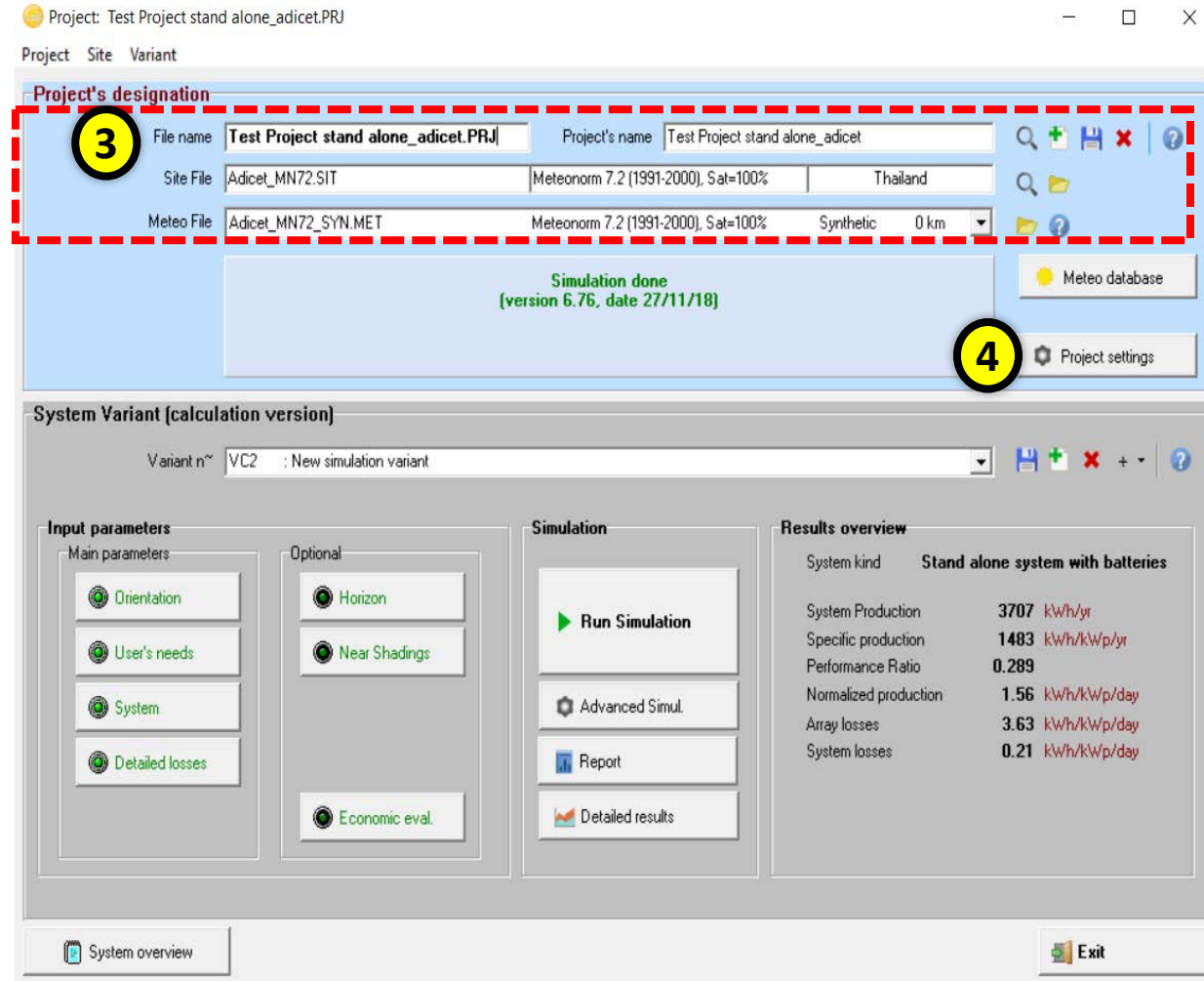
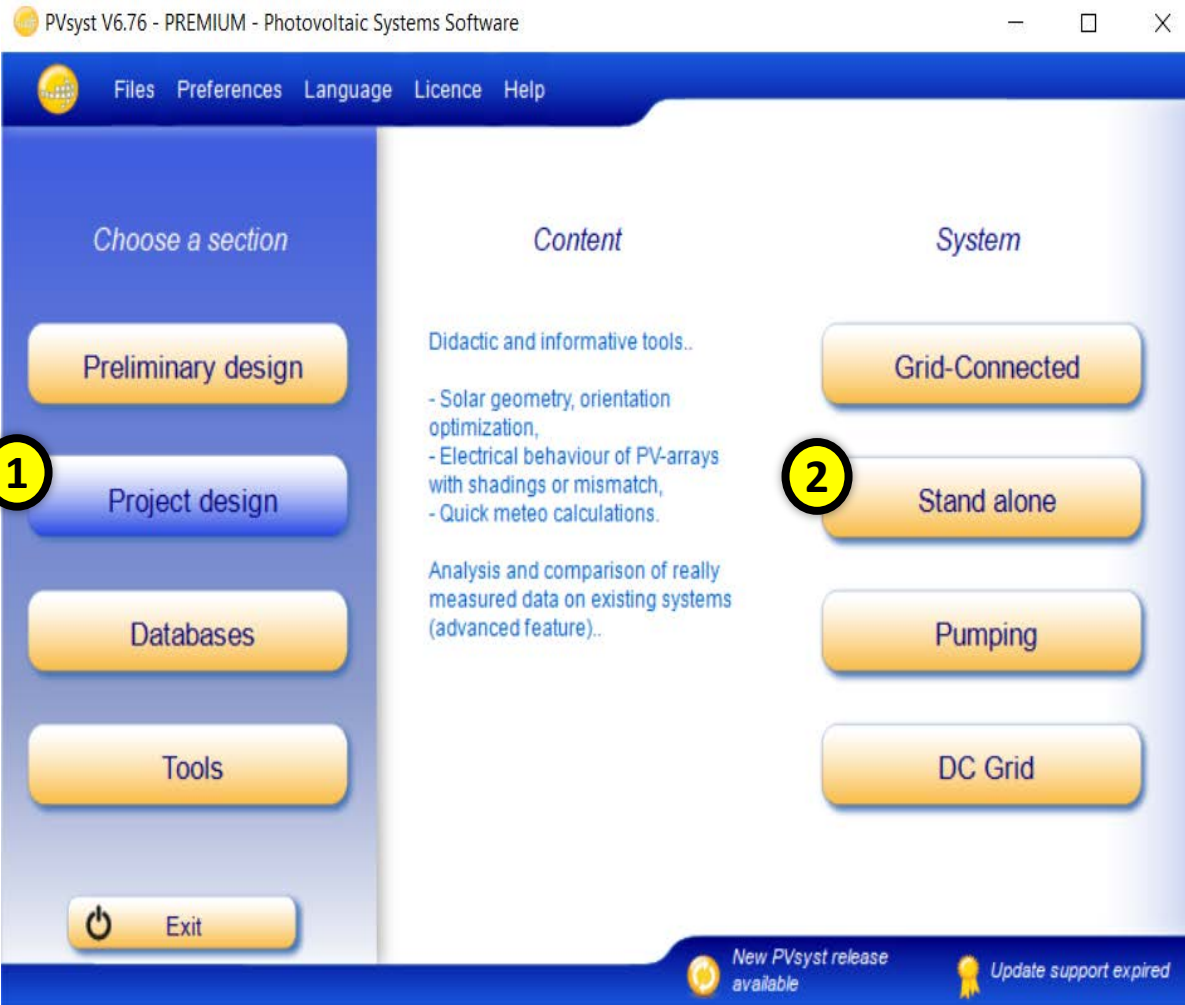
Preliminary design



Project Design



Pvsyst : Project Design



Pvsyst : Project Design

5 Albedo Design conditions Other limitations Preferences

Albedo values ?

Monthly values

Jan.	0.20	July	0.20
Feb.	0.20	Aug.	0.20
Mar.	0.20	Sep.	0.20
Apr.	0.20	Oct.	0.20
May	0.20	Nov.	0.20
June	0.20	Dec.	0.20

Set a common value

Common value

(Default: albedo = 0.2)

☒ Set

Usual values for albedo

Urban situation	0.14 - 0.22
Grass	0.15 - 0.25
Fresh Grass	0.26
Fresh snow	0.82
Wet snow	0.55 - 0.75
Dry asphalt	0.09 - 0.15
Wet asphalt	0.18
Concrete	0.25 - 0.35
Red tiles	0.33
Aluminium	0.85
New galvanised steel	0.35
Very dirty galvanised steel	0.08

☒ Cancel ☒ OK

6 Design conditions Other limitations Preferences

Site-dependent Design parameters

Reference temperatures for array design by respect to the inverter input voltages ?

		Default
Lower temperature for Absolute Voltage limit	-10	~C <input checked="" type="checkbox"/>
Winter operating temperature for VmppMax design	20	~C <input checked="" type="checkbox"/>
Usual operating temperature under 1000 W/m	50	~C <input checked="" type="checkbox"/>
Summer operating temperature for VmppMin design	60	~C <input checked="" type="checkbox"/>

Other design Parameters

Array Max. voltage

☒ IEC (usually 1000 V)
☐ UL (usually 600 V)

muVoc value

☒ From one-diode model
☐ From specification ?

Limit overload loss for design % ☒

Transposition Model for this project

☐ Hay model (robust) ?
☒ Perez-Ineichen model (sophisticated)

☒ Cancel **7** ☒ OK

Pvsyst : Project Design

Project: Test Project stand alone_adicet.PRJ

Project Site Variant

Project's designation

File name: **Test Project stand alone_adicet.PRJ** | Project's name: **Test Project stand alone_adicet**

Site File: **Adicet_MN72.SIT** | Meteorom 7.2 (1991-2000), Sat=100% | **Thailand**

Meteo File: **Adicet_MN72_SYN.MET** | Meteorom 7.2 (1991-2000), Sat=100% | **Synthetic** | **0 km**

Simulation done
(version 6.76, date 27/11/18)

Meteo database

Project settings

System Variant (calculation version)

Variant n°: **VC2** : New simulation variant

Input parameters

Main parameters:

- Orientation**
- User's needs
- System
- Detailed losses

Optional:

- Horizon
- Near Shadings
- Economic eval.

Simulation

Run Simulation

Advanced Simul.

Report

Detailed results

Results overview

System kind: **Stand alone system with batteries**

System Production	3707 kWh/yr
Specific production	1483 kWh/kWp/yr
Performance Ratio	0.289
Normalized production	1.56 kWh/kWp/day
Array losses	3.63 kWh/kWp/day
System losses	0.21 kWh/kWp/day

System overview

Exit

Orientation, Variant "New simulation variant"

Field type

- Fixed Tilted Plane**
- Fixed Tilted Plane
- Seasonal tilt adjustment
- Unlimited sheds
- Unlimited sun-shields
- One-axis tracking planes
- Horiz. axis, unlimited trackers
- Tracking tilted or horiz. N-S axis
- Tracking, horizontal axis E-W
- Tracking, vertical axis
- Tracking sun-shields
- Two-axis tracking planes
- Tracking two axis

Field parameters

Plane Tilt: **19.0** [°]

Azimuth: **0.0** [°]

Optimisation by respect to

- Yearly irradiation yield
- Summer (Apr-Sep)
- Winter (Oct-Mar)**

Winter meteo yield

Transposition Factor FT	1.18
Loss By Respect To Optimum	-5.9%
Global on collector plane	1062 kWh/m²

Show Optimisation

Cancel OK

Pvsyst : Project Design

Daily use of Energy, Variant "New simulation variant"

Definition of Daily Household consumptions, year

Consumptions | Hourly distribution

Daily consumptions

Number	Appliance	Power	Daily use	Hourly distrib	Daily energy
6	Lamps (LED or fluo)	8 W/lamp	6.0 h/day	OK	288 Wh
2	Fan	55 W/app.	10.0 h/day	OK	1100 Wh
1	TV	110 W/app.	4.0 h/day	OK	440 Wh
0	Fridge / Deep-freeze	0.00 kWh/day	0.0 h/day		0 Wh
0	Dish- & Cloth-washers	0.0 W aver.	0.0 h/day		0 Wh
1	Fridge	70 W/app.	24.0 h/day	OK	1680 Wh
1	Computer	100 W/app.	4.0 h/day	OK	400 Wh
Stand-by consumers		0 W tot	24 h/day		0 Wh
Total daily energy					3908 Wh/day
Total monthly energy					117.2 kWh/month

Appliances info

Consumption definition by

☒ Year ☐ Seasons ☐ Months

Week-end or Weekly use

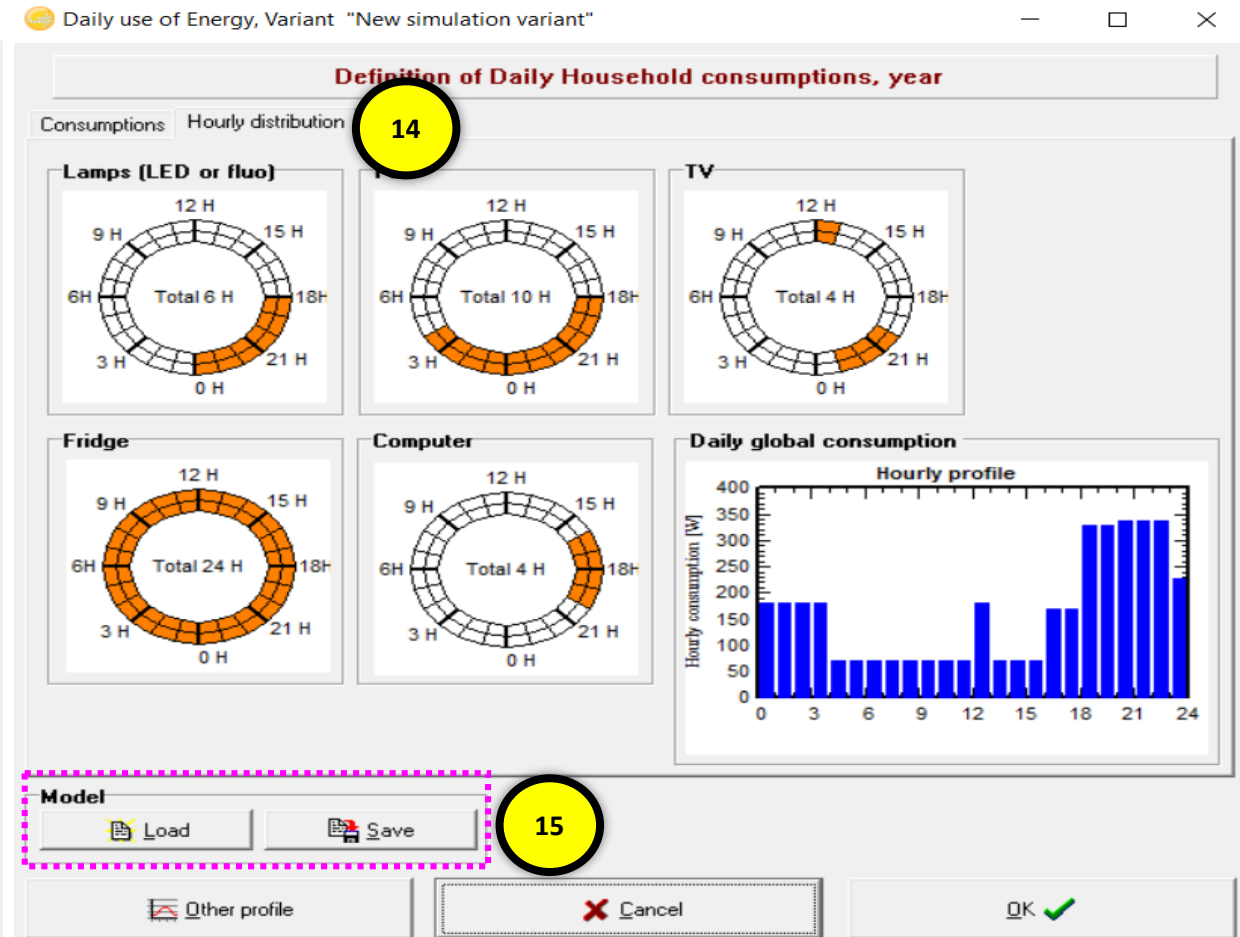
☐ Use only during

days in a week

Model

Load Save

Other profile Cancel OK



Setting Load

- Number of devices, their individual power, the duration of their use.
- Operating hours in the day.

Pvsyst : Project Design

Project: Test Project stand alone_adicet.PRJ

Project Site Variant

Project's designation

File name: **Test Project stand alone_adicet.PRJ** Project's name: **Test Project stand alone_adicet**

Site File: **Adicet_MN72.SIT** Meteorom 7.2 (1991-2000), Sat=100% Thailand

Meteo File: **Adicet_MN72_SYN.MET** Meteorom 7.2 (1991-2000), Sat=100% Synthetic 0 km

Simulation done (version 6.76, date 27/11/18)

Meteo database

Project settings

System Variant (calculation version)

Variant n° **VC2** : New simulation variant

Input parameters

Main parameters

- Orientation
- User's needs
- System
- Detailed losses

Optional

- Horizon
- Near Shadings
- Economic eval.

Simulation

- Run Simulation
- Advanced Simul.
- Report
- Detailed results

Results overview

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System losses	0.21 kWh/kWp/day

System overview

Exit

17

Specified User's needs Pre-sizing suggestions System summary

Av. daily needs : **3.9 kWh/day** Enter accepted LOL **3.0** % Enter requested autonomy **2.0** day(s)

Battery (user) voltage **48** V Suggested capacity **191** Ah Suggested PV power **1125** Wp (nom.)

Detailed pre-sizing

Storage PV Array Back-up Schema

Procedure

1. - Pre-sizing Define the desired Pre-sizing conditions (LOL, Autonomy, Battery voltage)
2. - Storage Define the battery pack (default checkboxes will approach the pre-sizing)
3. - PV Array design Design the PV array (PV module) and the control mode. You are advised to begin with a universal controller.
4. - Back-up Define an eventual Genset

Specify the Battery set

18

Sort Batteries by ☒ voltage ☐ capacity ☐ manufacturer

Panasonic 48.1 V 54 Ah Li LCO DCB102Z Since 2017 Open

Lithium-ion The selected battery is a module

1 modules in serie Number of modules 4

4 modules in parallel Number of elements 936

Battery pack voltage 48 V

Global capacity 216 Ah

Stored energy (80% DOD) 9.4 kWh

Total weight 80 kg

Nb. cycles at 50% DOD 1475

Total stored energy during the battery life 7767 kWh

Operating battery temperature

Temper. mode Fixed (tempered local)

Fixed temperature 30 °C

19

The battery temperature is important for the ageing of the battery. An increase of 10 °C divides the "static" battery life by a factor of 2.

Cancel

OK

Pvsyst : Project Design

Specified User's needs
Pre-sizing suggestions
System summary

Av. daily needs : 3.9 kWh/day
Enter accepted LOL 3.0 %
Enter requested autonomy 2.0 day(s)
Battery (user) voltage 48 V
Suggested capacity 191 Ah
Suggested PV power 1125 Wp (nom.)

Storage
PV Array
Back-up
Schema

Sub-array name and Orientation
Name PV Array
Orient. Fixed Tilted Plane
Tilt 19°
Azimut 0°

Resizing help
No Sizing
Enter planned power 1.1 kWp.
... or available area 9 m²

Select the PV module
All modules
Sort modules by: power
Scheuten
250 Wp 27V Si-poly Multisol P6/66 250 Until 2015 Manufacturer 200
Approx. needed modules 5
Sizing voltages: V_{mpp} (60°C) 26.6 V
V_{oc} (-10°C) 46.0 V

Select the control mode and the controller
Universal controller
MPPT power converter
Max. Charging - Discharging current
MPPT 360 W 48 V 23 A 7 A
Universal controller with MPPT conv. C

PV Array design
Number of modules and strings
Mod. in serie 2
Nb. strings 2
Nb modules 4
Area 7 m²
Operating conditions :
V_{mpp} (60°C) 53 V
V_{mpp} (20°C) 66 V
V_{oc} (-10°C) 92 V
Plane irradiance 1000 W/m²
I_{mpp} (STC) 15.6 A
I_{sc} (STC) 16.9 A
I_{sc} (at STC) 16.6 A
Max. operating power at 1000 W/m² and 50°C 0.9 kW
Array's nom. power (STC) 1.0 kWp

Cancel
OK

Pvsyst : Project Design

Project: Test Project stand alone_adicet.PRJ

Project Site Variant

Project's designation

File name: **Test Project stand alone_adicet.PRJ** Project's name: Test Project stand alone_adicet

Site File: Adicet_MN72.SIT Meteoronorm 7.2 (1991-2000), Sat=100% Thailand

Meteo File: Adicet_MN72_SYN.MET Meteoronorm 7.2 (1991-2000), Sat=100% Synthetic 0 km

Simulation done
(version 6.76, date 27/11/18)

Meteo database

Project settings

System Variant (calculation version)

Variant n°: VC2 : New simulation variant

Input parameters

Main parameters: Orientation, User's needs, System, Detailed losses

Optional: Horizon, Near Shadings, Economic eval.

Simulation

Run Simulation

Advanced Simul.

Report

Detailed results

Results overview

System kind: Stand alone system with batteries

System Production	3707 kWh/yr
Specific production	1483 kWh/kWp/yr
Performance Ratio	0.289
Normalized production	1.56 kWh/kWp/day
Array losses	3.63 kWh/kWp/day
System losses	0.21 kWh/kWp/day

System overview

Exit

PV field detailed losses parameter

Thermal parameter | Ohmic Losses | Module quality | **25** | Soiling Loss | IAM Losses | Spectral Correction

Yearly soiling loss factor

Yearly loss factor: 3.0 % ☒ Default

☐ Define monthly values

Losses graph

Cancel

OK

Pvsyst : Project Design

Project: Test Project stand alone_adicet.PRJ

Project Site Variant

Project's designation

File name: **Test Project stand alone_adicet.PRJ** Project's name: Test Project stand alone_adicet

Site File: Adicet_MN72.SIT Meteoronorm 7.2 (1991-2000), Sat=100% Thailand

Meteo File: Adicet_MN72_SYN.MET Meteoronorm 7.2 (1991-2000), Sat=100% Synthetic 0 km

Simulation done
(version 6.76, date 27/11/18)

Meteo database

Project settings

System Variant (calculation version)

Variant n°: VC2 : New simulation variant

Input parameters

Main parameters: Orientation, User's needs, System, Detailed losses

Optional: Horizon, Near Shadings, Economic eval.

Simulation

26 Run Simulation

Advanced Simul.

Report

Detailed results

Results overview

System kind: **Stand alone system with batteries**

System Production	3707 kWh/yr
Specific production	1483 kWh/kWp/yr
Performance Ratio	0.289
Normalized production	1.56 kWh/kWp/day
Array losses	3.63 kWh/kWp/day
System losses	0.21 kWh/kWp/day

System overview

Exit

Hourly Simulation Progress

Status: **Simulation ended successfully**

4.4 sec

Attenuation factors for Diffuse

	IAM	Shading	IAM*Shading
Diffuse	0.041	0.000	0.041
Albedo	0.145	0.000	0.145

Display

☐ Hourly Values
☒ Daily Values
☐ Monthly Values

Display daily values

Simulation 31/12/90

Meteo: Global, Diffuse, Tamb 4.99, 1.02kWh/m².day, 22.9°C, 1.0 m/s

On coll: Global, Diffuse, Glob. eff. 6.36, 1.21, 0.03, 6.04 kWh/m².day

System : EMax, ENet, EUse 12.23, 4.43, 3.91kWh/day

Load : ELoad, EUsed, EOver 3.913.9, 7.8 kWh/day

27 OK

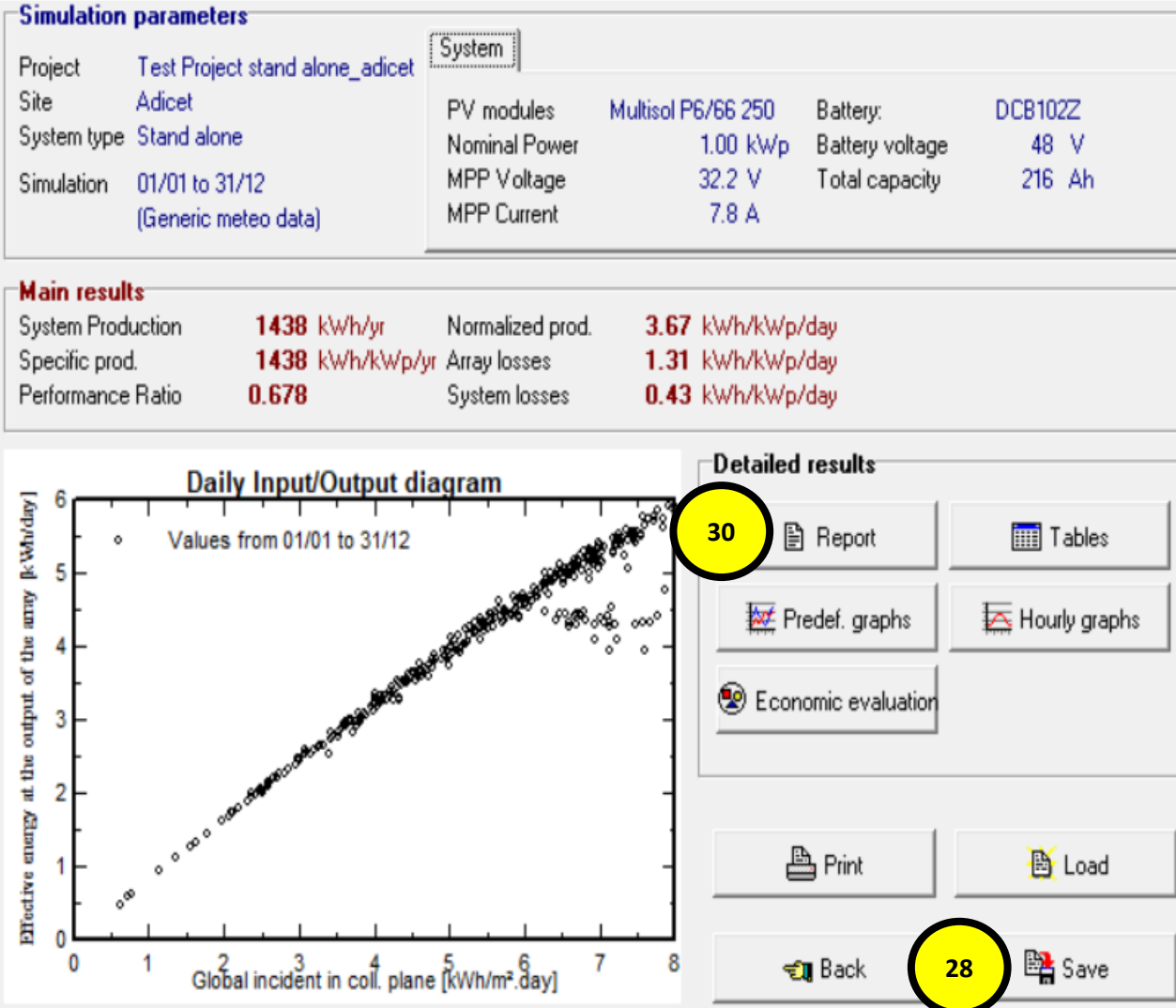
Automatically close when simulation ends successfully

Step by step

Continue

Pvsyst : Project Design

Results, variant VC3 "New simulation variant"



Saving the simulation Variant ...

Description

New simulation variant

File name Test Project stand alone_adicet.VC2

Directory C:\Users\Nectec\PV syst660_Data\Projects

Test Project stand alone_adicet.VC0
Test Project stand alone_adicet.VC1
Test Project stand alone_adicet.VC2
Test Project stand alone_adicet.VC3
Test Project stand alone_adicet.VC4

Cancel

Save

Save As New

Pvsyst : Project Design

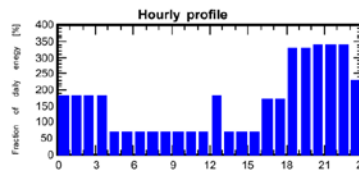
PVSYST V6.76	27/11/18	Page 1/4
Stand alone system: Simulation parameters		
Project :	Test Project stand alone_adicet	
Geographical Site	Adicet	Country Thailand
Situation	Latitude 19.02° N	Longitude 98.94° E
Time defined as	Legal Time	Time zone UT+7
	Albedo 0.20	Altitude 381 m
Meteo data:	Adicet	Meteonorm 7.2 (1991-2000), Sat=100% - Synthetic
Simulation variant :	New simulation variant	
	Simulation date	27/11/18 11h27
Simulation parameters	System type	Stand alone system with batteries
Collector Plane Orientation	Tilt 19°	Azimuth 0°
Models used	Transposition Perez	Diffuse Perez, Meteonorm
User's needs :	Daily household consumers average	Constant over the year 3.9 kWh/Day
PV Array Characteristics	Si-poly	Model Multisol P6/66 250
PV module	Original PVsyst database	Scheuten
Number of PV modules	In series 2 modules	In parallel 2 strings
Total number of PV modules	Nb. modules 4	Unit Nom. Power 250 Wp
Array global power	Nominal (STC) 1000 Wp	At operating cond. 880 Wp (50°C)
Array operating characteristics (50°C)	U mpp 56 V	I mpp 16 A
Total area	Module area	7.3 m²
System Parameter	System type	Stand alone system
Battery	Model DCB102Z	
	Manufacturer Panasonic	
Battery Pack Characteristics	Nb. of units 4 in parallel	
	Voltage 48 V	Nominal Capacity 216 Ah
	Discharging min. SOC 10.0 %	Stored energy 9.4 kWh
	Temperature Fixed (30°C)	
Controller	Model	Universal controller with MPPT converter
	Technology MPPT converter	Temp coeff. -5.0 mV/°C/elem.
Converter	Maxi and EURO efficiencies 97.0 / 95.0 %	
Battery Management control	Threshold commands as	SOC calculation
	Charging SOC = 0.96 / 0.80	
	Discharging SOC = 0.10 / 0.35	
PV Array loss factors		
Array Soiling Losses	Uc (const) 20.0 W/m²K	Loss Fraction 3.0 %
Thermal Loss factor		Uv (wind) 0.0 W/m²K / m/s
Wiring Ohmic Loss	Global array res. 62 mOhm	Loss Fraction 1.5 % at STC
Series Diode Loss	Voltage Drop 0.7 V	Loss Fraction 1.1 % at STC
Module Quality Loss		Loss Fraction 0.5 %
Module Mismatch Losses		Loss Fraction 1.0 % at MPP
Strings Mismatch loss		Loss Fraction 0.10 %
Incidence effect, ASHRAE parametrization	IAM = 1 - bo (1/cos i - 1)	bo Param. 0.05

Detail System

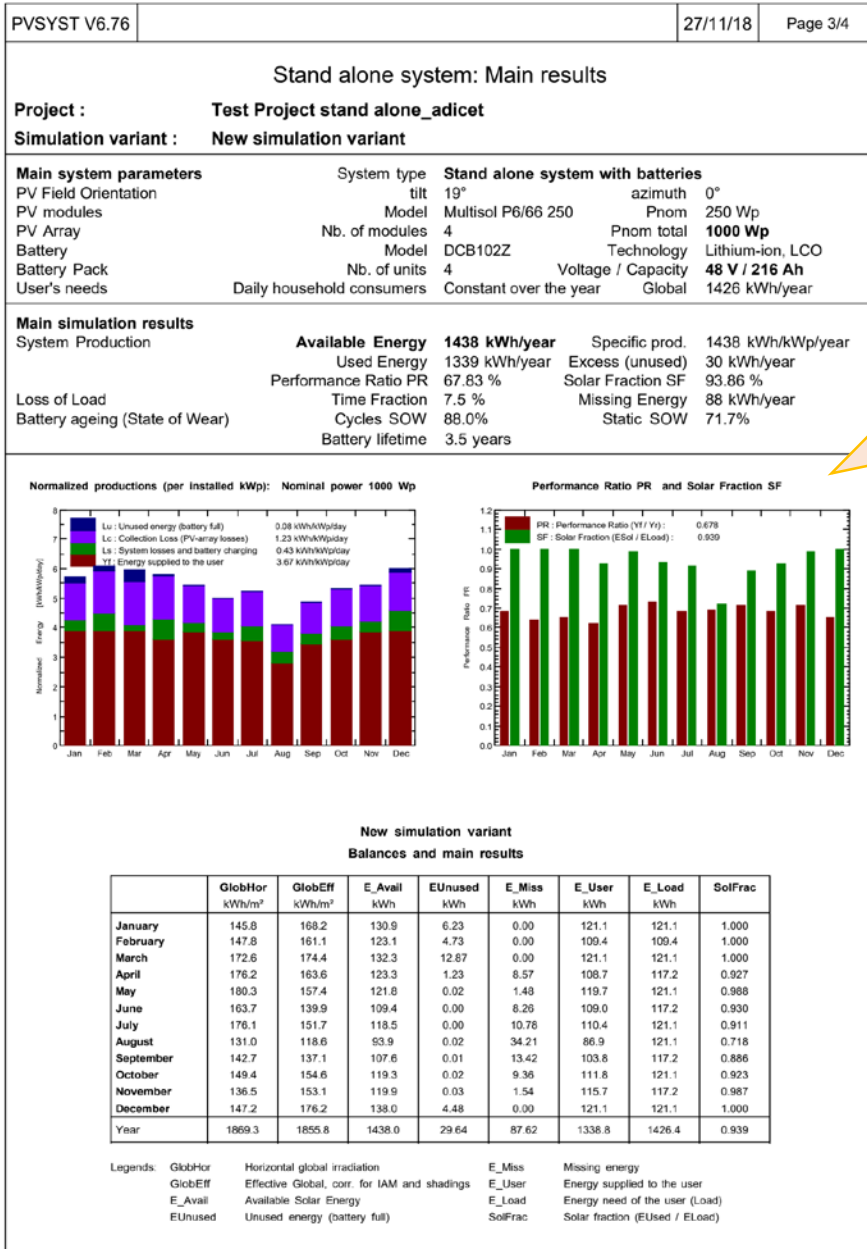
- Location
- PV
- Battery
- Loss factor

Detail Load

- Electric equipment
- Time use

PVSYST V6.76			27/11/18	Page 2/4
Stand alone system: Detailed User's needs				
Project :	Test Project stand alone_adicet			
Simulation variant :	New simulation variant			
Main system parameters		System type	Stand alone system with batteries	
PV Field Orientation		tilt	19°	azimuth 0°
PV modules		Model	Multisol P6/66 250	Pnom 250 Wp
PV Array		Nb. of modules	4	Pnom total 1000 Wp
Battery		Model	DCB102Z	Technology Lithium-Ion, LCO
Battery Pack		Nb. of units	4	Voltage / Capacity 48 V / 216 Ah
User's needs	Daily household consumers	Constant over the year	Global	1426 kWh/year
Daily household consumers, Constant over the year, average = 3.9 kWh/day				
Annual values				
	Number	Power	Use	Energy
Lamps (LED or fluo)	6	8 W/lamp	6 h/day	288 Wh/day
Fan	2	55 W/app	10 h/day	1100 Wh/day
TV	1	110 W/app	4 h/day	440 Wh/day
Fridge	1	70 W tot	24 h/day	1680 Wh/day
Computer	1	100 W tot	4 h/day	400 Wh/day
Total daily energy				3908 Wh/day
				

Pvsyst : Project Design

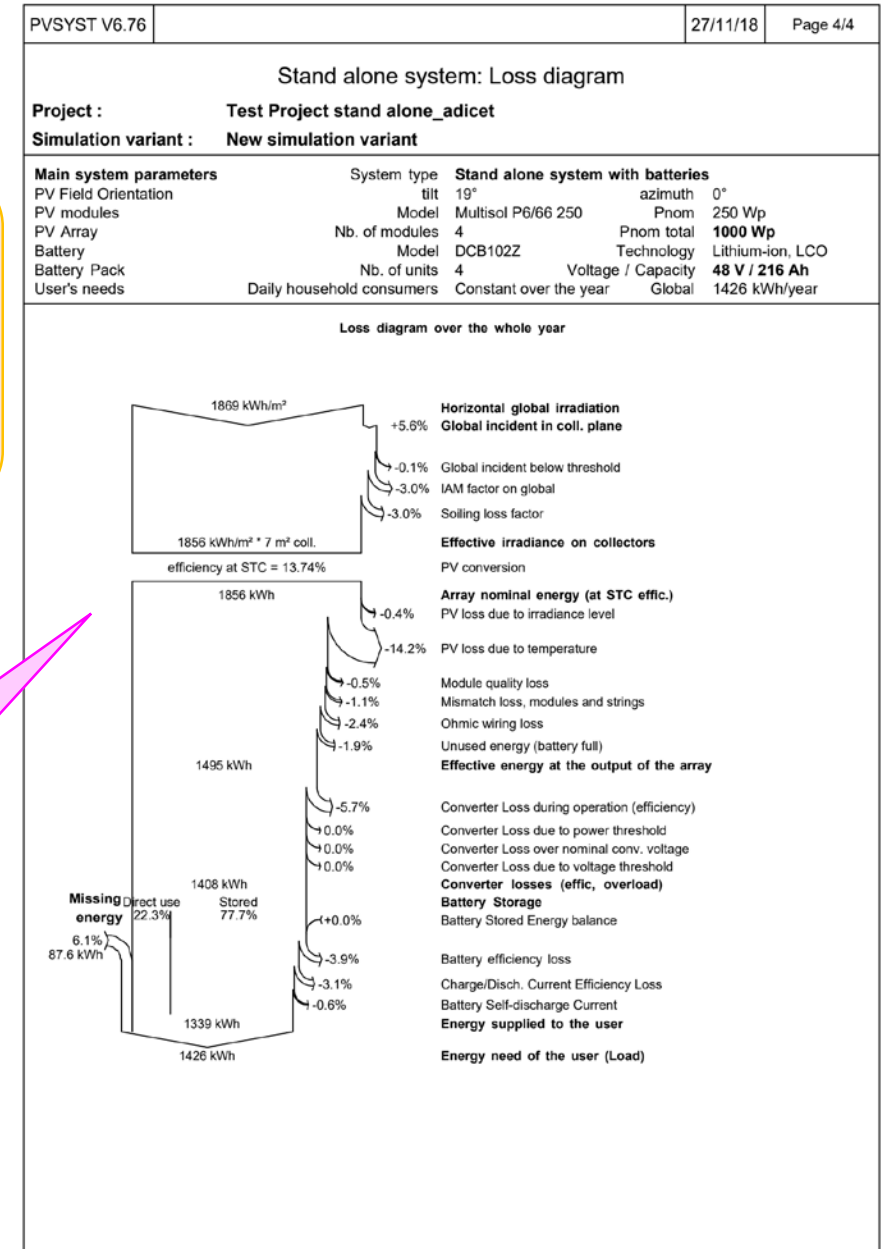


Result System

- System Production (Power output PR etc.)
- Loss of load
- Battery

Result Loss

- environment loss
- System loss



Thank You.



Question

Load

Electric equipment	Power (W)	Number	Time (hr)	Energy (kWh)
LED	8	6	6	0.288
FAN	55	2	10	1.10
TV 21"	110	1	4	0.44
Computer	100	1	4	0.40
Fridge	70	1	24	1.68
Total Energy				3.908

Location

- Tshongdu, Paro, Bhutan
- 27.421679, 89.416208

Design stand alone
PV system



Afternoon Section

Pvsyst : Project Design

3D Shading

Project: Test Project stand alone_adicet.PRJ

Project Site Variant

Project's designation

File name: **Test Project stand alone_adicet.PRJ** Project's name: **Test Project stand alone_adicet**

Site File: **Adicet_MN72.SIT** | Meteorom 7.2 (1991-2000), Sat=100% | **Thailand**

Meteo File: **Adicet_MN72_SYN.MET** | Meteorom 7.2 (1991-2000), Sat=100% | **Synthetic** | **0 km**

Simulation done
(version 6.76, date 27/11/18)

Meteo database

Project settings

System Variant (calculation version)

Variant n°: **VC2** : New simulation variant

Input parameters

Main parameters

- Orientation
- User's needs
- System
- Detailed losses

Optional

- Horizon
- Near Shadings
- Economic eval.

Simulation

Run Simulation

Advanced Simul.

Report

Detailed results

Results overview

System kind: **Stand alone system with batteries**

System Production	3707 kWh/yr
Specific production	1483 kWh/KWp/yr
Performance Ratio	0.289
Normalized production	1.56 kWh/KWp/day
Array losses	3.63 kWh/KWp/day
System losses	0.21 kWh/KWp/day

System overview

Exit

Near Shadings definition, Variant "New simulation variant"

Comment: **Test Project stand alone_adicet V2**

Compatibility with Orientation and System parameter

	Orient./System	Shadings
Active area	7 m²	7 m²
Fields tilt	19.0°	19.0°
Fields azimuth	0.0°	0.0°

Warning

The Shading area is slightly lower than the PV modules area.

Shading Factor tables

Table

Graph

Use in simulation

☐ No Shadings
☒ Linear shadings
☐ According to module strings

Calculation mode

☒ Fast (table)
☐ Slow (simul.)

Fraction for electrical effect: **100.0** %

System overview

Print

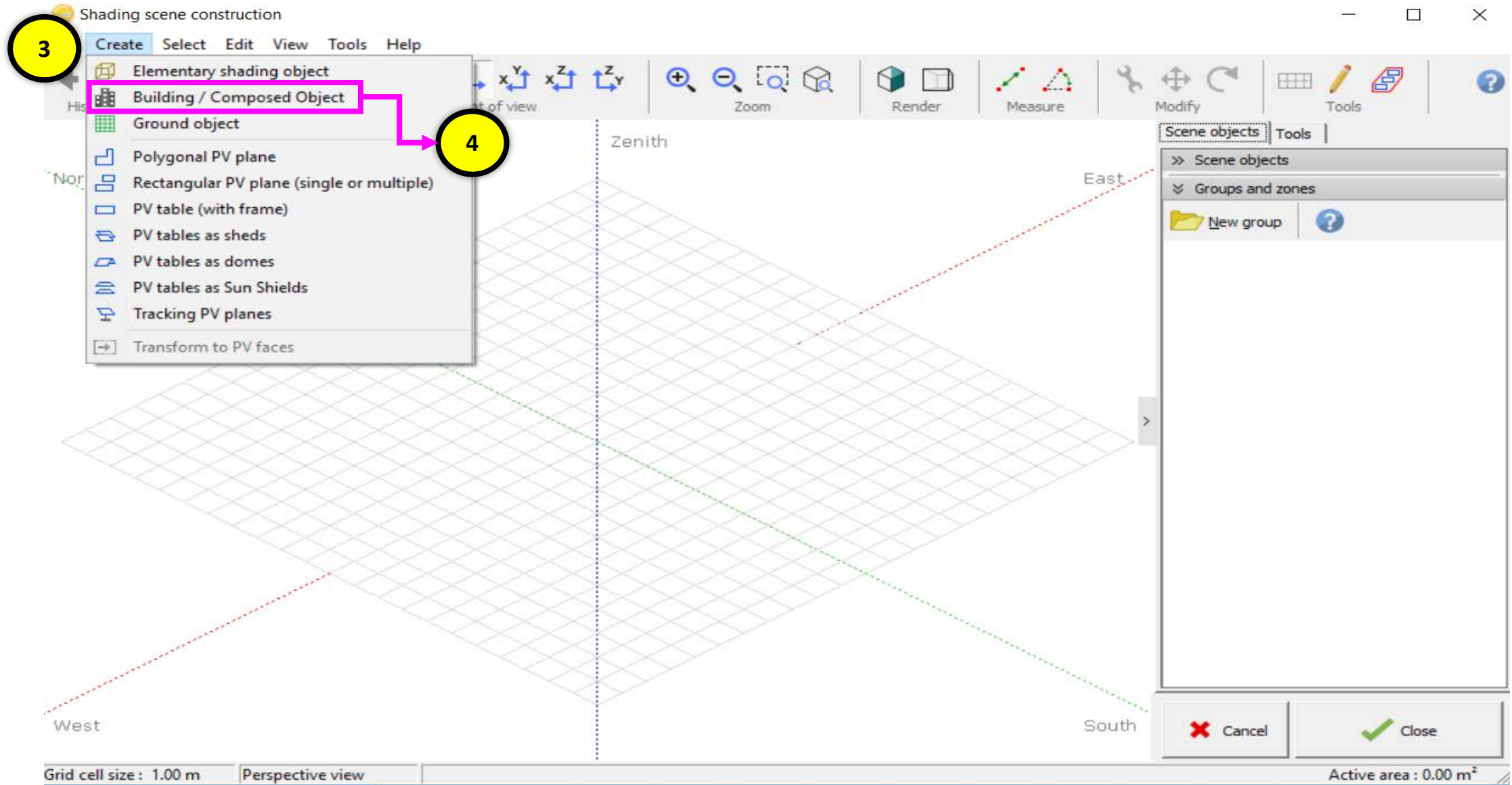
Open

Cancel

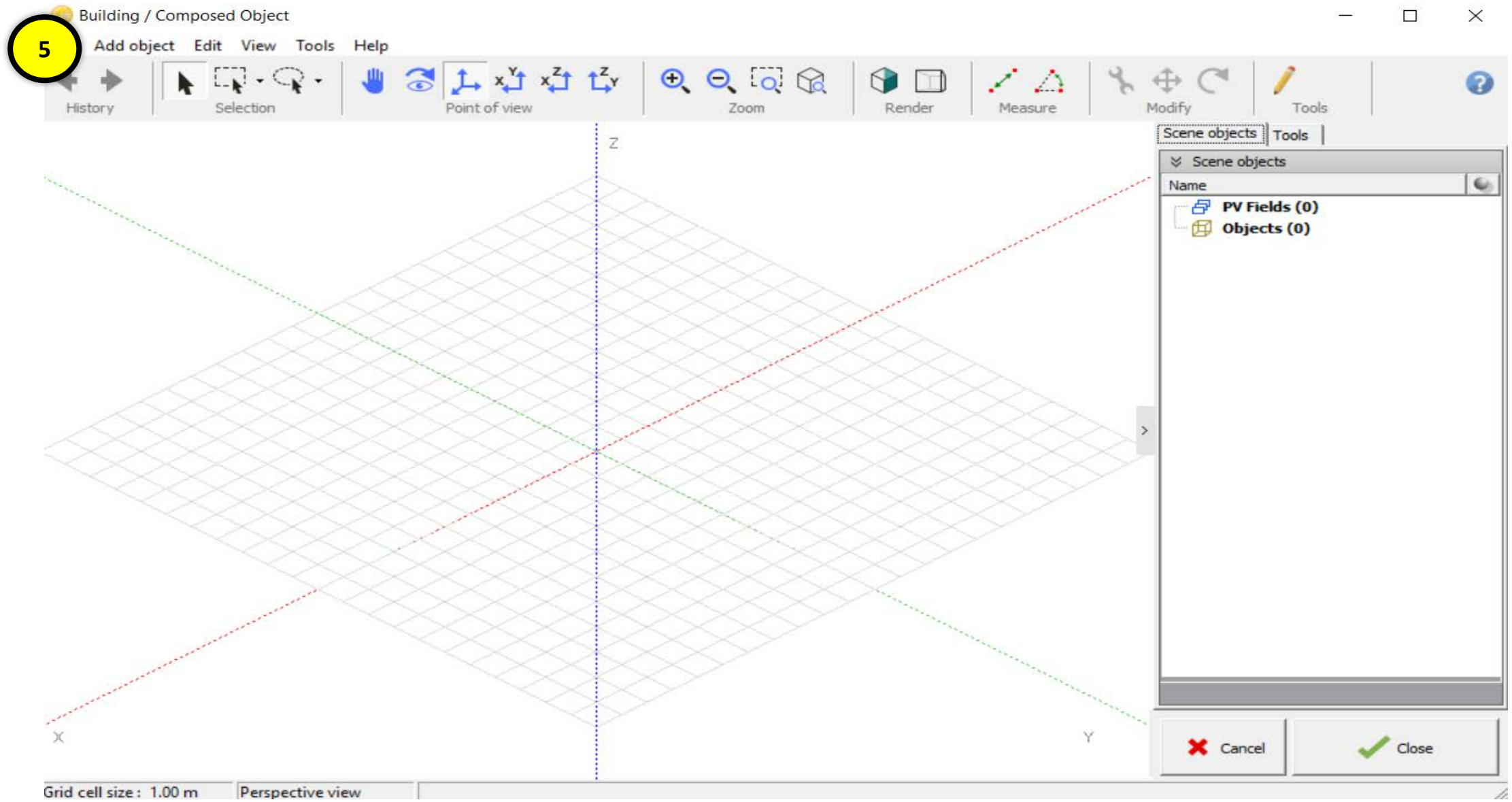
Save

OK

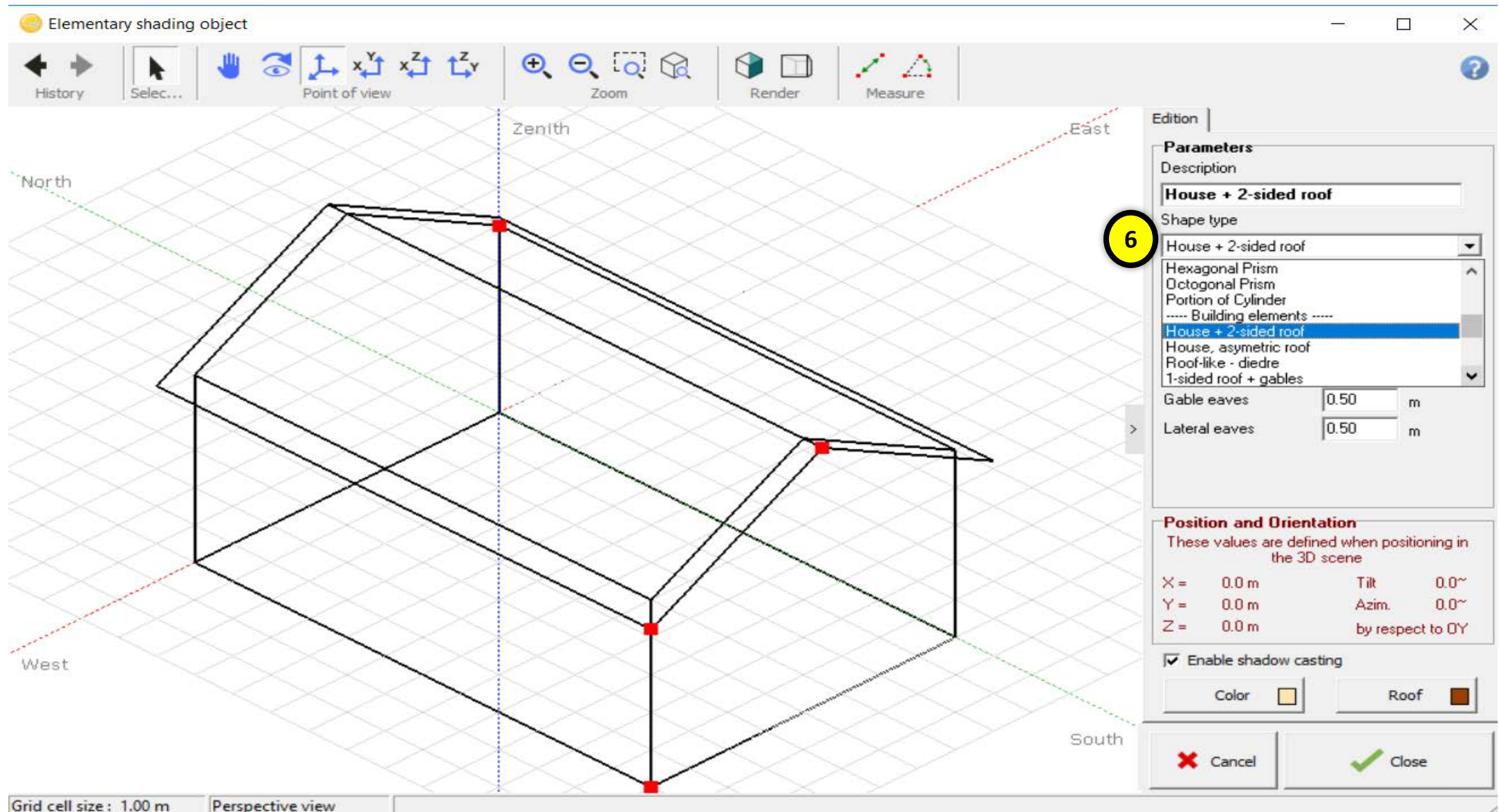
Pvsyst : Project Design



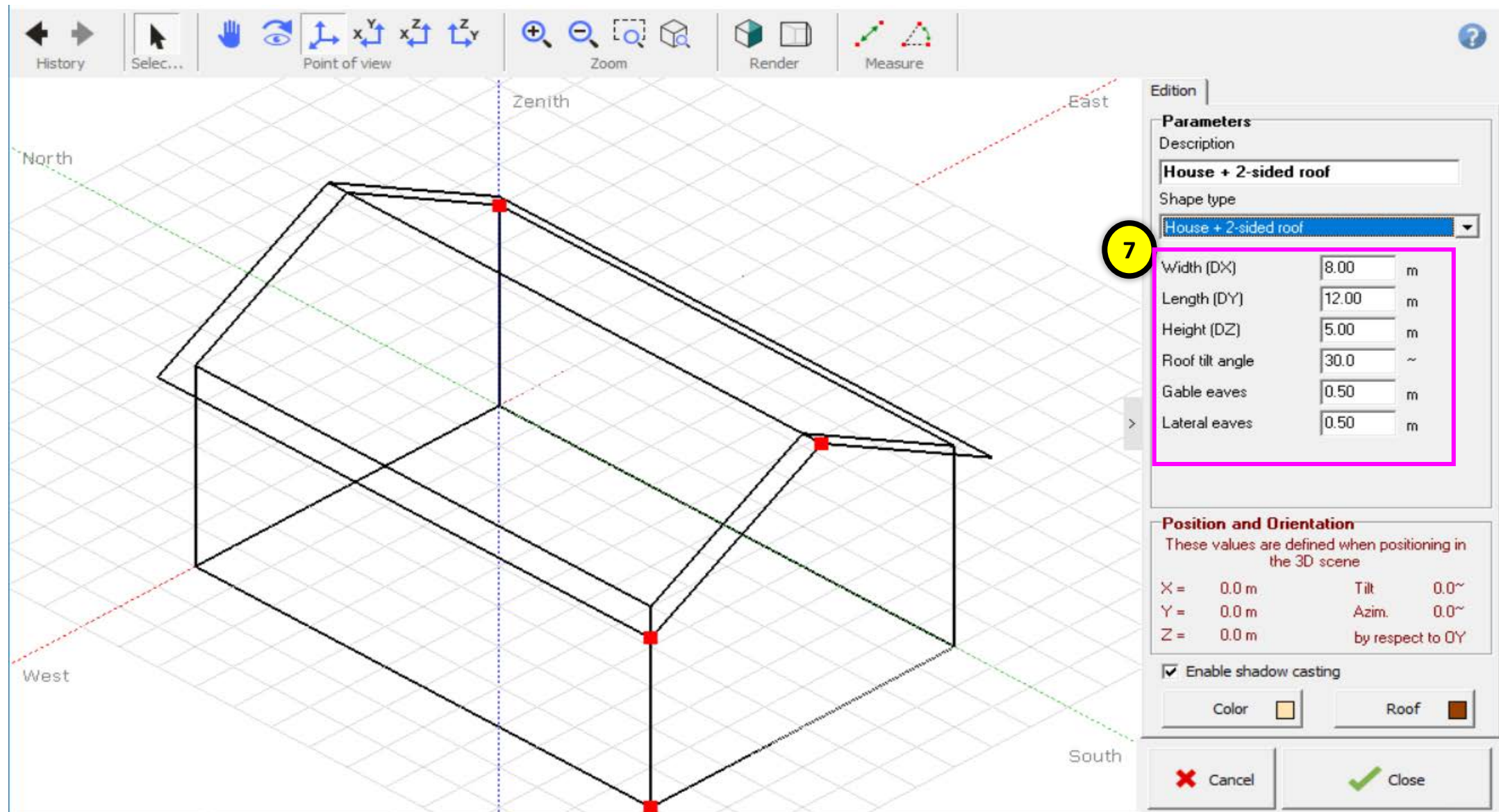
Pvsyst : Project Design



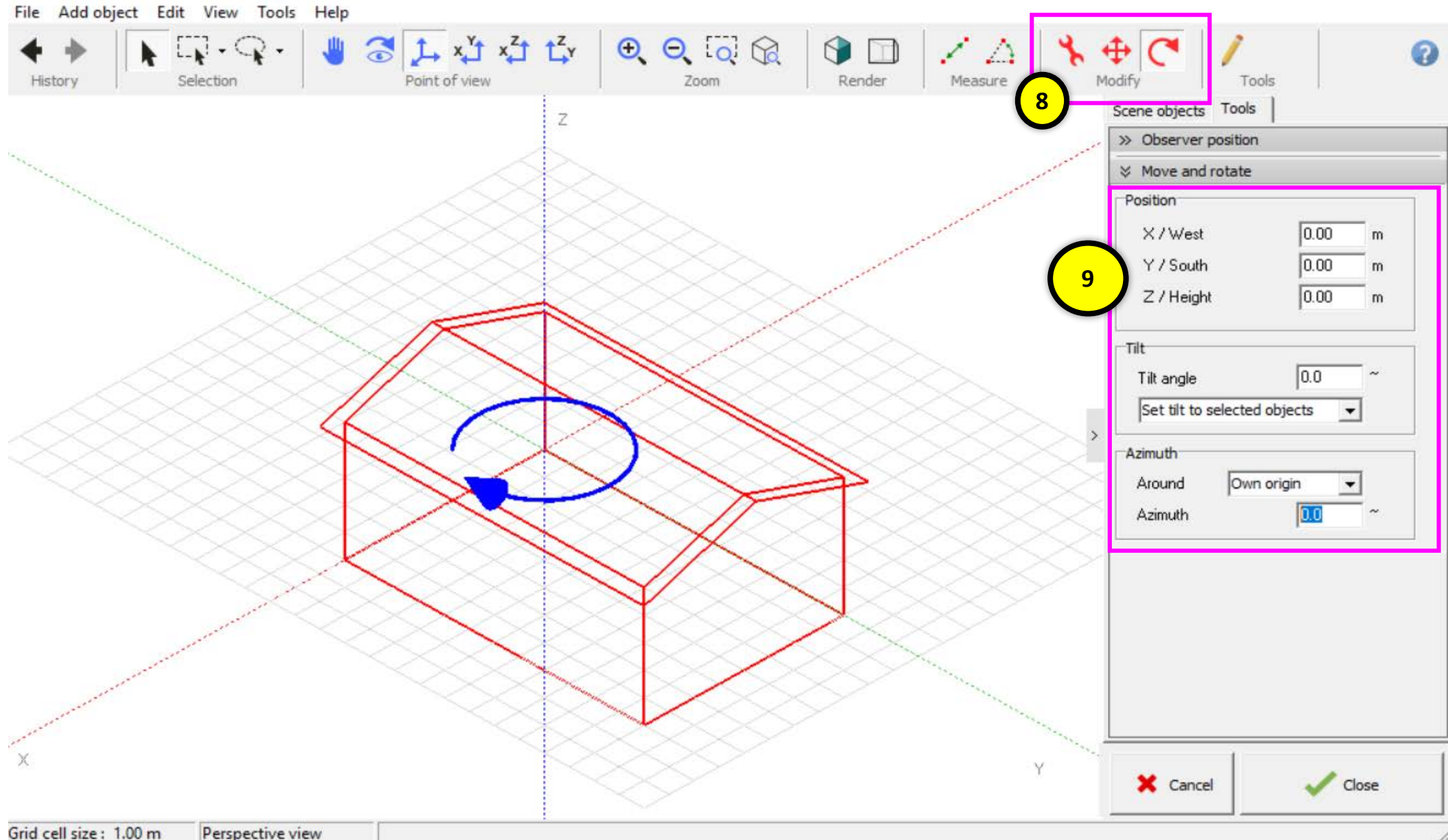
Pvsyst : Project Design



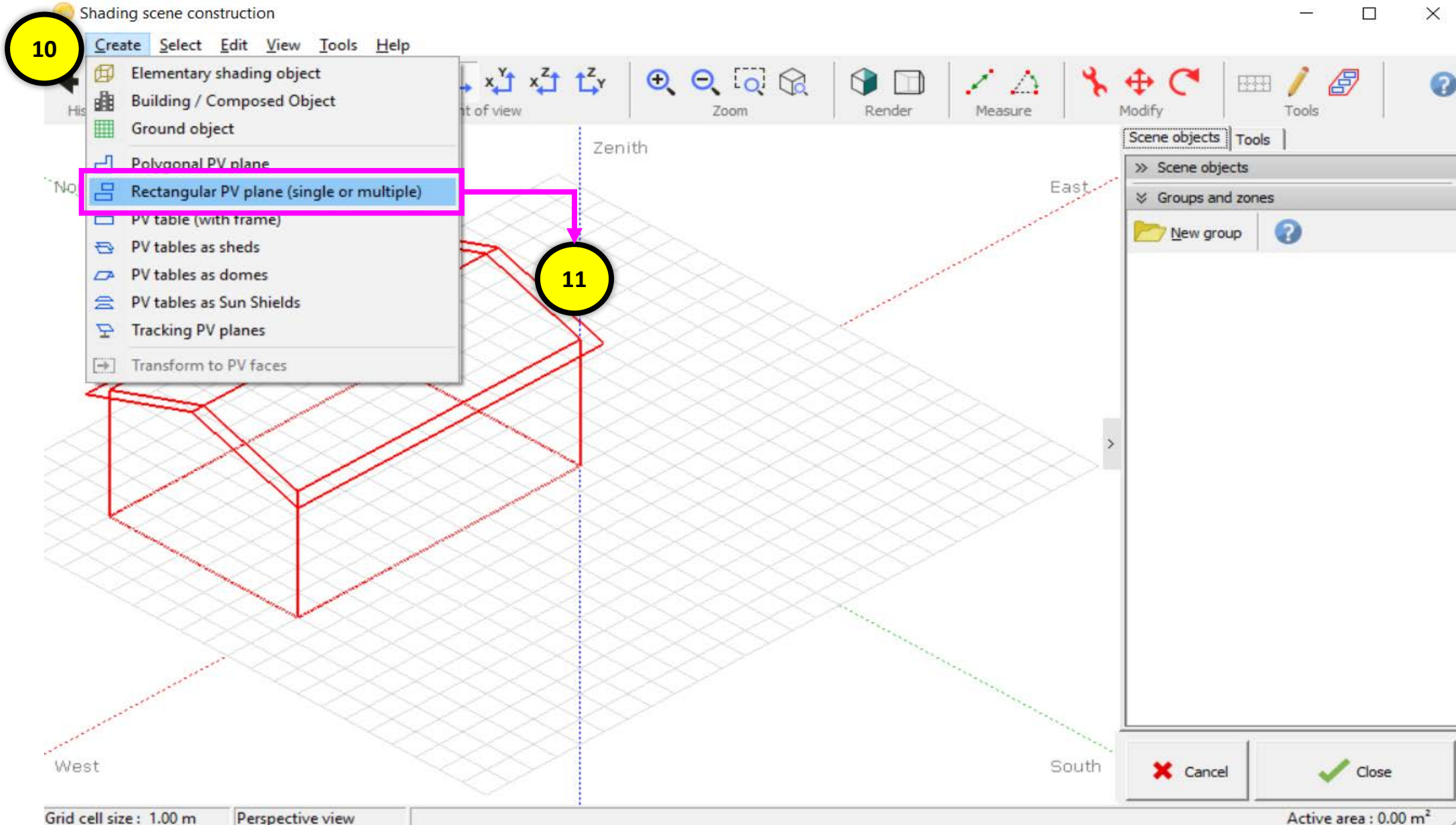
Pvsyst : Project Design



Pvsyst : Project Design



Pvsyst : Project Design



Pvsyst : Project Design

(Multi) Rectangular field

History | Selec... | Point of view | Zoom | Measure

Orth

West | East

Grid cell size : 1.00 m | Perspective view

12

13

Adjust to modules

Modules by rectangle

Selected module

Multisol P6/66 250

Module width **1.000 m**

Module height **1.820 m**

Orientation **Portrait**

Nb X modules **4**

Nb Y modules **1**

Modules X spacing **0.02 m**

Modules Y spacing **0.02 m**

Single rectangle

Width **1.84 m**

Length **4.08 m**

Nb. modules **4**

Rectangle area **7.5 m²**

Total area

Nb. modules **4**

Total area **7.5 m²**

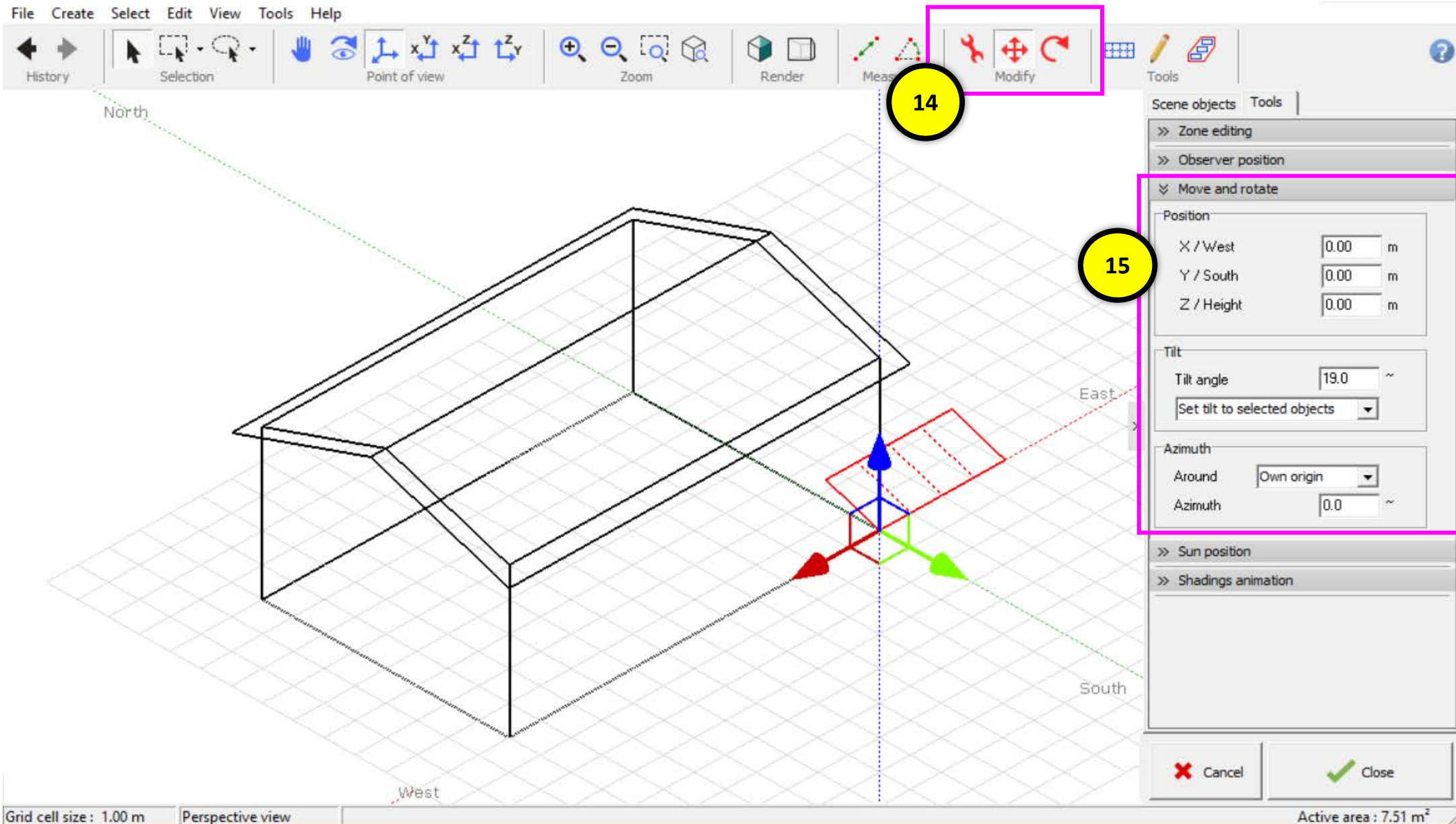
Required area **7.3 m²**

☒ Enable shadow casting

Color Shades

Cancel **Close**

Pvsyst : Project Design



After setting

Position

X / West 6.00 m

Y / South 0.00 m

Z / Height 5.10 m

Tilt

Tilt angle 19.0 ~

Set tilt to selected objects

Azimuth

Around Own origin

Azimuth 0.0 ~

Pvsyst : Project Design

The screenshot displays the Pvsyst software interface. The main window shows a 3D perspective view of a solar panel array on a grid. The grid cell size is 1.00 m. The view is labeled 'Perspective view'. The active area is 7.51 m². The interface includes a menu bar (File, Create, Select, Edit, View, Tools, Help) and a toolbar with various icons for selection, zoom, render, and animation.

The 'Shadings animation' dialog box is open on the right side. It contains the following information:

- Scene objects:** Tools
- Shadings animation:**
 - Day of year: 21/12/ 2560
 - Step duration: 15 minutes
 - Shading loss on clear day: Beam linear loss 0.0%
- Information:**
 - Date: 21/12/2560
 - Sun height: 30
 - Linear: 0.000
 - According to module:

Annotations in the image highlight specific features:

- 16:** Points to the 'Shadings animation' dialog box.
- 17:** Points to the 'Play animation' button (a green play icon).
- 18:** Points to the 'Save VOD file' button (a floppy disk icon).

At the bottom of the dialog box, there are 'Cancel' and 'Close' buttons.

Pvsyst : Project Design

Project: Test Project stand alone_adicet.PRJ

Project Site Variant

Project's designation

File name: **Test Project stand alone_adicet.PRJ** Project's name: Test Project stand alone_adicet

Site File: Adicet_MN72.SIT Meteoronorm 7.2 (1991-2000), Sat=100% Thailand

Meteo File: Adicet_MN72_SYN.MET Meteoronorm 7.2 (1991-2000), Sat=100% Synthetic 0 km

Simulation done
(version 6.76, date 27/11/18)

Meteo database

Project settings

System Variant (calculation version)

Variant n°: VC2 : New simulation variant

Input parameters

Main parameters: Orientation, User's needs, System, Detailed losses

Optional: Horizon, Near Shadings, Economic eval.

19 Run Simulation

Advanced Simul.

Report

21 Detailed results

Results overview

System kind: **Stand alone system with batteries**

System Production	3707 kWh/yr
Specific production	1483 kWh/kWp/yr
Performance Ratio	0.289
Normalized production	1.56 kWh/kWp/day
Array losses	3.63 kWh/kWp/day
System losses	0.21 kWh/kWp/day

System overview

Exit

Hourly Simulation Progress

Status: **Simulation ended successfully**

4.4 sec

Attenuation factors for Diffuse

	IAM	Shading	IAM*Shading
Diffuse	0.041	0.000	0.041
Albedo	0.145	0.000	0.145

Display

☐ Hourly Values
☒ Daily Values
☐ Monthly Values

Display daily values

Simulation 31/12/90

Meteo: Global, Diffuse, Tamb 4.99, 1.02kWh/m².day, 22.9°C, 1.0 m/s

On coll: Global, Diffuse, Glob. eff. 6.36, 1.21, 0.03, 6.04 kWh/m².day

System : EMax, ENet, EUse 12.23, 4.43, 3.91kWh/day

Load : ELoad, EUsed, EOver 3.913.9, 7.8 kWh/day

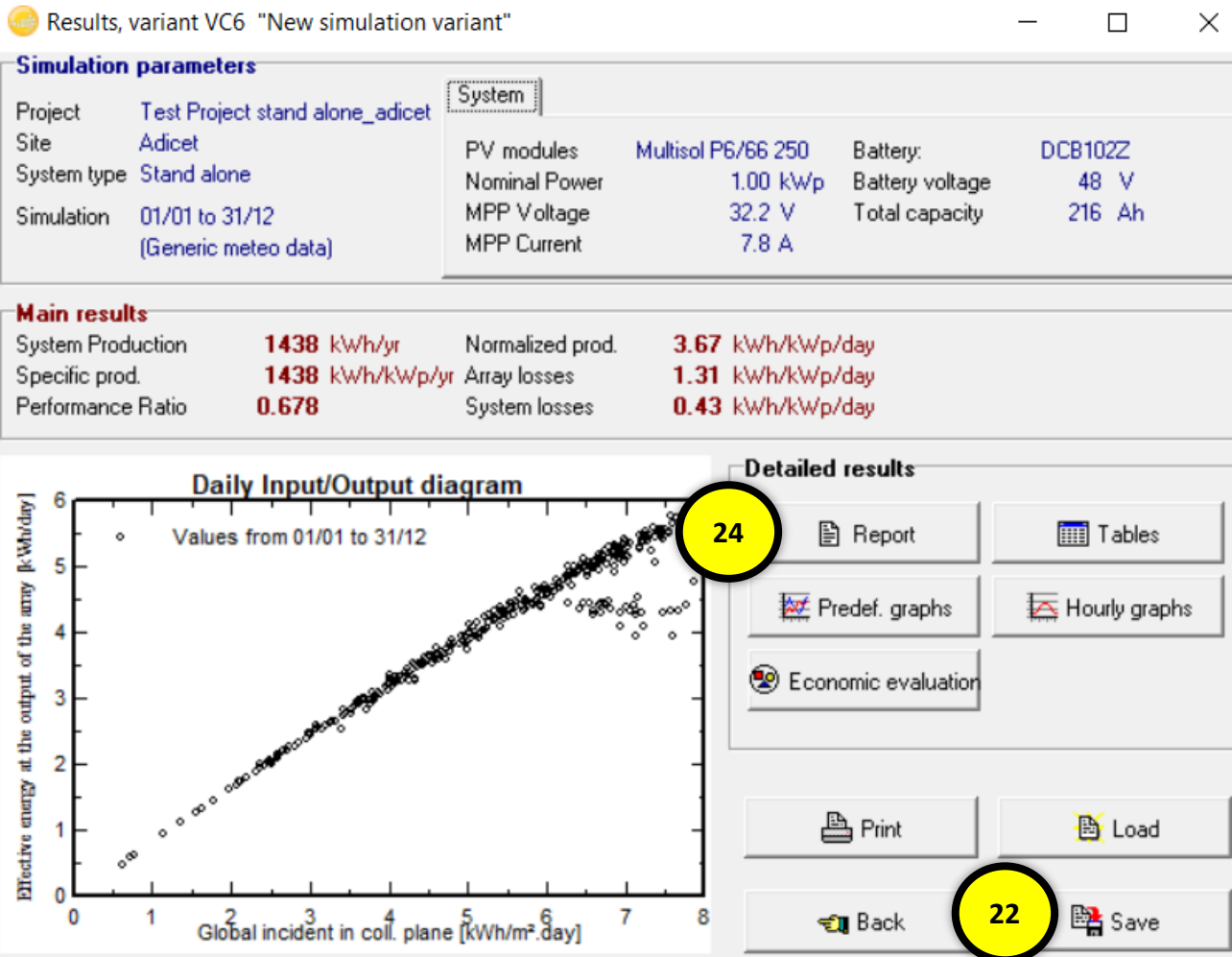
20 OK

Automatically close when simulation ends successfully

Step by step

Continue

Pvsyst : Project Design



Saving the simulation Variant ...

Description

New simulation variant

File name

Test Project stand alone_adicet.VC6

Directory

C:\Users\Nectec\PV\sys660_Data\Projects

Test Project stand alone_adicet.VC0
Test Project stand alone_adicet.VC1
Test Project stand alone_adicet.VC2
Test Project stand alone_adicet.VC3
Test Project stand alone_adicet.VC4
Test Project stand alone_adicet.VC5
Test Project stand alone_adicet.VC6

Cancel

Save

23

Save As New

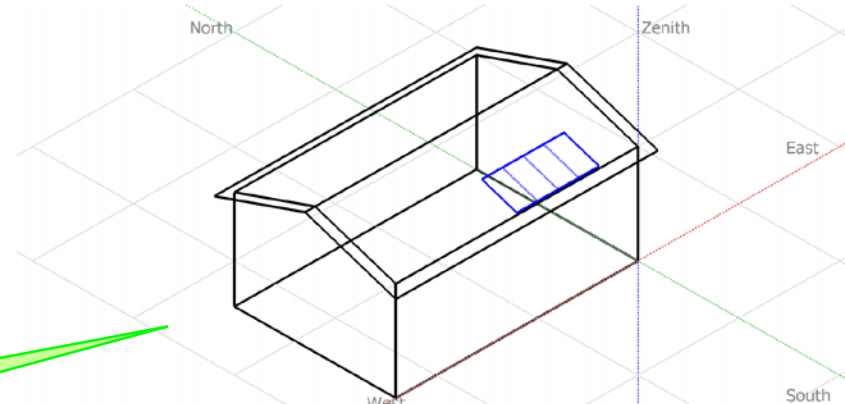
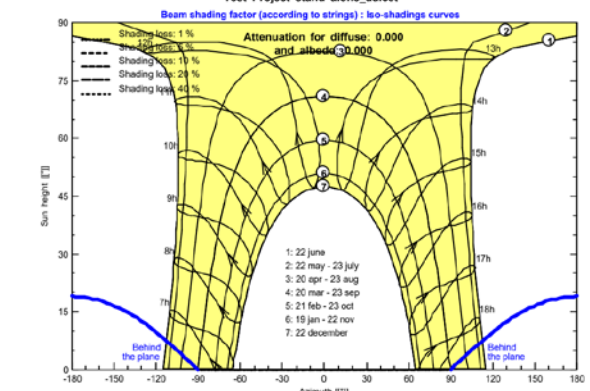
Pvsyst : Project Design

PVSYST V6.76	27/11/18	Page 1/5
Stand alone system: Simulation parameters		
Project : Test Project stand alone_adicet		
Geographical Site	Adicet	Country Thailand
Situation	Latitude 19.02° N	Longitude 98.94° E
Time defined as	Legal Time	Time zone UT+7
	Albedo	0.20
Meteo data:	Adicet	Meteonorm 7.2 (1991-2000), Sat=100% - Synthetic
Simulation variant : New simulation variant		
	Simulation date	27/11/18 18h17
Simulation parameters	System type	Stand alone system with batteries
Collector Plane Orientation	Tilt	19°
	Azimuth	0°
Models used	Transposition	Perez
	Diffuse	Perez, Meteonorm
Near Shadings	According to strings	Electrical effect 100 %
User's needs :	Daily household consumers average	Constant over the year 3.9 kWh/Day
PV Array Characteristics		
PV module	Si-poly	Model Multisol P6/66 250
Original Pvsyst database	Manufacturer	Scheuten
Number of PV modules	In series	2 modules
Total number of PV modules	Nb. modules	4
Array global power	Nominal (STC)	1000 Wp
Array operating characteristics (50°C)	U mpp	56 V
Total area	Module area	7.3 m²
System Parameter		
System type	Stand alone system	
Battery	Model	DCB102Z
Battery Pack Characteristics	Manufacturer	Panasonic
	Nb. of units	4 in parallel
	Voltage	48 V
	Nominal Capacity	216 Ah
	Discharging min. SOC	10.0 %
	Temperature	Fixed (30°C)
Controller	Model	Universal controller with MPPT converter
Converter	Technology	MPPT converter
	Maxi and EURO efficiencies	97.0 / 95.0 %
Battery Management control	Threshold commands as	SOC calculation
	Charging	SOC = 0.96 / 0.80
	Discharging	SOC = 0.10 / 0.35
PV Array loss factors		
Array Soiling Losses	Uc (const)	20.0 W/m²K
Thermal Loss factor		Loss Fraction 3.0 %
	Global array res.	62 mOhm
Wiring Ohmic Loss	Voltage Drop	0.7 V
Loss Fraction		1.5 % at STC
Module Quality Loss		Loss Fraction 1.1 % at STC
Module Mismatch Losses		Loss Fraction 0.5 %
Strings Mismatch loss		Loss Fraction 1.0 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)
	bo Param.	0.05

Detail System

- Location
- PV
- Battery
- Loss factor

Shading

PVSYST V6.76	27/11/18	Page 2/5
Stand alone system: Near shading definition		
Project : Test Project stand alone_adicet		
Simulation variant : New simulation variant		
Main system parameters	System type	Stand alone system with batteries
Near Shadings	According to strings	Electrical effect 100 %
PV Field Orientation	tilt	19°
PV modules	Model	Multisol P6/66 250
PV Array	Nb. of modules	4
Battery	Model	DCB102Z
Battery Pack	Nb. of units	4
User's needs	Daily household consumers	Constant over the year
	Global	1426 kWh/year
Perspective of the PV-field and surrounding shading scene		
		
Iso-shadings diagram		
		

Pvsyst : Project Design

PVSYST V6.76 27/11/18 Page 3/5

Stand alone system: Detailed User's needs

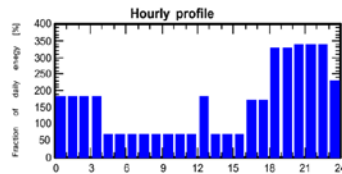
Project : Test Project stand alone_adicet
Simulation variant : New simulation variant

Main system parameters	System type	Stand alone system with batteries
Near Shadings	According to strings	Electrical effect 100 %
PV Field Orientation	tilt 19°	azimuth 0°
PV modules	Model Multisol P6/66 250	Pnom 250 Wp
PV Array	Nb. of modules 4	Pnom total 1000 Wp
Battery	Model DCB102Z	Technology Lithium-ion, LCO
Battery Pack	Nb. of units 4	Voltage / Capacity 48 V / 216 Ah
User's needs	Daily household consumers	Constant over the year Global 1426 kWh/year

Daily household consumers, Constant over the year, average = 3.9 kWh/day

Annual values

	Number	Power	Use	Energy
Lamps (LED or fluo)	6	8 W/lamp	6 h/day	288 Wh/day
Fan	2	55 W/app	10 h/day	1100 Wh/day
TV	1	110 W/app	4 h/day	440 Wh/day
Fridge	1	70 W tot	24 h/day	1680 Wh/day
Computer	1	100 W tot	4 h/day	400 Wh/day
Total daily energy				3908 Wh/day



Detail Load

- Electric equipment
- Time use

Result System

- System Production (Power output PR etc.)
- Loss of load
- Battery

PVSYST V6.76 27/11/18 Page 4/5

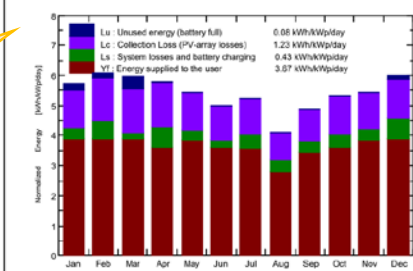
Stand alone system: Main results

Project : Test Project stand alone_adicet
Simulation variant : New simulation variant

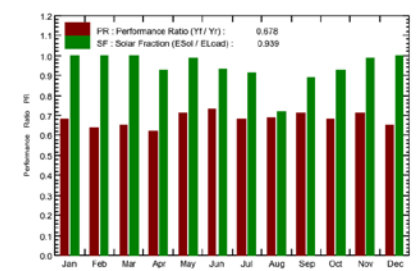
Main system parameters	System type	Stand alone system with batteries
Near Shadings	According to strings	Electrical effect 100 %
PV Field Orientation	tilt 19°	azimuth 0°
PV modules	Model Multisol P6/66 250	Pnom 250 Wp
PV Array	Nb. of modules 4	Pnom total 1000 Wp
Battery	Model DCB102Z	Technology Lithium-ion, LCO
Battery Pack	Nb. of units 4	Voltage / Capacity 48 V / 216 Ah
User's needs	Daily household consumers	Constant over the year Global 1426 kWh/year

Main simulation results	Available Energy	1438 kWh/year	Specific prod.	1438 kWh/kWp/year
System Production	Used Energy	1339 kWh/year	Excess (unused)	30 kWh/year
	Performance Ratio PR	67.83 %	Solar Fraction SF	93.86 %
Loss of Load	Time Fraction	7.5 %	Missing Energy	88 kWh/year
Battery ageing (State of Wear)	Cycles SOW	88.0%	Static SOW	71.7%
	Battery lifetime	3.5 years		

Normalized productions (per installed kWp): Nominal power 1000 Wp



Performance Ratio PR and Solar Fraction SF



New simulation variant
Balances and main results

	GlobHor kWh/m²	GlobEff kWh/m²	E_Avail kWh	E_Unused kWh	E_Miss kWh	E_User kWh	E_Load kWh	SolFrac
January	145.8	168.2	130.9	6.26	0.00	121.1	121.1	1.000
February	147.8	161.1	123.1	4.73	0.00	109.4	109.4	1.000
March	172.6	174.4	132.3	12.87	0.00	121.1	121.1	1.000
April	175.2	163.6	123.3	1.23	8.57	108.7	117.2	0.927
May	180.3	157.4	121.3	0.02	1.49	119.7	121.1	0.988
June	163.7	136.9	109.4	0.00	8.26	109.0	117.2	0.930
July	178.1	151.7	118.5	0.00	10.78	110.4	121.1	0.911
August	131.0	118.6	93.9	0.02	34.22	86.9	121.1	0.718
September	142.7	137.1	107.6	0.01	13.42	103.8	117.2	0.886
October	149.4	154.6	119.3	0.02	9.36	111.8	121.1	0.923
November	136.5	153.1	119.9	0.03	1.54	115.7	117.2	0.987
December	147.2	176.2	138.0	4.43	0.00	121.1	121.1	1.000
Year	1866.3	1855.8	1438.0	26.66	87.63	1338.8	1426.4	0.939

Legends: GlobHor Horizontal global irradiation
GlobEff Effective Global, corr. for IAM and shadings
E_Avail Available Solar Energy
E_Unused Unused energy (battery full)
E_Miss Missing energy
E_User Energy supplied to the user
E_Load Energy need of the user (Load)
SolFrac Solar fraction (E_Load / E_User)

Pvsyst : Project Design

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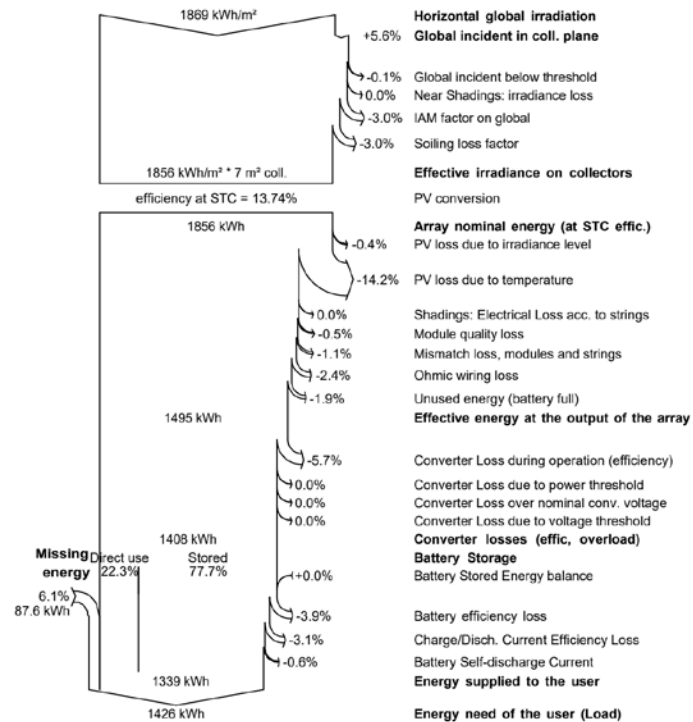
Stand alone system: Loss diagram

Project : Test Project stand alone_adicet

Simulation variant : New simulation variant

Main system parameters	System type	Stand alone system with batteries
Near Shadings	According to strings	Electrical effect 100 %
PV Field Orientation	tilt 19°	azimuth 0°
PV modules	Model Multisol P6/66 250	Pnom 250 Wp
PV Array	Nb. of modules 4	Pnom total 1000 Wp
Battery	Model DCB102Z	Technology Lithium-ion, LCO
Battery Pack	Nb. of units 4	Voltage / Capacity 48 V / 216 Ah
User's needs	Daily household consumers	Constant over the year Global 1426 kWh/year

Loss diagram over the whole year



Result Loss

- environment loss
- System loss

Kadrin Chhe.

