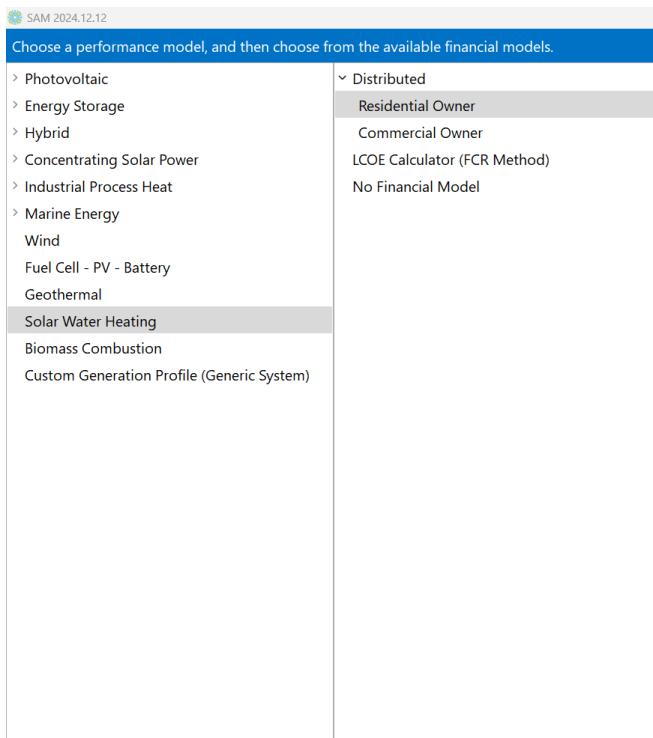


CURSO EFICIENCIA ENERGÉTICA Y ENERGÍA SOLAR TÉRMICA

Prácticas

Práctica 4. Simulación de un sistema solar térmico

1. Elegir el tipo de modelo



2. Introducir los datos de entrada del sistema

Cargar datos climáticos de la ubicación considerada

Solar water Residential

- Location and Resource
- Solar Water Heating
- AC Degradation
- Installation Costs
- Operating Costs
- Financial Parameters
- Incentives
- Electricity Rates
- Electric Load

Solar Resource Library

The Solar Resource library is a list of weather files on your computer. Choose a file from the library and verify the weather data information below.

The default library comes with only a few weather files to help you get started. Use the download tools below to build a library of locations you frequently model. Once you build your library, it is available for all of your work in SAM.

Filter: Name

Name	Latitude	Longitude	Time zone	Elevation	Station ID	Source
phoenix_az_33.450495_-111.983688_psmv3_60_tmy...	33.45	-111.98	-7	358	78208	NSRDB
phoenix_az_33.450495_-111.983688_psmv3_60_tmy...	33.45	-111.98	-7	358	78208	NSRDB
tucson_az_32.116521_-110.933042_psmv3_60_tmy...	32.13	-110.94	-7	773	67345	NSRDB
zaragoza_41.6518_-0.88114_msg-iodc_60_2019	41.65	-0.9	1	236	313854	NSRDB
zaragoza_41.6518_-0.88114_nsrdbs-msg-v1-0-0-tmy...	41.65	-0.9	1	236	333291	NSRDB

SAM scans the following folders on your computer for valid weather files and adds them to your Solar Resource library. To use weather files stored on your computer, click Add/remove Weather File Folders and add folders containing valid weather files.

C:\Users\Usario\SAM Downloaded Weather Files Add/remove weather file folders... Refresh library

Download Weather Files

The NSRDB is a database of thousands of weather files that you can download and add to your solar resource library. Download a default typical-year (TMY) file for most long-term cash flow analyses, or choose files to download for single-year or uncertainty (P50/P90) analyses. See Help for details.

One location Multiple locations Advanced download

Type a location name, street address, or lat,lon in decimal degrees Default TMY file Download and add to library...

For locations not covered by the NSRDB, visit the SAM website Weather Page for links to other data sources.

Weather Data Information

The following information describes the data in the highlighted weather file from the Solar Resource library above. This is the file SAM will use when you click Simulate.

Weather file C:\Users\Usario\SAM Downloaded Weather Files\zaragoza_41.6518_-0.88114_nsrdbs-msg-v1-0-0-tmy_60_tmy.csv View data...

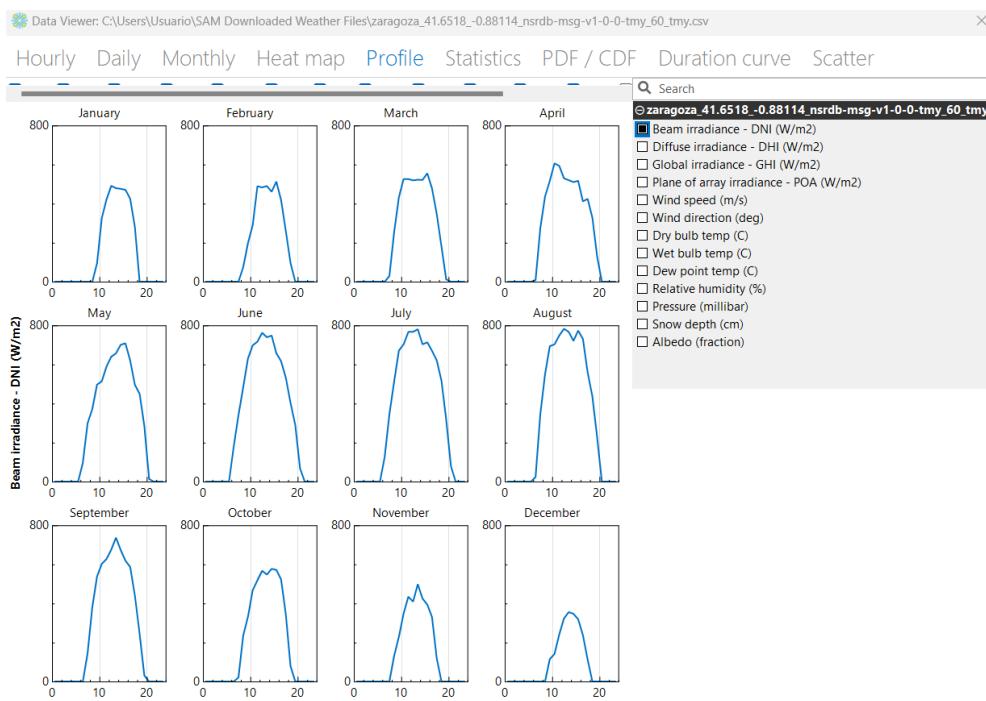
Header Data from Weather File

Latitude	41.65	degrees	Location	333291
Longitude	-0.9	degrees	Data Source	NSRDB
Time zone	GMT 1		For NSRDB data, the latitude and longitude shown here from the weather file header are the coordinates of the NSRDB grid cell and may be different from the values in the file name, which are the coordinates of the requested location.	
Elevation	236	m		
Time step	60	minutes		

Annual Averages Calculated from Weather File Data

Global horizontal	4.56	kWh/m ² /day	Optional Data
Direct normal (beam)	5.49	kWh/m ² /day	
Diffuse horizontal	1.38	kWh/m ² /day	
Average temperature	15.9	°C	
Average wind speed	3.2	m/s	*NaN indicates missing data.

Los datos de irradiación se pueden ver, de forma más detallada, en cada hora, día, mes, etc.



También, se deben introducir los datos de demanda, del sistema (inclinación, fluido de trabajo, sombras, etc.), de los colectores (superficie, número de unidades, pérdidas, etc.), del sistema de almacenamiento (volumen, temperaturas, etc.), las tuberías (longitud y diámetro, coeficiente de conductividad...) y equipos auxiliares.

Solar water Residential

- Location and Resource
- Solar Water Heating**
- AC Degradation
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Hot Water Draw

Hourly hot water draw profile kg/hr Scale draw profile to average daily usage

Total annual hot water draw kg/year Average daily hot water usage kg/day

System

Tilt	40 deg	Diffuse sky model	<input type="button" value="Isotropic"/>
Azimuth	0 deg	Irradiance inputs	<input type="button" value="Beam and Diffuse"/>
Working fluid	<input type="button" value="Water"/>	Albedo	0.2 0.1
Number of collectors	<input type="text" value="2"/>	Total system collector area	<input type="text" value="10"/> m ²
		Rated system size	<input type="text" value="6.300"/> kW

Shading

System Availability

Constant loss: 0.0 %
Time series losses not enabled
Custom periods not enabled

Collector

Enter user-defined parameters
 Choose from library

User-defined collector

Collector area	<input type="text" value="5"/> m ²
FRta	<input type="text" value="0.75"/>
FRUL	<input type="text" value="4"/> W/m ² C
IAM coefficient	<input type="text" value="0.15"/>
Test fluid	<input type="button" value="Water"/>
Test flow	<input type="text" value="0.02"/> kg/s

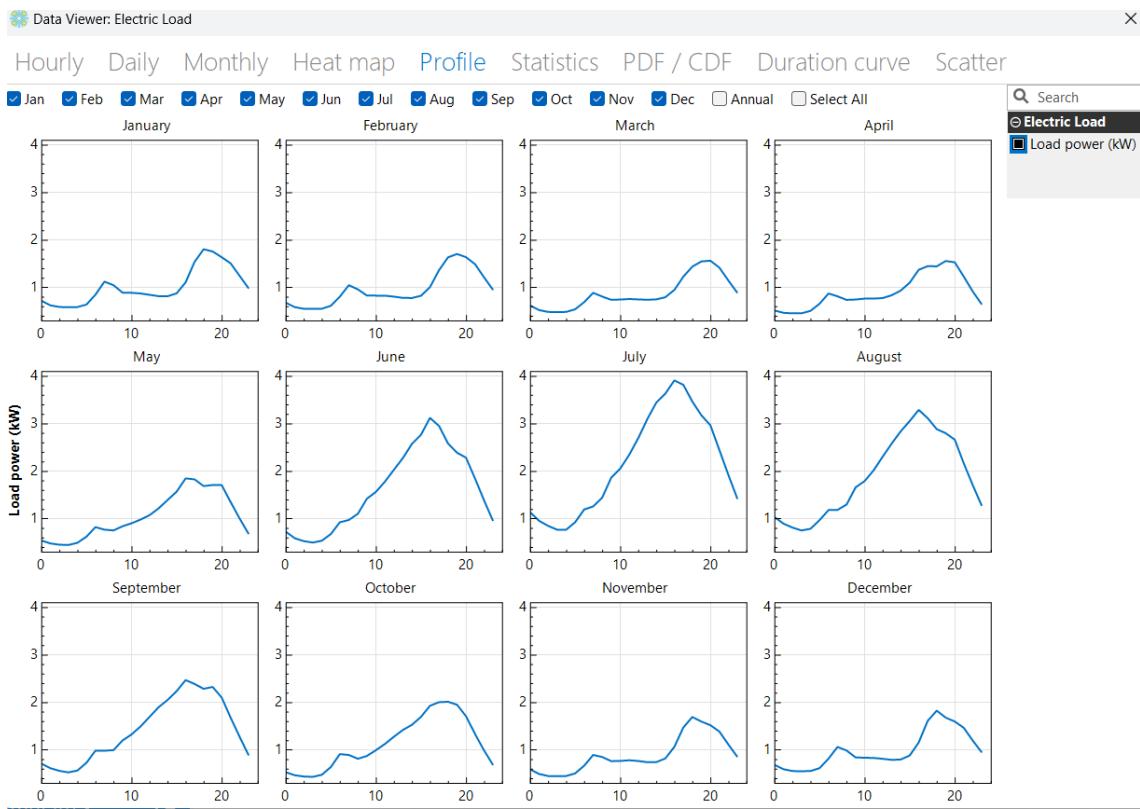
Simulate >

Solar Tank and Heat Exchanger					
Solar tank volume	0.24 m ³	Heat exchanger effectiveness	0.75 0.1		
Solar tank height to diameter ratio	2	Outlet set temperature	50 C		
Solar tank heat loss coefficient (U value)	0.8 W/m ² C	Mechanical room temperature	20 C		
Solar tank maximum water temperature	80 C				
Piping and Pumping					
Total piping length in system	20 m	Pump power	80 W		
Pipe diameter	0.02 m	Pump efficiency	0.85 0.1		
Pipe insulation conductivity	0.03 W/mC				
Pipe insulation thickness	0.012 m				
Advanced					
Use custom mains profile	<input checked="" type="checkbox"/>	Use custom set temperatures	<input type="checkbox"/>		
Hourly custom mains profile	Edit array...	C	Hourly custom set temperatures	Edit array...	C

Datos de la carga eléctrica

Electric Load Data		
Electric load data describes the electricity usage of a building or facility for electricity bill calculations. Enter or import an hourly or subhourly load profile and use the adjustment options to scale the profile or to account for annual load growth. See Help for details.		
Hourly or Subhourly Load Profile		
Electric load power	Edit array... kW i	
Electric load scaling factor (optional)	1 i	
Electric load annual growth rate	Value Scale 0 %/yr i	
View load data...		
Monthly Load Summary		
These monthly and annual values are calculated from the hourly or subhourly load profile and shown here for reference.		
Energy (kWh)	Peak (kW)	
Jan	752.19	1.85
Feb	642.38	1.76
Mar	647.75	1.82
Apr	643.76	2.30
May	777.22	2.69
Jun	1,151.70	4.05
Jul	1,594.78	4.30
Aug	1,393.36	4.20
Sep	1,016.16	3.67
Oct	837.85	2.55
Nov	640.38	1.71
Dec	731.81	1.87
Annual	10,829.34	4.30

Se puede ver más detalladamente los datos energéticos de la carga (horarios, diarios, mensuales...)



Se pueden cargar los costes y datos financieros si disponemos de ellos, y si no el programa carga automáticamente unos valores estándar según los datos de entrada.

Direct Capital Costs			
Number of Collectors	2	Collector cost	600.00 \$/m ²
		Storage cost	2000.00 \$/m ³
		Balance of system	\$ 1,000.00
		Installation cost	\$ 2,500.00
		Contingency	0 %
		Total direct cost	\$ 9,980.00

Indirect Capital Costs			
% of Direct Cost	Non-fixed Cost	Fixed Cost	Total
Engineer, Procure, Construct	0 %	\$ 0.00	\$ 0.00
Project, Land, Miscellaneous	0 %	\$ 0.00	\$ 0.00
		Total indirect cost	\$ 0.00

Sales Tax			
Sales tax of	5 %	applies to	100 % of direct cost
			\$ 499.00

Total Installed Costs			
Total Installed Cost excludes financing costs (if any, see Financing Page)	Total installed cost	\$ 10,479.00	
	Total installed cost per capacity (\$/Wt)	\$ 1.66	

Residential Loan Type																										
<input checked="" type="radio"/> Standard loan	Standard loan interest payments are not tax deductible.																									
<input type="radio"/> Mortgage	Mortgage interest payments are tax deductible.																									
Loan Parameters																										
Debt fraction	60 %	Net capital cost	10,479.00 \$	The weighted average cost of capital (WACC) is displayed for reference. SAM does not use the value for calculations.																						
Loan term	25 years	Debt	6,287.40 \$																							
Loan rate	7 %/year	WACC	6.94 %	For a project with no debt, set the debt fraction to zero.																						
Analysis Parameters																										
Analysis period	25 years	Inflation rate	2.5 %/year																							
		Real discount rate	6.4 %/year																							
		Nominal discount rate	9.06 %/year																							
Project Tax and Insurance Rates																										
-Income Tax																										
Federal income tax rate	15 %/year	-Property Tax																								
State income tax rate	7 %/year	Assessed percentage	100 % of installed cost	Assessed value	10,479.00 \$	Annual decline	0 %/year	Sales tax rate	1 %/year	-Sales Tax and Insurance		Insurance rate (annual)	1 % of installed cost	Sales tax	5 % of total direct cost	The sales tax rate applies to the total direct cost on the Installation Costs page.					Salvage Value		Net salvage value	0 % of installed cost	End of analysis period value	0.00 \$
Assessed percentage	100 % of installed cost																									
Assessed value	10,479.00 \$																									
Annual decline	0 %/year																									
Sales tax rate	1 %/year																									
-Sales Tax and Insurance																										
Insurance rate (annual)	1 % of installed cost																									
Sales tax	5 % of total direct cost																									
The sales tax rate applies to the total direct cost on the Installation Costs page.																										
Salvage Value																										
Net salvage value	0 % of installed cost	End of analysis period value	0.00 \$																							

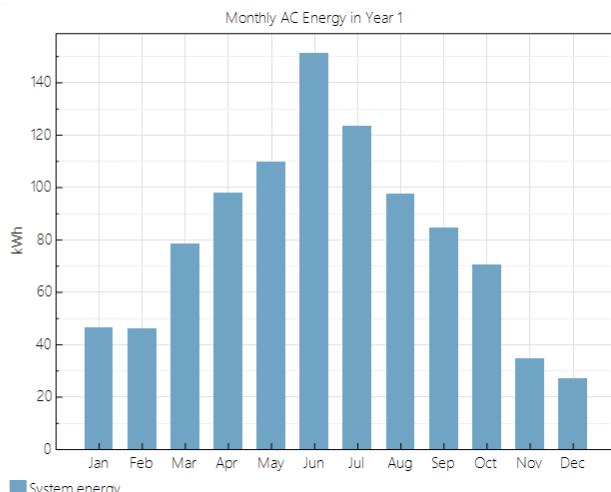
3. Simulación del sistema diseñado

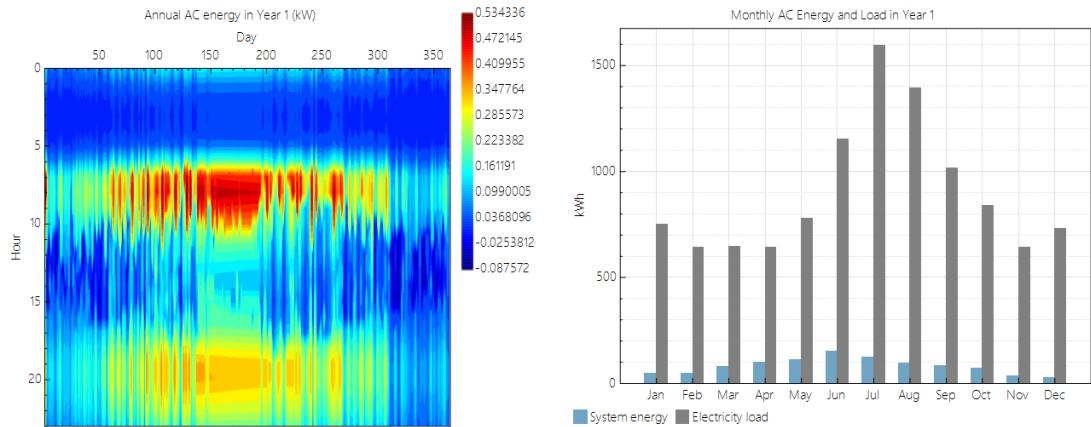


4. Visualización de los resultados obtenidos

Resultados energéticos y financieros

Metric	Value
Annual AC energy saved (year 1)	967 kWh
Solar fraction (year 1)	0.45
Aux with solar (year 1)	956.3 kWh
Aux without solar (year 1)	2,135.6 kWh
Capacity factor (year 1)	1.8%
LCOE Levelized cost of energy nominal	102.48 ¢/kWh
LCOE Levelized cost of energy real	81.36 ¢/kWh
Electricity bill without system (year 1)	\$1,514
Electricity bill with system (year 1)	\$1,398
Net savings with system (year 1)	\$116
Net present value	\$-8,466
Simple payback period	NaN
Discounted payback period	NaN
Net capital cost	\$10,479
Equity	\$4,192
Debt	\$6,287





	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
ENERGY																								
Electricity net generation (kWh)	0	967	967	967	967	967	967	967	967	967	967	967	967	967	967	967	967	967	967	967	967	967	967	
SAVINGS																								
Electricity bill without system (\$/yr)	0	1,514	1,552	1,590	1,630	1,671	1,713	1,756	1,799	1,844	1,891	1,938	1,986	2,036	2,087	2,139	2,192	2,247	2,303	2,361	2,420	2,481	2,543	
minus:																								
Electricity bill with system (\$/yr)	0	1,398	1,432	1,468	1,505	1,543	1,581	1,621	1,661	1,703	1,745	1,789	1,834	1,880	1,927	1,975	2,024	2,075	2,127	2,180	2,234	2,290	2,347	
equals:																								
Value of electricity savings (\$)	0	116	119	122	125	128	132	135	138	142	145	149	153	156	160	164	168	173	177	181	186	190	195	
Property tax net assessed value (\$)	0	10,479	10,479	10,479	10,479	10,479	10,479	10,479	10,479	10,479	10,479	10,479	10,479	10,479	10,479	10,479	10,479	10,479	10,479	10,479	10,479	10,479		
OPERATING EXPENSES																								
O&M fixed expense (\$)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
O&M production-based expense (\$)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
O&M capacity-based expense (\$)	0	101	103	106	109	111	114	117	120	123	126	129	132	136	139	142	146	150	153	157	161	165	169	
Property tax expense (\$)	0	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105	
Insurance expense (\$)	0	105	107	110	113	116	119	122	125	128	131	134	137	141	144	148	152	156	159	163	168	172	176	
Net salvage value (\$)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total operating expense (\$)	0	310	316	321	326	332	337	343	349	355	362	368	375	381	388	395	403	410	418	425	433	442	450	