

CURSO EFICIENCIA ENERGÉTICA Y ENERGÍA SOLAR TÉRMICA

Prácticas

Práctica 4. Simulación de un sistema solar térmico

1. Elegir el tipo de modelo

SAM 2024.12.12

Choose a performance model, and then choose from the available financial models.

> Photovoltaic

> Energy Storage

> Hybrid

> Concentrating Solar Power

> Industrial Process Heat

> Marine Energy

Wind

Fuel Cell - PV - Battery

Geothermal

Solar Water Heating

Biomass Combustion

Custom Generation Profile (Generic System)

▼ Distributed

Residential Owner

Commercial Owner

LCOE Calculator (FCR Method)

No Financial Model

2. Introducir los datos de entrada del sistema

Cargar datos climáticos de la ubicación considerada

FileAdduntitled

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_nsrdb-msg-v1-0-0-tmy...	41.65	-0.9	1	236	333291	NSRDB

C:\Users\Usuario\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 degreesDefault TMY fileDownload 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 fileC:\Users\Usuario\SAM Downloaded Weather Files\zaragoza_41.6518_-0.88114_nsrdb-msg-v1-0-0-tmy_60_tmy.csv

View data...

Header Data from Weather File

Latitude41.65degrees
Longitude-0.9degrees
Time zoneGMT 1
Elevation236m
Time step60minutes

Location333291
Data SourceNSRDB

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.

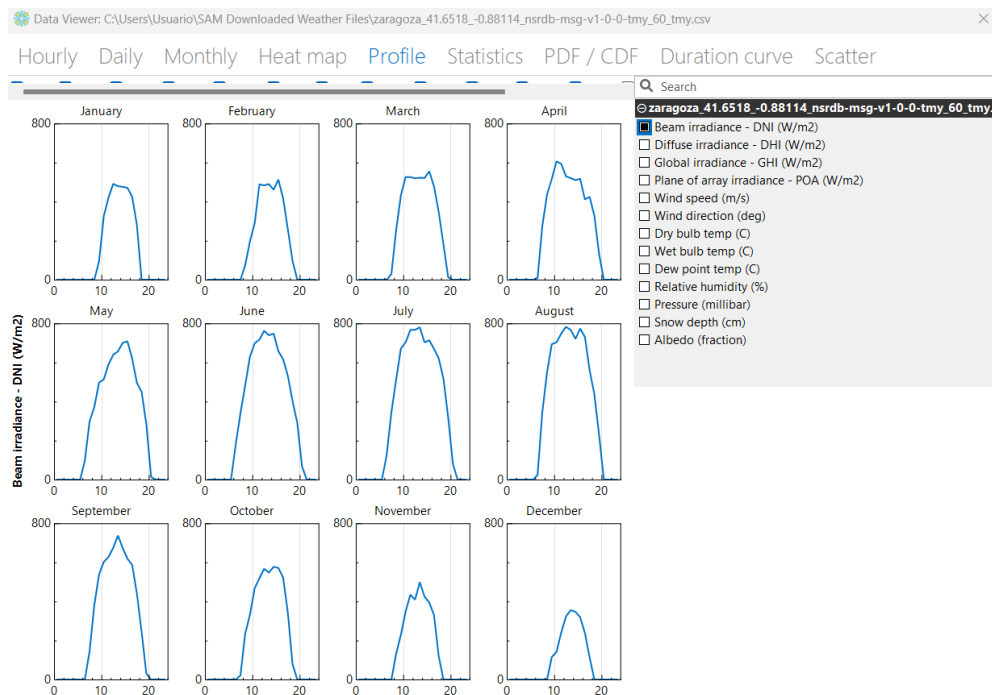
Annual Averages Calculated from Weather File Data

Global horizontal4.56kWh/m²/day
Direct normal (beam)5.49kWh/m²/day
Diffuse horizontal1.38kWh/m²/day
Average temperature15.9°C
Average wind speed3.2m/s

Optional Data

*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

Installation Costs

Operating Costs

Financial Parameters

Incentives

Electricity Rates

Electric Load

Simulate >

Parameters Stochastic

P50 / P90 Macros

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 deg

Diffuse sky model

Azimuth deg

Irradiance inputs

Working fluid

Albedo

Number of collectors

Total system collector area m2

Rated system size 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 m2

FRta

FRUL W/m2.C

IAM coefficient

Test fluid

Test flow kg/s

Filter: Name

Name	SRCC Number	Type	Area	IAM	FRta	FRUL	Test Fluid	Te
Heliodyne Inc. Gobi 408 001	2007027C	Glazed Flat-Plate	2.99	-0...	0.73	3.41	0	0.0
Heliodyne Inc. Gobi 406 001	2007027B	Glazed Flat-Plate	2.5	-0...	0.726	3.4	0	0.0
Heliodyne Inc. Gobi 336 001	2007027A	Glazed Flat-Plate	2.49	-0...	0.725	3.24	0	0.0
Heliodyne Inc. Gobi 406 002	1981085G	Glazed Flat-Plate	2.5	0.09	0.719	5.31	0	0.0
Heliodyne Inc. Gobi 410 002	1981085D	Glazed Flat-Plate	3.73	0.09	0.719	5.31	0	0.0
Heliodyne Inc. Gobi 408 002	1981085C	Glazed Flat-Plate	3	0.09	0.719	5.31	0	0.0
Heliodyne Inc. Gobi 404 001	2007027E	Glazed Flat-Plate	1.52	-0...	0.713	3.38	0	0.0

Solar Tank and Heat Exchanger

Solar tank volume

0.24

m3

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/m2.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/m.C

Pipe insulation thickness

0.012

m

Advanced

Use custom mains profile

☒

Use custom set temperatures

☐

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

Electric load scaling factor (optional)

1

Electric load annual growth rate

Value

0

%/yr

Adjust Load Profile to Monthly Usage

☐

Scale electric load profile to monthly usage

Monthly electricity usage for scaling

Edit values...

kWh

Download

Click Download Electric Load Data to run a macro that downloads modeled hourly load data. See Help for details.

Download Electric Load Data

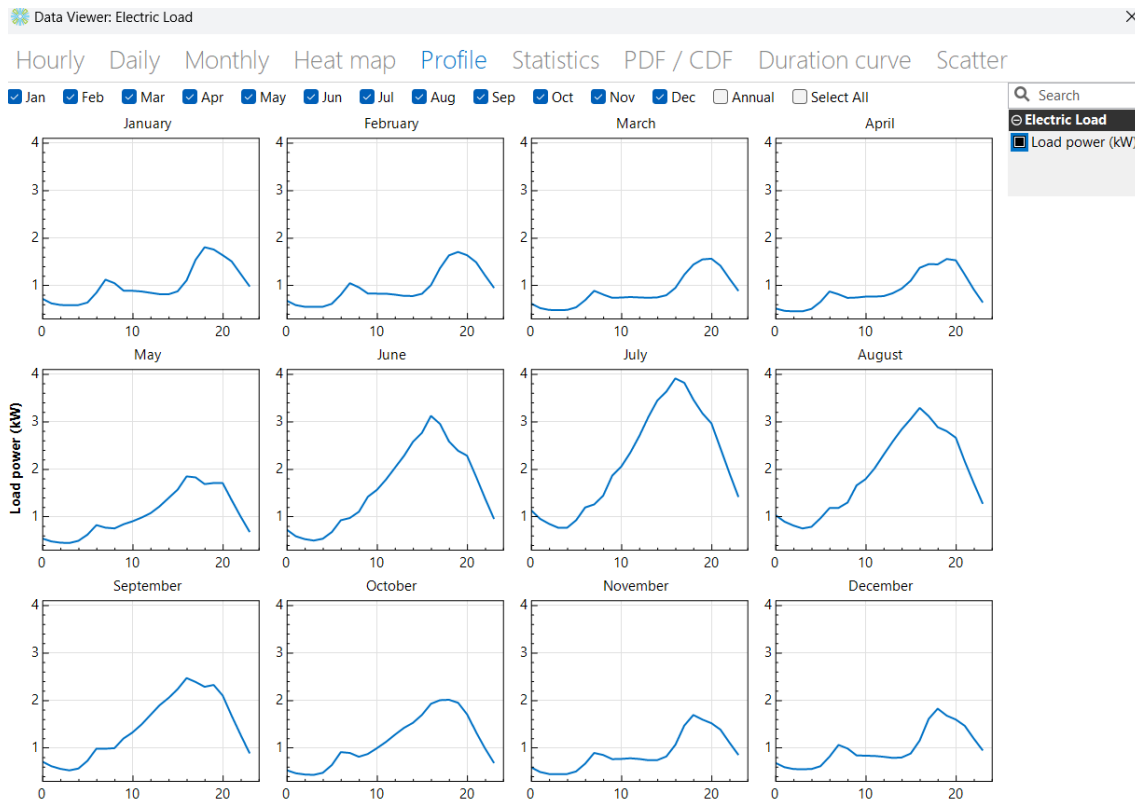
View load data...

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 Collector cost \$/m2

Storage cost \$/m3

Balance of system

Installation cost

Contingency

Total direct cost

Indirect Capital Costs

	% of Direct Cost	Non-fixed Cost	Fixed Cost	Total
Engineer, Procure, Construct	<input type="text" value="0 %"/>	<input type="text" value="\$ 0.00"/>	<input type="text" value="\$ 0.00"/>	<input type="text" value="\$ 0.00"/>
Project, Land, Miscellaneous	<input type="text" value="0 %"/>	<input type="text" value="\$ 0.00"/>	<input type="text" value="\$ 0.00"/>	<input type="text" value="\$ 0.00"/>

Total indirect cost

Sales Tax

Sales tax of applies to of direct cost

Total Installed Costs

Total Installed Cost excludes financing costs (if any, see Financing Page)

Total installed cost

Total installed cost per capacity (\$/Wt)

Residential Loan Type

☒ Standard loan Standard loan interest payments are not tax deductible.
☐ 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. For a project with no debt, set the debt fraction to zero.
Loan term	25 years	Debt	6,287.40 \$	
Loan rate	7 %/year	WACC	6.94 %	

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

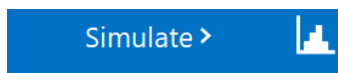
-Income Tax		-Property Tax	
Federal income tax rate	15 %/year	Assessed percentage	100 % of installed cost
State income tax rate	7 %/year	Assessed value	10,479.00 \$
-Sales Tax and Insurance		Annual decline	0 %/year
Insurance rate (annual)	1 % of installed cost	Property tax rate	1 %/year
Sales tax	5 % 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 \$
-------------------	-----------------------	------------------------------	---------

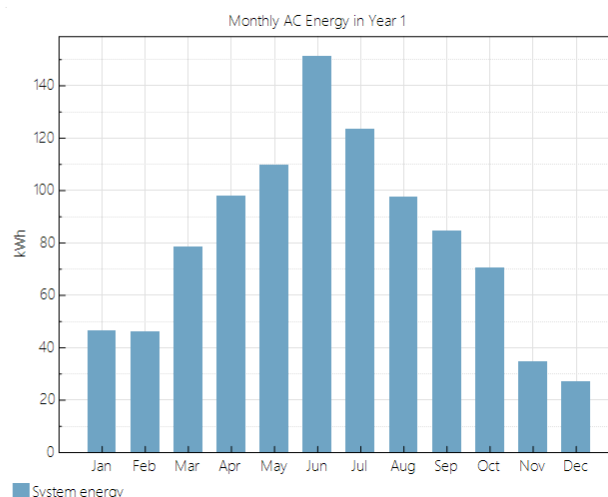
3. Simulación del sistema diseñado

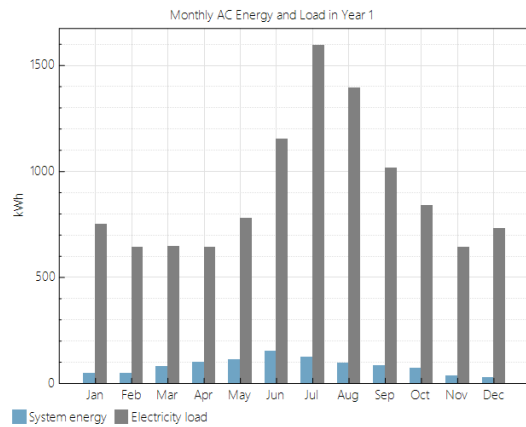
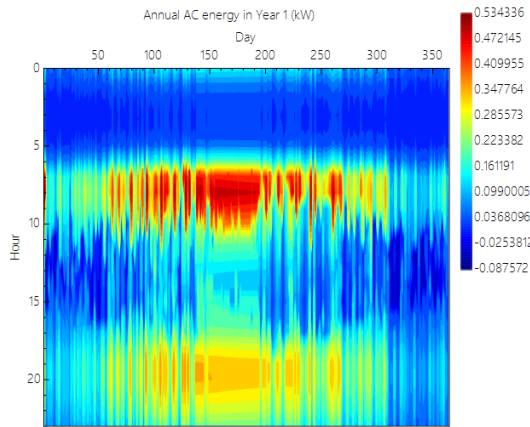


4. Visualización de los resultados obtenidos

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																							
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	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