



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
- Greenhouse Gas Analysis
- Financial Summary

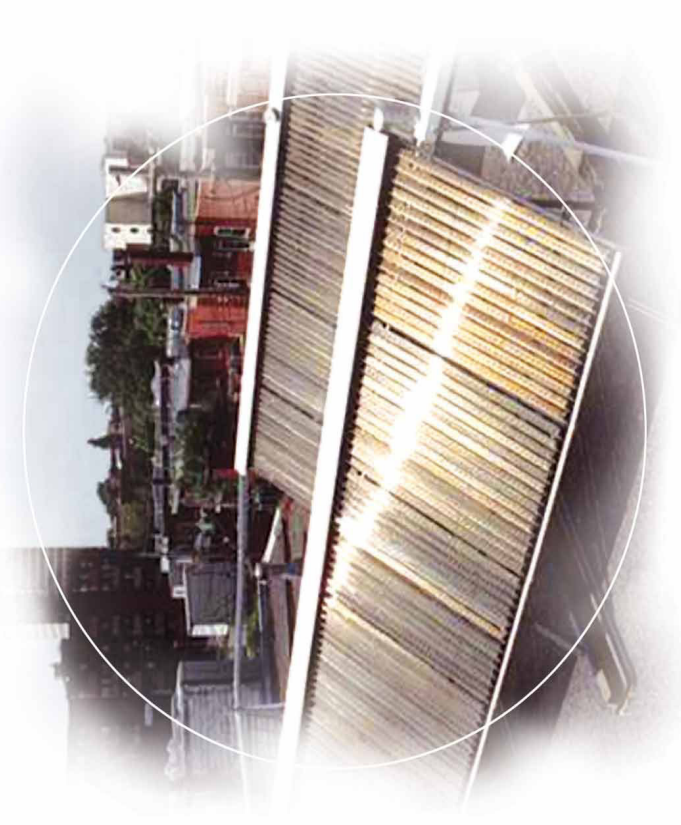
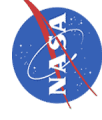
Features

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

**Clean Energy
Decision Support Centre**
www.retscreen.net

Training & Support
Internet Forums
Marketplace
Case Studies
e-Textbook

Partners



Site Conditions		Estimate	Notes/Range
Project name		Dom	See Online Manual
Project location		Opole, Polska	
Nearest location for weather data		Opole	→ Complete SR&HL sheet
Annual solar radiation (tilted surface)	MWh/m ²	1,21	
Annual average temperature	°C	8,3	-20.0 to 30.0
Annual average wind speed	m/s	4,6	
Desired load temperature	°C	55	
Hot water use	L/d	240	
Number of months analysed	month	12,00	
Energy demand for months analysed	MWh	4,44	

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		Watt	See Product Database
Solar water heating collector model		3000 SU	
Area per collector	m ²	2,06	1.00 to 5.00
Fr (tau alpha) coefficient	-	0,79	0.50 to 0.90
Fr UL coefficient	(W/m ²)/°C	3,78	3.50 to 6.00
Suggested number of collectors		2	
Number of collectors		3	
Total collector area	m ²	6,2	
Storage			
Ratio of storage capacity to coll. area	L/m ²	40,0	37.5 to 100.0
Storage capacity	L	247	
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 (12,00 months analysed)		Estimate	Notes/Range
Pumping energy (electricity)	MWh	0,15	
Specific yield	kWh/m ²	420	
System efficiency	%	35%	
Solar fraction	%	58%	
Renewable energy delivered	MWh	2,59	
	GJ	9,32	

[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		Opole	See Weather Database
Latitude of project location	°N	51,0	-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	0,92	-2,1	89,0	5,4	2,05
February	1,00	1,66	-1,0	88,0	5,2	2,91
March	1,00	2,58	2,7	82,0	5,2	3,36
April	1,00	3,80	7,9	77,0	4,5	4,04
May	1,00	4,71	12,9	75,0	4,1	4,40
June	1,00	4,63	16,8	71,0	3,9	4,10
July	1,00	5,04	18,0	65,0	3,9	4,57
August	1,00	4,28	17,5	64,0	3,9	4,31
September	1,00	2,89	13,7	71,0	4,3	3,42
October	1,00	1,92	8,8	80,0	4,5	3,03
November	1,00	0,97	4,0	86,0	4,9	1,87
December	1,00	0,70	0,1	89,0	5,4	1,60
			Annual	Season of Use		
Solar radiation (horizontal)		MWh/m ²	1,04	1,04		
Solar radiation (tilted surface)		MWh/m ²	1,21	1,21		
Average temperature		°C	8,3	8,3		
Average wind speed		m/s	4,6	4,6		

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	4	
Rate of occupancy	%	100%	50% to 100%
Estimated hot water use (at ~60 °C)	L/d	240	
Hot water use	L/d	240	
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	12,00	
Energy demand for months analysed	MWh	4,44	
	GJ	15,99	

[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	6,2	PLN 652	PLN 4 020	-	-	-
Solar storage tank	L	247	PLN 11,00	PLN 2 713	-	-	-
Solar loop piping materials	m	39	PLN 26,00	PLN 1 005	-	-	-
Circulating pump(s)	W	92	PLN 5,00	PLN 462	-	-	-
Heat exchanger	kW	3,7	PLN -	PLN -	-	-	-
Transportation	project	1	PLN -	PLN -	-	-	-
Other - Energy equipment	Cost	1	PLN 8 350	PLN 8 350	-	-	-
Sub-total :				PLN 16 549	97,4%	-	-
Balance of System							
Collector support structure	m ²	6,2	PLN 71	PLN 438	-	-	-
Plumbing and control	project	1	PLN -	PLN -	-	-	-
Collector installation	m ²	6,2	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 438	2,6%	-	-
Miscellaneous							
Training	p-h	4	PLN -	PLN -	-	-	-
Contingencies	%	0%	PLN 16 987	PLN -	-	-	-
Sub-total :				PLN -	0,0%	-	-
Initial Costs - Total				PLN 16 987	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	150	PLN 0,4000	PLN 60	100,0%	-	-
Annual Costs - Total				PLN 60	100,0%	-	-

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	Opole, 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	5,5%	277,7	0,0108	0,0093	100,0%	1,011
Solar	94,5%	0,0	0,0000	0,0000	100,0%	0,000
Heating energy mix	100,0%	16,0	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})
	1,042	0,058	2,59	2,55
	Net GHG emission reduction t _{CO2} /yr			2,55

[Complete Financial Summary sheet](#)

RETScreen® Financial Summary - Solar Water Heating Project

Annual Energy Balance			
Project name	Dom	MWh	MWh
Project location	Opole, Polska		
Renewable energy delivered	2,59	Net GHG reduction	0,15
Heating fuel displaced	Electricity	Net GHG emission reduction - 25 yrs	2,55
		t _{CO2}	63,67

Financial Parameters			
Avoided cost of heating energy	PLN/kWh	0,400	Debt ratio
			0,0%
GHG emission reduction credit	PLN/t _{CO2}	-	Income tax analysis?
			yes/no
Retail price of electricity	PLN/kWh	0,400	
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	60
Engineering	0,0%	PLN	-
Energy equipment	97,4%	PLN	16 549
Balance of system	2,6%	PLN	438
Miscellaneous	0,0%	PLN	-
Initial Costs - Total	100,0%	PLN	16 987
Incentives/Grants		PLN	-
Periodic Costs (Credits)			
Valves and fittings		PLN	-
End of project life -		PLN	-
Annual Costs and Debt			
O&M		PLN	-
Electricity		PLN	60
Annual Costs and Debt - Total		PLN	60
Annual Savings or Income			
Heating energy savings/income		PLN	1 068
Annual Savings - Total		PLN	1 068

Financial Feasibility			
Pre-tax IRR and ROI	%	5,4%	Calculate GHG reduction cost?
After-tax IRR and ROI	%	5,4%	yes/no
Simple Payback	yr	16,9	Project equity
Year-to-positive cash flow	yr	14,4	PLN
Net Present Value - NPV	PLN	(1 907)	16 987
Annual Life Cycle Savings	PLN	(156)	
Benefit-Cost (B-C) ratio	-	0,89	

Yearly Cash Flows			
Year #	Pre-tax PLN	After-tax PLN	Cumulative PLN
0	(16 987)	(16 987)	(16 987)
1	1 028	1 028	(15 959)
2	1 048	1 048	(14 911)
3	1 069	1 069	(13 841)
4	1 091	1 091	(12 750)
5	1 113	1 113	(11 638)
6	1 135	1 135	(10 503)
7	1 158	1 158	(9 345)
8	1 181	1 181	(8 165)
9	1 204	1 204	(6 960)
10	1 228	1 228	(5 732)
11	1 253	1 253	(4 479)
12	1 278	1 278	(3 201)
13	1 304	1 304	(1 897)
14	1 330	1 330	(568)
15	1 356	1 356	789
16	1 383	1 383	2 172
17	1 411	1 411	3 583
18	1 439	1 439	5 022
19	1 468	1 468	6 491
20	1 497	1 497	7 988
21	1 527	1 527	9 515
22	1 558	1 558	11 073
23	1 589	1 589	12 662
24	1 621	1 621	14 283
25	1 653	1 653	15 937

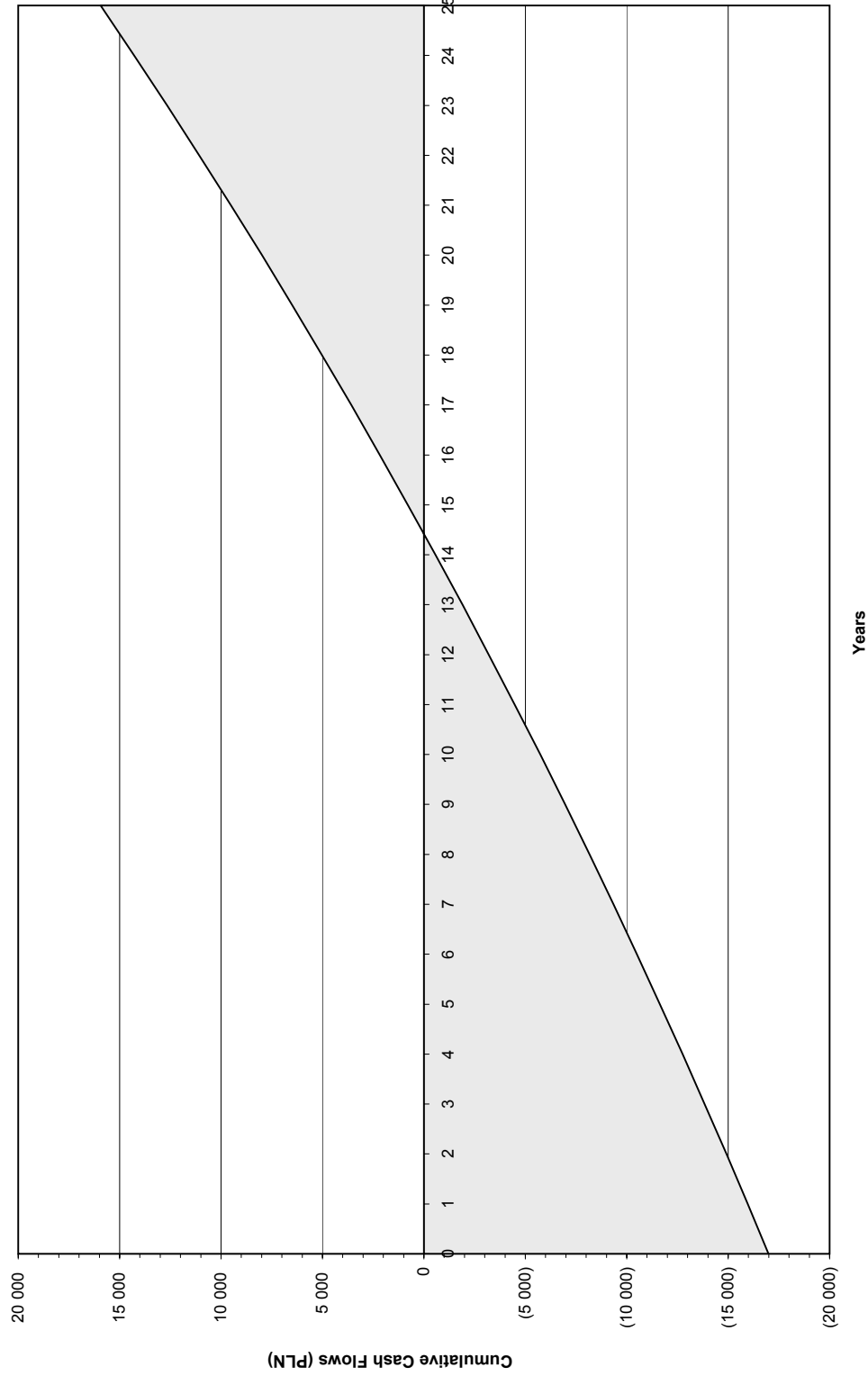
Cumulative Cash Flows Graph

SWH Project Cumulative Cash Flows Dom, Opole, Polska

Renewable energy delivered (MWh/yr): 2.59

Total Initial Costs: PLN 16 987

Net average GHG reduction (t_{CO2}/yr): 2.55



IRR and ROI: 5.4%

Year-to-positive cash flow: 14.4 yr

Net Present Value: PLN (1 907)