Guide to Using the SegenSolar Battery Calculator

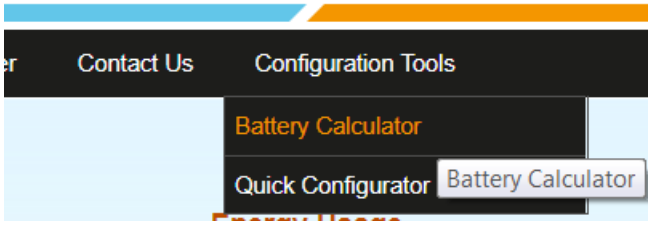
Perfect your battery sizing process with SegenSolar's battery calculator tool. We know that every project involving the use of battery storage is different: there is no 'standard' list of components that you can offer to a customer because their needs will vary.

Sizing the battery capacity is dependent on many factors, and it is important to agree with the customer what the proposed system will deliver in terms of functionality, capacity and compatibility.

SegenSolar's Battery Storage Guide talks about how to go about these initial discussions with your customer: agreeing what the daily demand is, and what they consider to be essential.

Once you have the all-important daily energy demand value, the SegenSolar Battery Calculator can be used to help agree a suitable battery capacity with the customer.

From the SegenSolar portal home page, go to 'Configuration Tools' and 'Battery Calculator'.



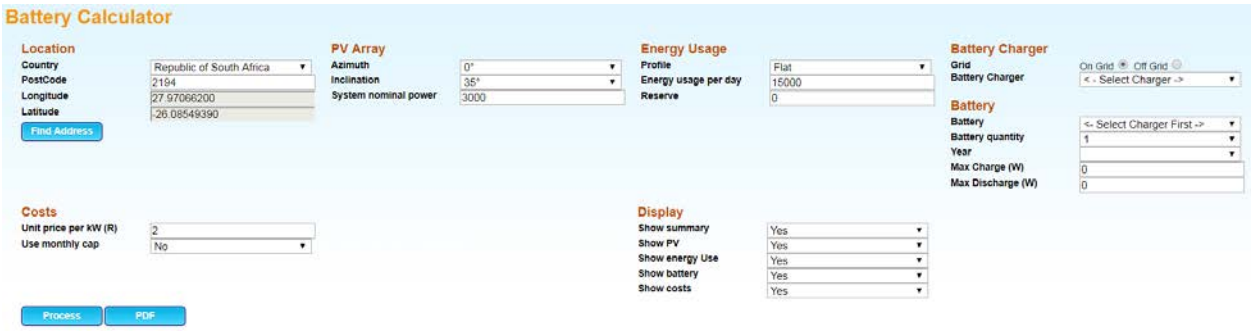
You will be taken through to the calculator page. It's intended to be a standalone tool, and won't produce a quote of parts at the end. It will help you decide what amount of battery capacity is appropriate, and once you know that, you're ready to either use the Design Tool, or speak to us about one of our storage packages. You can find a complete list of the storage packages under 'Products' and PV Storage Products'.

Simply put, the tool will show what amount of PV yield is available from a given system, and compare the hourly output with the hourly energy demands of the building. Whatever is left over is available to be stored in a battery. It also shows how the battery state of charge (SOC) varies through the day and night, based on the chosen load profile.

This document is a brief guide explaining how to complete the information field and how to interpret the results and explain them to your customer.

Completing the site information section

Many of these fields are already defaulted based on your user profile. For example the Location information will default to the address we have registered for you. Some of the other fields will need to be adjusted before results can be produced. Here is an explanation of the fields.



Location

Country — This will default to your registered country.

Postcode — This will default to your registered postcode, but you can change it to your customer's site. Click 'Find Address' and there will be a short delay while the tool uses an online web server to look up the PV yield data for that exact location. You will see the site coordinates update once it has successfully found the data for the new location.

PV Array

Azimuth — Which way is the array facing? Azimuth means ideal (north facing). This field is asking how many degrees off ideal the array faces. By default it will be set to 0, which means it is facing north. If your system is facing east, you set it to -90, and west would be 90.

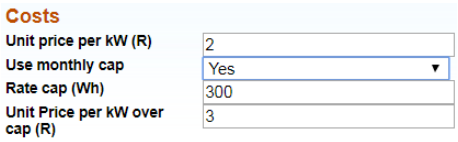
Inclination — What angle will the PV array be at?

System Power — This is what the rating of the PV array is in Watts. Eg 4kWp would be entered as 4000.

Costs

Unit Price — The cost of imported grid energy at the site. The currency and base value will default depending on the country you've selected in the Location section.

Monthly Cap — If the site is on a tariff where the unit cost increases above a certain monthly usage, you can add the total higher unit rate and the point at which it's applied. For example our basic rate here is R2/kWh and a higher rate of R3 will be used for any consumption above 300kWh per month.



Energy Usage

Profile — You need to select an energy usage profile. A load profile is how the daily energy consumption is distributed throughout the 24 hour period. Every building and occupant is a bit different, and therefore the pattern of energy usage will pretty much be unique. The main thing to be aware of is whether there are people at home during the day or not. That will greatly affect how much of the PV generated energy is available to be stored.

Energy Usage — This is a daily total of energy consumption in Watt Hours (Wh). This is the value that will be modeled using the Load Profile to work out what the hourly consumption is for the site. The tool will give you
a default usage value when you choose the load profile, but it's important that the daily total is something you've confirmed with your customer. It needs to be as accurate as possible.

Reserve — You can add a reserve amount of capacity (in Wh) and the tool will set that amount of battery capacity aside when it runs the calculations. It's useful for certain sites that have energy demands that must always be fulfilled, for example medical equipment. Especially useful if the grid supply is inconsistent.

Be aware, adding an energy reserve will effectively reduce the usage battery capacity for all the other loads in the building. Also, the battery capacity will reduce over time but the reserve amount will remain constant. It will therefore take up more and more of the usable capacity of the system.

Display

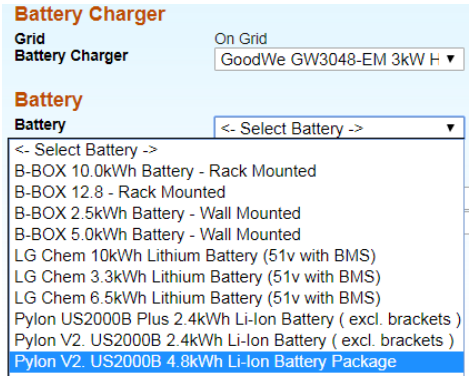
You can toggle which parts of the results are displayed when the calculation is run. For example, you could choose to hide the Costs section, and then the results would not include any of it. This could be useful when discussing the results with your client.

Battery Charger

Choose which product will charge and discharge the battery. The list of chargers includes hybrids, inverter/chargers and DC string controllers. They are listed alphabetically.

Battery

Battery — Choose the type of battery to use in the calculation. The dropdown will show all the batteries that are compatible with the charger you chose.



Year — Battery capacity always decreases as time passes. When you are working out the most appropriate battery capacity, you'll want to make sure it can supply the

necessary loads after some time has passed, not just when it's brand new. We would suggest running the calculation based on the maximum year value to get more useful results.

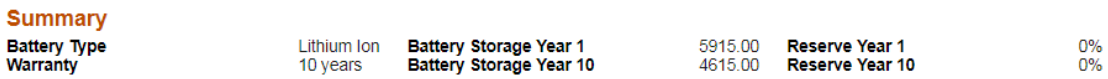
Max Charge — This is the charging capacity (in Watts) of the charger/battery combination you have chosen. Certain products, when used together, achieve lower charge values than the datasheets of the individual components state. This is usually a deliberate software limitation that ensures the components are not overworked and last their full expected lifetime.

Max Discharge — This is the discharge capacity (in Watts) of the combination of products. This will usually, but not always, be the same as the maximum charge rate.

When you have entered all the site information and design parameters, click Process or PDF

The Results section and how to interpret it

When you click Process, the tool will work for a moment and then display the results.



The first section is a summary of the battery capacity. The usable battery storage will be shown in year 1 and also for the year you chose earlier. This is showing you how the usable capacity will reduce as time passes. The usable capacity of a battery takes into account its available Depth of Discharge (DoD). In this example, a lithium battery pack rated at 6.5kWh has a DoD of 91%, so the usable energy capacity is 5.9kWh in year 1. By year 10, that capacity has reduced to 4.6kWh.

If you entered a Reserve, you will notice that it will take up a greater proportion of the usable battery capacity as time passes.

Here is a summary of what the results tables and charts show.

PV array yield

The results tables are all laid out in the same sort of format. You read the hours of the day from left to right, and the different months top to bottom. The results from the whole year have been averaged to give a typical day for each month.

Table A - PV [Wh/kWp]

	01:00:00	02:00:00	03:00:00	04:00:00	05:00:00	06:00:00	07:00:00	08:00:00	09:00:00	10:00:00	11:00:00	12:00:00	13:00:00	14:00:00	15:00:00	16:00:00	17:00:00	18:00:00	19:00:00	20:00:00	21:00:00	22:00:00	23:00:00	24:00:00	Total	Month
Jan	0	0	0	0	0	3.11	51.92	198.96	369.55	483.57	536.80	513.80	514.80	467.60	404.69	321.92	226.36	105.68	22.82	0	0	0	0	0	4181.48	129.626
Feb	0	0	0	0	0	0.12	31.23	176.91	326.86	459.91	563.32	593.45	572.04	504.54	447.67	369.06	266.56	128.04	11.36	0	0	0	0	0	4319.49	120.946
Mar	0	0	0	0	0	0	12.53	182.81	348.28	470.30	569.37	579.00	578.03	549.88	476.37	370.16	240.40	98.02	1.44	0	0	0	0	0	4458.59	138.216
Apr	0	0	0	0	0	0	3.66	170.73	326.86	459.43	552.64	565.47	561.90	540.77	490.14	384.23	227.85	29.41	0.00	0	0	0	0	0	4315.10	129.453
May	0	0	0	0	0	0	0.66	200.36	384.96	507.72	582.75	630.10	620.43	568.27	500.11	388.99	213.94	2.79	0	0	0	0	0	0	4601.08	142.634
Jun	0	0	0	0	0	0	0.02	181.88	380.06	520.10	603.67	645.00	631.66	588.40	520.18	405.07	236.65	0.78	0	0	0	0	0	0	4723.48	141.704
Jul	0	0	0	0	0	0	0.02	181.08	379.47	530.61	627.80	674.60	671.99	633.46	553.51	433.57	232.71	2.79	0	0	0	0	0	0	4921.63	152.577
Aug	0	0	0	0	0	0	1.35	201.15	399.81	542.72	635.64	686.02	688.57	650.24	571.39	448.58	256.35	10.85	0	0	0	0	0	0	5092.68	157.873
Sep	0	0	0	0	0	0.01	29.35	242.64	423.61	554.34	644.12	650.13	655.90	616.20	530.53	406.35	255.39	37.42	0.00	0	0	0	0	0	5045.98	151.379
Oct	0	0	0	0	0	2.60	93.39	260.12	426.69	535.03	606.09	583.47	586.79	530.05	452.39	339.46	194.64	57.06	0.45	0	0	0	0	0	4674.27	144.902
Nov	0	0	0	0	0	11.24	104.11	244.46	392.40	496.67	542.60	546.65	541.16	493.26	403.74	308.70	186.74	68.63	4.19	0	0	0	0	0	4346.56	130.397
Dec	0	0	0	0	0	11.78	86.89	216.15	381.89	484.05	539.28	497.78	511.10	499.10	445.12	330.79	225.63	96.11	17.26	0	0	0	0	0	4282.94	132.771
																								Yearly total [kWh]		1672.478

Table B - Energy prod. [Wh]

	01:00:00	02:00:00	03:00:00	04:00:00	05:00:00	06:00:00	07:00:00	08:00:00	09:00:00	10:00:00	11:00:00	12:00:00	13:00:00	14:00:00	15:00:00	16:00:00	17:00:00	18:00:00	19:00:00	20:00:00	21:00:00	22:00:00	23:00:00	24:00:00	Total
Jan	0	0	0	0	0	12.44	207.68	795.84	1436.20	1814.28	2147.20	2054.00	2059.20	1871.20	1618.76	1287.68	905.44	422.72	91.28	0	0	0	0	0	16725.92
Feb	0	0	0	0	0	0.48	124.92	707.64	1307.44	1839.24	2253.28	2133.80	2048.16	2018.16	1790.68	1476.24	1026.32	512.16	45.44	0	0	0	0	0	17277.96
Mar	0	0	0	0	0	0	50.12	731.24	1393.12	1881.20	2209.48	2316.00	2312.12	2199.52	1901.48	1480.64	961.60	392.08	5.76	0	0	0	0	0	17834.96
Apr	0	0	0	0	0	0	14.64	682.92	1315.52	1837.72	2210.56	2261.88	2247.60	2163.08	1960.56	1536.92	911.40	117.64	0.00	0	0	0	0	0	17260.44
May	0	0	0	0	0	0	2.64	801.44	1539.84	2030.88	2331.00	2520.40	2481.72	2270.08	2000.44	1555.96	855.76	11.16	0	0	0	0	0	0	18404.32
Jun	0	0	0	0	0	0	0.08	727.52	1520.24	2080.40	2414.68	2620.00	2526.64	2353.60	2080.72	1620.28	946.60	3.12	0	0	0	0	0	0	18893.88
Jul	0	0	0	0	0	0	0.08	724.32	1517.88	2122.44	2511.20	2699.20	2687.96	2533.92	2214.04	1734.28	930.84	11.16	0	0	0	0	0	0	19687.32
Aug	0	0	0	0	0	0	5.40	804.60	1599.24	2170.88	2542.56	2744.08	2754.28	2600.96	2285.56	1794.32	1025.40	43.40	0	0	0	0	0	0	20370.66
Sep	0	0	0	0	0	0.04	117.40	970.56	1694.44	2217.36	2576.48	2600.52	2623.60	2464.80	2122.12	1625.40	1021.56	149.68	0.00	0	0	0	0	0	20183.96
Oct	0	0	0	0	0	10.40	373.56	1040.48	1714.76	2140.12	2432.36	2333.88	2355.16	2120.20	1809.56	1357.92	778.56	228.32	1.80	0	0	0	0	0	18697.08
Nov	0	0	0	0	0	44.96	416.44	977.84	1569.60	1985.68	2170.40	2186.60	2164.72	1973.12	1614.96	1234.80	754.96	274.52	16.76	0	0	0	0	0	17386.36
Dec	0	0	0	0	0	47.12	347.56	864.60	1407.56	1816.20	2157.12	1991.12	2044.40	1996.40	1780.48	1323.16	902.52	384.44	69.04	0	0	0	0	0	17131.72

The first two tables show what amount of PV yield is available for that site. Table A gives the yield per kWp of installed power, and B shows the total available for the system size. For this site we have 1672kWh/kWp and a 4kWp PV array, so the total annual yield will be about 6700kWh.

The site energy consumption

The next two tables are normally read together. They show what energy the site is using every hour and what impact the PV array is having on the amount of energy being drawn from the grid.

Table C - Energy Use [Wh]

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
	388.22	315.55	283.68	265.46	263.98	256.66	294.24	393.53	549.47	634.90	643.89	672.93	699.89	627.49	584.96	588.79	679.75	778.02	788.34	785.76	731.37	667.31	597.97	497.84	13000

Table D - Difference [Wh]

	01:00:00	02:00:00	03:00:00	04:00:00	05:00:00	06:00:00	07:00:00	08:00:00	09:00:00	10:00:00	11:00:00	12:00:00	13:00:00	14:00:00	15:00:00	16:00:00	17:00:00	18:00:00	19:00:00	20:00:00	21:00:00	22:00:00	23:00:00	24:00:00
Jan	-388.22	-315.55	-283.68	-265.46	-263.98	-244.22	-86.56	402.31	888.73	1179.38	1503.31	1381.07	1359.31	1243.71	1033.80	688.89	225.69	-355.30	-697.06	-785.76	-731.37	-667.31	-597.97	-497.84
Feb	-388.22	-315.55	-283.68	-265.46	-263.98	-256.18	-169.32	314.11	757.97	1198.34	1609.39	1460.87	1348.27	1390.67	1205.72	877.45	346.57	-265.86	-742.90	-785.76	-731.37	-667.31	-597.97	-497.84
Mar	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-244.12	337.71	843.65	1246.30	1565.59	1643.07	1612.23	1572.03	1316.52	861.85	281.85	-385.94	-782.58	-785.76	-731.37	-667.31	-597.97	-497.84
Apr	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-279.60	289.39	766.05	1202.82	1566.67	1588.95	1547.71	1535.59	1375.60	938.13	231.65	-660.08	-788.34	-785.76	-731.37	-667.31	-597.97	-497.84
May	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-291.60	407.91	990.37	1395.98	1687.11	1847.47	1781.83	1645.59	1415.48	957.17	176.01	-788.86	-788.34	-785.76	-731.37	-667.31	-597.97	-497.84
Jun	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-294.16	333.99	970.77	1445.50	1770.79	1947.07	1826.76	1726.11	1495.76	1021.49	266.85	-774.90	-788.34	-785.76	-731.37	-667.31	-597.97	-497.84
Jul	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-294.16	330.79	968.41	1497.54	1867.31	2029.97	1988.07	1906.43	1629.00	1139.49	251.09	-788.86	-788.34	-785.76	-731.37	-667.31	-597.97	-497.84
Aug	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-288.84	411.07	1049.77	1535.96	1898.67	2071.15	2054.39	1975.47	1700.60	1195.53	345.65	-734.52	-788.34	-785.76	-731.37	-667.31	-597.97	-497.84
Sep	-388.22	-315.55	-283.68	-265.46	-263.98	-256.62	-176.84	577.03	1144.97	1582.46	1932.59	1927.59	1922.71	1837.31	1537.16	1026.61	341.81	-628.34	-788.34	-785.76	-731.37	-667.31	-597.97	-497.84
Oct	-388.22	-315.55	-283.68	-265.46	-263.98	-246.26	79.32	646.96	1165.29	1505.22	1788.47	1660.95	1656.27	1492.71	1224.60	760.13	98.81	-549.70	-788.34	-785.76	-731.37	-667.31	-597.97	-497.84
Nov	-388.22	-315.55	-283.68	-265.46	-263.98	-211.70	122.20	584.31	1020.13	1351.76	1526.51	1513.67	1464.83	1345.63	1030.00	636.01	75.21	-503.50	-771.56	-785.76	-731.37	-667.31	-597.97	-497.84
Dec	-388.22	-315.55	-283.68	-265.46	-263.98	-209.54	53.32	471.07	858.09	1181.30	1513.23	1318.19	1344.51	1368.91	1195.52	724.37	222.77	-393.58	-719.30	-785.76	-731.37	-667.31	-597.97	-497.84

Table C shows the baseline energy consumption of the site over the 24 hour period. You will see the daily energy total in Wh that you entered earlier. The load profile you chose has determined how that daily total is distributed over 24 hours. In this example, the house is using 388.22Wh between 1am and 2am, and 672.93Wh between noon and 1pm. If you keep the daily total consumption value the same but change the load profile selection, the values in C will change to reflect the different pattern of energy usage.

Table D overlays the PV generation on top of the baseline consumption values. All the red boxes with negative values are where energy is being drawn from the grid. We have a standard PV array here at the moment, so during the night the values for each hour should match the baseline values in C. However, as the morning passes, the amount of energy available from the PV will start to reduce the amount of energy required from the grid. When the numbers become positive and green, it means there is a net excess of energy for that hour. The excess energy day peaks in the middle of the day and then tails off again into the evening. The numbers will become red and negative and eventually match the load profile base values again.

Table G - Battery Charge By Year (10)

	01:00:00	02:00:00	03:00:00	04:00:00	05:00:00	06:00:00	07:00:00	08:00:00	09:00:00	10:00:00	11:00:00	12:00:00	13:00:00	14:00:00	15:00:00	16:00:00	17:00:00	18:00:00	19:00:00	20:00:00	21:00:00	22:00:00	23:00:00	24:00:00
Jan	-	-	-	-	-	-	-	392.12	1258.35	2407.87	3673.12	4615.00	4615.00	4615.00	4615.00	4615.00	4615.00	4256.25	3555.57	2762.65	2025.06	1352.62	750.52	249.82
Feb	-	-	-	-	-	-	-	306.16	1044.94	2212.94	3781.58	4615.00	4615.00	4615.00	4615.00	4615.00	4615.00	4348.33	3599.03	2805.11	2068.54	1396.06	793.96	293.28
Mar	-	-	-	-	-	-	-	329.16	1151.45	2366.19	3892.14	4615.00	4615.00	4615.00	4615.00	4615.00	4615.00	4227.35	3437.67	2644.75	1907.18	1234.72	632.62	131.92
Apr	-	-	-	-	-	-	-	282.06	1026.71	2201.07	3728.07	4615.00	4615.00	4615.00	4615.00	4615.00	4615.00	3949.56	3154.03	2361.11	1623.54	951.06	348.96	-
May	-	-	-	-	-	-	-	397.58	1362.87	2723.50	4367.89	4615.00	4615.00	4615.00	4615.00	4615.00	4615.00	3841.32	3045.77	2252.85	1515.26	842.62	240.72	-
Jun	-	-	-	-	-	-	-	325.53	1271.72	2680.62	4406.57	4615.00	4615.00	4615.00	4615.00	4615.00	4615.00	3833.14	3037.59	2244.67	1507.10	834.64	232.54	-
Jul	-	-	-	-	-	-	-	322.41	1266.30	2716.17	4536.20	4615.00	4615.00	4615.00	4615.00	4615.00	4615.00	3841.32	3045.77	2252.85	1515.26	842.62	240.72	-
Aug	-	-	-	-	-	-	-	400.66	1423.85	2920.94	4615.00	4615.00	4615.00	4615.00	4615.00	4615.00	4615.00	3874.13	3078.58	2285.66	1548.09	875.63	273.53	-
Sep	-	-	-	-	-	-	-	562.42	1678.40	3220.79	4615.00	4615.00	4615.00	4615.00	4615.00	4615.00	4615.00	3982.10	3186.55	2393.63	1656.06	983.60	381.50	-
Oct	-	-	-	-	-	-	77.31	707.88	1843.66	3310.77	4615.00	4615.00	4615.00	4615.00	4615.00	4615.00	4615.00	4061.91	3268.09	2475.17	1737.60	1065.14	463.04	-
Nov	-	-	-	-	-	-	119.11	668.62	1682.92	3000.47	4488.33	4615.00	4615.00	4615.00	4615.00	4615.00	4615.00	4106.58	3330.10	2537.18	1799.61	1127.15	525.05	24.35
Dec	-	-	-	-	-	-	51.97	511.11	1347.47	2498.86	3973.77	4615.00	4615.00	4615.00	4615.00	4615.00	4615.00	4219.64	3494.35	2701.43	1963.86	1291.40	689.30	188.60

Table H - Reduced power from grid [Wh] By Year (10)

	01:00:00	02:00:00	03:00:00	04:00:00	05:00:00	06:00:00	07:00:00	08:00:00	09:00:00	10:00:00	11:00:00	12:00:00	13:00:00	14:00:00	15:00:00	16:00:00	17:00:00	18:00:00	19:00:00	20:00:00	21:00:00	22:00:00	23:00:00	24:00:00	Total	Cost
Jan	-138.40	-315.55	-283.68	-265.46	-263.98	-244.22	-86.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-1597.85	R 148,30
Feb	-94.94	-315.55	-283.68	-265.46	-263.98	-256.18	-169.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-1649.11	R 138,23
Mar	-256.30	-315.55	-283.68	-265.46	-263.98	-256.66	-244.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-1885.75	R 175,07
Apr	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-279.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-148.86	-2202.01	R 197,88
May	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-291.60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-257.12	-2322.27	R 215,67
Jun	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-294.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-265.30	-2333.01	R 209,67
Jul	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-294.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-257.12	-2324.83	R 215,91
Aug	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-288.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-224.31	-2286.70	R 212,36
Sep	-388.22	-315.55	-283.68	-265.46	-263.98	-256.62	-176.84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-116.34	-2066.69	R 185,70
Oct	-388.22	-315.55	-283.68	-265.46	-263.98	-246.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-34.80	-1797.95	R 166,91
Nov	-363.67	-315.55	-283.68	-265.46	-263.98	-211.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-1704.24	R 153,08
Dec	-199.62	-315.55	-283.68	-265.46	-263.98	-209.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-1537.83	R 142,72

So what amount of energy is available to charge a battery?

The next two tables split the answer down to two views: firstly the excess energy from site, and then what is still being drawn from the grid.

Table E - Surplus [Wh]

	01:00:00	02:00:00	03:00:00	04:00:00	05:00:00	06:00:00	07:00:00	08:00:00	09:00:00	10:00:00	11:00:00	12:00:00	13:00:00	14:00:00	15:00:00	16:00:00	17:00:00	18:00:00	19:00:00	20:00:00	21:00:00	22:00:00	23:00:00	24:00:00	Total
Jan	-	-	-	-	-	-	-	402.31	888.73	1179.36	1503.31	1361.07	1359.31	1243.71	1033.80	688.69	225.69	-	-	-	-	-	-	-	9906.20
Feb	-	-	-	-	-	-	-	314.11	757.97	1196.34	1609.39	1460.87	1348.27	1390.67	1205.72	877.45	346.57	-	-	-	-	-	-	-	10509.36
Mar	-	-	-	-	-	-	-	337.71	843.65	1246.30	1565.59	1643.07	1612.23	1572.03	1316.52	881.85	261.85	-	-	-	-	-	-	-	11300.60
Apr	-	-	-	-	-	-	-	289.39	766.05	1202.62	1566.67	1586.95	1547.71	1535.59	1375.60	938.13	231.65	-	-	-	-	-	-	-	11042.56
May	-	-	-	-	-	-	-	407.91	990.37	1395.96	1667.11	1647.47	1781.63	1645.59	1415.48	957.17	176.01	-	-	-	-	-	-	-	12304.92
Jun	-	-	-	-	-	-	-	333.99	970.77	1445.50	1770.79	1947.07	1826.75	1726.11	1495.76	1021.49	266.85	-	-	-	-	-	-	-	12805.08
Jul	-	-	-	-	-	-	-	330.79	968.41	1487.54	1867.31	2026.27	1988.07	1906.43	1629.08	1135.49	251.09	-	-	-	-	-	-	-	13590.48
Aug	-	-	-	-	-	-	-	411.07	1049.77	1535.96	1898.67	2071.15	2054.39	1973.47	1700.60	1195.53	345.65	-	-	-	-	-	-	-	14236.26
Sep	-	-	-	-	-	-	-	577.03	1144.97	1582.46	1932.39	1927.59	1923.71	1897.31	1597.16	1026.61	341.61	-	-	-	-	-	-	-	13951.24
Oct	-	-	-	-	-	-	79.32	646.95	1165.29	1505.22	1788.47	1660.95	1655.27	1492.71	1224.60	759.13	98.81	-	-	-	-	-	-	-	12076.72
Nov	-	-	-	-	-	-	122.20	584.31	1020.13	1351.76	1526.51	1513.67	1464.83	1345.63	1030.00	636.01	75.21	-	-	-	-	-	-	-	10670.26
Dec	-	-	-	-	-	-	53.32	471.07	858.09	1161.30	1513.23	1316.19	1344.51	1368.91	1195.52	724.37	222.77	-	-	-	-	-	-	-	10251.26

Table F - Deficit [Wh]

	01:00:00	02:00:00	03:00:00	04:00:00	05:00:00	06:00:00	07:00:00	08:00:00	09:00:00	10:00:00	11:00:00	12:00:00	13:00:00	14:00:00	15:00:00	16:00:00	17:00:00	18:00:00	19:00:00	20:00:00	21:00:00	22:00:00	23:00:00	24:00:00	Total	Cost
Jan	-388.22	-315.55	-283.68	-265.46	-263.98	-244.22	-86.56	-	-	-	-	-	-	-	-	-	-	-355.30	-697.05	-765.76	-731.37	-667.31	-597.97	-497.84	-6180.26	R 574,47
Feb	-388.22	-315.55	-283.68	-265.46	-263.98	-256.18	-169.32	-	-	-	-	-	-	-	-	-	-	-265.86	-742.90	-765.76	-731.37	-667.31	-597.97	-497.84	-6231.40	R 523,14
Mar	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-244.12	-	-	-	-	-	-	-	-	-	-	-385.94	-762.58	-765.76	-731.37	-667.31	-597.97	-497.84	-6466.44	R 601,08
Apr	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-279.60	-	-	-	-	-	-	-	-	-	-	-660.38	-768.34	-765.76	-731.37	-667.31	-597.97	-497.84	-6782.12	R 610,09
May	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-291.60	-	-	-	-	-	-	-	-	-	-	-766.66	-768.34	-765.76	-731.37	-667.31	-597.97	-497.84	-6900.60	R 641,46
Jun	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-294.16	-	-	-	-	-	-	-	-	-	-	-774.90	-768.34	-765.76	-731.37	-667.31	-597.97	-497.84	-6911.20	R 621,71
Jul	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-294.16	-	-	-	-	-	-	-	-	-	-	-766.86	-768.34	-765.76	-731.37	-667.31	-597.97	-497.84	-6903.16	R 641,69
Aug	-388.22	-315.55	-283.68	-265.46	-263.98	-256.66	-288.84	-	-	-	-	-	-	-	-	-	-	-734.62	-768.34	-765.76	-731.37	-667.31	-597.97	-497.84	-6865.60	R 638,20
Sep	-388.22	-315.55	-283.68	-265.46	-263.98	-256.62	-176.84	-	-	-	-	-	-	-	-	-	-	-626.34	-768.34	-765.76	-731.37	-667.31	-597.97	-497.84	-6547.26	R 597,96
Oct	-388.22	-315.55	-283.68	-265.46	-263.98	-246.26	-	-	-	-	-	-	-	-	-	-	-	-549.70	-766.54	-765.76	-731.37	-667.31	-597.97	-497.84	-6379.64	R 593,01
Nov	-388.22	-315.55	-283.68	-265.46	-263.98	-211.70	-	-	-	-	-	-	-	-	-	-	-	-503.50	-771.58	-765.76	-731.37	-667.31	-597.97	-497.84	-6283.92	R 565,25
Dec	-388.22	-315.55	-283.68	-265.46	-263.98	-209.54	-	-	-	-	-	-	-	-	-	-	-	-393.66	-719.30	-765.76	-731.37	-667.31	-597.97	-497.84	-6119.56	R 568,62

In Table E, the total amount of excess PV energy is shown in the Total column on the right, and Table F shows the total daily energy consumption and the monthly cost. You can use these two tables to give your customer a recommendation about whether it is worth adding battery storage to their site. If there is very little excess energy left over once the energy demands have been taken into account, then there is little point adding storage. You might also want to use these tables to show the energy savings that are possible with just PV.

Adding storage capacity

Now we see what happens when we add battery storage. Table G shows the battery state of charge (SoC) in Wh. This is an indication of how full the battery is in each hour. The hours in each day when there is no battery charge are shown with an '-'. Looking at Table G, in the morning until 7am, there is no excess energy available so the battery remains empty. As the supply starts to outstrip demand, the amount of stored energy increases until the battery is full (at 4.615kWh). During the middle of the day the PV is producing more than the house can use, and so the battery remains completely full. Then in the afternoon, as energy demand in the house becomes higher than the energy from the PV, the battery SoC starts to drop until by about 1am (or 12pm in winter) the battery is empty again.

Table H shows how the battery has impacted on the amount of imported energy and shows the new monthly cost on the right.

These tables are showing you graphically what difference a given PV and storage capacity will make. You can experiment with increasing the battery capacity or increasing the amount of PV energy. Here's what happens to Table G if we change the charger selection and double the usable battery capacity.

Table G - Battery Charge By Year (10)

	01:00:00	02:00:00	03:00:00	04:00:00	05:00:00	06:00:00	07:00:00	08:00:00	09:00:00	10:00:00	11:00:00	12:00:00	13:00:00	14:00:00	15:00:00	16:00:00	17:00:00	18:00:00	19:00:00	20:00:00	21:00:00	22:00:00	23:00:00	24:00:00
Jan	4503.52	4187.78	3903.95	3638.36	3374.25	3129.92	3043.35	3435.47	4301.70	5451.22	6916.47	8262.57	9230.00	9230.00	9230.00	9230.00	9230.00	8874.46	8176.48	7389.54	6657.15	5968.99	5360.34	4892.03
Feb	4547.10	4231.36	3947.53	3681.94	3417.83	3161.53	2992.16	3298.32	4037.10	5205.10	6773.74	8197.62	9230.00	9230.00	9230.00	9230.00	9230.00	8964.01	8220.06	7433.12	6700.73	6032.57	5433.92	4935.61
Mar	4387.07	4071.33	3787.50	3521.91	3257.80	3001.01	2755.76	3085.94	3906.23	5122.97	6648.92	8250.39	9230.00	9230.00	9230.00	9230.00	9230.00	8843.78	8060.03	7273.09	6540.70	5872.54	5273.89	4775.58
Apr	4106.31	3790.57	3506.74	3241.15	2977.04	2720.25	2440.50	2722.56	3469.21	4641.57	6168.57	7717.29	9228.61	9230.00	9230.00	9230.00	9230.00	8568.79	7779.27	6992.33	6259.94	5591.76	4993.13	4494.82
May	3999.54	3683.80	3399.97	3134.38	2870.27	2613.48	2321.72	2719.30	3684.59	5045.22	6589.61	8490.30	9230.00	9230.00	9230.00	9230.00	9230.00	8462.02	7672.50	6885.56	6153.17	5485.01	4886.36	4386.05
Jun	3991.48	3675.74	3391.91	3126.32	2862.21	2605.42	2311.10	2636.63	3582.82	4991.72	6717.67	8615.44	9230.00	9230.00	9230.00	9230.00	9230.00	8483.96	7694.44	6877.50	6145.11	5476.95	4878.30	4379.99
Jul	3999.54	3683.80	3399.97	3134.38	2870.27	2613.48	2319.16	2641.57	3585.46	5035.33	6885.36	8830.33	9230.00	9230.00	9230.00	9230.00	9230.00	8462.02	7672.50	6885.56	6153.17	5485.01	4886.36	4386.05
Aug	4031.67	3716.13	3432.30	3166.71	2902.60	2645.81	2356.61	2757.47	3780.66	5277.75	7126.34	9147.05	9230.00	9230.00	9230.00	9230.00	9230.00	8494.35	7704.83	6917.89	6185.50	5517.34	4918.69	4420.38
Sep	4138.43	3822.69	3538.86	3273.27	3009.16	2752.41	2575.51	3137.93	4253.91	5796.30	7679.96	9230.00	9230.00	9230.00	9230.00	9230.00	9230.00	8600.91	7811.39	7024.45	6292.06	5623.90	5025.25	4526.94
Oct	4219.05	3903.31	3619.48	3353.89	3089.78	2843.40	2920.71	3551.26	4687.06	6154.17	7897.35	9230.00	9230.00	9230.00	9230.00	9230.00	9230.00	8679.73	7892.01	7105.07	6372.68	5704.52	5105.87	4607.56
Nov	4280.35	3964.61	3680.78	3415.19	3151.08	2939.29	3058.40	3627.91	4622.21	5939.76	7427.62	8902.96	9230.00	9230.00	9230.00	9230.00	9230.00	8726.02	7953.31	7166.37	6433.96	5765.82	5167.17	4668.86
Dec	4442.89	4127.15	3843.32	3577.73	3313.62	3104.00	3155.97	3615.11	4451.47	5602.86	7077.77	8362.56	9230.00	9230.00	9230.00	9230.00	9230.00	8836.13	8115.85	7328.91	6596.52	5928.36	5329.71	4831.40

Table H - Reduced power from grid [Wh] By Year (10)

	01:00:00	02:00:00	03:00:00	04:00:00	05:00:00	06:00:00	07:00:00	08:00:00	09:00:00	10:00:00	11:00:00	12:00:00	13:00:00	14:00:00	15:00:00	16:00:00	17:00:00	18:00:00	19:00:00	20:00:00	21:00:00	22:00:00	23:00:00	24:00:00	Total	Cost
Jan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	R 0,00
Feb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	R 0,00
Mar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	R 0,00
Apr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	R 0,00
May	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	R 0,00
Jun	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	R 0,00
Jul	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	R 0,00
Aug	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	R 0,00
Sep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	R 0,00
Oct	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	R 0,00
Nov	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	R 0,00
Dec	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	R 0,00

Once again, the battery is fully charged in the middle of the day, but now there is stored energy available until late into the evening, and all through until the next morning, at which point the PV starts to contribute again. This house no longer has to draw from the grid, so the costs are down to zero.

A completely off grid site obviously won't be able to draw from the grid, but you could use Table G to identify when a backup generator would need to be considered, or increase the battery capacity until there is energy available 24/7.

Bear in mind that this is all based on averages: average PV production and average consumption and it is assuming that the grid is always available to draw from. As long as you have an accurate daily value for the site and an idea of the occupants' pattern of usage, this is a very useful tool for making recommendations from.

Costs and Savings

Finally, a summary table represents these results in the form of costs and savings.

Costs and Savings

	Monthly usage kWh	Monthly costs - Before PV	Monthly costs - Before storage	Year 1 monthly costs - With battery	Year 1 monthly saving - With battery	Year 10 monthly costs - With battery	Year 10 monthly saving - With battery
Jan	403	R 1 208,70	R 574,47	R 27,90	R 546,57	R 148,30	R 426,17
Feb	364	R 1 091,70	R 523,14	R 29,48	R 493,66	R 138,23	R 384,91
Mar	403	R 1 208,70	R 601,08	R 54,60	R 546,48	R 175,07	R 426,01
Apr	390	R 1 169,70	R 610,09	R 81,48	R 528,61	R 197,88	R 412,21
May	403	R 1 208,70	R 641,46	R 95,39	R 546,07	R 215,67	R 425,79
Jun	390	R 1 169,70	R 621,71	R 93,27	R 528,44	R 209,67	R 412,04
Jul	403	R 1 208,70	R 641,69	R 95,63	R 546,06	R 215,91	R 425,78
Aug	403	R 1 208,70	R 638,20	R 92,08	R 546,12	R 212,36	R 425,84
Sep	390	R 1 169,70	R 597,96	R 69,30	R 528,66	R 185,70	R 412,26
Oct	403	R 1 208,70	R 593,01	R 46,70	R 546,31	R 166,91	R 426,10
Nov	390	R 1 169,70	R 565,25	R 36,50	R 528,75	R 153,08	R 412,17
Dec	403	R 1 208,70	R 568,82	R 22,25	R 546,57	R 142,72	R 426,10
Total	**4745**	**R 14 231,40**	**R 7 176,88**	**R 744,58**	**R 6 432,30**	**R 2 161,50**	**R 5 015,38**

The leftmost columns show the baseline consumption and costs. These should hopefully be quite close to the actual baseline data of the building. In reality energy usage (and therefore costs) will vary significantly throughout the year and we are assuming pretty much constant consumption, but hopefully the annual total will be quite close. The most important thing is the daily energy total. That's what everything is based on.

The next column shows the monthly costs with a standard PV system (ie before storage). Since it's based purely on energy savings (ie not government incentives), it's a very stable dataset to draw conclusions from.

The next four columns show the reduced costs and corresponding savings in year 1 and the final year of the battery warranty period. You will notice here the annual savings by year 10 have reduced when compared to year 1.

Summary

The SegenSolar battery calculator is there as a guide to help you determine what battery capacity is appropriate for a given site. It's important that you know how much energy is needed for the site and what the pattern of usage is (load profile).

The load profile you choose will show in Table C what amount of energy is assumed as being used for a given hour in the calculation. If, in reality, the occupants decide to stay up all night with the TV on they will be deviating significantly from the load profile and the battery system will be depleted faster than normal.

Table G also makes it very clear that using energy-hungry loads during the day is a good idea. Even when we increased the battery capacity in our example it was still full in the middle of the day and any excess would be wasted. Combine the introduction of PV and batteries with making the occupants aware of the importance of managing their energy consumption and choosing the best time to use appliances.