Version 7.3.1

PVsyst - Simulation report

Standalone system

Project: Eudaimonia villa

Variant: New simulation variant

Standalone system with batteries

System power: 40.6 kWp

Ras El Hekma, North Coast - Egypt

Author

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Project summary

Geographical Site
Ras El Hekma, North Coast
Egypt

Situation

Latitude	31.07 °N
Longitude	27.47 °E
Altitude	0 m
Time zone	UTC+2

Project settings

Albedo	0.20

Meteo data
Ras El Hekma, North Coast
Meteonorm 8.1 (1991-2010), Sat=82% - Synthetic

System summary

Standalone system

Standalone system with batteries

PV Field Orientation

Fixed plane	
Tilt/Azimuth	29 / 0 °

User's needs

Daily profile	
Constant over the year	
Average	203 kWh/Day

System information

PV Array

Nb. of modules	116 units
Pnom total	40.6 kWp

Battery pack

Technology	Lead-acid, sealed, Gel
Nb. of units	100 units
Voltage	48 V
Capacity	5000 Ah

Results summary

Available Energy	70980 kWh/year	Specific production	1748 kWh/kWp/year	Perf. Ratio PR	77.46 %
Used Energy	65908 kWh/year			Solar Fraction SF	88.77 %

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General parameters

Standalone system | **Standalone system with batteries**

PV Field Orientation

Orientation		Sheds configuration		Models used	
Fixed plane		No 3D scene defined		Transposition	Perez
Tilt/Azimuth	29 / 0 °			Diffuse	Perez, Meteonorm
				Circumsolar	separate

User's needs

Daily profile
Constant over the year
Average 203 kWh/Day

Hourly load	0 h	1 h	2 h	3 h	4 h	5 h	6 h	7 h	8 h	9 h	10 h	11 h	
	6.85	6.77	6.12	6.04	6.04	6.04	6.12	7.90	1.60	2.32	2.32	2.40	kW
	12 h	13 h	14 h	15 h	16 h	17 h	18 h	19 h	20 h	21 h	22 h	23 h	
	4.16	4.99	3.34	6.82	6.82	15.72	14.27	17.37	17.11	18.23	17.03	17.03	kW

PV Array Characteristics

PV module

Manufacturer	Jinkosolar
Model	JKM 350M-72-V
(Original PVsyst database)	
Unit Nom. Power	350 Wp
Number of PV modules	116 units
Nominal (STC)	40.6 kWp
Modules	29 Strings x 4 In series
At operating cond. (50°C)	
Pmpp	36.6 kWp
U mpp	141 V
I mpp	259 A

Battery

Manufacturer	Narada
Model	AcmeG 12V 200
Technology	Lead-acid, sealed, Gel
Nb. of units	25 in parallel x 4 in series
Discharging min. SOC	20.0 %
Stored energy	197.9 kWh
Battery Pack Characteristics	
Voltage	48 V
Nominal Capacity	5000 Ah (C10)
Temperature	Fixed 20 °C

Controller

Manufacturer	Victron
Model	SmartSolar MPPT 250/85 48V
Nb. units	7 units
Technology	MPPT converter
Temp coeff.	-2.7 mV/°C/Elem.
Converter	
Maxi and EURO efficiencies	99.0 / 97.0 %

Battery Management control

Threshold commands as	Battery voltage
Charging	59.4 / 51.3 V
Corresp. SOC	0.95 / 0.80
Discharging	47.6 / 49.7 V
Corresp. SOC	0.21 / 0.50

Total PV power

Nominal (STC)	41 kWp
Total	116 modules
Module area	225 m²
Cell area	198 m²

Array losses

Thermal Loss factor
Module temperature according to irradiance
Uc (const) 20.0 W/m²K
Uv (wind) 0.0 W/m²K/m/s

DC wiring losses
Global array res. 9.1 mΩ
Loss Fraction 1.5 % at STC

Serie Diode Loss
Voltage drop 0.7 V
Loss Fraction 0.4 % at STC

Module Quality Loss
Loss Fraction -0.8 %

Module mismatch losses
Loss Fraction 2.0 % at MPP

Strings Mismatch loss
Loss Fraction 0.1 %

IAM loss factor
ASHRAE Param.: IAM = 1 - bo (1/cosi -1)
bo Param. 0.05

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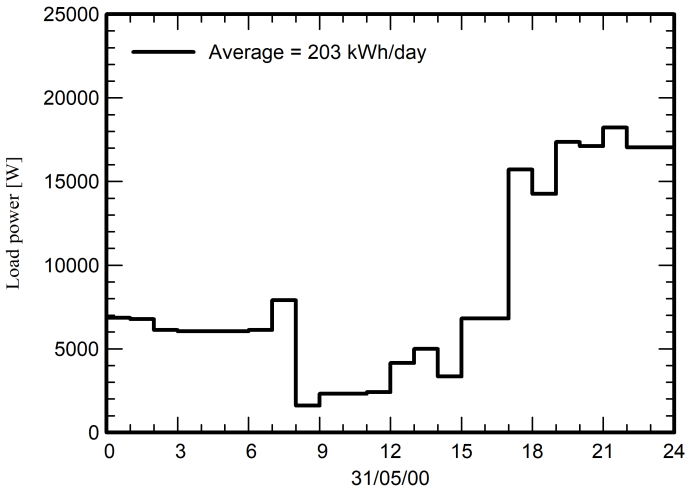
Detailed User's needs

Daily profile, Constant over the year, average = 203 kWh/day

Hourly load	0 h	1 h	2 h	3 h	4 h	5 h	6 h	7 h	8 h	9 h	10 h	11 h	
	6.85	6.77	6.12	6.04	6.04	6.04	6.12	7.90	1.60	2.32	2.32	2.40	kW
	12 h	13 h	14 h	15 h	16 h	17 h	18 h	19 h	20 h	21 h	22 h	23 h	
	4.16	4.99	3.34	6.82	6.82	15.72	14.27	17.37	17.11	18.23	17.03	17.03	kW

Daily profile



Main results

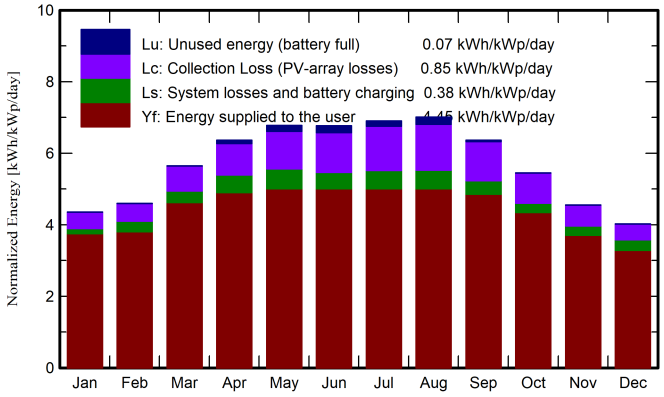
System Production

Available Energy	70980 kWh/year	Performance Ratio PR	77.46 %
Used Energy	65908 kWh/year	Solar Fraction SF	88.77 %
Excess (unused)	1024 kWh/year		
Loss of Load		**Battery aging (State of Wear)**	
Time Fraction	16.3 %	Cycles SOW	76.0 %
Missing Energy	8335 kWh/year	Static SOW	91.7 %
		Battery lifetime	4.2 years

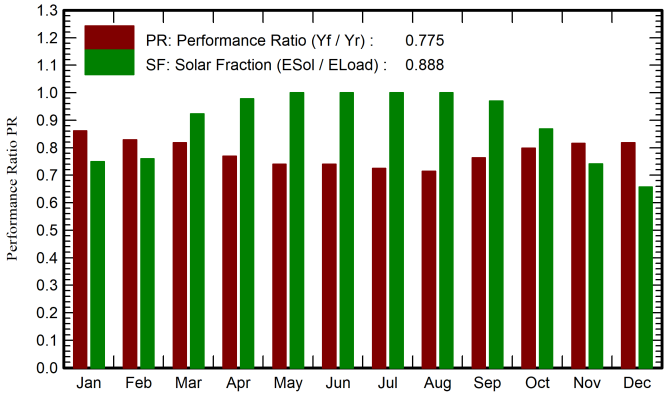
Economic evaluation

Investment		**Yearly cost**		**LCOE**	
Global	40,914.24 EUR	Annuities	800.66 EUR/yr	Energy cost	0.07 EUR/kWh
Specific	1.01 EUR/Wp	Run. costs	5,194.47 EUR/yr		
		Payback period	3.5 years		

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

	GlobHor kWh/m²	GlobEff kWh/m²	E_Avail kWh	EUnused kWh	E_Miss kWh	E_User kWh	E_Load kWh	SolFrac ratio
January	94.8	132.2	4813	0.2	1582	4724	6306	0.749
February	102.8	125.9	4564	0.0	1366	4329	5695	0.760
March	152.7	171.1	6105	0.0	488	5817	6306	0.923
April	183.6	186.5	6545	111.2	136	5966	6102	0.978
May	220.4	204.3	7054	202.2	0	6306	6306	1.000
June	223.9	197.1	6738	227.5	0	6102	6102	1.000
July	232.4	207.8	6982	182.5	0	6306	6306	1.000
August	216.4	211.7	7069	252.4	0	6306	6306	1.000
September	171.0	186.5	6284	48.2	187	5915	6102	0.969
October	135.1	165.4	5674	0.2	834	5472	6306	0.868
November	98.7	133.3	4740	0.0	1580	4522	6102	0.741
December	85.4	121.9	4413	0.2	2162	4143	6306	0.657
Year	1917.1	2043.8	70980	1024.4	8335	65908	74243	0.888

Legends

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

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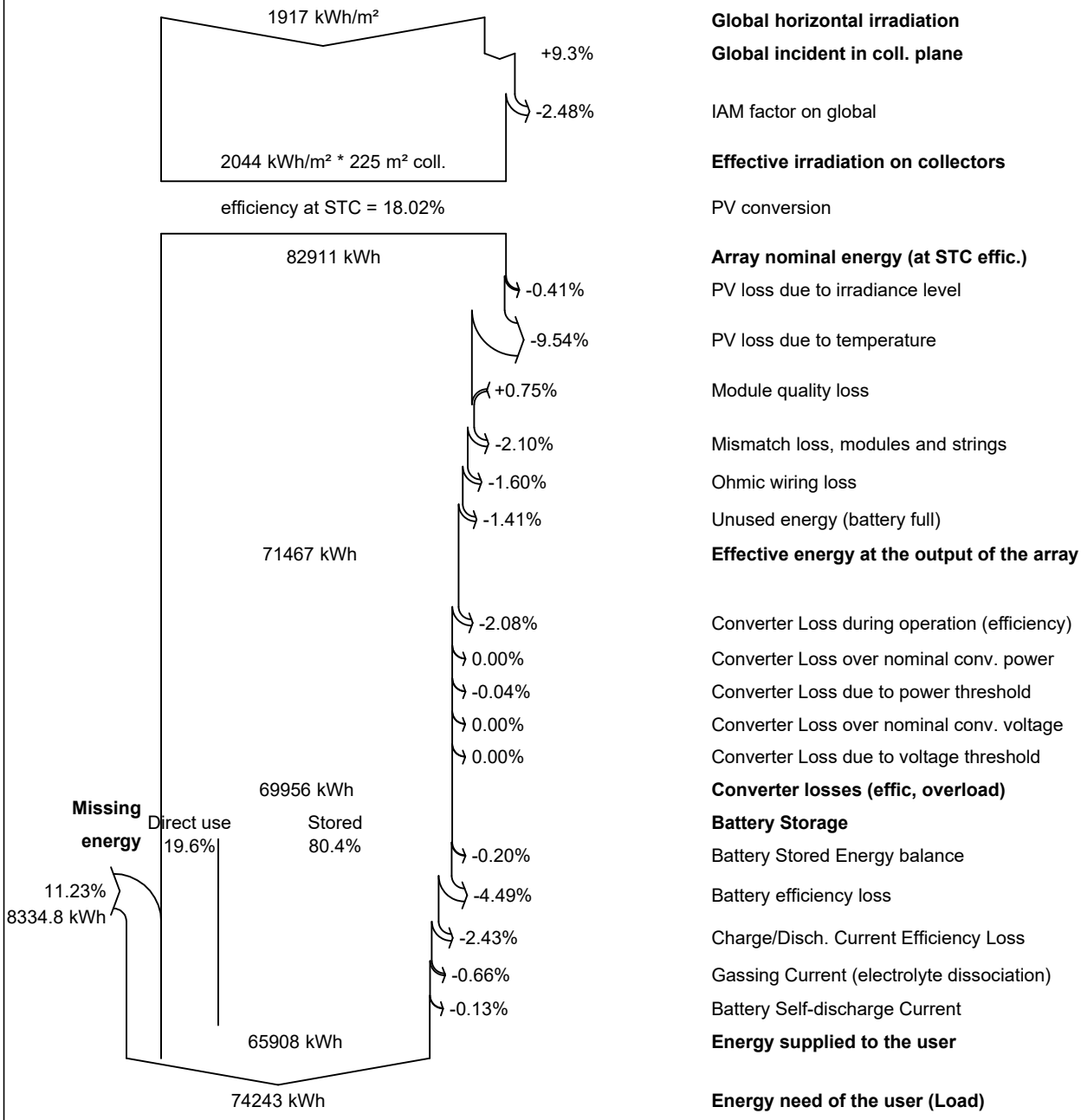
Loss diagram



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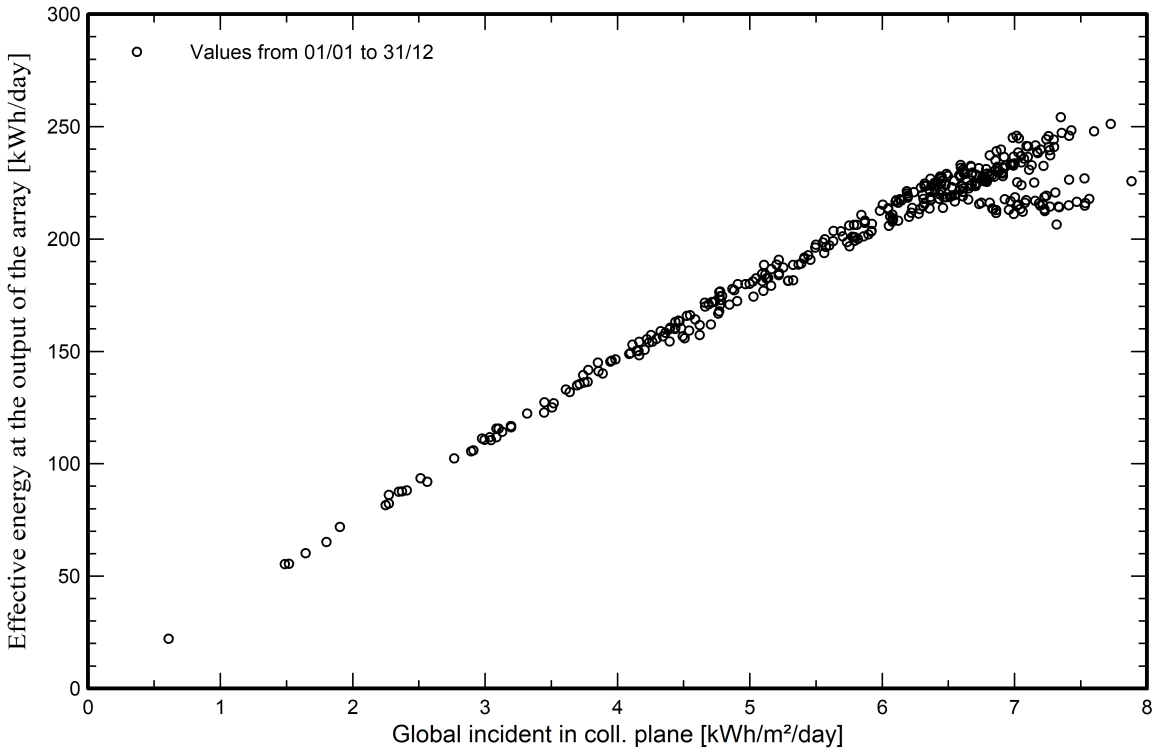
Predef. graphs

Daily Input/Output diagram



Cost of the system

Installation costs

Item	Quantity units	Cost EUR	Total EUR
PV modules			
JKM 350M-72-V	116	38.89	4,511.24
Supports for modules	116	20.00	2,320.00
Batteries	100	49.47	4,947.00
Controllers	7	844.00	5,908.00
Other components			
Accessories, fasteners	1	700.00	700.00
Wiring	1	200.00	200.00
Studies and analysis			
Engineering	1	150.00	150.00
Permitting and other admin. Fees	1	250.00	250.00
Installation			
Global installation cost per battery	100	200.00	20,000.00
Transport	1	500.00	500.00
Settings	1	150.00	150.00
Insurance			
Building insurance	1	50.00	50.00
Liability insurance	1	50.00	50.00
Loan bank charges			100.00
Taxes			
VAT	1	0.00	1,078.00
		Total	40,914.24
		Depreciable asset	18,386.24

Operating costs

Item	Total EUR/year
Maintenance	
Salaries	700.00
Repairs	250.00
Cleaning	150.00
Provision for battery replacement	1,166.97
Land rent	1,500.00
Insurance	
Facilities insurance	150.00
Liability insurance	150.00
Total (OPEX)	4,066.97
Including inflation (2.50%)	5,194.47

System summary

Total installation cost	40,914.24 EUR
Operating costs (incl. inflation 2.50%/year)	5,194.47 EUR/year
Excess energy (battery full)	1.0 MWh/year
Used solar energy	65.9 MWh/year
Used energy cost	0.108 EUR/kWh

Financial analysis

Simulation period

Project lifetime	20 years	Start year	2025

Income variation over time

Inflation	2.50 %/year
Production variation (aging)	-0.50 %/year
Discount rate	0.00 %/year

Depreciable assets

Asset	Depreciation method	Depreciation period (years)	Salvage value (EUR)	Depreciable (EUR)
PV modules				
JKM 350M-72-V	Straight-line	20	0.00	4,511.24
Supports for modules	Straight-line	20	0.00	2,320.00
Batteries	Straight-line	20	0.00	4,947.00
Controllers	Straight-line	20	0.00	5,908.00
Accessories, fasteners	Straight-line	20	0.00	700.00
		Total	0.00	18,386.24

Financing

Own funds	18,000.00 EUR		
Subsidies	10,914.00 EUR		
Loan 1 - Redeemable with fixed annuity - 20 years	4,000.00 EUR	Interest rate:	1.00%/year
Loan 2 - Redeemable with fixed annuity - 18 years	4,000.00 EUR	Interest rate:	1.00%/year
Loan 3 - Redeemable with fixed annuity - 15 years	4,000.00 EUR	Interest rate:	3.00%/year

Electricity sale

Feed-in tariff	Peak tariff	0.3000 EUR/kWh	
	Off-peak tariff	0.2000 EUR/kWh	20:00-09:00

Return on investment

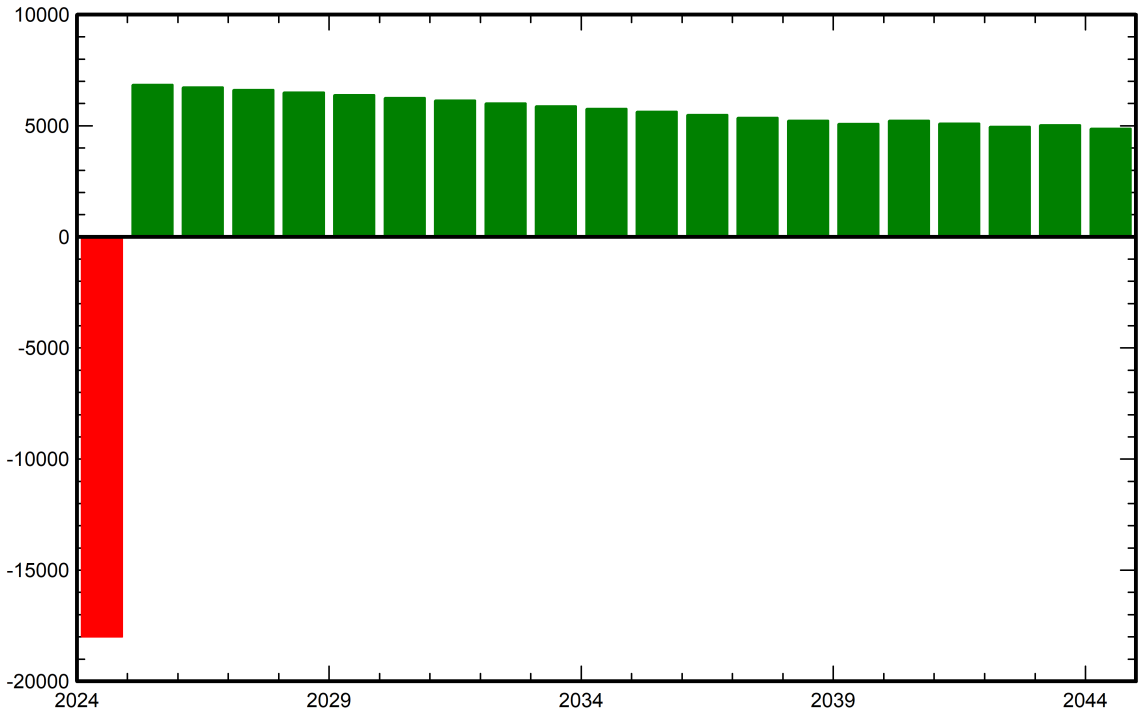
Payback period	3.5 years
Net present value (NPV)	117,362.33 EUR
Internal rate of return (IRR)	42.92 %
Return on investment (ROI)	391.2 %
Paid dividends	20,304.35 EUR

Financial analysis

Detailed economic results (EUR)

Year	Electricity sale	Own funds	Loan principal	Loan interest	Run. costs	Deprec. allow.	Taxable income	Taxes	After-tax profit	Divid. 15.00%	Cumul. profit	% amorti.
0	0	18,000	0	0	0	0	0	0	0	0	-18,000	0.0%
1	15,673	0	601	200	4,067	919	10,487	2,753	8,053	1,208	-9,947	28.8%
2	15,595	0	611	190	4,169	919	10,317	2,708	7,917	1,188	-2,030	57.3%
3	15,517	0	622	179	4,273	919	10,145	2,663	7,780	1,167	5,750	85.3%
4	15,439	0	632	168	4,380	919	9,972	2,618	7,641	1,146	13,391	112.9%
5	15,362	0	643	157	4,489	919	9,796	2,571	7,501	1,125	20,892	140.0%
6	15,285	0	655	146	4,601	919	9,618	2,525	7,358	1,104	28,250	166.7%
7	15,209	0	666	135	4,716	919	9,438	2,478	7,214	1,082	35,464	193.0%
8	15,133	0	678	123	4,834	919	9,256	2,430	7,068	1,060	42,532	218.8%
9	15,057	0	690	111	4,955	919	9,072	2,381	6,920	1,038	49,451	244.2%
10	14,982	0	702	98	5,079	919	8,885	2,332	6,770	1,015	56,221	269.1%
11	14,907	0	715	86	5,206	919	8,696	2,283	6,617	993	62,838	293.5%
12	14,832	0	728	73	5,336	919	8,504	2,232	6,463	969	69,302	317.5%
13	14,758	0	741	60	5,470	919	8,310	2,181	6,307	946	75,608	341.0%
14	14,684	0	755	46	5,606	919	8,113	2,130	6,148	922	81,756	364.0%
15	14,611	0	769	32	5,747	919	7,913	2,077	5,987	898	87,742	386.5%
16	14,538	0	448	18	5,890	919	7,710	2,024	6,158	924	93,900	408.5%
17	14,465	0	452	13	6,037	919	7,495	1,967	5,995	899	99,895	430.0%
18	14,393	0	457	9	6,188	919	7,276	1,910	5,829	874	105,724	451.0%
19	14,321	0	217	4	6,343	919	7,054	1,852	5,904	886	111,628	471.4%
20	14,249	0	219	2	6,502	919	6,826	1,792	5,734	860	117,362	491.2%
Total	**299,008**	**18,000**	**12,000**	**1,850**	**103,889**	**18,386**	**174,883**	**45,907**	**135,362**	**20,304**	**117,362**	**491.2%**

Yearly net profit (EUR)



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Financial analysis

Cumulative cashflow (EUR)