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RETScreen® International

Clean Energy Project Analysis Software

Solar Water Heating Project Model

Click Here to Start

- Description & Flow Chart
- Colour Coding
- Online Manual

Worksheets

- Energy Model
- Solar Resource & Heating Load
- Cost Analysis
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- Financial Summary

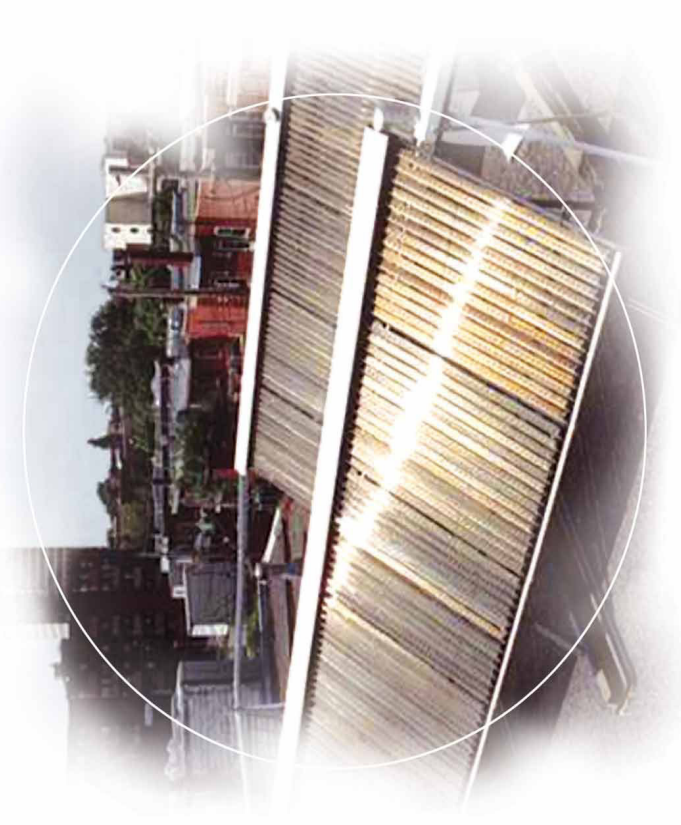
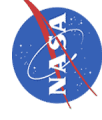
Features

- Product Data
- Weather Data
- Cost Data
- Currency Options
- Sensitivity Analysis

**Clean Energy
Decision Support Centre**
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Training & Support
Internet Forums
Marketplace
Case Studies
e-Textbook

Partners



Site Conditions		Estimate	Notes/Range
Project name		Dom	See Online Manual
Project location		Katowice, Polska	
Nearest location for weather data		Katowice	→ Complete SR&HL sheet
Annual solar radiation (tilted surface)	MWh/m ²	1,13	
Annual average temperature	°C	7,7	-20.0 to 30.0
Annual average wind speed	m/s	4,6	
Desired load temperature	°C	55	
Hot water use	L/d	360	
Number of months analysed	month	11,20	
Energy demand for months analysed	MWh	6,25	

System Characteristics		Estimate	Notes/Range
Application type		Service hot water (with storage)	
Base Case Water Heating System			
Heating fuel type	-	Electricity	
Heating system seasonal efficiency	%	97%	55% to 350%
Solar Collector			
Collector type	-	Glazed	See Technical Note 1
Solar water heating collector manufacturer		Viessmann	See Product Database
Solar water heating collector model		VitoSol 100	
Area per collector	m ²	2,50	1.00 to 5.00
Fr (tau alpha) coefficient	-	0,85	0.50 to 0.90
Fr UL coefficient	(W/m ²)/°C	4,07	3.50 to 6.00
Suggested number of collectors		3	
Number of collectors		3	
Total collector area	m ²	7,5	
Storage			
Ratio of storage capacity to coll. area	L/m ²	40,0	37.5 to 100.0
Storage capacity	L	300	
Balance of System			
Heat exchanger/antifreeze protection	yes/no	Yes	
Heat exchanger effectiveness	%	100%	50% to 85%
Suggested pipe diameter	mm	10	8 to 25 or PVC 35 to 50
Pipe diameter	mm	16	8 to 25 or PVC 35 to 50
Pumping power per collector area	W/m ²	15	3 to 22, or 0
Piping and solar tank losses	%	2%	1% to 10%
Losses due to snow and/or dirt	%	5%	2% to 10%
Horz. dist. from mech. room to collector	m	10	5 to 20
# of floors from mech. room to collector	-	2	0 to 20

Annual Energy Production (11,20 months analysed)		Estimate	Notes/Range
Pumping energy (electricity)	MWh	0,17	
Specific yield	kWh/m ²	389	
System efficiency	%	38%	
Solar fraction	%	47%	
Renewable energy delivered	MWh	2,92	
	GJ	10,50	Complete Cost Analysis sheet

RETScreen® Solar Resource and Heating Load Calculation - Solar Water Heating Project

Site Latitude and Collector Orientation		Estimate	Notes/Range
Nearest location for weather data		Katowice	See Weather Database
Latitude of project location	°N	51,1	-90.0 to 90.0
Slope of solar collector	°	45,0	0.0 to 90.0
Azimuth of solar collector	°	0,0	0.0 to 180.0

Monthly Inputs

(Note: 1. Cells in grey are not used for energy calculations; 2. Revisit this table to check that all required inputs are filled if you change system type or solar collector type or pool type or method for calculating cold water temperature).

Month	Fraction of month used (0 - 1)	Monthly average daily radiation on horizontal surface (kWh/m ² /d)	Monthly average temperature (°C)	Monthly average relative humidity (%)	Monthly average wind speed (m/s)	Monthly average daily radiation in plane of solar collector (kWh/m ² /d)
January	1,00	0,79	-2,8	89,0	5,4	1,63
February	1,00	1,45	-1,5	88,0	5,2	2,41
March	1,00	2,37	2,1	82,0	5,2	3,01
April	1,00	3,51	7,5	77,0	4,5	3,69
May	1,00	4,64	12,5	75,0	4,1	4,34
June	1,00	4,72	16,2	71,0	3,9	4,18
July	0,60	4,94	17,4	65,0	3,9	4,48
August	0,60	4,17	16,8	64,0	3,9	4,19
September	1,00	2,75	13,1	71,0	4,3	3,22
October	1,00	1,93	8,4	80,0	4,5	3,07
November	1,00	0,89	3,6	86,0	4,9	1,64
December	1,00	0,61	-0,5	89,0	5,4	1,28
			Annual	Season of Use		
Solar radiation (horizontal)		MWh/m ²	1,00	0,89		
Solar radiation (tilted surface)		MWh/m ²	1,13	1,02		
Average temperature		°C	7,7	7,1		
Average wind speed		m/s	4,6	4,7		

Water Heating Load Calculation		Estimate	Notes/Range
Application type	-	Service hot water	
System configuration	-	With storage	
Building or load type	-	House	
Number of units	Occupant	6	
Rate of occupancy	%	100%	50% to 100%
Estimated hot water use (at ~60 °C)	L/d	360	
Hot water use	L/d	360	
Desired water temperature	°C	55	
Days per week system is used	d	7	1 to 7
Cold water temperature	-	User-defined	
Minimum	°C	8,0	1.0 to 10.0
Maximum	°C	15,0	5.0 to 15.0
Months SWH system in use	month	11,20	
Energy demand for months analysed	MWh	6,25	
	GJ	22,48	

[Return to Energy Model sheet](#)

RETScreen® Cost Analysis - Solar Water Heating Project

 Type of project: **Pre-feasibility**

 Currency: **Poland**

 Cost references: **None**

Initial Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
Feasibility Study							
Other - Feasibility study	Cost	0	PLN -	PLN -	-	-	-
Sub-total :				PLN -	0,0%	-	-
Development							
Other - Development	Cost	0	PLN -	PLN -	-	-	-
Sub-total :				PLN -	0,0%	-	-
Engineering							
Other - Engineering	Cost	0	PLN -	PLN -	-	-	-
Sub-total :				PLN -	0,0%	-	-
Energy Equipment							
Solar collector	m ²	7,5	PLN 1 617	PLN 12 128	-	-	-
Solar storage tank	L	300	PLN 9,50	PLN 2 850	-	-	-
Solar loop piping materials	m	39	PLN 26,00	PLN 1 005	-	-	-
Circulating pump(s)	W	113	PLN 5,00	PLN 563	-	-	-
Heat exchanger	kW	4,5	PLN -	PLN -	-	-	-
Transportation	project	1	PLN -	PLN -	-	-	-
Other - Energy equipment	Cost	1	PLN 3 350	PLN 3 350	-	-	-
Sub-total :				PLN 19 895	100,0%	-	-
Balance of System							
Collector support structure	m ²	7,5	PLN -	PLN -	-	-	-
Plumbing and control	project	1	PLN -	PLN -	-	-	-
Collector installation	m ²	7,5	PLN -	PLN -	-	-	-
Solar loop installation	m	39	PLN -	PLN -	-	-	-
Auxiliary equipment installation	project	1	PLN -	PLN -	-	-	-
Transportation	project	1	PLN -	PLN -	-	-	-
Other - Balance of system	Cost	0	PLN -	PLN -	-	-	-
Sub-total :				PLN -	0,0%	-	-
Miscellaneous							
Training	p-h	4	PLN -	PLN -	-	-	-
Contingencies	%	0%	PLN 19 895	PLN -	-	-	-
Sub-total :				PLN -	0,0%	-	-
Initial Costs - Total				PLN 19 895	100,0%	-	-

Annual Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
O&M							
Property taxes/Insurance	project	0	PLN -	PLN -	-	-	-
O&M labour	project	0	PLN -	PLN -	-	-	-
Other - O&M	Cost	0	PLN -	PLN -	-	-	-
Contingencies	%	10%	PLN -	PLN -	-	-	-
Sub-total :				PLN -	0,0%	-	-
Electricity	kWh	166	PLN -	PLN -	0,0%	-	-
Annual Costs - Total				PLN -	0,0%	-	-

Periodic Costs (Credits)	Unit	Period	Unit Cost	Amount	Interval Range	Unit Cost Range
Valves and fittings	Cost	10 yr	PLN -	PLN -	-	-
				PLN -	-	-
				PLN -	-	-
End of project life		-		PLN -		Go to GHG Analysis sheet

RETScreen® Greenhouse Gas (GHG) Emission Reduction Analysis - Solar Water Heating Project

Use GHG analysis sheet? Yes

Type of analysis: Standard

Background Information

Project Information		Global Warming Potential of GHG	
Project name	Dom	1 tonne CH4 =	21 tonnes CO2 (IPCC 1996)
Project location	Katowice, Polska	1 tonne N2O =	310 tonnes CO2 (IPCC 1996)

Base Case Electricity System (Baseline)

Fuel type	Fuel mix (%)	CO ₂ emission factor (kg/GJ)	CH ₄ emission factor (kg/GJ)	N ₂ O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (t _{CO2} /MWh)
Coal	90,4%	94,6	0,0020	0,0030	35,0%	10,0%	1,092
Large hydro	1,6%	0,0	0,0000	0,0000	100,0%		0,000
Diesel (#2 oil)	0,7%	74,1	0,0020	0,0020	30,0%		0,897
Biomass	3,7%	0,0	0,0320	0,0040	25,0%		0,028
Natural gas	3,6%	56,1	0,0030	0,0010	45,0%		0,452
Electricity mix	100%	277,7	0,0108	0,0093		9,0%	1,011

Base Case Heating System (Baseline)

Fuel type	Fuel mix (%)	CO ₂ emission factor (kg/GJ)	CH ₄ emission factor (kg/GJ)	N ₂ O emission factor (kg/GJ)	Fuel conversion efficiency (%)	GHG emission factor (t _{CO2} /MWh)
Heating system						
Electricity	100,0%	277,7	0,0108	0,0093	97,0%	1,042

Proposed Case Heating System (Solar Water Heating Project)

Fuel type	Fuel mix (%)	CO ₂ emission factor (kg/GJ)	CH ₄ emission factor (kg/GJ)	N ₂ O emission factor (kg/GJ)	Fuel conversion efficiency (%)	GHG emission factor (t _{CO2} /MWh)
Heating system						
Electricity	5,4%	277,7	0,0108	0,0093	100,0%	1,011
Solar	94,6%	0,0	0,0000	0,0000	100,0%	0,000
Heating energy mix	100,0%	15,8	0,0006	0,0005		0,058

GHG Emission Reduction Summary

Heating system	Base case GHG emission factor (t _{CO2} /MWh)	Proposed case GHG emission factor (t _{CO2} /MWh)	End-use annual energy delivered (MWh)	Annual GHG emission reduction (t _{CO2} /yr)
	1,042	0,058	2,92	2,87
	Net GHG emission reduction			2,87

[Complete Financial Summary sheet](#)

RETScreen® Financial Summary - Solar Water Heating Project

Annual Energy Balance			
Project name	Dom	MWh	MWh
Project location	Katowice, Polska	2,92	0,17
Renewable energy delivered	Electricity	Net GHG reduction	2,87
Heating fuel displaced	Electricity	Net GHG emission reduction - 25 yrs	71,82
		t _{CO2}	

Financial Parameters			
Avoided cost of heating energy	PLN/kWh	0,400	80,0%
Debt ratio	%		
Debt interest rate	%		7,0%
Debt term	yr		10
GHG emission reduction credit	PLN/t _{CO2}		
Income tax analysis?	yes/no		No
Retail price of electricity	PLN/kWh		
Energy cost escalation rate	%	2,0%	
Inflation	%	2,0%	
Discount rate	%	6,5%	
Project life	yr	25	

Project Costs and Savings			
Initial Costs			
Feasibility study	0,0%	PLN	
Development	0,0%	PLN	
Engineering	0,0%	PLN	
Energy equipment	100,0%	PLN	19 895
Balance of system	0,0%	PLN	
Miscellaneous	0,0%	PLN	
Initial Costs - Total	100,0%	PLN	19 895
Incentives/Grants		PLN	3 979
Periodic Costs (Credits)			
Valves and fittings		PLN	
End of project life -		PLN	
Annual Costs and Debt			
O&M		PLN	
Electricity		PLN	
Debt payments - 10 yrs		PLN	2 266
Annual Costs and Debt - Total		PLN	2 266
Annual Savings or Income			
Heating energy savings/Income		PLN	1 203
Annual Savings - Total		PLN	1 203

Financial Feasibility			
Pre-tax IRR and ROI	%	8,5%	Calculate GHG reduction cost?
After-tax IRR and ROI	%	8,5%	yes/no
Simple Payback	yr	13,2	Project equity
Year-to-positive cash flow	yr	immediate	PLN
Net Present Value - NPV	PLN	1 714	Debt payments
Annual Life Cycle Savings	PLN	141	Debt service coverage
Benefit-Cost (B-C) ratio	-	1,43	

Yearly Cash Flows			
Year #	Pre-tax PLN	After-tax PLN	Cumulative PLN
0	-	-	-
1	(1 039)	(1 039)	(1 039)
2	(1 014)	(1 014)	(2 053)
3	(989)	(989)	(3 042)
4	(964)	(964)	(4 006)
5	(938)	(938)	(4 943)
6	(911)	(911)	(5 855)
7	(884)	(884)	(6 738)
8	(856)	(856)	(7 595)
9	(828)	(828)	(8 423)
10	(799)	(799)	(9 222)
11	1 496	1 496	(7 726)
12	1 526	1 526	(6 200)
13	1 556	1 556	(4 644)
14	1 588	1 588	(3 056)
15	1 619	1 619	(1 437)
16	1 652	1 652	215
17	1 685	1 685	1 900
18	1 718	1 718	3 618
19	1 753	1 753	5 371
20	1 788	1 788	7 159
21	1 824	1 824	8 982
22	1 860	1 860	10 843
23	1 897	1 897	12 740
24	1 935	1 935	14 675
25	1 974	1 974	16 649

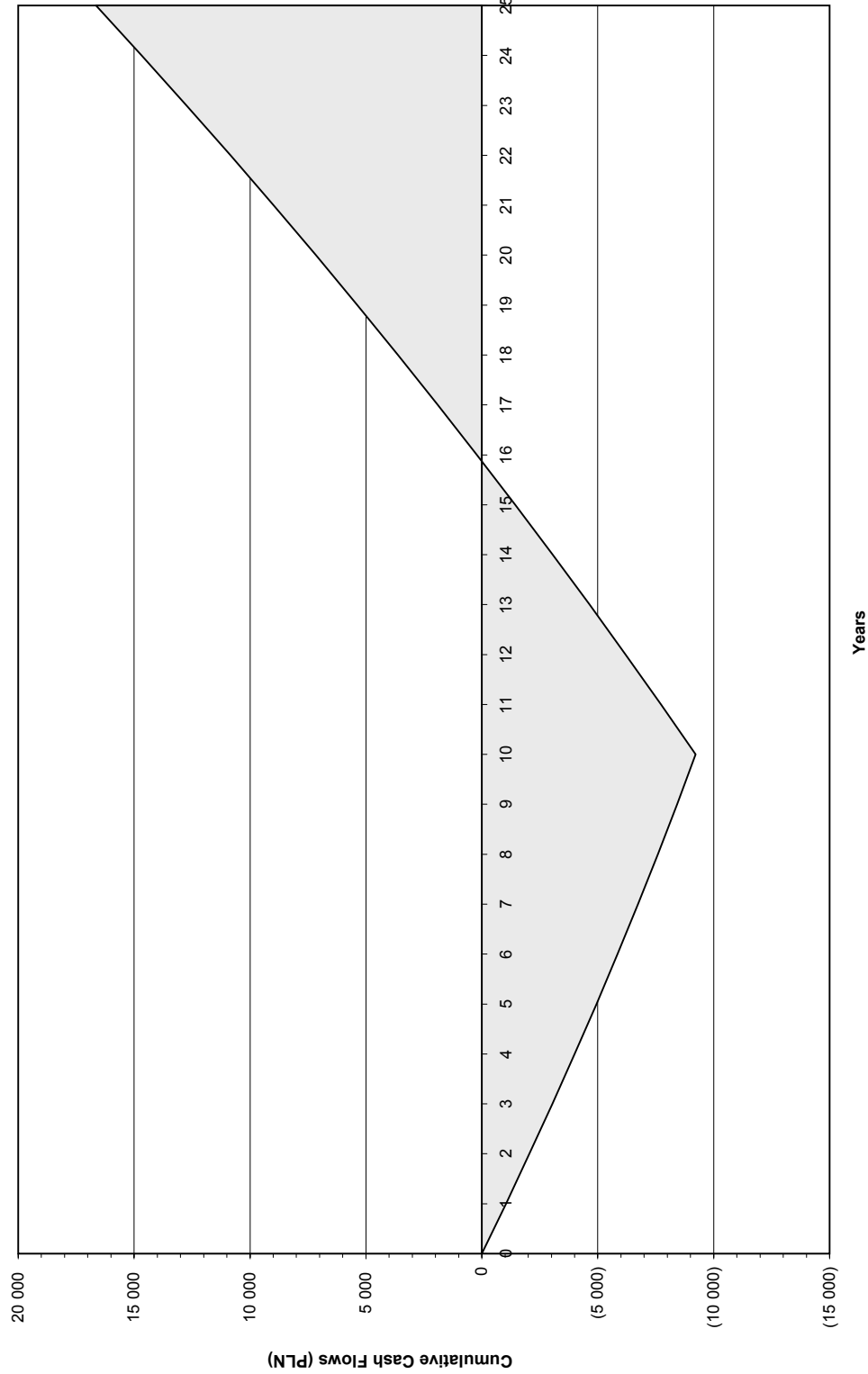
Cumulative Cash Flows Graph

SWH Project Cumulative Cash Flows Dom, Katowice, Polska

Renewable energy delivered (MWh/yr): 2.92

Total Initial Costs: PLN 19 895

Net average GHG reduction (t_{CO2}/yr): 2.87



IRR and ROI: 8.5%

Year-to-positive cash flow: immediate

Net Present Value: PLN 1 714