

GCEC Battery-PV-GSHP benefits, finance, and business model for an illustrative cluster of sheltered bungalows on Economy 7 tariffs

Sharenergy Version with updates for Stroud District Council 21 July 2020

Home Assumptions - storage heater baseline

Dwelling heat demand inc. hot water	7000 kWh/year
Proportion of heat at day rate	10%
Heat pump capacity	3 kW
Heat pump CoP	3.5
Heat pump electricity use	2000 kWh/year
Other electricity daily use	8 kWh/day
Other electricity annual use	2920 kWh/year
Total annual electricity use	4920 kWh/year
Heating days per year	220 days

Battery assumptions

Battery size	4.8 kWh
Cycle depth allowed	80%
Battery cycle efficiency	85%
Battery lifetime	10 years
Battery cost (subsidised by NG)	£1,000
Battery flex payments per day	£0.07 per day

PV assumptions

PV panel size	3 kWp
Annual production per kWp	850 kWh
Annual production	2550 kWh
PV panel cost (subsidised by NG)	£1,000

Tariffs - British Gas Economy 7 (1 year fixed)

PV export tariff	£0.055 per kWh
Daytime electricity tariff	£0.219 per kWh
Night tariff	£0.091 per kWh
Standing charge - TOD	£0.223 per day

Benefit Model

Baseline annual cost	£1,512.36
Annual cost with system	£627.20
Electricity savings inc. export	£885.16
Demand response income	£25.55
Total annual benefit	£910.71
Benefit from battery	£224.26
Benefit from PV and GSHP	£686.45

Baseline ave. cost per day

Baseline ave. cost per day	£4.14
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Heating day model with system

Electricity demand	17.67 kWh/day
PV gen in heating season	42%
Avg PV gen per day	4.87 kWh/day
Self consumption ave.	80%
PV consumed	3.89 kWh/day
PV exported	0.97 kWh/day
Battery kWh shifted	3.84 kWh/day
Battery losses	0.576 kWh/day
Non-shifted overnight use	0.8 kWh/day
Total night consumption	5.216 kWh/day
Daytime grid consumption	8.56 kWh/day
Night tariff cost	£0.48
Day tariff cost	£1.87
Total import cost per day	£2.57
Export income per day	£0.05
Net cost per day	£2.52

Non-heating day model with system

Electricity demand	8.576 kWh/day
PV gen in summer	58%
Avg PV gen per day	10.2 kWh/day
Self-consumption unshifted	20%
PV consumed directly	2.04 kWh/day
PV exported	3.74 kWh/day
Battery kWh shifted	3.84 kWh/day
Battery losses	0.576 kWh/day
Non-shifted overnight use	0.8 kWh/day
Daytime grid consumption	1.90 kWh/day
Night tariff cost	£0.07
Day tariff cost	£0.64
Total import cost per day	£0.71
Export income per day	£0.21
Net cost per day	£0.51
Total PV self consumption	1792.92
As proportion of generation	70%

Battery Finance Model

Interest rate	2.5%																						
Years to payback	10																						
Initial capital cost	£1,000																						
10 year replacement	£1,000																						
Share repayment		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Totals over term	
Interest on debt		£89.26	£91.49	£93.78	£96.12	£98.52	£100.99	£103.51	£106.10	£108.75	£111.47	£89.26	£91.49	£93.78	£96.12	£98.52	£100.99	£103.51	£106.10	£108.75	£111.47		£2,000.00
Co-op expenditure		£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£114.26	£2,285.18
<b>PV Finance Model</b>																							
Interest rate	2.5%																						
Years to payback	20																						
Capital cost	£1,000																						
Share repayment		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Totals over term	
Interest on debt		£39.15	£40.13	£41.13	£42.16	£43.21	£44.29	£45.40	£46.53	£47.70	£48.89	£50.11	£51.36	£52.65	£53.96	£55.31	£56.70	£58.11	£59.57	£61.06	£62.58		£1,000.00
Co-op expenditure		£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£64.15	£1,282.94
<b>Co-op business model for battery and PV</b>																							
Annual inflation in tariffs and DR	2.5%																						
Co-op outlay for battery and PV		£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£178.41	£3,568.12
Income from grid balancing		£25.55	£26.19	£26.84	£27.51	£28.20	£28.91	£29.63	£30.37	£31.13	£31.91	£32.71	£33.52	£34.36	£35.22	£36.10	£37.00	£37.93	£38.88	£39.85	£40.85		£652.67
Smart Export Guarantee income		£41.64	£42.68	£43.75	£44.84	£45.96	£47.11	£48.29	£49.50	£50.73	£52.00	£53.30	£54.63	£56.00	£57.40	£58.84	£60.31	£61.81	£63.36	£64.94	£66.57		£1,063.66
Total annual Co-op secure income		£67.19	£68.87	£70.59	£72.36	£74.16	£76.02	£77.92	£79.87	£81.86	£83.91	£86.01	£88.16	£90.36	£92.62	£94.94	£97.31	£99.74	£102.24	£104.79	£107.41		£1,716.33
Electricity net savings for consumer		£843.52	£864.61	£886.22	£908.38	£931.09	£954.37	£978.22	£1,002.68	£1,027.75	£1,053.44	£1,079.78	£1,106.77	£1,134.44	£1,162.80	£1,191.87	£1,221.67	£1,252.21	£1,283.52	£1,315.60	£1,348.49	surplus or loss/battery & PV system	£0.00

RHI Finance Model - Shared Network GSHP for multiple dwellings each with battery and PV as in green block above

Capital cost per dwelling	£13,000																						
Interest rate on shares	3%																						
Years of payback	20																						
Capital cost/share investment	£91,000																						
RPI	2.5%																						
Admin and maintenance %	3%																						
Share Repayment		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Totals over term	
Interest to shareholders		£3,562.39	£3,651.45	£3,742.73	£3,836.30	£3,932.21	£4,030.52	£4,131.28	£4,234.56	£4,340.42	£4,448.94	£4,560.16	£4,674.16	£4,791.02	£4,910.79	£5,033.56	£5,159.40	£5,288.39	£5,420.60	£5,556.11	£5,695.01		£91,000.00
Admin and maintenance		£2,275.00	£2,185.94	£2,094.65	£2,001.09	£1,905.18	£1,806.87	£1,706.11	£1,602.83	£1,496.96	£1,388.45	£1,277.23	£1,163.23	£1,046.37	£926.60	£803.83	£677.99	£549.00	£416.79	£281.28	£142.38		£25,747.77
Total expenditure on GSHP system		£8,567.39	£8,635.64	£8,705.59	£8,777.30	£8,850.80	£8,926.13	£9,003.35	£9,082.50	£9,163.63	£9,246.78	£9,332.02	£9,419.39	£9,508.94	£9,600.72	£9,694.81	£9,791.24	£9,890.09	£9,991.41	£10,095.26	£10,201.70		£186,484.69

Co-Op Income

No of dwellings	7																						
Total GSHP rating	21 kW																						
Total annual heat demand	49,000 kWh																						
Tier 1 tariff	£0.096 per kWh																						
CPI index	2.5%																						
Consumer service charge rate	£75 per deemed MWh per annum																						
Service charge per dwelling	£525.00 per annum																						
RHI Payment		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Totals over term	
Consumer savings contribution		£4,684.40	£4,801.51	£4,921.55	£5,044.59	£5,170.70	£5,299.97	£5,432.47	£5,568.28	£5,707.49	£5,850.17	£5,996.43	£6,146.34	£6,300.00	£6,457.50	£6,618.93	£6,784.41	£6,954.02	£7,127.87	£7,306.07	£7,488.72		£119,661.39
Total income from GSHP system		£8,359.40	£8,568.39	£8,782.59	£9,002.16	£9,227.21	£9,457.89	£9,694.34	£9,936.70	£10,185.12	£10,439.75	£10,700.74	£10,968.26	£11,242.46	£11,523.53	£11,811.61	£12,106.90	£12,409.58	£12,719.82	£13,037.81	£13,363.76	surplus or loss from gshp	£27,053.32

Aggregated Co-op income and expenditure for complete project for number of dwellings in K45

Total GCEC investment	£105,000																						
Total annual expenditure		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Totals over term	
Total annual income		£9,816.23	£9,884.48	£9,954.44	£10,026.14	£10,099.64	£10,174.97	£10,252.19	£10,331.34	£10,412.47	£10,495.63	£10,580.86	£10,668.23	£10,757.78	£10,849.57	£10,943.65	£11,040.08	£11,138.93	£11,240.25	£11,344.10	£11,450.54		£211,461.51
Net margin		£8,829.73	£9,050.47	£9,276.73	£9,508.65	£9,746.37	£9,990.02	£10,239.77	£10,495.77	£10,758.16	£11,027.12	£11,302.80	£11,585.37	£11,875.00	£12,171.87	£12,476.17	£12,788.08	£13,107.78	£13,435.47	£13,771.36	£14,115.64		£225,552.32
		£-986.50	£-834.01	£-677.71	£-517.49	£-353.27	£-184.95	£-12.42	£164.43	£345.69	£531.49	£721.93	£917.14	£1,117.22	£1,322.31	£1,532.52	£1,747.99	£1,968.85	£2,195.22	£2,427.26	£2,665.10		£14,090.81

