Solar Butter

HISTORIC SIMULATION REPORT

Modern heat pump, battery, solar on flat tariff

Created by admin | Account: Government Warm Homes Model
South Yorkshire | 2016-01-01 to 2016-12-31 | UTC

Workspace

Site location
South Yorkshire (53.48, -1.01) · UTC

Batteries
Larger battery (12 kWh)

Inverter
5kW (5 kW)
setpoints: Auto-optimise battery setpoints

Solar Arrays
east (Generic 450, 5 panels, 2.3 kW)
west (Generic 450, 5 panels, 2.3 kW)

Load profile
house load (3,500 kWh/yr)

Heat pump
heat pump (modern) (rated 5,000 W · design house 21 °C · design flow 45 °C)

Tariff
standard flat
import: 0.28 · export: 0.12 · daily standing: 0.60

Annual Summary

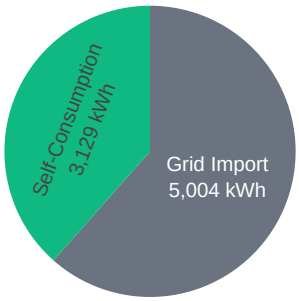
Solar Generated	**3,459 kWh**		(**3,459** (utilised) + **0** (clipped))
Load Consumed	**8,133 kWh**	**2,277 GBP**	(cost without solar)
Space heating electric (heat pump)	**3,881 kWh**		(thermal generated **16,456**)
Hot water electric (heat pump)	**743 kWh**		(thermal generated **2,185**)
Grid Import	**5,004 kWh**	**1,401 GBP**	(**0.28** (average import price GBP/kWh))
Grid Export	**275 kWh**	**33 GBP**	(**0.12** (average export price GBP/kWh))
Total benefit from solar & battery		**909 GBP**	
New electricity bill		**1,588 GBP**	(**1,401** (import) - **33** (export) + **220** (standing))

Self-Consumption

Share of load met from PV and batteries vs grid import.

38.5%

Spring: 50.6% Summer: 91.6%
Autumn: 30.7% Winter: 10.7%

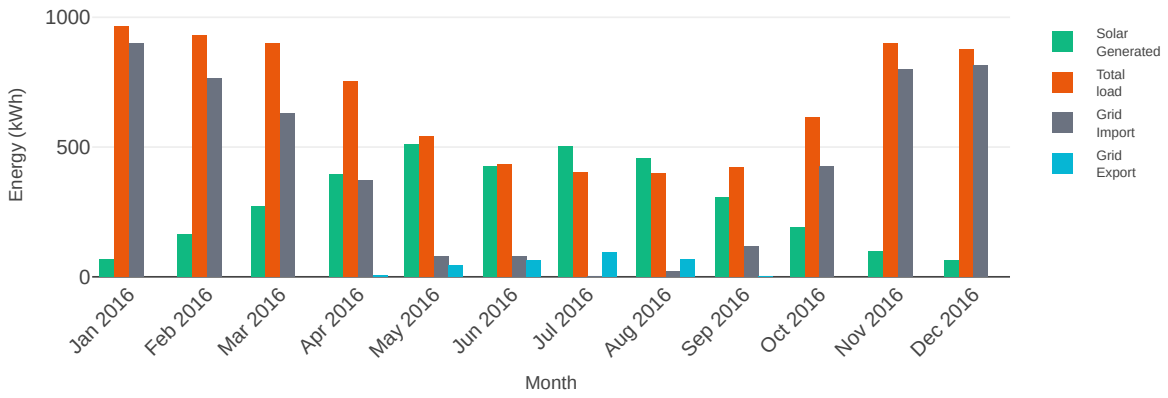


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Yearly Summary

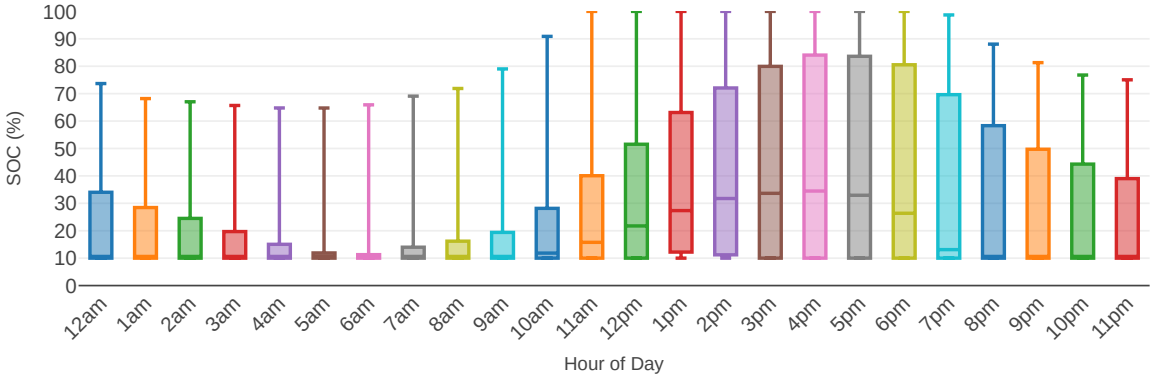
Monthly Energy Totals

Energy flows by month: solar, load, grid import, grid export.



SOC Distribution by Hour

Spread of battery charge levels by hour (box plot).



Monthly Summary

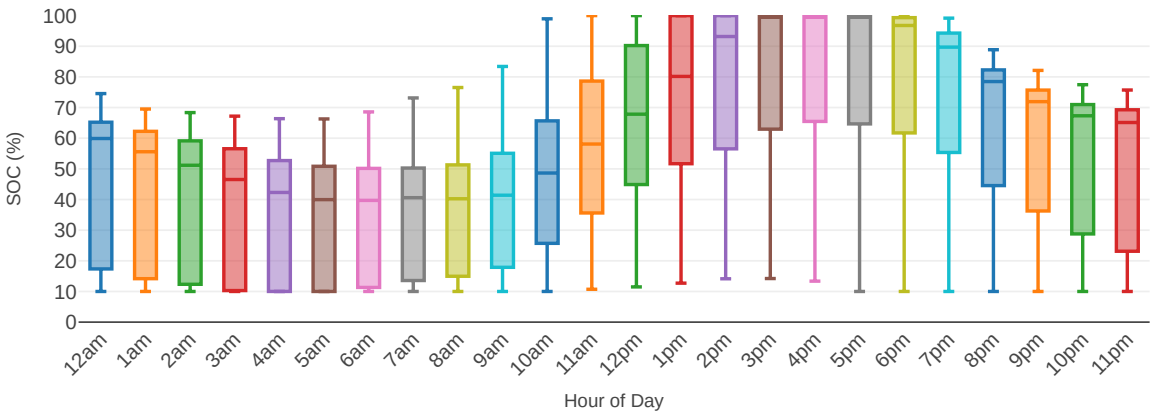
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Solar Generated kWh	68	164	272	395	512	426	503	455	307	192	99	65
Total load kWh	966	930	898	753	540	432	402	401	422	613	899	878
Average SOC %	10	11	16	25	45	46	67	56	32	15	10	10
Grid Import kWh/GBP	898 / 252	767 / 215	630 / 176	371 / 104	81 / 23	80 / 22	4 / 1	20 / 6	117 / 33	424 / 119	801 / 224	813 / 228
Grid Export kWh/GBP	0 / 0	0 / 0	0 / 0	5 / 1	44 / 5	63 / 8	95 / 11	66 / 8	2 / 0	0 / 0	0 / 0	0 / 0
Net electricity cost GBP	252	215	176	103	17	15	-10	-2	32	119	224	228

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Summer Monthly Summary

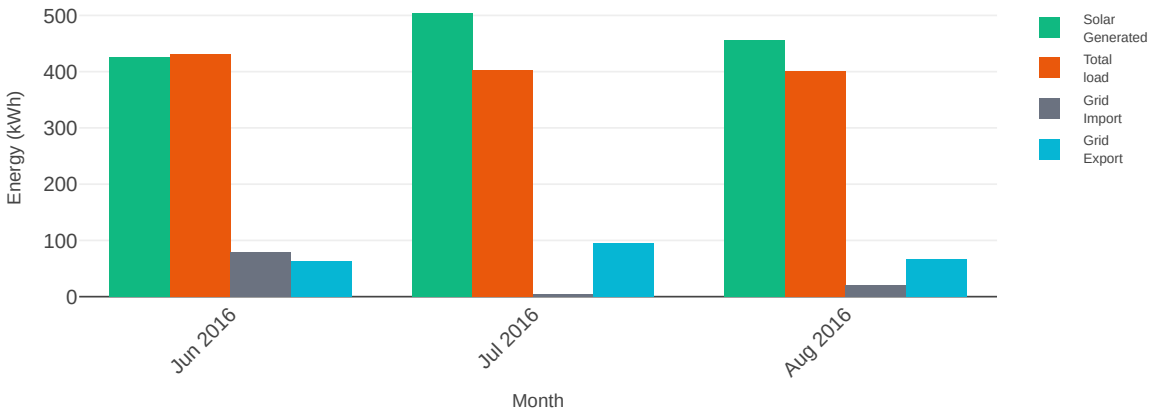
Summer SOC Distribution by Hour

Spread of battery charge levels by hour for June, July, August.



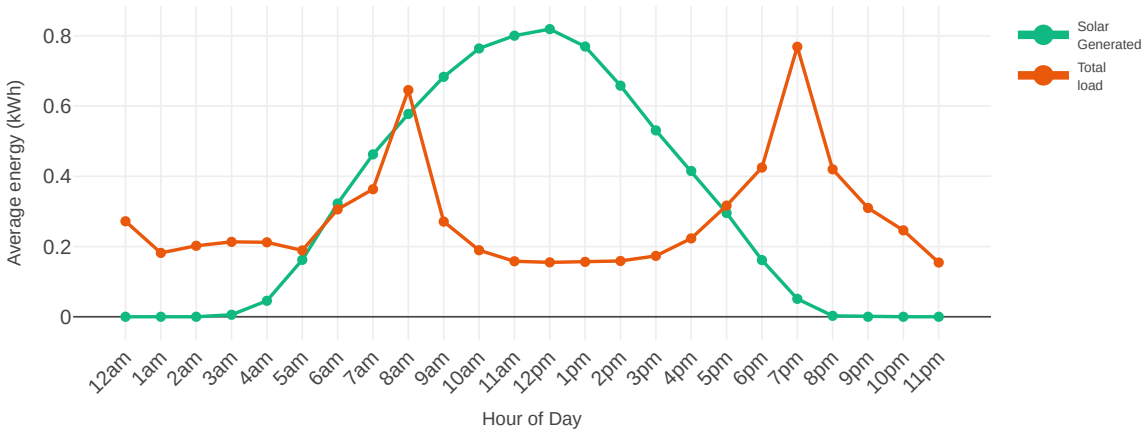
Summer Energy Totals by Month

Energy flows for June, July, August: solar, load, grid import, grid export.



Summer Hourly Average Energy

Average hourly solar generation vs load for that season's months.

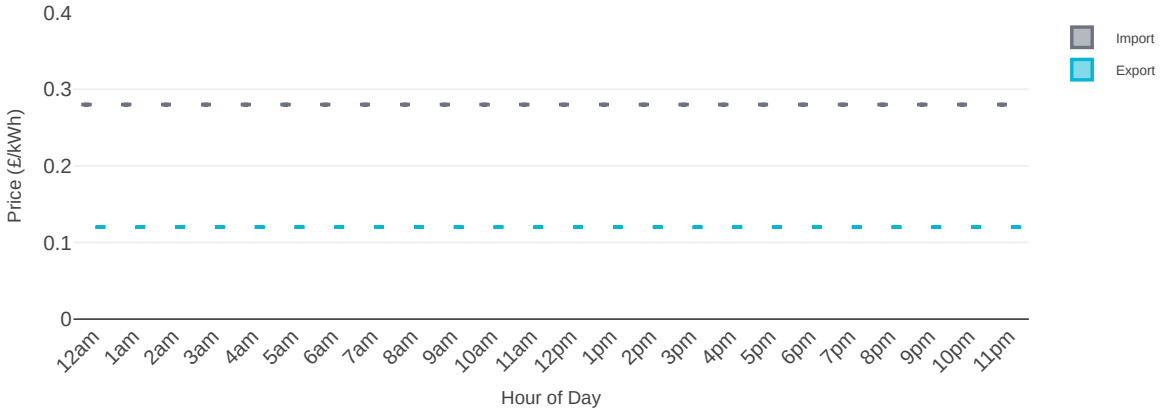


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Summer Prices and Power

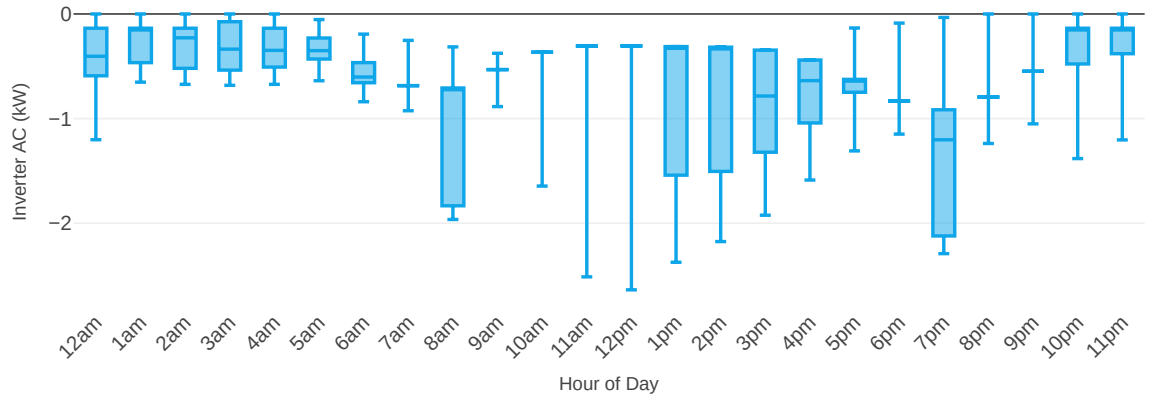
Summer Import & Export Price Distribution by Hour

Spread of import and export tariff rates by hour for June, July, August.



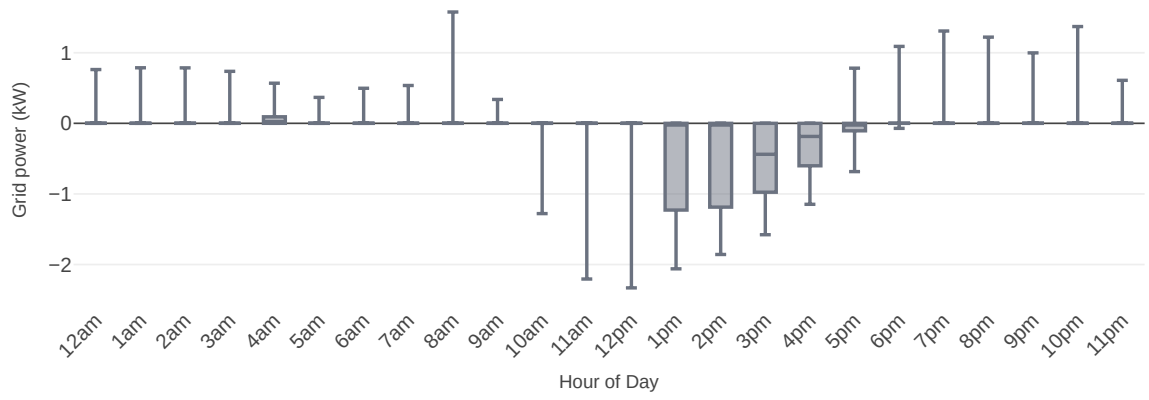
Summer Inverter AC Power Distribution by Hour (inverter charge is positive)

Spread of inverter AC power flows by hour for June, July, August.



Summer Grid Power Distribution by Hour (import is positive)

Spread of net grid power by hour for June, July, August.

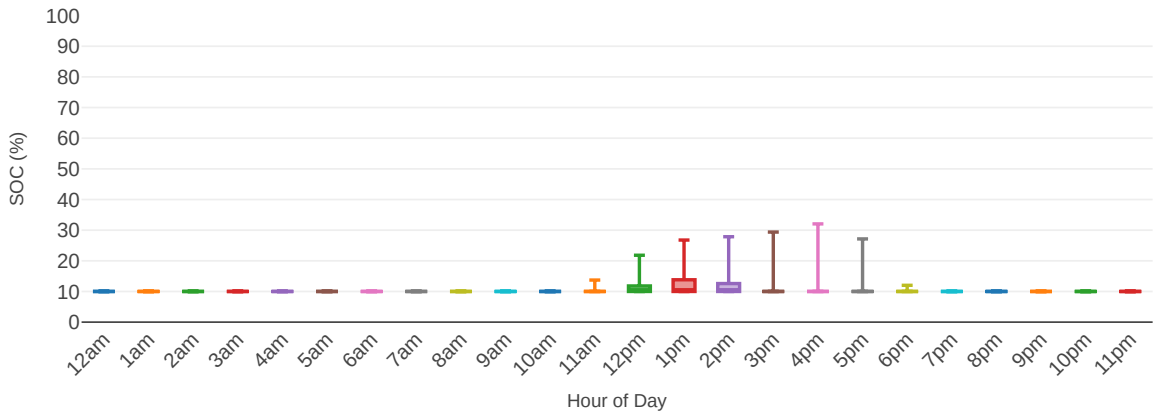


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Winter Monthly Summary

Winter SOC Distribution by Hour

Spread of battery charge levels by hour for December, January, February.



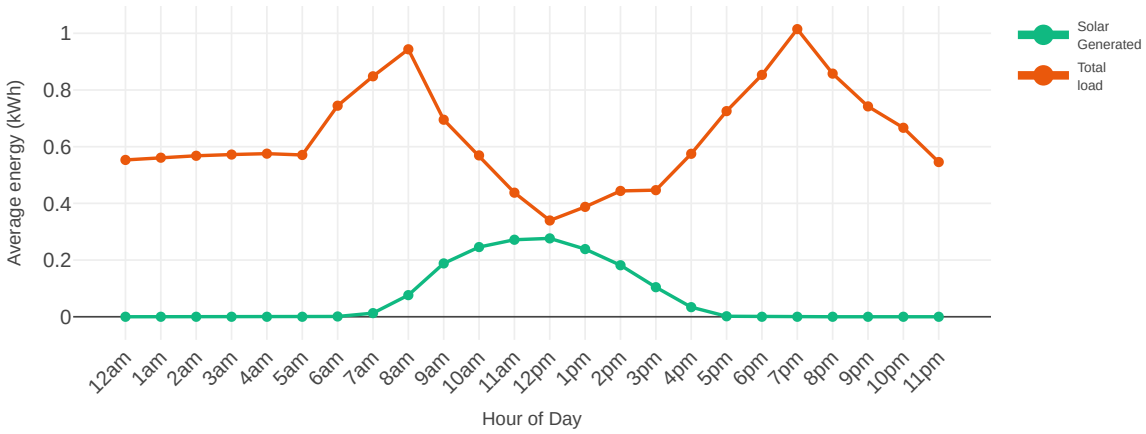
Winter Energy Totals by Month

Energy flows for December, January, February: solar, load, grid import, grid export.



Winter Hourly Average Energy

Average hourly solar generation vs load for that season's months.

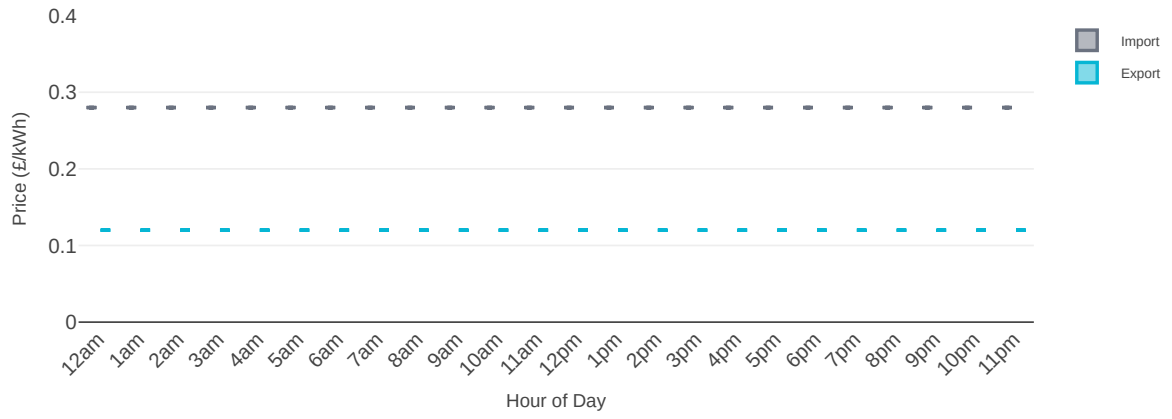


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Winter Prices and Power

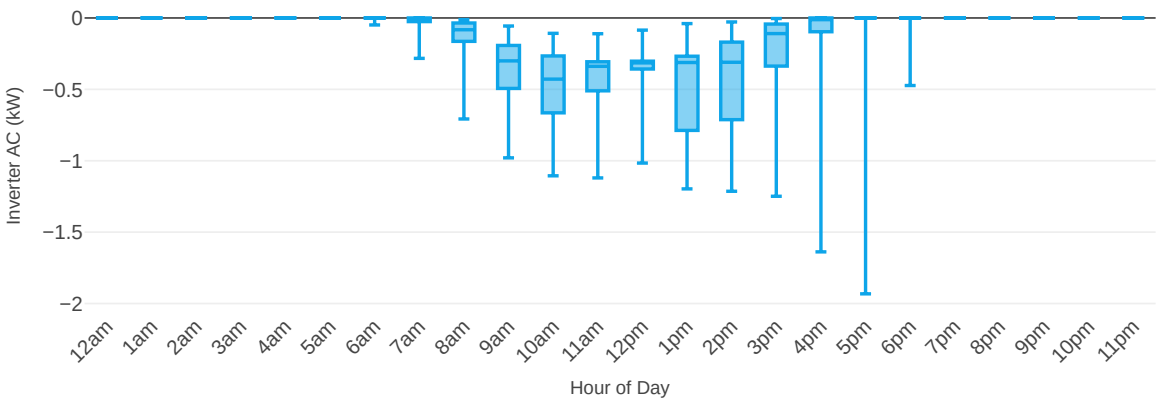
Winter Import & Export Price Distribution by Hour

Spread of import and export tariff rates by hour for December, January, February.



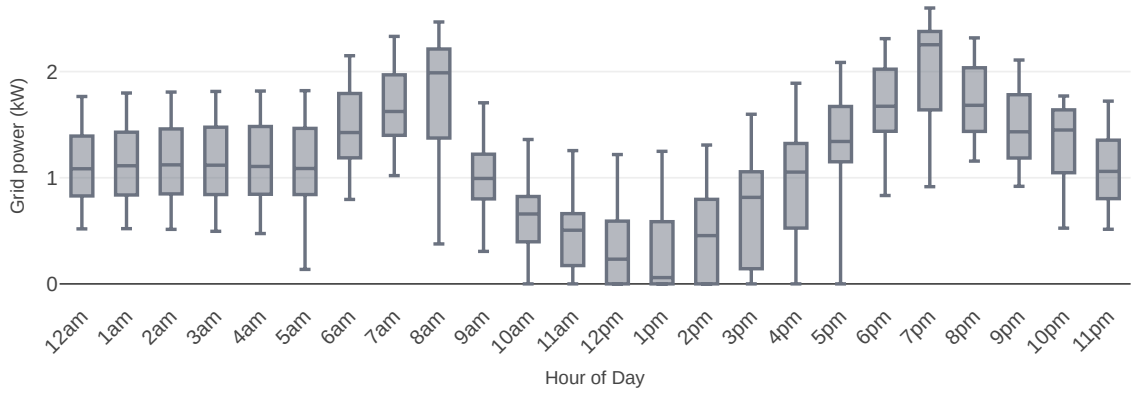
Winter Inverter AC Power Distribution by Hour (inverter charge is positive)

Spread of inverter AC power flows by hour for December, January, February.



Winter Grid Power Distribution by Hour (import is positive)

Spread of net grid power by hour for December, January, February.

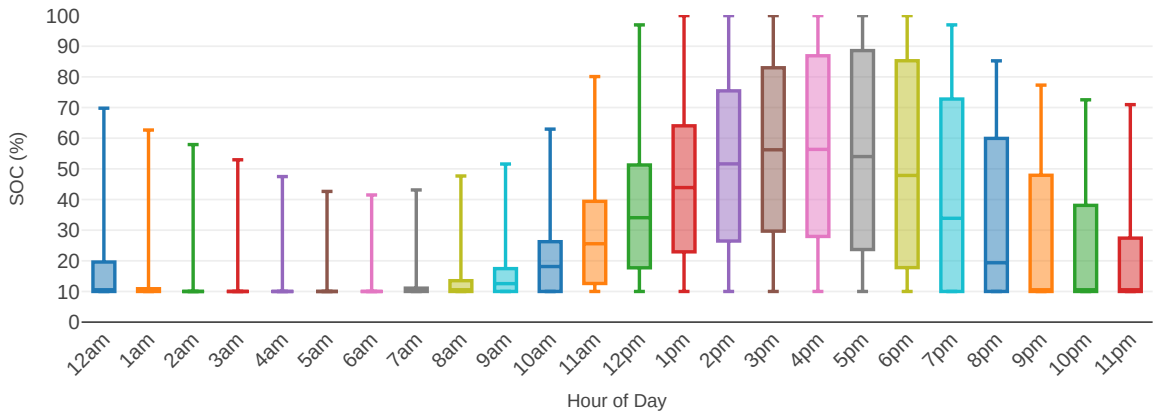


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Spring Monthly Summary

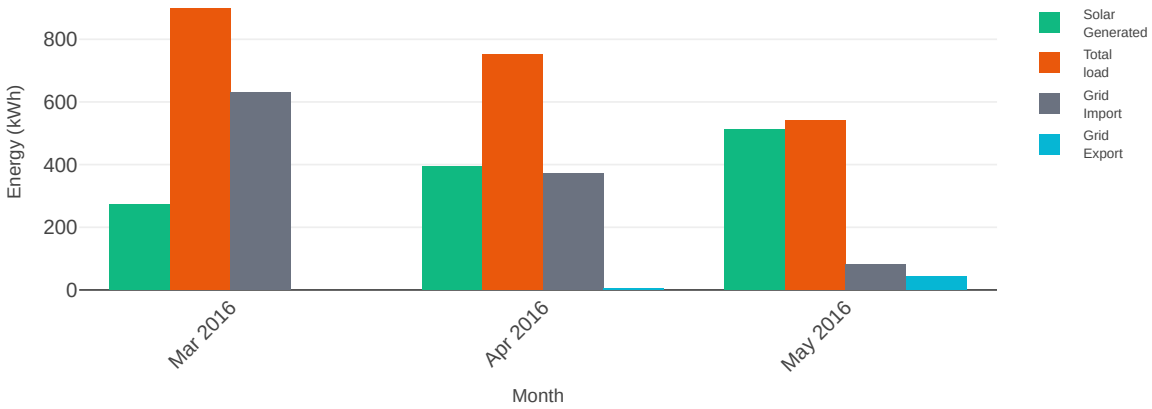
Spring SOC Distribution by Hour

Spread of battery charge levels by hour for March, April, May.



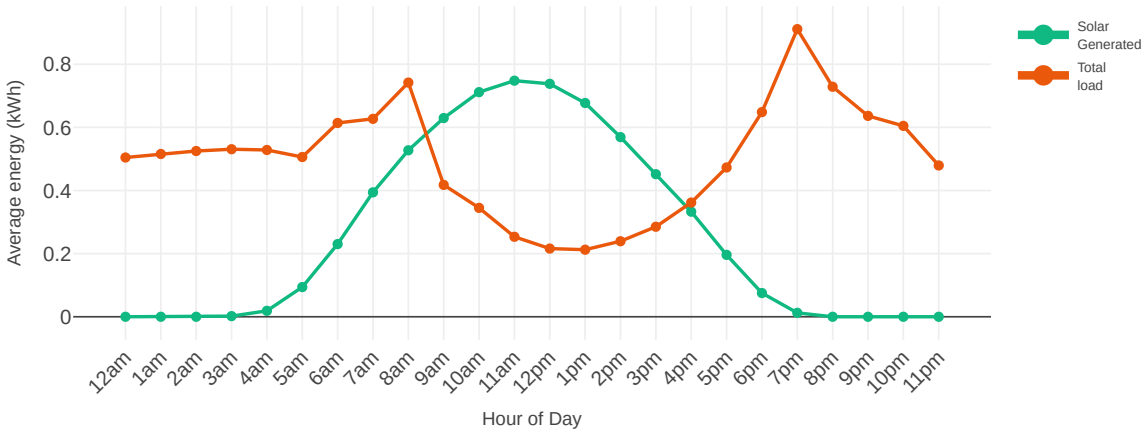
Spring Energy Totals by Month

Energy flows for March, April, May: solar, load, grid import, grid export.



Spring Hourly Average Energy

Average hourly solar generation vs load for that season's months.

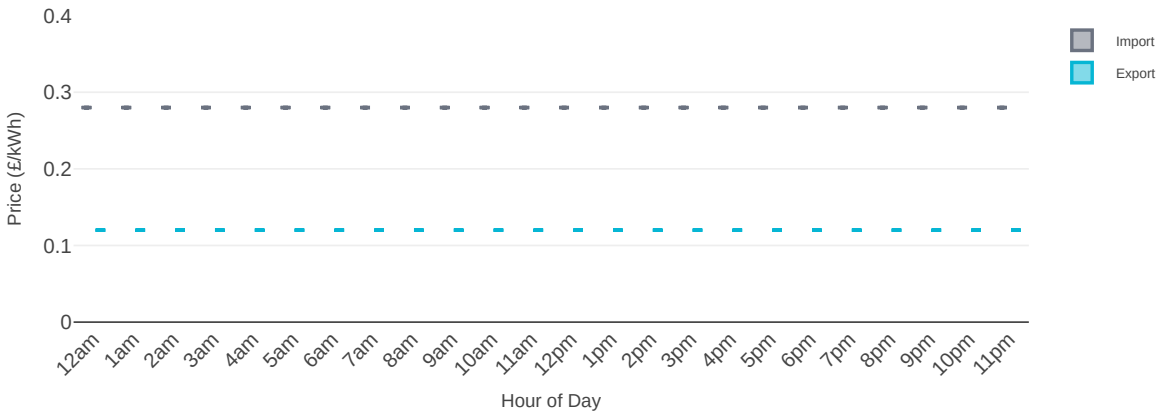


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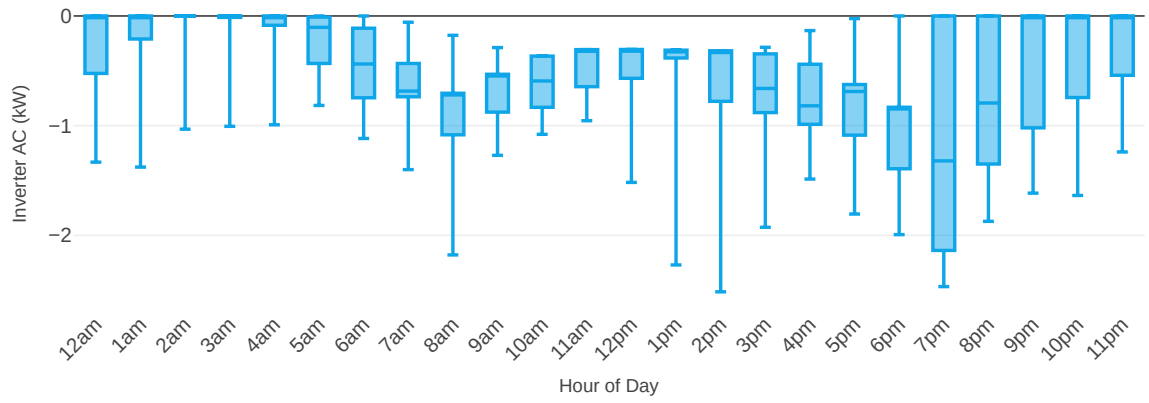
Spring Import & Export Price Distribution by Hour

Spread of import and export tariff rates by hour for March, April, May.



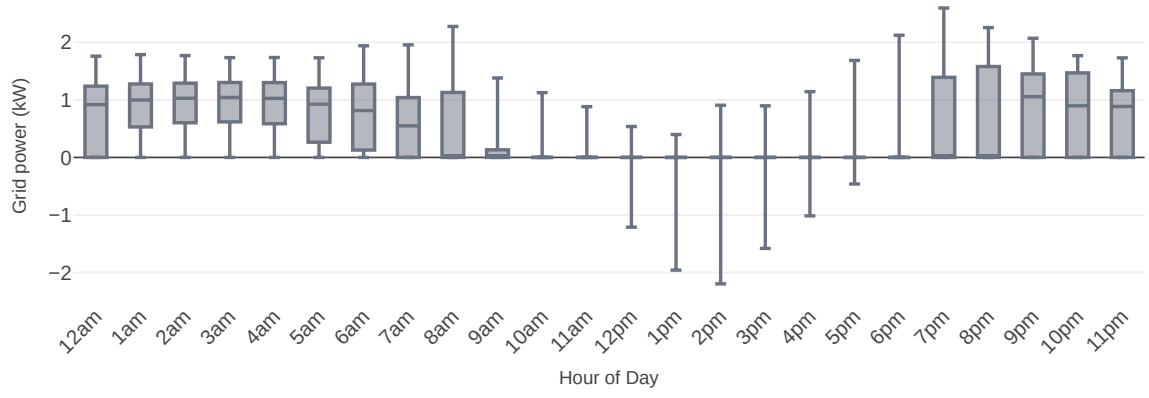
Spring Inverter AC Power Distribution by Hour (inverter charge is positive)

Spread of inverter AC power flows by hour for March, April, May.



Spring Grid Power Distribution by Hour (import is positive)

Spread of net grid power by hour for March, April, May.

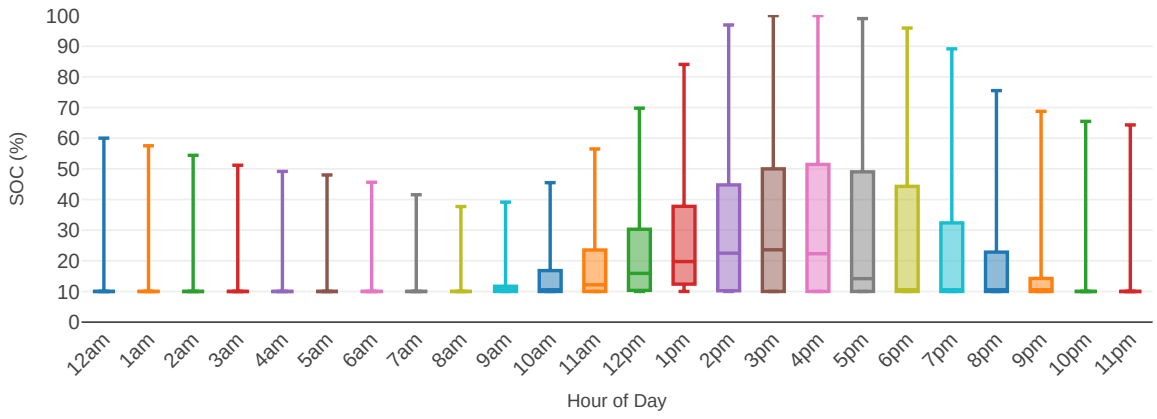


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Autumn Monthly Summary

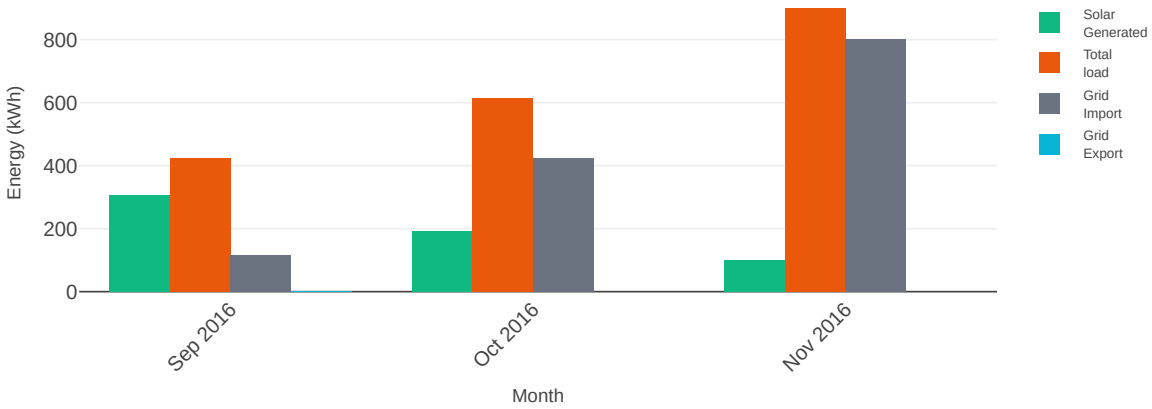
Autumn SOC Distribution by Hour

Spread of battery charge levels by hour for September, October, November.



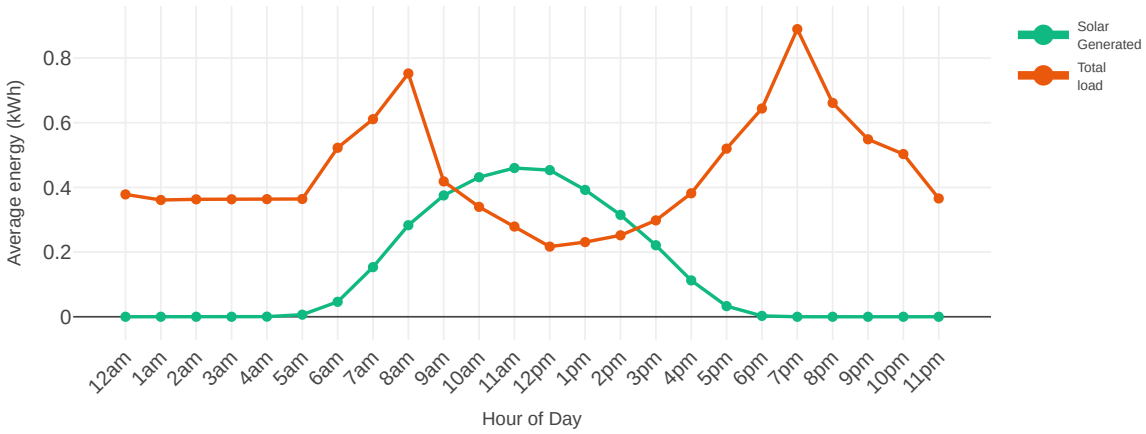
Autumn Energy Totals by Month

Energy flows for September, October, November: solar, load, grid import, grid export.



Autumn Hourly Average Energy

Average hourly solar generation vs load for that season's months.

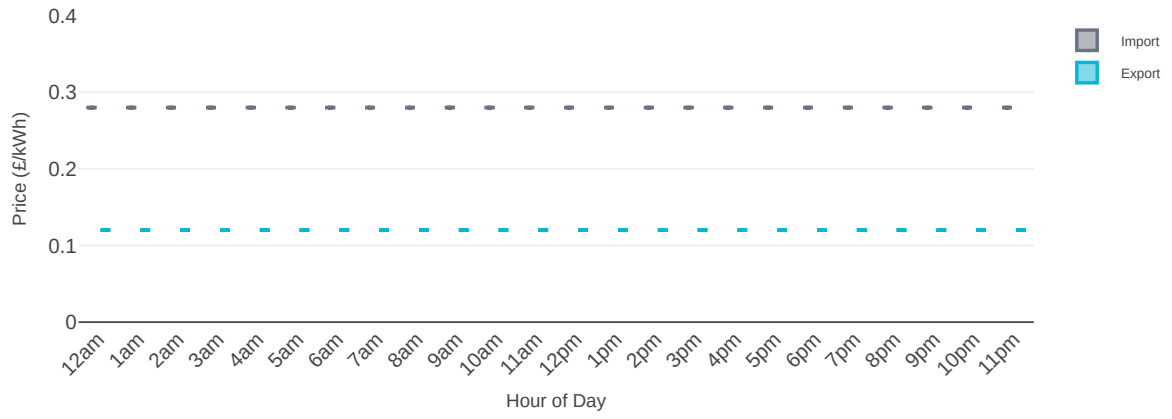


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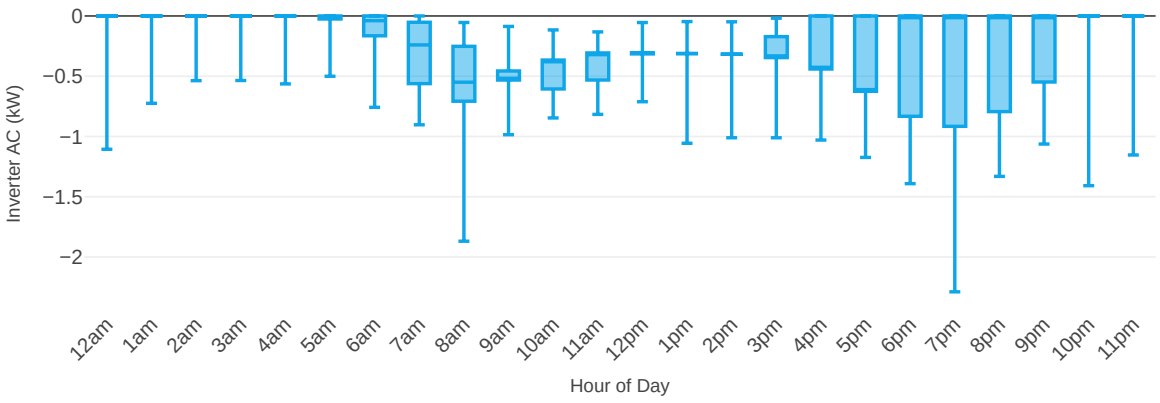
Autumn Import & Export Price Distribution by Hour

Spread of import and export tariff rates by hour for September, October, November.



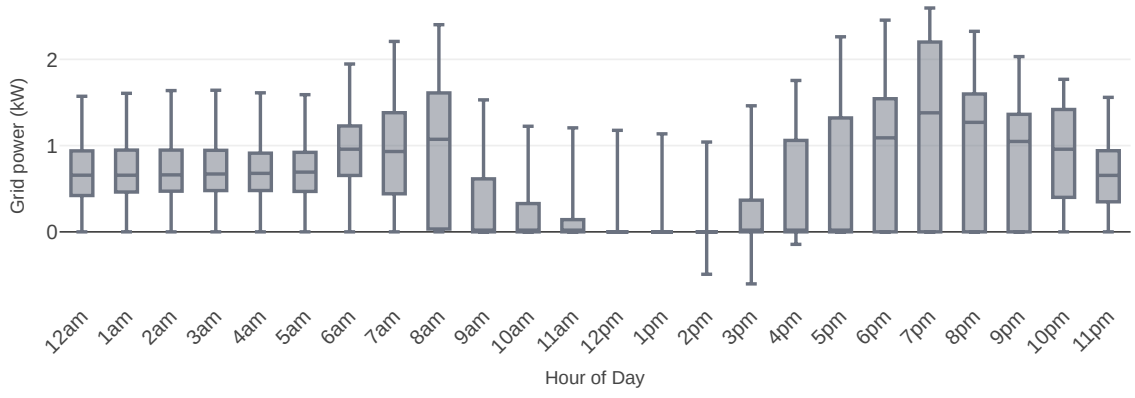
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Spread of inverter AC power flows by hour for September, October, November.



Autumn Grid Power Distribution by Hour (import is positive)

Spread of net grid power by hour for September, October, November.



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Solar Butter price list

Indicative only, and not a quotation. Solar butter offers competitive pricing as a company run exclusively by electricians and engineers who carry out the installations, cutting out operations and sales overhead.

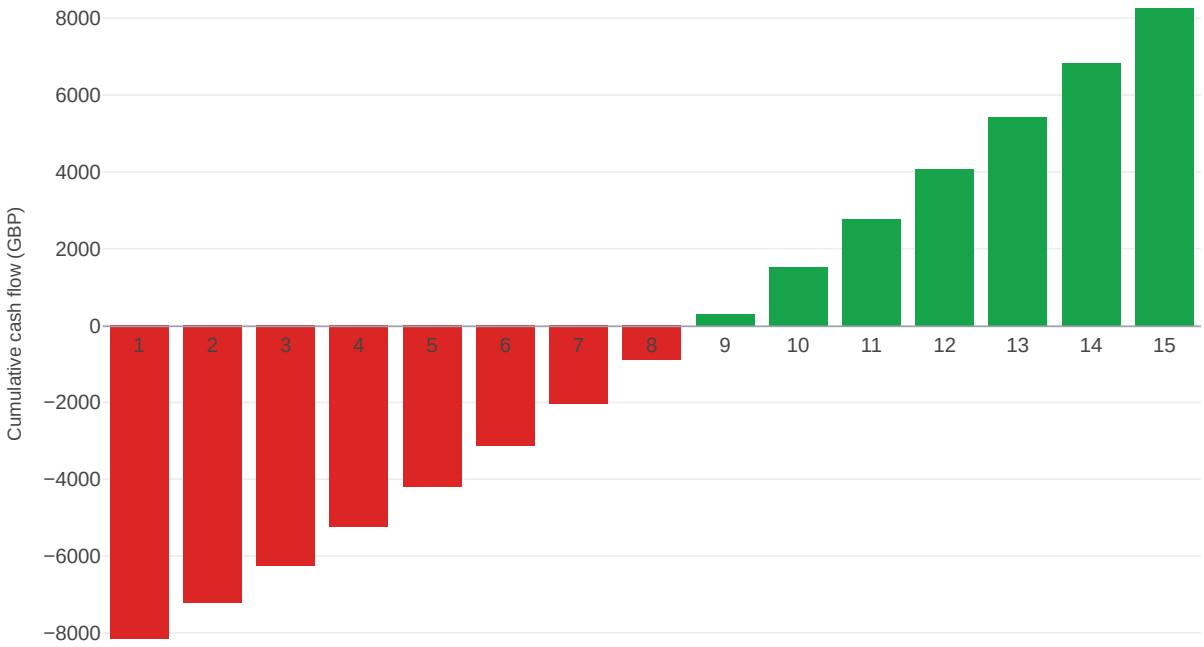
Item	Rating	Qty	Unit price ex VAT	Line total ex VAT
Generic 450 ESTIMATED	450 W	10	100.00	1,000.00
5kW ESTIMATED	5 kW	1	1,600.00	1,600.00
Larger battery ESTIMATED	12 kWh	1	2,400.00	2,400.00
Labour		4	350.00	1,400.00
Scaffolding		2	600.00	1,200.00
Survey, design, commissioning and DNO		1	450.00	450.00
Sales overhead		1	100.00	100.00
Travel		1	100.00	100.00
Company profit margin		1	825.00	825.00
Subtotal ex VAT				**£ 9,075.00**
VAT (0%)				**£ 0.00**
Indicative total inc VAT				**£ 9,075.00**

Join the waiting list here

Payback time: 8.8 years

Cumulative cash flow

From today, over the next 15 years.



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Cumulative cash flow

Year	Solar generated (kWh)	Grid import (kWh)	Grid export (kWh)	Import price (GBP/kWh)	Export price (GBP/kWh)	Total benefit (£/year)	Cumulative benefit (£)
1	3,459	5,004	275	0.28	0.12	909	-8166
2	3,442	5,020	273	0.29	0.12	939	-7227
3	3,425	5,036	272	0.30	0.12	971	-6256
4	3,408	5,052	271	0.31	0.12	1003	-5253
5	3,391	5,068	269	0.33	0.12	1036	-4217
6	3,374	5,083	268	0.34	0.12	1071	-3145
7	3,357	5,099	267	0.35	0.12	1107	-2038
8	3,340	5,114	265	0.37	0.12	1144	-894
9	3,323	5,130	264	0.38	0.12	1183	288
10	3,307	5,145	263	0.40	0.12	1222	1511
11	3,290	5,160	261	0.41	0.12	1264	2775
12	3,274	5,175	260	0.43	0.12	1306	4081
13	3,257	5,190	259	0.45	0.12	1350	5431
14	3,241	5,205	258	0.47	0.12	1396	6827
15	3,225	5,220	256	0.48	0.12	1443	8270

The 15-year cash flow repeats that year. Import prices rise by 4% a year. Panel output falls by 0.5% a year. The export price stays the same. The starting cost is the indicative price list.

Payback time is estimated based on the weather for the year selected, the tariff and equipment shown in the workspace and the illustrative pricing list example. The tariffs from your energy supplier are subject to change. This should not be interpreted as financial or technical advice. **Enquire here** for a quotation.

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Methods and Assumptions

How it works

A physics based model of the entire system is created from all the equipment shown in your workspace and input data. It starts by pulling hourly weather data for the year and geographic region you have selected. The simulation is run on a half-hourly basis and calculates values for each half-hourly period for the entire year.

Where auto-optimisation has been selected, inverter setpoints are set to try and deliver the least possible cost for any period (least cost function) based off the tariff rates entered and the historic weather forecast for each day. Where a heat pump is selected, the load is added to your baseline load profile.

General Assumptions

- The model outputs have been validated for only a subset of parameters, and where possible this is based off real-world solar and heat pump data but only from a small sample size. Feedback has been sought and in most cases the results have aligned well to actual performance. However each individual site and manufactured products can have different performance and efficiency. What's more, the effectiveness of the install depends on the skill and care taken by your installer during the survey, design and installation. No claim is made of the accuracy of the results of this report.
- Hourly weather data is requested for the entire year and region close to you. We rely on a well known reputable company (NASA) as the weather data provider. We do not and cannot verify the data is accurate for all locations. As a free tool for general use, we accept no liability for inaccurate predictions.
- This report and its outputs are only as good as the inputs, some inputs require technical understanding of the subject. If you would like a system modelled for you, **get in touch here**. If you are unsure of the results or interpretation, further clarification can be provided.
- Where an Agile price tariff is selected, the pricing data is requested for the year selected. If there is no pricing available for your selected report year, the report will fail to generate.

Solar Assumptions

- Weather is pulled for the single year selected. As the weather can vary significantly from year to year, it is recommended to compare the output from different years.
- Modelled tariff is subject to change at the discretion of your energy provider. This may significantly change the financial projections.
- Auto-optimisation, when enabled, actively sets the inverter and batteries to charge during low rate periods and discharge at high export rate periods, where it makes sense to do so. The auto-optimisation algorithm uses the least cost function algorithm to ascertain where charging and discharging is appropriate. For instance, it may not make sense to charge the batteries in the morning at the off-peak rate if the weather forecast predicts sunshine for the rest of the day.
- When using auto-optimisation this assumes the user or control software will be proactive in controlling their system according to the tariff rates available. This means the user or the control software would have to adjust the active setpoints according to the weather forecast and/or changing prices where applicable. This can require understanding and effort on the part of the end user, or the use of control software, which may cost money.

Heat Pump Assumptions

- Weather is pulled for the single year selected. As the weather can vary significantly from year to year, it is recommended to compare the output from different years.
- A semi-empirical model of the house and heat pump system is used. Many inputs require deep technical understanding of the subject matter and will significantly affect the results. The model is physics based and adjusted to match observed performance where possible.
- Daily hot water use is based on occupancy, at 50 litres per person. 40% is used between 6am and 9am, and 60% between 6pm and 10pm.
- A full breakdown of most of the parameters used is given in **How does property heat loss affect heat pump running costs?**