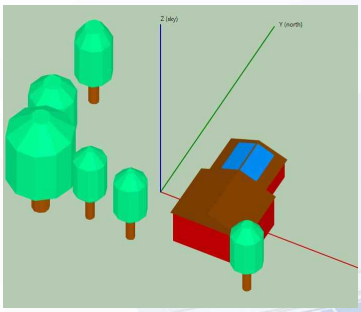
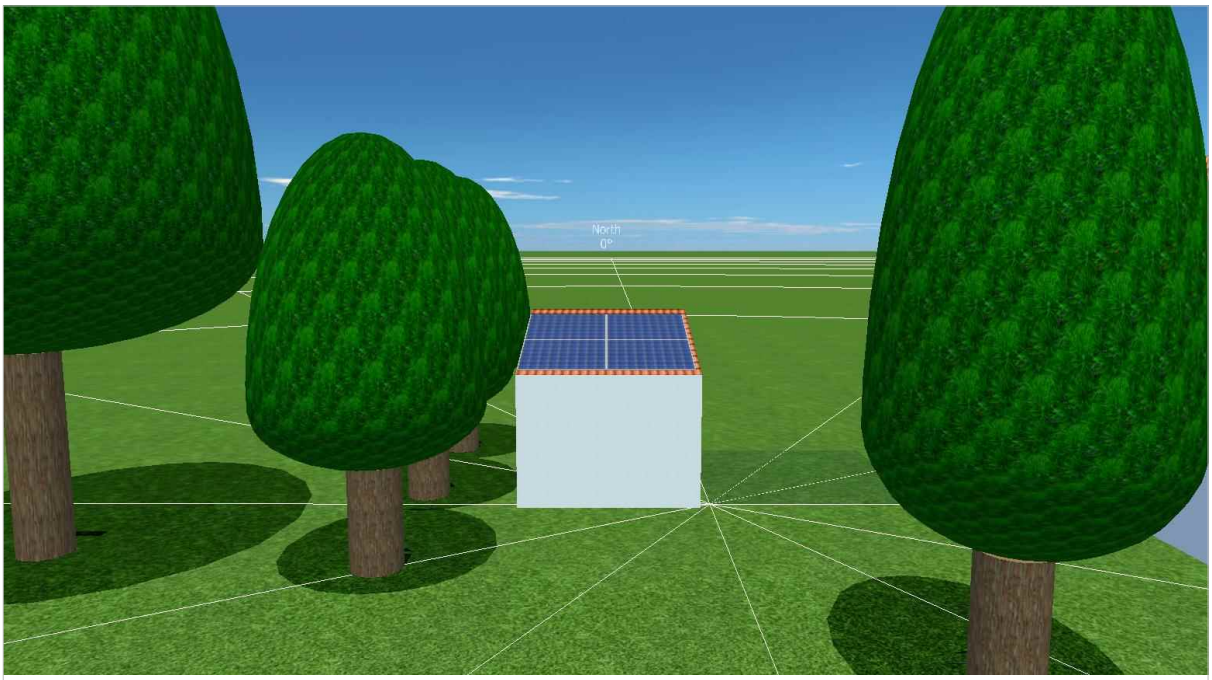
Company

Please enter in Options > User data.

Client

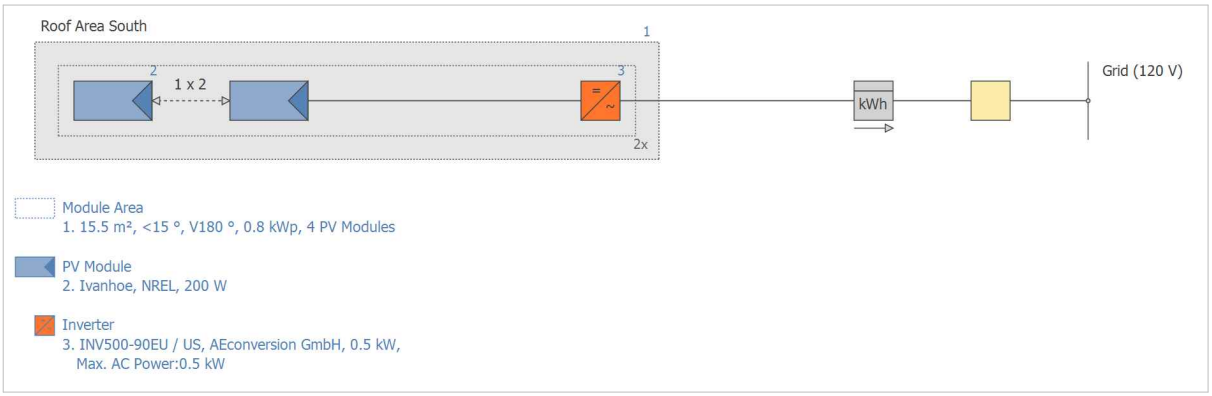
Project





3D, Grid Connected PV System

Climate Data	DENVER INTL AP (1991 - 2005)	
PV Generator Output	0.8	kWp
PV Generator Surface	15.5	m²
Number of PV Modules	4	
Number of Inverters	2	



The yield

PV Generator Energy (AC grid)	815	kWh
Spec. Annual Yield	1,019.21	kWh/kWp
Performance Ratio (PR)	57.2	%
Calculation of Shading Losses	31.5	%/year
CO_2 Emissions avoided	489	kg / year

Your Gain		
Total investment costs	1,200.00	$
Return on Assets	1.31	%
Amortization Period	More than 20	Years
Electricity Production Costs	0.08	$/kWh

The results have been calculated with a mathematical model calculation from Valentin Software GmbH (PV*SOL algorithms). The actual yields from the solar power system may differ as a result of weather variations, the efficiency of the modules and inverter, and other factors.

Set-up of the system

Climate Data	DENVER INTL AP
Type of System	3D, Grid Connected PV System

PV Generator Module Area

Name	Roof Area South	
PV Modules*	4 x Ivanhoe	
Manufacturer	NREL	
Inclination	15	°
Orientation	South 180	°
Installation Type	Roof parallel	
PV Generator Surface	15.5	m²

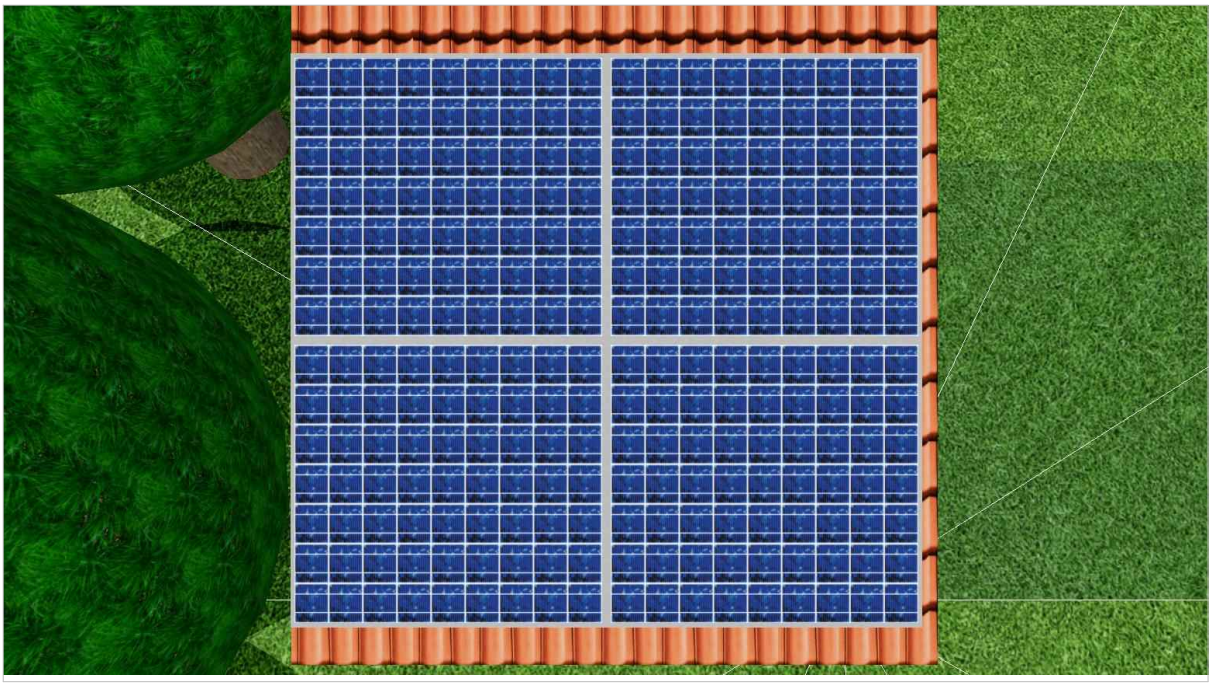


Figure: 3D Design for Roof Area South

Losses

Inverter

Module Area	**Roof Area South**
Inverter 1*	2 x INV500-90EU / US
Manufacturer	AEconversion GmbH
Configuration	MPP 1: 1 x 2

AC Mains

Number of Phases	3	
Mains Voltage (1-phase)	120	V
Displacement Power Factor (cos phi)	+/- 1	

Cable	
Max. Total Loss	0 %

* The guarantee provisions of the respective manufacturer apply

Simulation Results

PV System

PV Generator Output	0.8	kWp
Spec. Annual Yield	1,019.21	kWh/kWp
Performance Ratio (PR)	57.2	%
Yield Reduction due to Shading	31.5	%/year
Grid Feed-in	815	kWh/year
Grid Feed-in in the first year (incl. module degradation)	815	kWh/year
Stand-by Consumption	0	kWh/year
CO_2 Emissions avoided	489	kg / year

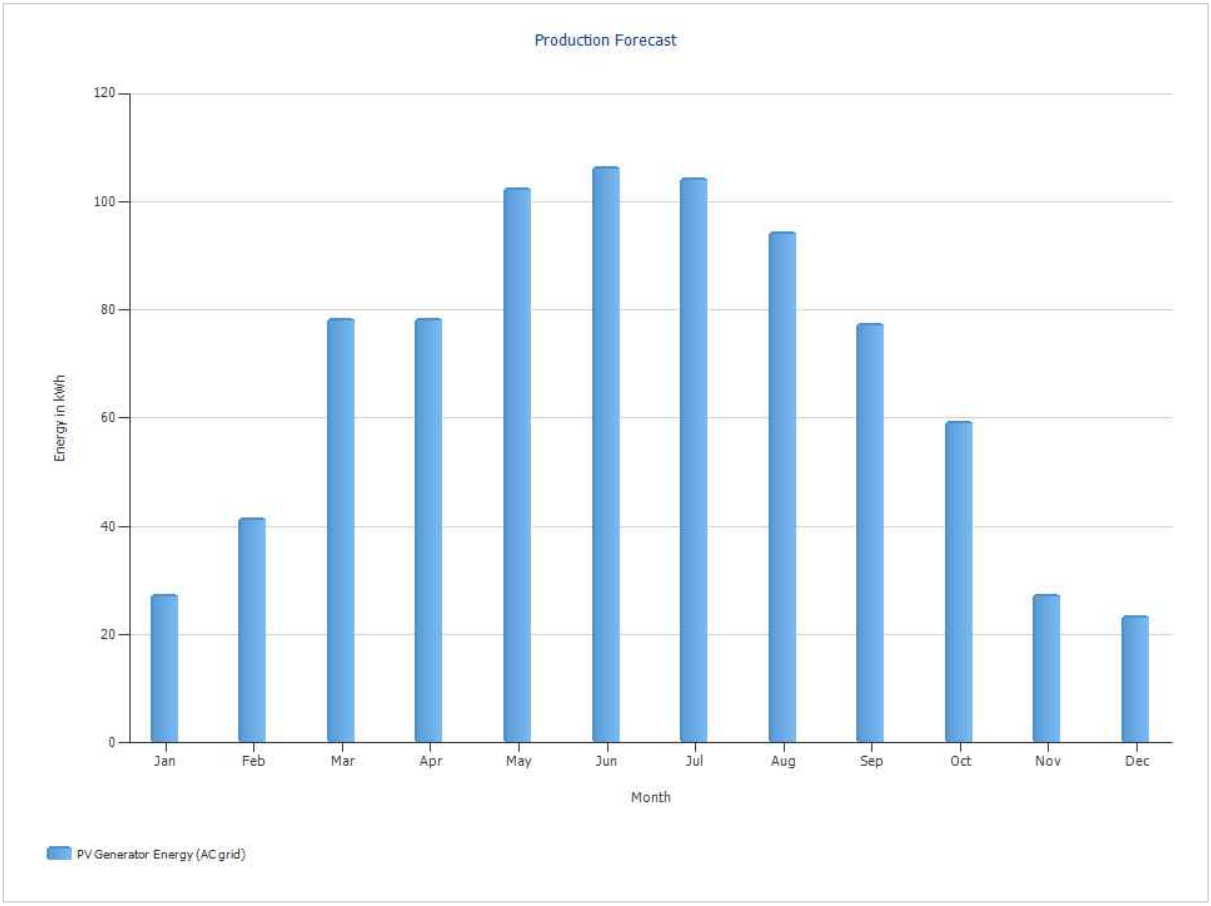


Figure: Production Forecast

Results per Module Area

Roof Area South

PV Generator Output	0.8	kWp
PV Generator Surface	15.5	m²
Global Radiation at the Module	1780.4	kWh/m²
PV Generator Energy (AC grid)	815.4	kWh/year
Spec. Annual Yield	1019.2	kWh/kWp
Performance Ratio (PR)	57.2	%

PV System Energy Balance

Global radiation - horizontal	**1,670.2**	**kWh/m²**	
Deviation from standard spectrum	-16.70	kWh/m²	-1.00 %
Orientation and inclination of the module surface	182.49	kWh/m²	11.04 %
Shading of diffuse radiation by horizon	-55.63	kWh/m²	-3.03 %
Reflection on the Module Interface	-82.20	kWh/m²	-4.62 %
Global Radiation at the Module	**1,698.2**	**kWh/m²**	
	1,698.2	kWh/m²	
	x 15.53	m²	
	= 26,377.0	kWh	
Global PV Radiation	**26,377.0**	**kWh**	
Soiling	0.00	kWh	0.00 %
STC Conversion (Rated Efficiency of Module 5.15 %)	-25,017.83	kWh	-94.85 %
Rated PV Energy	**1,359.2**	**kWh**	
Module-specific Partial Shading	-156.66	kWh	-11.53 %
Low-light performance	-186.65	kWh	-15.52 %
Deviation from the nominal module temperature	-54.05	kWh	-5.32 %
Diodes	-5.17	kWh	-0.54 %
Mismatch (Manufacturer Information)	-19.13	kWh	-2.00 %
Mismatch (Configuration/Shading)	-4.75	kWh	-0.51 %
PV Energy (DC) without inverter regulation	**932.8**	**kWh**	
Regulation on account of the MPP Voltage Range	-38.60	kWh	-4.14 %
Regulation on account of the max. DC Current	0.00	kWh	0.00 %
Regulation on account of the max. DC Power	0.00	kWh	0.00 %
Regulation on account of the max. AC Power/cos phi	0.00	kWh	0.00 %
MPP Matching	-0.03	kWh	0.00 %
PV energy (DC)	**894.1**	**kWh**	
Energy at the Inverter Input	**894.1**	**kWh**	
Input voltage deviates from rated voltage	-0.37	kWh	-0.04 %
DC/AC Conversion	-78.39	kWh	-8.77 %
Stand-by Consumption	-0.26	kWh	-0.03 %
Total Cable Losses	0.00	kWh	0.00 %
PV energy (AC) minus standby use	**815.1**	**kWh**	
Grid Feed-in	**815.4**	**kWh**	

Financial Analysis

System Data

Grid Feed-in in the first year (incl. module degradation)	815	kWh/year
PV Generator Output	0.8	kWp
Start of Operation of the System	1/1/2015	
Assessment Period	20	Years

Economic Parameters

Return on Assets	1.31	%
Accrued Cash Flow (Cash Balance)	56.90	$
Amortization Period	More than 20	Years
Electricity Production Costs	0.08	$/kWh

Payment Overview

Specific Investment Costs	1,500.00	$/kWp
Investment Costs	1,200.00	$
One-off Payments	0.00	$
Incoming Subsidies	0.00	$
Annual Costs	0.00	$/year
Other Revenue or Savings	0.00	$/year

Remuneration and Savings

Total Payment from Utility in First Year	0.00	$

California feed-in tariff program - 20 year term - All

Validity	8/5/2016 -	8/4/2036
Specific feed-in / export Remuneration	0.0895	$/kWh
Feed-in / Export Tariff	72.98	$/year

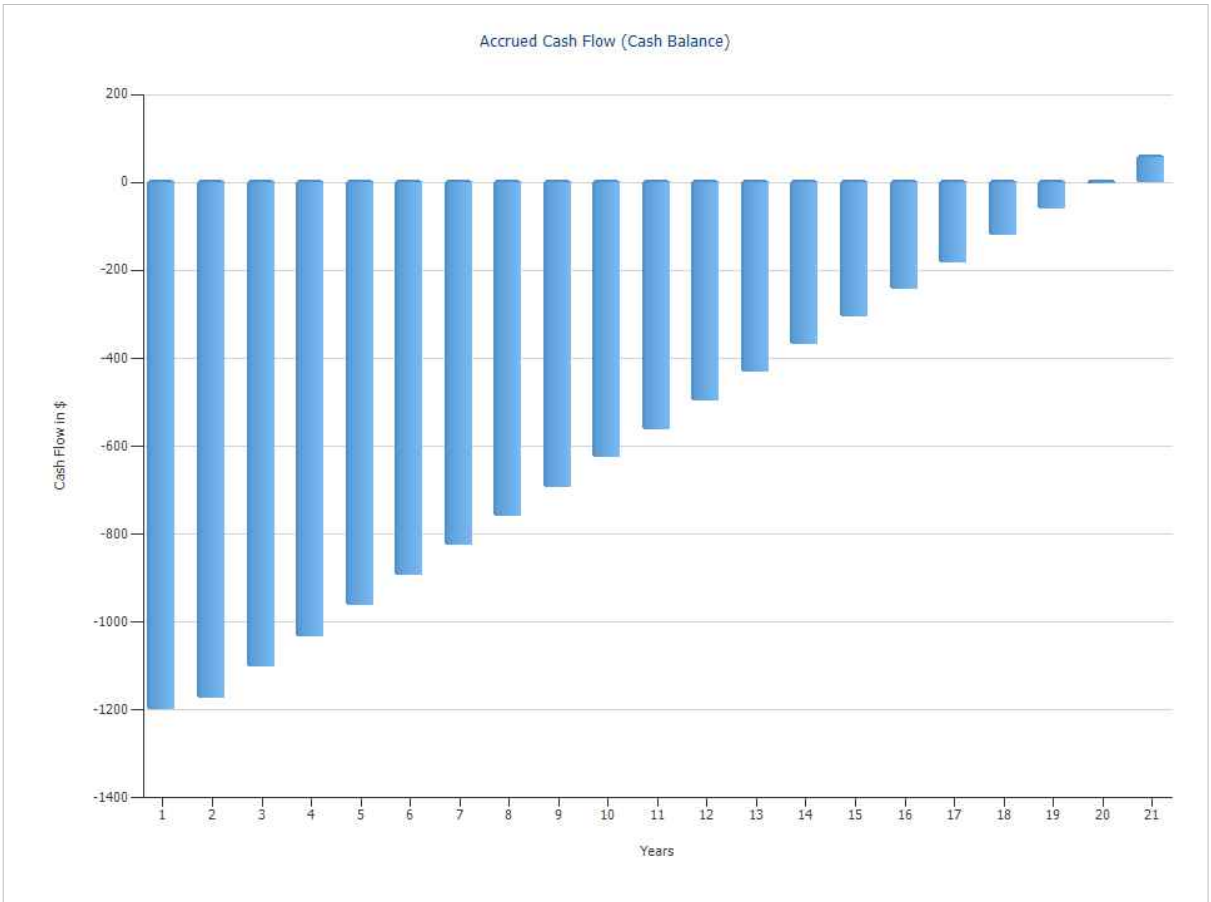


Figure: Accrued Cash Flow (Cash Balance)

Cashflow Table

	year 1	year 2	year 3	year 4	year 5
Investments	($1,200.00)	$0.00	$0.00	$0.00	$0.00
Feed-in / Export Tariff	$0.00	$24.59	$70.83	$70.13	$69.43
Annual Cash Flow	**($1,200.00)**	**$24.59**	**$70.83**	**$70.13**	**$69.43**
Accrued Cash Flow (Cash Balance)	($1,200.00)	($1,175.41)	($1,104.58)	($1,034.45)	($965.02)

	year 6	year 7	year 8	year 9	year 10
Investments	$0.00	$0.00	$0.00	$0.00	$0.00
Feed-in / Export Tariff	$68.75	$68.07	$67.39	$66.72	$66.06
Annual Cash Flow	**$68.75**	**$68.07**	**$67.39**	**$66.72**	**$66.06**
Accrued Cash Flow (Cash Balance)	($896.27)	($828.20)	($760.81)	($694.09)	($628.02)

	year 11	year 12	year 13	year 14	year 15
Investments	$0.00	$0.00	$0.00	$0.00	$0.00
Feed-in / Export Tariff	$65.41	$64.76	$64.12	$63.49	$62.86
Annual Cash Flow	**$65.41**	**$64.76**	**$64.12**	**$63.49**	**$62.86**
Accrued Cash Flow (Cash Balance)	($562.62)	($497.85)	($433.73)	($370.25)	($307.39)

	year 16	year 17	year 18	year 19	year 20
Investments	$0.00	$0.00	$0.00	$0.00	$0.00
Feed-in / Export Tariff	$62.23	$61.62	$61.01	$60.40	$59.81
Annual Cash Flow	**$62.23**	**$61.62**	**$61.01**	**$60.40**	**$59.81**
Accrued Cash Flow (Cash Balance)	($245.15)	($183.54)	($122.53)	($62.12)	($2.32)

	year 21
Investments	$0.00
Feed-in / Export Tariff	$59.21
Annual Cash Flow	**$59.21**
Accrued Cash Flow (Cash Balance)	$56.90

Degradation and inflation rates are applied on a monthly basis over the entire observation period.
This is done in the first year.

PV Module: Ivanhoe

Manufacturer	NREL	
Available	Yes	

Electrical Data

Cell Type	Si polycrystalline	
Only Transformer Inverters suitable	No	
Number of Cells	60	
Number of Bypass Diodes	3	

Mechanical Data

Width	1875	mm
Height	2071	mm
Depth	38	mm
Frame Width	0	mm
Weight	22	kg
Framed	No	

I/V Characteristics at STC

MPP Voltage	28.3	V
MPP Current	7.07	A
Power Rating	200	W
Open Circuit Voltage	36.1	V
Short-Circuit Current	7.7	A
Increase open circuit voltage before stabilisation	0	%

I/V Part Load Characteristics (calculated)

Values source	Standard (Two-diode Model)	
Series resistance Rs	7.51e-03	Ω
Parallel Resistance Rp	1.802	Ω
Saturation Current Parameters Cs1	195.8	A/K³
Saturation Current Parameters Cs2	-1.459e-13	A/K^(2,5)
Photocurrent Parameters C1	6.957e-03	m²/V
Photocurrent Parameters C2	2.6e-06	m²/V
Photocurrent	7.732	A

Further

Voltage Coefficient	-123	mV/K
Electricity Coefficient	2.6	mA/K
Output Coefficient	-0.4	%/K
Incident Angle Modifier	95	%
Maximum System Voltage	1000	V
Spec. Heat Capacity	920	J/(kg*K)
Absorption Coefficient	70	%
Emissions Coefficient	85	%

Inverter: INV500-90EU / US

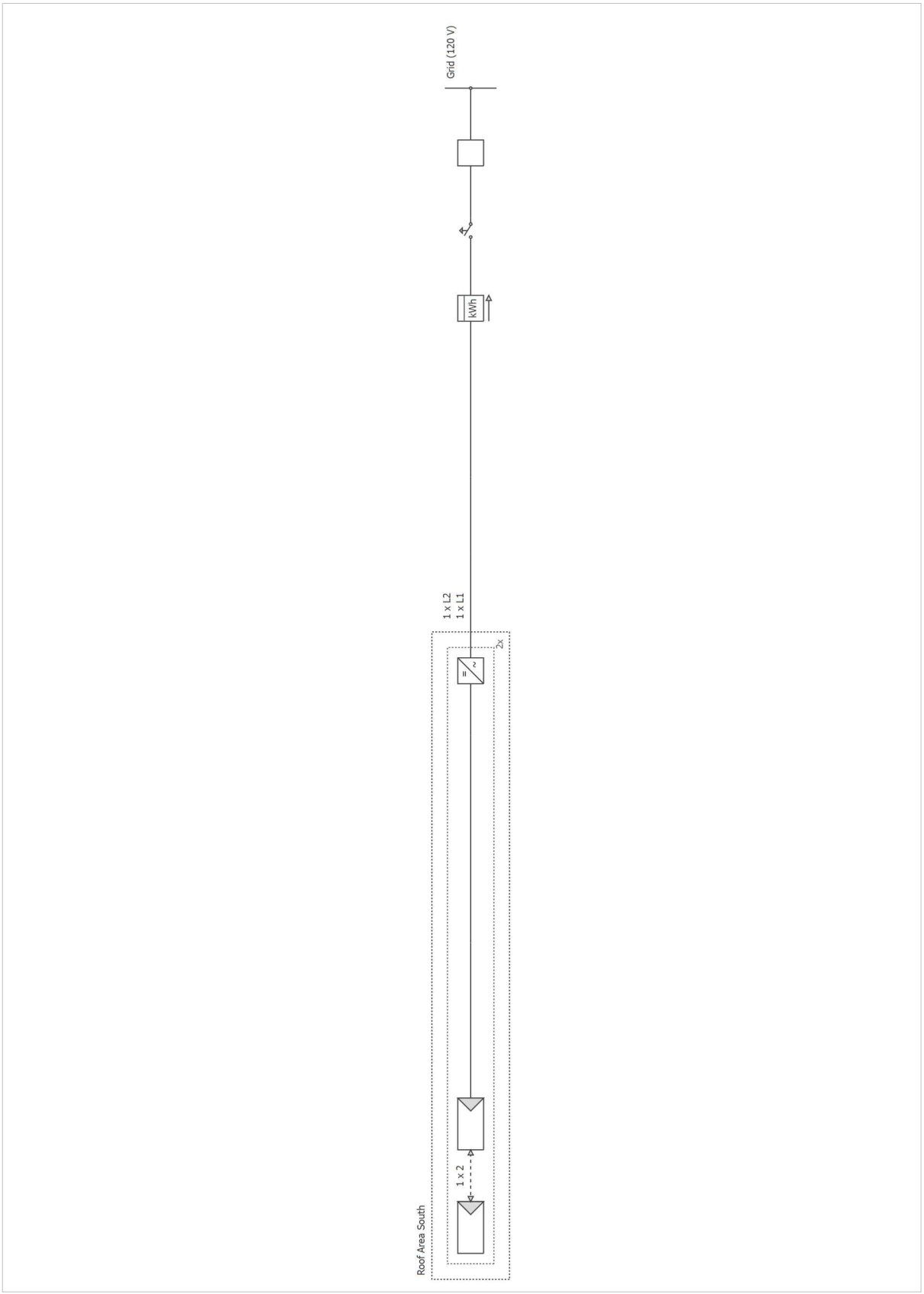
Manufacturer	AEconversion GmbH	
Available	Yes	

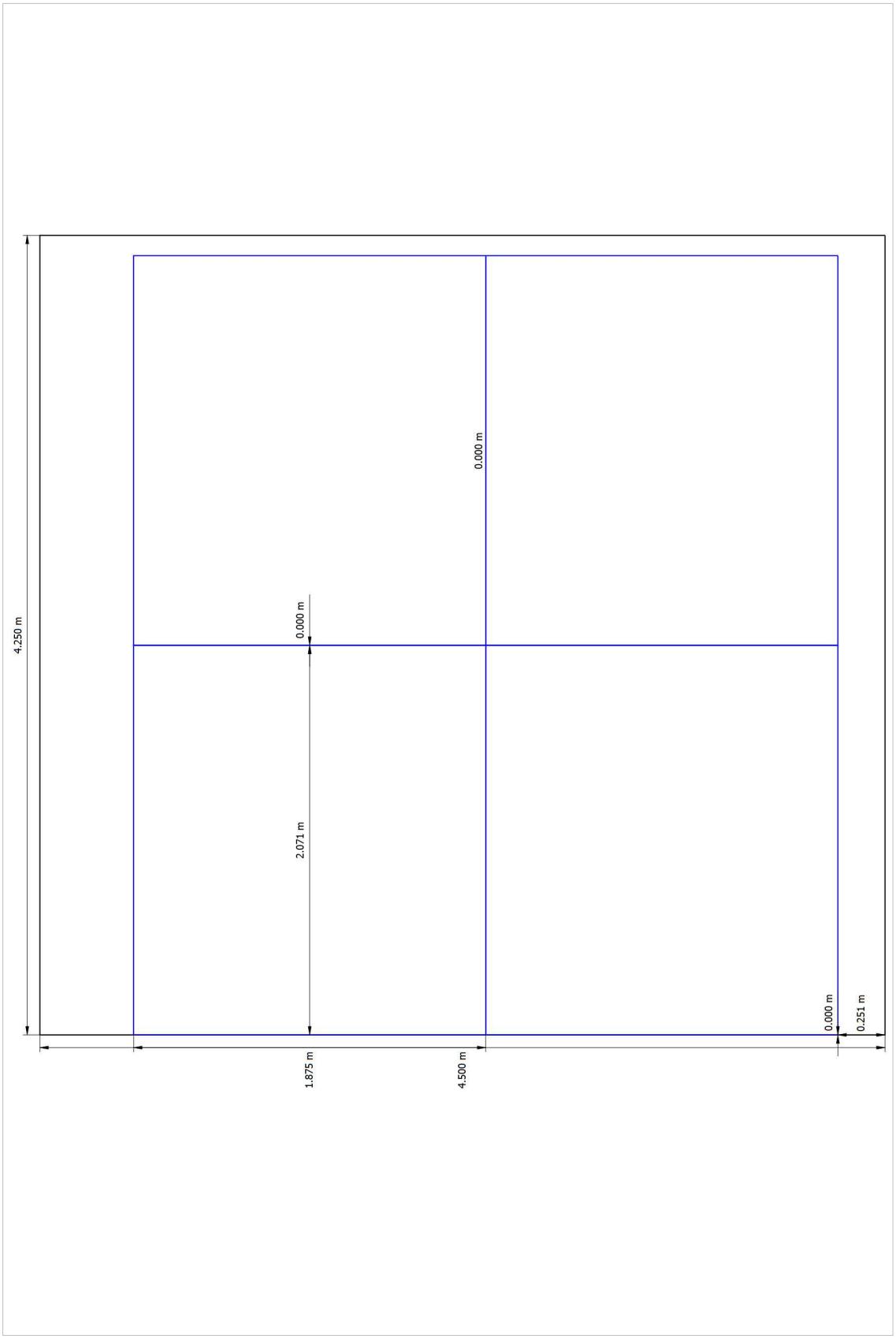
Electrical Data

DC Power Rating	0.5	kW
AC Power Rating	0.47	kW
Max. DC Power	0.51	kW
Max. AC Power	0.47	kW
Stand-by Consumption	0.03	W
Night Consumption	0.03	W
Feed-in from	3	W
Max. Input Current	11	A
Max. Input Voltage	90	V
Nom. DC Voltage	60	V
Number of Feed-in Phases	1	
Number of DC Inlets	1	
With Transformer	Yes	
Change in Efficiency when Input Voltage deviates from Rated Voltage	0.5	%/100V

MPP Tracker

Output Range < 20% of Power Rating	99.98	%
Output Range > 20% of Power Rating	100	%
No. of MPP Trackers	1	
Max. Input Current per MPP Tracker	11	A
Max. Input Power per MPP Tracker	0.51	kW
Min. MPP Voltage	40	V
Max. MPP Voltage	78	V


Grid (120 V)
kWh
1 x L2
1 x L1
2x
1 x 2
Roof Area South



Roof Area South