

Financial Modelling To Decarbonise Corporate Buildings

Using ASHP Combined with Solar PV To Achieve 81% Carbon Reductions



November 2022



1.0 INTRODUCTION

The process described in this document has been agreed and completed with Gloucestershire County Council on their corporate buildings and traveller sites as a means to :

- **Decarbonise each building**
 - average 81% reduction in CO2 emissions was achieved for each building
- **Provide protection to the authority against future energy price rises**
 - as energy prices are expected to certainly double in the next year
- **Support Salix funding applications**
 - meets funding requirements such as PSDS

We are delighted to provide the following comments on our services from Pete Wiggins of Gloucestershire County Council

“Asset Utilities has recently completed financial modelling of solar PV, ASHP and combined technologies over 3 tariffs as a way to help them achieve energy protection and decarbonisation of our buildings. This has very clearly demonstrated below 5-year paybacks across the board, which we have used to develop our £1.1m 3-year heat decarbonisation programme, covering 12 corporate sites and 4 traveller sites.

The work was endorsed by the council’s Property Board.

This has enabled us to safeguard the council’s £1m Salix Recycling Fund and will take us the rest of the way to achieving our 80% carbon reduction target by 2030, which we should now reach by 2026. The work included building surveys and providing financial assessments, to exacting timescales, which are now being used to develop the full business case for approval by Cabinet in the Autumn.

I have no hesitation in endorsing the work.”

Pete Wiggins, Gloucestershire County Council



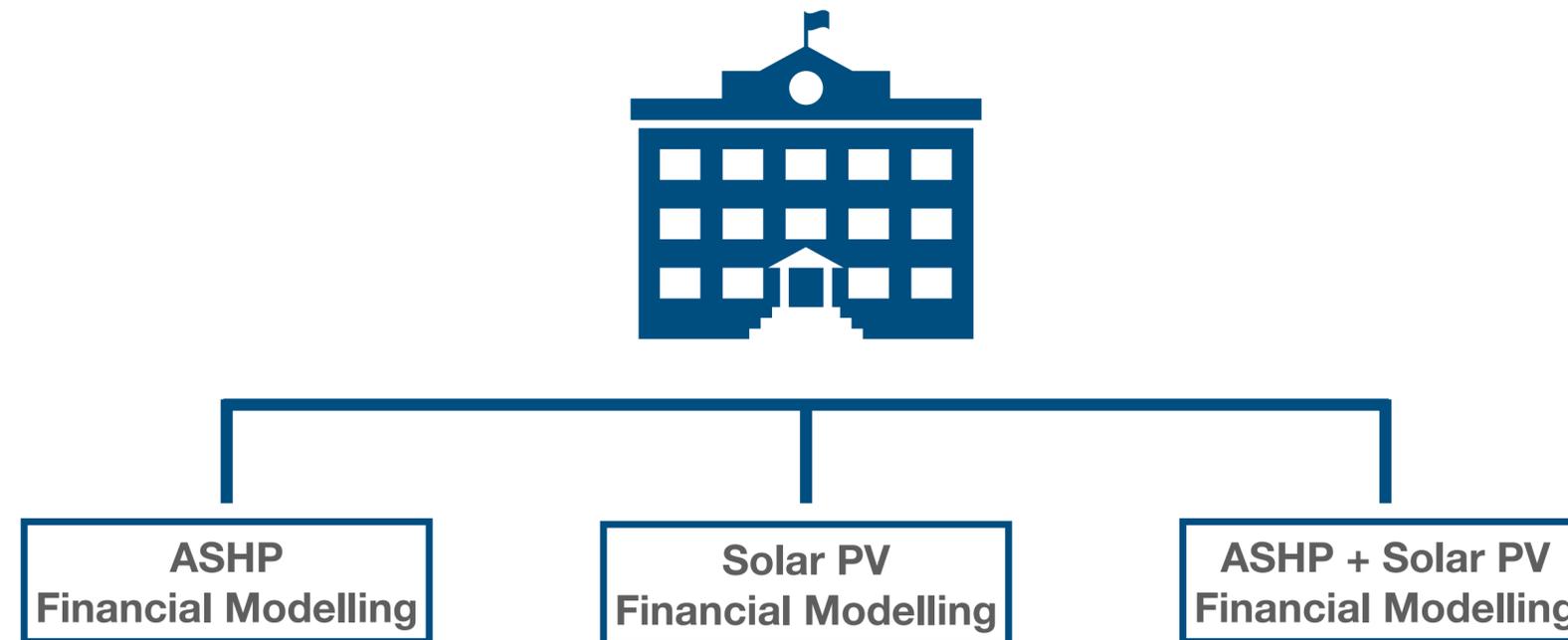
2.0 OUR SERVICE

The **first stage** is to complete financial modelling for the installation of renewable technologies, namely Air Source Heat Pumps (ASHP) and Solar PV.

Each technology is assessed individually and then combined to understand the benefits of utilising generated electricity to power the heat pump.

Each financial assessment considers both the financial returns and carbon emission reductions that can be achieved.

1. **Financial Modelling : Air Source Heat Pump (ASHP) as a standalone technology**
2. **Financial Modelling : Solar PV as a standalone technology**
3. **Financial Modelling : Both technologies combined**



2.0 OUR SERVICE

The **second stage** is to understand how increases in the electricity and gas tariffs, due to the uncertainty in the energy sector will impact on the financial results from the modelling. This is important for the following reasons :

1. Future Energy Price Rises

Experts are predicting that energy prices could double from their present levels.

2. Installation Timescales

The installation of these renewable technologies will be in 12-18 months following technical design, council approval, tendering and installation/commissioning.

We therefore calculate the financial modelling by applying three tariffs in (which can be amended to suit clients) as follows :

Local Authorities

- **Low Tariff** (present) of 20p/kWh electricity and 5p/kWh gas
- **Medium Tariff** (doubles) of 40p/kWh electricity and 10p/kWh gas
- **High Tariff** (trebles) of 60p/kWh electricity and 15p/kWh gas

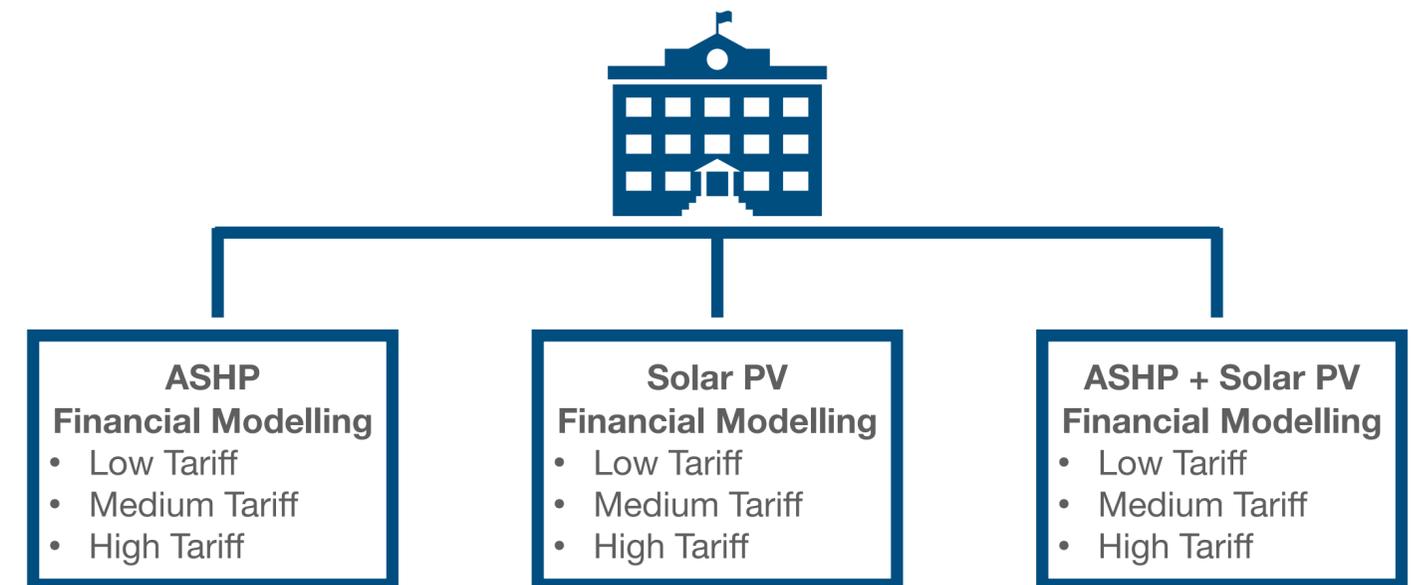
SME Businesses

- **Low Tariff** (capped rate) of 21p/kWh electricity and 7.5p/kWh gas
- **Medium Tariff** (post April 2023) of 60p/kWh electricity and 21p/kWh gas
- **High Tariff** (possible future rate) of £1/kWh electricity and 35p/kWh gas

This results in **9 reports** being produced ie 3 for each technology.

The **final stage** produces a final summary report that compares each of the results in a format that permits the authority to gain internal support for the likes of Salix and PSDS funding applications.

Being able to verify that the technologies are financially viable will successfully decarbonise each building, allowing the authority to instruct technical surveys and assessments on each building.



3.0 ILLUSTRATION OF HOW THE RESULTS ARE PRESENTED

Financial Modelling : AIR SOURCE HEAT PUMP (only) - MEDIUM TARIFF

This table demonstrates the final modelling results for an ASHP to replace the the buildings heat demand.

Inflation	Variable	Value	Unit	Year											
				0	1	2	3	4	5	10	15	20			
System															
	System size	7	kW												
	Output thermal	28,120	kWh _{th}												
CAPEX															
	Equipment costs	8,524	£												
	Total system cost	8,524	£												
Cashflow															
2.0%	Operation and maintenance	1	%/capex												
1.0%	RHI Revenue Tier 1	0.0000	£/kWp		£0.0000	£0.0000	£0.0000	£0.0000	£0.0000	£0.0000	£0.0000	£0.0000	£0.0000	£0.0000	£0.0000
5.0%	Grid electricity cost	0.4000	£/kWp		£0.4000	£0.4200	£0.4410	£0.4630	£0.4862	£0.6205	£0.7920	£1.0108			
5.0%	Current heating fuel cost	0.1000	£/kWp		£0.1000	£0.1050	£0.1103	£0.1158	£0.1216	£0.1551	£0.1980	£0.2527			
Investment Return															
5.0%	Value of fuel saved	3,515	£/kWp		£3,515	£3,691	£3,875	£4,069	£4,273	£5,453	£6,959	£8,882			
5.0%	Value of electricity to run heat pump	3,047	£/kWp		-£3,047	-£3,199	-£3,359	-£3,527	-£3,704	-£4,727	-£6,033	-£7,700			
2.0%	Operation and maintenance	85	£/kWp		-£85	-£87	-£89	-£90	-£92	-£102	-£112	-£124			
1.0%	RHI Revenue	0	£/kWp		£0	£0	£0	£0	£0	£0	£0	£0			
	Annual total	383	£/year		£383	£404	£427	£451	£476	£624	£814	£1,058			
	Cumulative cashflow	-8,41	£/year		-£8,141	-£7,737	-£7,310	-£6,859	-£6,382	-£3,572	£98	£4,876			
	Unlevered MIRR	4	%												
	Simple payback	15	years												
6.0%	NPV	-1,588	£												

Shows the recommended ASHP size and installation cost

The cashflow demonstrates that if the electricity cost remains unchanged, it would take 15 years to payback the investment.

The summary results shows 100% heat met, with carbon savings of 6 tonnes, representing 72% of the total emissions.

Technology	Technical Feasibility	Generation Potential	% of Energy Demands met		Carbon Emission Savings			Financial Breakdown			
			Heat	Of Total Energy	tCO ₂ e	% saving from total	Capital Cost (£k)	Revenue (£k/year)	MIRR (%)	NPV (£)	Simple Payback
Air Source Heat	Based on questionnaires	Heat (MWh)	100.0	55.2	6	72	9	0	3.5	-1,588	15

3.0 ILLUSTRATION OF HOW THE RESULTS ARE PRESENTED

Financial Modelling : SOLAR PV (only) - MEDIUM TARIFF

This table demonstrates the final modelling results across 5 different options to identify the best returns from each option.

In this example, the results show the 23 kWp system offers the best return across each option.

Will show the different sizes of installation and how much of the electricity is met and how much of the generated electricity is used on site. In this case 30% is used on site, with 70% being exported.

Shows the income generated and assumes no export income is received to demonstrate the value of purely site consumption. Export income can be included and would reduce payback period.

Shows the simple payback and the difference in payback years between each option. Plus the annual carbon saving achieved.

Description	Unoptimised	Maximise Internal Rate of Return	Maximise NPV	Simple Payback	Maximise CO ₂ Reduction
Area that can be used for PV (m ²)	238	238	238	238	238
Roof Orientation	South	South	South	South	South
Roof Inclination	0°	0°	0°	0°	0°
Panel type	Monocrystalline silicon PV	Monocrystalline silicon PV	Monocrystalline silicon PV	Monocrystalline silicon PV	Monocrystalline silicon PV
Shading level	None 0%	None 0%	None 0%	None 0%	None 0%
Power output (kWh/kWp)	910.46	910.46	910.46	910.46	910.46
Battery type	No Battery	No Battery	No Battery	No Battery	No Battery
Battery capacity (kWh/kWp)	0.0	0.0	0.0	0.0	0.0
Generation Potential All figures here are estimates. Detailed analysis is needed for the technology to be deployed.					
Estimated power generation (kWh/yr)	20,523	20,523	20,523	20,523	20,523
Installed capacity PV (kWp)	23	23	23	23	23
Electricity demand met (%)	40.8	40.8	40.8	40.8	40.8
Energy generated by solar panels used onsite (%)	30.16	30.16	30.16	30.16	30.16
Usable electricity generated (kWh/yr)	6,190	6,190	6,190	6,190	6,190
Commercial Summary Costs					
Engineering, procurement and construction (EPC) (£/kWp)	975	975	975	975	975
Total capital investment (£) (includes installation, investment, battery and heat pump costs)	21,977	21,977	21,977	21,977	21,977
Annual operation and maintenance (£)	158	158	158	158	158
Revenue First Year £					
Export revenue (£)	0	0	0	0	0
Value of electricity / heating fuel saved (£)	2,476	2,476	2,476	2,476	2,476
Net operating revenue (£)	2,318	2,318	2,318	2,318	2,318
Investment Return					
Capital MIRR (%)	7.6	7.6	7.6	7.6	7.6
Simple payback (years)	9	9	9	9	9
NPV (£)	17,765	17,765	17,765	17,765	17,765
Average annual CO ₂ benefit (tonnes)	0.62	0.62	0.62	0.62	0.62

3.0 ILLUSTRATION OF HOW THE RESULTS ARE PRESENTED

Financial Modelling : AIR SOURCE HEAT PUMP and SOLAR PV (Combined) - LOW and MEDIUM TARIFF

These tables show the summary results for ASHP and Solar PV as standalone technologies, then the combined results.

The combined results of both technologies demonstrate that the payback period reduces from 14 years for the low tariff to 8 years with the medium tariff, proving their financial viability and that 82% of the building's carbon emissions can be saved.

Low Tariff : Electricity 20p/kWh and Gas 5p/kWh

	ASHP	Solar PV Only (Unoptimised Option)	Both Technologies
Heat Pump Details			
Heat Pump Size	6.84kW	N/A	6.84kW
Heat Generation	28,120kW	N/A	28,120kW
Percentage of generation Usable Onsite	100%	N/A	100%
Annual Heat pump electricity usage	7,631	N/A	7,631
Solar PV Details			
Installed Capacity	N/A	23 kWp	23kWp
Electricity Demand Met	N/A	40.8%	23%
Generated Electricity Used on Site	N/A	30%	35.5%
Commercial Summary			
Total Capital Investment	£8,524	£21,977	£30,501
Revenue First Year			
Cost Of Gas Saved	£1,757	N/A	*Net Figure Shown Below
Cost Of Electricity Saved (ASHP represents additional electricity shown as a negative)	-£1,526	£1,238	*Net Figure Shown Below
Net Revenue First Year	£231	£1,238	£1,850
Investment Return			
Unlevered MIRR	-1%	3.7%	4.1%
Simple Payback	No Payback in 20 years	15 years	14 years
NPV	-£5,672	-£3,616	-£2,715
CO2 Saved	6 tonnes	1 tonnes	7 tonnes
CO2 Saved Percentage	72%	8%	82%

Medium Tariff : Electricity 40p/kWh and Gas 10p/kWh

	ASHP	Solar PV Only (Unoptimised Option)	Both Technologies
Heat Pump Details			
Heat Pump Size	6.84kW	N/A	6.84kW
Heat Generation	28,120kW	N/A	28,120kW
Percentage of generation Usable Onsite	100%	N/A	100%
Annual Heat pump electricity usage	7,618	N/A	7,618
Solar PV Details			
Installed Capacity	N/A	23kWp	23kWp
Electricity Demand Met	N/A	40.8%	35.5%
Generated Electricity Used on Site	N/A	30%	39%
Commercial Summary			
Total Capital Investment	£8,524	£21,977	£30,501
Revenue First Year			
Cost Of Gas Saved	£3,515	N/A	*Net Figure Shown Below
Cost Of Electricity Saved (ASHP represents additional electricity shown as a negative)	-£3,047	£2,476	*Net Figure Shown Below
Net Revenue First Year	£468	£2,476	£3,704
Investment Return			
Unlevered MIRR	4%	7.6%	8.1%
Simple Payback	15 years	9 years	8 years
NPV	-£1,588	£17,765	£29,306
CO2 Saved	6 tonnes	1 tonnes	7 tonnes
CO2 Saved Percentage	72%	8%	82%

3.0 ILLUSTRATION OF HOW THE RESULTS ARE PRESENTED

Financial Modelling : AIR SOURCE HEAT PUMP and SOLAR PV (Combined) - HIGH TARIFF

This table shows the summary results for ASHP and Solar PV as standalone technologies, then the combined results for just the high tariff.

The combined results of both technologies demonstrate that the payback period reduces to 6 years with the HIGH tariff, proving their financial viability and that 82% of the carbon emissions can be saved.

High Tariff : Electricity 60p/kWh and Gas 15p/kWh			
	ASHP	Solar PV Only (Unoptimised Option)	Both Technologies
Heat Pump Details			
Heat Pump Size	6.84kW	N/A	6.84kW
Heat Generation	28,120kW	N/A	28,120kW
Percentage of generation Usable Onsite	100%	N/A	100%
Annual Heat pump electricity usage	7,618	N/A	7,618
Solar PV Details			
Installed Capacity	N/A	23kWp	23kWp
Electricity Demand Met	N/A	40.8%	35.5%
Generated Electricity Used on Site	N/A	30%	39%
Commercial Summary			
Total Capital Investment	£8,524	£21,977	£30,501
Revenue First Year			
Cost Of Gas Saved	£5,272	N/A	*Net Figure Shown Below
Cost Of Electricity Saved (ASHP represents additional electricity shown as a negative)	-£4,571	£3,714	*Net Figure Shown Below
Net Revenue First Year	£701	£3,714	£5,556
Investment Return			
Unlevered MIRR	6%	9.9%	10.4%
Simple Payback	11 years	6 years	6 years
NPV	£2,452	£39,145	£61,291
CO2 Saved	6 tonnes	1 tonnes	7 tonnes
CO2 Saved Percentage	72%	8%	82%

4.0 INFORMATION REQUIRED

In order to complete our assessments we require the following information for each property.

- Name and postal address of building
- Annual electricity consumption
- Annual gas consumption
- Borrowing rate of interest
- Export income price (can be assumed at 5p/kWh)

5.0 OUR FEES

The following table provides our fee to complete a desktop study for each building with a reduced rate for a larger number of buildings.

For each building 9 reports will be provided, together with a report summarising all the results.

Number of Buildings	Fee Per Building
1	£1,050 plus vat
2-20	£950 plus vat
31-50	£900 plus vat
51-100	£850 plus vat
100	£800 plus vat

This process works because it completes the due diligence to provide the authority with the confidence to instruct technical surveys.

For further information, please contact :

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Some our key local authority clients include :