THERMAL SOLAR DESIGN FOR POOL

Conversion factors:

1 gal H_2O = 3.79 kg

1 gal/min = 227.27 kg/hr.

1 hp = 746 watts

1 gal = 0.0038 m^3

$^oC = 5/9(^oF - 32)$

NEEDS FOR SOLAR THERMAL DESIGN FOR POOL

POOL

1. Total capacity of water in pool and ancillary storage; **250,000 gal = 947,000 kg= 3598.6 m^3**

   (a) Separate size of storage(if available)

2. Flow rate of water during use; **350 gpm = 79544.5 kg/hr**

3. Desired temperature of water; **82F = 27.8C**

4. Power (V, A, phases, PF)/hp/flow design of water pump(s); **208 V, 3ϕ**

   2-15 hp = 22380 W

   1-10 hp = 7460 W

   1-5hp = 3730 W

   TOTAL ELECTRICAL (POOL) = 33570 W = 33.57 kW

5. Other: **40 ton unit, 208 V, 3ϕ, 2-35 hp compressors = 52220 W = 52.22 kW**

SPA

1. **10,000 gal = 37,900 kg = 144 m^3**
2. **2-7.5 hp = 22389 W= 22.389 kW, 208V, 3ϕ**
3. **Water 102 F = 38,9C, space 84F = 28.9C**

JVM 10/18/2016

File ⌄ ⊕ Add CE POOL SOLAR THERMAL ⌄

Solar water, Commercial

- Location and Resource
- Solar Water Heating
- System Costs
- Lifetime
- Financial Parameters
- Incentives
- Electricity Rates
- Electric Load

Simulate ›

Parametrics Stochastic

Download a weather file from the NREL NSRDB

Download... Click Download and type a street address or latitude and longitude to download a weather file from the NREL NSRDB for United States and some internati onal locations. SAM adds the downloaded file to the solar resource library so it will ap pear in the list below.

NSRDB Map

Choose a weather file from the solar resource library

Click a name in the list to choose a file from the library. Type a few letters of the name in the search box to fil ter the list. If your location is not in the library downloading a file (see above).

Search for: Name ⌄

Name	Station ID	Latitude	Longitude	Time zone	Elevatic
USA MD Patuxent River Nas (TMY3)	724040	38.3	-76.417	-5	14
USA MD Salisbury Wicomico Co Ap (TMY3)	724045	38.333	-75.517	-5	15
USA ME Auburn-lewiston (TMY3)	726184	44.05	-70.283	-5	88
USA ME Augusta Airport (TMY3)	726185	44.317	-69.8	-5	107
USA ME Bangor International Ap (TMY3)	726088	44.8	-68.817	-5	56
USA ME Bar Harbor (awos) (TMY3)	726077	44.45	-68.367	-5	26

<

City Portland Intl Jetport | Time zone GMT -5 | Latitude 43.65 °N

State ME | Elevation 14 m | Longitude -70.3 °E

Country USA | Data Source TMY3 | Station ID 726 060

Data file C:\SAM\2016.3.14\solar_resource\USA ME Portland Intl Jetport (TMY3).csv

Tools

View data...

Refresh library

Folder settings...

Open library folder.

Annual Weather Data Summary

Global horizontal	3.88	kWh/m²/day	Average temperature	7.4	°C
Direct normal (beam)	4.01	kWh/m²/day	Average wind speed	3.6	m/s
Diffuse horizontal	1.68	kWh/m²/day			

Visit SAM weather data website

Use a specific weather file on disk

☐

Hot Water Draw

Hourly hot water draw profile: Edit data... kg/hr

Scale draw profile to average daily usage: ☑

Total annual hot water draw: 6.96811e+008 kg/year

Average daily hot water usage: 1.90907e+006 kg/day

System

Tilt	30 deg	Diffuse sky model	Isotropic
Azimuth	180 deg	Irradiance inputs	Beam and Diffuse
Total system flow rate	22.1 kg/s	Albedo	0.2 0..1
Working fluid	Glycol	Total system collector area	32 m2
Number of collectors	8	Rated system size	18.704 kW

Shading

Shading losses: Edit shading... | Open 3D shade calculator...

Curtailment and Availabilty

Edit losses...

Constant loss: 0.0 %
Hourly losses: None
Custom periods: None

Collector

◉ Enter user-defined parameters
○ Choose from library

User-defined collector

Collector area	4	m2
FRta	0.7	
FRUL	3.85	W/m2.C
Incidence angle modifier	0.2	
Test fluid	Glycol	
Test flow	0.06	kg/s

Name

Search for: Name

Name	SRCC Number	Type	Area	IAM	FRta
Thermo Dynamics Ltd. Micro-Flo S32-P	2009007A	Glazed Flat-Plate	2.98	0.34	0.685
TiSUN LLC TiSUN FM-W S 4	2007054A	Glazed Flat-Plate	2.55	0.17	0.733
TiSUN LLC TiSUN FA 2 5	2007052C	Glazed Flat-Plate	10.1	0	0.732
TiSUN LLC TiSUN FA 2 6	2007052D	Glazed Flat-Plate	12.1	0	0.731
TiSUN LLC TiSUN FA 2 3	2007052B	Glazed Flat-Plate	6.1	0	0.726
TiSUN LLC TiSUN FA 2 4	2007052A	Glazed Flat-Plate	8.08	0	0.708
TrendSetter Solar Products Inc. Trendsetter TS-22-S	2007029B	Tubular	3.16	-0.09	0.355
TrendSetter Solar Products Inc. Trendsetter TS-30-S	2007029A	Tubular	4.02	-1.29	0.355
Tsinghua Solar Systems Ltd. Tsinghua Solar SLU-1500 12	2007034Ai	Tubular	1.28	-1.8	0.3

Solar Tank and Heat Exchanger

Solar tank volume	3598.6	m3	Heat exchanger effectiveness	0.75	0..1
Solar tank height to diameter ratio	0.5		Outlet set temperature	55	C
Solar tank heat loss coefficient (U value)	1	W/m2.C	Mechanical room temperature	27	C
Solar tank maximum water temperature	28	C			

Piping and Pumping

Total piping length in system	20	m	Pump power	33570	W
Pipe diameter	0.019	m	Pump efficiency	0.85	0..1
Pipe insulation conductivity	0.03	W/m.C			
Pipe insulation thickness	0.006	m			

Advanced

Use custom mains profile	☐		Use custom set temperatures	☐	
Hourly custom mains profile	Edit data...	C	Hourly custom set temperatures	Edit data...	C

Direct Capital Costs

Number of Collectors	8	Collector cost	600.00 $/m2	$ 19,200.00
		Storage cost	0.00 $/m3	$ 0.00
			Balance of system	$ 4,000.00
			Installation cost	$ 2,000.00
			Contingency 0 %	$ 0.00
			Total direct cost	$ 25,200.00

Indirect Capital Costs

	% of Direct Cost	Non-fixed Cost	Fixed Cost	Total
Engineer, Procure, Construct	0 %	$ 0.00	$ 0.00	$ 0.00
Project, Land, Miscellaneous	0 %	$ 0.00	$ 0.00	$ 0.00
Sales tax of 0 % applies to 100 % of direct cost				$ 0.00
Total indirect cost				$ 0.00

Total Installed Costs

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

Total installed cost	$ 25,200.00
Total installed cost per capacity ($/Wt)	$ 1.35

Operation and Maintenance Costs

	First year cost		Escalation rate (above inflation)
Fixed annual cost (Value)	0	$/yr	0 %
Fixed cost by capacity (Value)	50	$/kW-yr	0 %
Variable cost by generation (Value)	0	$/MWh	0 %

In Value mode, SAM applies both inflation and escalation to the first year cost to calculate out-year costs. In Schedule mode, neither inflation nor escalation applies. See Help for details.

Input Time Series Load Data

Electric Load Data

Energy usage: Edit data... kW

☐ Normalize supplied load profile to monthly utility bill data

Scaling factor (optional): 1

Monthly energy usage: Edit values... kWh

View load data...

Monthly Load Summary

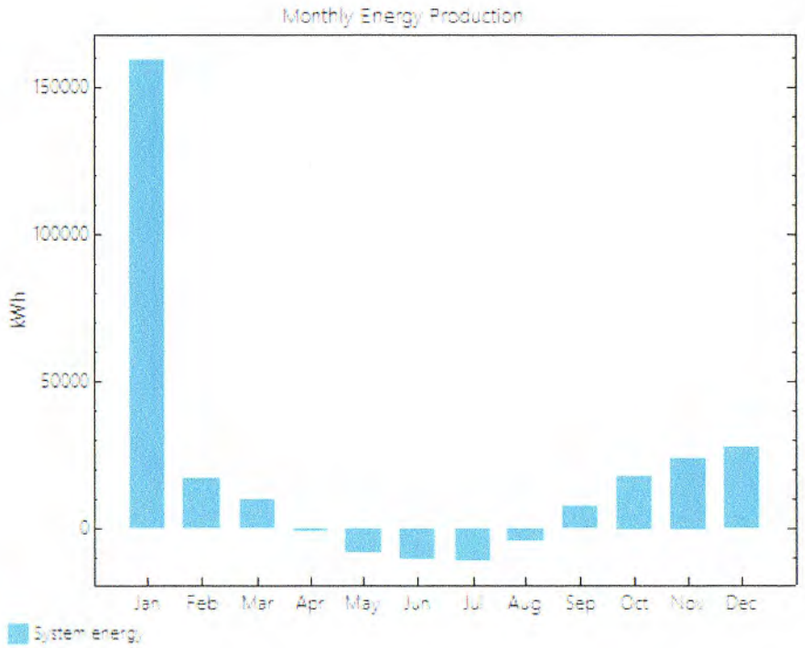
	Energy (kWh)	Peak (kW)
Jan	25,415.11	46.14
Feb	22,835.96	46.12
Mar	25,201.86	47.77
Apr	24,737.45	56.53
May	26,684.73	58.68
Jun	29,219.67	69.53
Jul	32,255.26	71.41
Aug	31,188.28	70.87
Sep	27,258.54	68.01
Oct	25,595.31	51.36
Nov	24,607.17	47.10
Dec	25,465.73	46.08
Annual	320,465.09	71.41

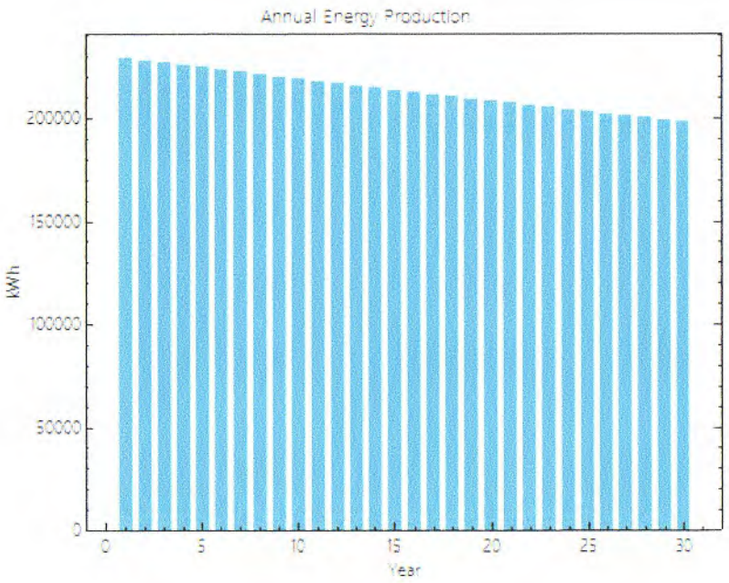
Annual Adjustment

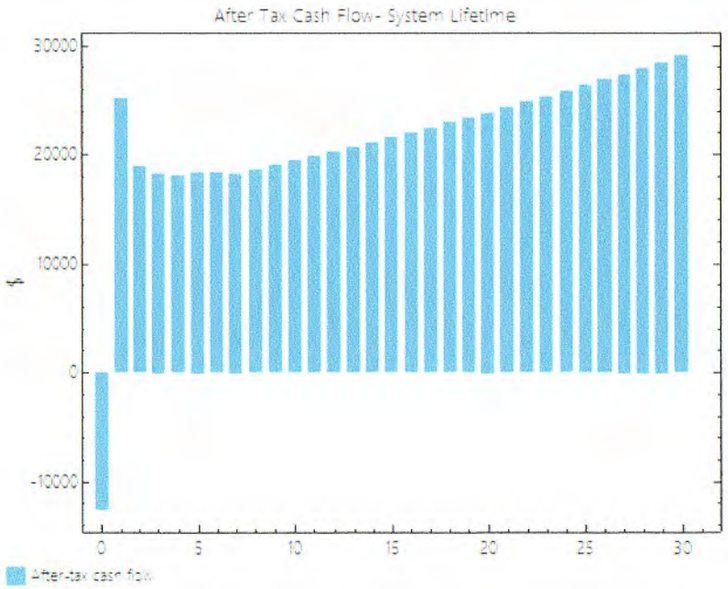
Load growth rate: Value 0 %/yr

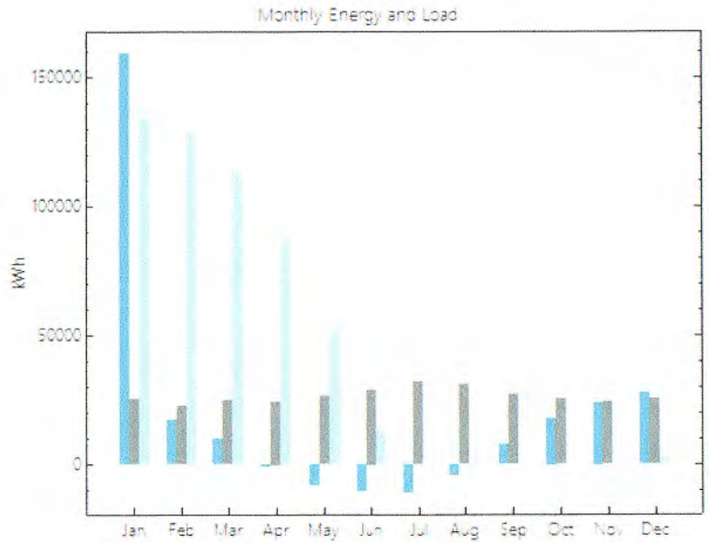
In Value mode, the growth rate applies to the previous year's annual kWh load starting in Year 2. In Schedule mode, each year's rate applies to the Year 1 kWh value. See Help for details.

Metric	Value
Annual energy saved (year 1)	229,502 kWh
Solar fraction (year 1)	0.01
Aux with solar (year 1)	35,499,924.0 kWh
Aux without solar (year 1)	35,867,932.0 kWh
Capacity factor (year 1)	140.1%
Levelized COE (nominal)	0.83 ¢/kWh
Levelized COE (real)	0.64 ¢/kWh
Electricity bill without system (year 1)	$38,456
Electricity bill with system (year 1)	$11,157
Net savings with system (year 1)	$27,299
Net present value	$220,019
Payback period	1.0 years
Net capital cost	$25,200
Equity	$12,600
Debt	$12,600




Annual Energy Production
kWh
200000
150000
100000
50000
0
0
5
10
15
20
25
30
Year


After Tax Cash Flow- System Lifetime
$
30000
20000
10000
0
-10000
0
5
10
15
20
25
30
After-tax cash flow


Monthly Energy and Load
150000
100000
50000
0
kWh
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec