



Natural Resources
Canada

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RETScreen® International

Clean Energy Project Analysis Software

Photovoltaic Project Model

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Partners



Site Conditions		Estimate	Notes/Range
Project name		Zespół Szkół	See Online Manual
Project location		Tychy, Polska	
Nearest location for weather data	-	Katowice	→ Complete SR&SL sheet
Latitude of project location	°N	51,1	-90.0 to 90.0
Annual solar radiation (tilted surface)	MWh/m ²	1,14	
Annual average temperature	°C	7,7	-20.0 to 30.0

System Characteristics		Estimate	Notes/Range
Application type	-	On-grid	
Grid type	-	Central-grid	
PV energy absorption rate	%	100,0%	
PV Array			
PV module type	-	mono-Si	
PV module manufacturer / model #		Solar Fabrik	See Product Database
Nominal PV module efficiency	%	10,0%	4.0% to 15.0%
NOCT	°C	45	40 to 55
PV temperature coefficient	% / °C	0,40%	0.10% to 0.50%
Miscellaneous PV array losses	%	4,0%	0.0% to 20.0%
Nominal PV array power	kWp	2,00	
PV array area	m ²	20,0	
Power Conditioning			
Average inverter efficiency	%	90%	80% to 95%
Suggested inverter (DC to AC) capacity	kW (AC)	1,8	
Inverter capacity	kW (AC)	2,0	
Miscellaneous power conditioning losses	%	0%	0% to 10%

Annual Energy Production (9,70 months analysed)		Estimate	Notes/Range
Specific yield	kWh/m ²	72,0	
Overall PV system efficiency	%	8,7%	
PV system capacity factor	%	8,2%	
Renewable energy collected	MWh	1,599	
Renewable energy delivered	MWh	1,439	
	kWh	1 439	
Excess RE available	MWh	0,000	Complete Cost Analysis sheet

RETScreen® Solar Resource and System Load Calculation - Photovoltaic Project

Site Latitude and PV Array 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
PV array tracking mode	-	Fixed	
Slope of PV array	°	45,0	0.0 to 90.0
Azimuth of PV array	°	0,0	0.0 to 180.0

Monthly Inputs					
Month	Fraction of month used (0 - 1)	Monthly average daily radiation on horizontal surface (kWh/m ² /d)	Monthly average temperature (°C)	Monthly average daily radiation in plane of PV array (kWh/m ² /d)	Monthly solar fraction (%)
January	1,00	0,79	-2,8	1,54	-
February	1,00	1,45	-1,5	2,34	-
March	1,00	2,37	2,1	3,00	-
April	1,00	3,51	7,5	3,76	-
May	1,00	4,64	12,5	4,45	-
June	0,50	4,72	16,2	4,30	-
July	0,20	4,94	17,4	4,61	-
August	0,20	4,17	16,8	4,29	-
September	0,80	2,75	13,1	3,24	-
October	1,00	1,93	8,4	2,99	-
November	1,00	0,89	3,6	1,55	-
December	1,00	0,61	-0,5	1,22	-
			Annual	Season of use	
Solar radiation (horizontal)		MWh/m ²	1,00	0,69	
Solar radiation (tilted surface)		MWh/m ²	1,14	0,83	
Average temperature		°C	7,7	5,6	

Load Characteristics	Estimate
Application type	On-grid

[Return to Energy Model sheet](#)

RETScreen® Cost Analysis - Photovoltaic Project

Type of analysis: 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	1	PLN -	PLN -	-	-	-
Sub-total :				PLN -	0,0%	-	-
Development							
Other - Development	Cost	1	PLN -	PLN -	-	-	-
Sub-total :				PLN -	0,0%	-	-
Engineering							
Other - Engineering	Cost	1	PLN -	PLN -	-	-	-
Sub-total :				PLN -	0,0%	-	-
Energy Equipment							
PV module(s)	kWp	2,00	PLN 24 291	PLN 48 582	-	-	-
Transportation	project	0	PLN -	PLN -	-	-	-
Other -Komputer, mierniki	Cost	1	PLN 5 300	PLN 5 300	-	-	-
Credit - Energy equipment	Credit	0	PLN -	PLN -	-	-	-
Sub-total :				PLN 53 882	83,9%	-	-
Balance of Equipment							
Module support structure	m ²	20,0	PLN 100	PLN 2 000	-	-	-
Inverter	kW AC	2,0	PLN 1 900	PLN 3 800	-	-	-
Other electrical equipment	kWp	2,00	PLN -	PLN -	-	-	-
System installation	kWp	2,00	PLN 750	PLN 1 500	-	-	-
Transportation	project	0	PLN -	PLN -	-	-	-
Other - Balance of equipment	Cost	0	PLN -	PLN -	-	-	-
Credit - Balance of equipment	Credit	0	PLN -	PLN -	-	-	-
Sub-total :				PLN 7 300	11,4%	-	-
Miscellaneous							
Training	p-h	6	PLN -	PLN -	-	-	-
Contingencies	%	5%	PLN 61 182	PLN 3 059	-	-	-
Sub-total :				PLN 3 059	4,8%	-	-
Initial Costs - Total				PLN 64 241	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	p-h	16	PLN -	PLN -	-	-	-
Other - O&M	Cost	0	PLN -	PLN -	-	-	-
Credit - O&M	Credit	0	PLN -	PLN -	-	-	-
Contingencies	%	0%	PLN -	PLN -	-	-	-
Sub-total :				PLN -	#DZIEL/0!	-	-
Annual Costs - Total				PLN -	#DZIEL/0!	-	-

Periodic Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Interval Range	Unit Cost Range
Inverter Repair/Replacement	Cost	12 yr	PLN -	PLN -	-	-
			PLN -	PLN -	-	-
			PLN -	PLN -	-	-
End of project life		-	PLN -	PLN -	-	-

[Go to GHG Analysis sheet](#)

RETScreen® Greenhouse Gas (GHG) Emission Reduction Analysis - Photovoltaic Project

Use GHG analysis sheet?

Type of analysis:

Background Information

Project Information		Global Warming Potential of GHG	
Project name	Zespół Szkół	1 tonne CH ₄ =	21 tonnes CO ₂ (IPCC 1996)
Project location	Tychy, Polska	1 tonne N ₂ O =	310 tonnes CO ₂ (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	90,5%	94,6	0,0020	0,0030	35,0%	11,0%	1,105
Natural gas	3,7%	56,1	0,0030	0,0010	45,0%	11,0%	0,508
Large hydro	1,6%	0,0	0,0000	0,0000	100,0%	11,0%	0,000
Biomass	3,8%	0,0	0,0320	0,0040	25,0%	11,0%	0,031
#6 oil	0,4%	77,4	0,0030	0,0020	30,0%	11,0%	1,053
Electricity mix	100,0%	281,2	0,0116	0,0095		11,0%	1,024

Proposed Case Electricity System (Photovoltaic 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 (%)	T & D losses (%)	GHG emission factor (t _{CO2} /MWh)
Electricity system							
Solar	100,0%	0,0	0,0000	0,0000	100,0%	5,0%	0,000

GHG Emission Reduction Summary

Electricity 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})
	1,024	0,000	1,368	1,40
			Net GHG emission reduction t _{CO2} /yr	1,40

[Complete Financial Summary sheet](#)

RETScreen® Financial Summary - Photovoltaic Project

Annual Energy Balance					
Project name	Zespół Szkół				
Project location	Tychy, Polska				
			Nominal PV array power	kWp	2,00
Renewable energy delivered	MWh	1,439	Net GHG reduction	t _{CO2} /yr	1,40
Firm RE capacity	kW	2,000	Net GHG emission reduction - 25 yrs	t _{CO2}	35,00
Application type	On-grid				

Financial Parameters					
Avoided cost of energy	PLN/kWh	0,390	Debt ratio	%	0,0%
RE production credit	PLN/kWh	-			
GHG emission reduction credit	PLN/t _{CO2}	-	Income tax analysis?	yes/no	No
Avoided cost of capacity	PLN/kW-yr	-			
Energy cost escalation rate	%	2,0%			
Inflation	%	2,0%			
Discount rate	%	5,0%			
Project life	yr	25			

Project Costs and Savings					
Initial Costs			Annual Costs and Debt		
Feasibility study	0,0%	PLN	-	O&M	PLN
Development	0,0%	PLN	-	Fuel	PLN
Engineering	0,0%	PLN	-		
Energy equipment	83,9%	PLN	53 882	Annual Costs and Debt - Total	PLN
Balance of equipment	11,4%	PLN	7 300		-
Miscellaneous	4,8%	PLN	3 059	Annual Savings or Income	
Initial Costs - Total	100,0%	PLN	64 241	Energy savings/income	PLN 561
Incentives/Grants		PLN	51 393	Capacity savings/income	PLN -
				Annual Savings - Total	PLN 561
Periodic Costs (Credits)					
Inverter Repair/Replacement		PLN	-		
		PLN	-		
		PLN	-		
End of project life -		PLN	-		

Financial Feasibility					
Pre-tax IRR and ROI	%	2,7%	Calculate energy production cost?	yes/no	No
After-tax IRR and ROI	%	2,7%	Calculate GHG reduction cost?	yes/no	No
Simple Payback	yr	22,9			
Year-to-positive cash flow	yr	18,7	Project equity	PLN	64 241
Net Present Value - NPV	PLN	(3 008)			
Annual Life Cycle Savings	PLN	(213)			
Benefit-Cost (B-C) ratio	-	0,95			

Yearly Cash Flows			
Year #	Pre-tax PLN	After-tax PLN	Cumulative PLN
0	(12 848)	(12 848)	(12 848)
1	573	573	(12 276)
2	584	584	(11 692)
3	596	596	(11 096)
4	608	608	(10 488)
5	620	620	(9 868)
6	632	632	(9 236)
7	645	645	(8 591)
8	658	658	(7 933)
9	671	671	(7 262)
10	684	684	(6 578)
11	698	698	(5 880)
12	712	712	(5 168)
13	726	726	(4 442)
14	741	741	(3 701)
15	756	756	(2 945)
16	771	771	(2 175)
17	786	786	(1 389)
18	802	802	(587)
19	818	818	231
20	834	834	1 065
21	851	851	1 916
22	868	868	2 784
23	885	885	3 669
24	903	903	4 572
25	921	921	5 493

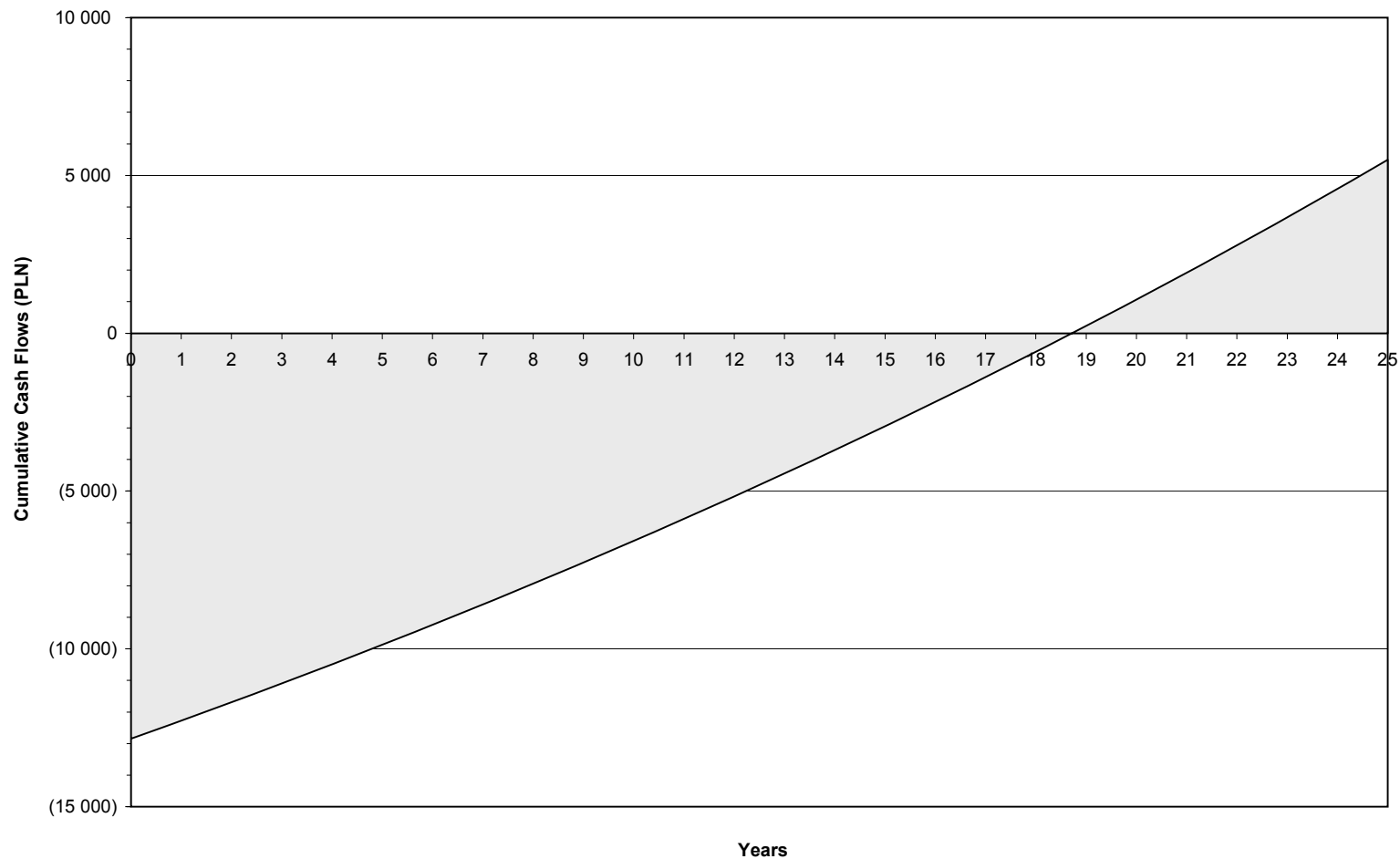
Cumulative Cash Flows Graph

Photovoltaic Project Cumulative Cash Flows Zespół Szkół, Tychy, Polska

Renewable energy delivered (MWh/yr): 1,439

Total Initial Costs: PLN 64 241

Net average GHG reduction (t_{CO2}/yr): 1,40



IRR and ROI: 2,7%

Year-to-positive cash flow: 18,7 yr

Net Present Value: PLN -3 008

RETScreen® Sensitivity and Risk Analysis - Photovoltaic Project

Use sensitivity analysis sheet?
 Perform risk analysis too?
 Project name
 Project location

Yes
 No
 Zespół Szkół
 Tychy, Polska

Perform analysis on **Net Present Value - NPV**
 Sensitivity range 40%
 Threshold 0 PLN

[Click here to Calculate Sensitivity Analysis](#)

Sensitivity Analysis for Net Present Value - NPV

		Avoided cost of energy (PLN/kWh)				
RE delivered (MWh)		0,2340 -40%	0,3120 -20%	0,3900 0%	0,4680 20%	0,5460 40%
0,864	-40%	-9 306	-8 125	-6 944	-5 763	-4 582
1,152	-20%	-8 125	-6 551	-4 976	-3 402	-1 827
1,439	0%	-6 944	-4 976	-3 008	-1 040	928
1,727	20%	-5 763	-3 402	-1 040	1 322	3 683
2,015	40%	-4 582	-1 827	928	3 683	6 438

		Avoided cost of energy (PLN/kWh)				
Initial costs (PLN)		0,2340 -40%	0,3120 -20%	0,3900 0%	0,4680 20%	0,5460 40%
38 545	-40%	-1 805	163	2 131	4 099	6 067
51 393	-20%	-4 374	-2 406	-438	1 530	3 498
64 241	0%	-6 944	-4 976	-3 008	-1 040	928
77 089	20%	-9 514	-7 546	-5 578	-3 610	-1 642
89 938	40%	-12 083	-10 115	-8 147	-6 179	-4 211

		Avoided cost of energy (PLN/kWh)				
Annual costs (PLN)		0,2340 -40%	0,3120 -20%	0,3900 0%	0,4680 20%	0,5460 40%
0	-40%	-6 944	-4 976	-3 008	-1 040	928
0	-20%	-6 944	-4 976	-3 008	-1 040	928
0	0%	-6 944	-4 976	-3 008	-1 040	928
0	20%	-6 944	-4 976	-3 008	-1 040	928
0	40%	-6 944	-4 976	-3 008	-1 040	928