Basic Energy Audit Report- Clipstone Village Hall

Produced by NEP Energy Services Ltd

Queens Walk Community Centre

Floor 2

Nottingham

NG2 2DF

Contents

Introduction

The following document lists energy saving opportunities found during a visit to the building and suggests environmentally and financially sustainable solutions which have the potential to reduce energy consumption.

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Survey Date: 30th April 2024 Report Date: 9th May 2024

Site Details

Site Name	Clipstone Village Hall
Site Address	90 Church Road Clipstone Mansfield NG21 9DL
Site Contact	Michelle Paxton
Date of Audit	30th April 2024

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Audit Summary

The audit covered the following services:

- Heating, Ventilation & Air Conditioning (HVAC)
- Hot Water Services (HWS)
- Building Fabric
- Lighting
- Small Power

The site is located in a residential area in the village of Clipstone, Nottinghamshire with residential properties on all aspects and a playing field to the north east. The site consists of a single-storey building used as a village hall for community use, as well as grassed areas and space for car parking. The building is made up of a multi-purpose hall with adjoining offices, meeting rooms, toilets and kitchenette.

Heating, Ventilation & Air Conditioning (HVAC)

- The building is heated by a non-condensing conventional gas-fired boiler with a rated efficiency of 79% as-built (given the age of the unit the efficiency is likely to be lower than this) serving a wet central heating system; heating is emitted via radiators, some of which are damaged.
- The heating system has two independent zones; one serving the hall and the other serving the offices and toilets.
- The system is thermostatically controlled via programmers for each zone at suitable temperatures – these are manually adjusted in the hall according to what activity is taking place; this is mostly done by staff members but some hall users are given control of the heating if using the hall into the evening. These programmers are tricky to operate and regularly need re-setting.
- The building is naturally ventilated throughout via manual openable windows and doors.
- There is no air conditioning in the building.



Figure 1 HVAC equipment (left to right) – ageing non-condensing boiler; heating system programmers are not fit for purpose; radiators in some cases are damaged

Hot Water Services (HWS)

- Domestic hot water is provided by a well insulated hot water cylinder; the cylinder is an older model with high standing losses and struggles to meet demand sufficiently, particularly towards the end of its run.
- Taps are fitted with standard fixtures with no water-saving devices in place.

Figure 2 HWS equipment (left to right) – hot water heater struggles to meet demand; taps are not fitted with water saving devices

Building Fabric

- The building was originally constructed c.1960s with solid brick walls and profiled pitched roof; the original building comprised the hall only and was extended (date unknown but assumed to be of the same decade) to include the office section with cavity brick walls – the roof was extended over this section. The original walls had a cavity brick slip pattern applied to uniform the building (no cavity between the internal solid brick and external slip).
- The solid walls and cavity walls are uninsulated, as is the roof space. The offices have a tiled suspended ceiling above which has been insulated in places but does not appear to have full coverage.
- Windows are fitted with uPVC-framed double glazing with thermally-improved spacers.

Figure 3 Building fabric (left to right) – cavity brick slips applied to original walls; cavity wall construction on frontage; underside of metal roof, no insulation as-built or above suspended ceiling

Lighting

- The majority of lighting is provided by efficient LEDs with PIR motion sensors in some areas such as corridors and toilets.
- Some older, inefficient T8, T5 and 2D fluorescent fittings remain, some with controls but mostly without.
- External lighting is provided by efficient LEDs on timers and photocells.

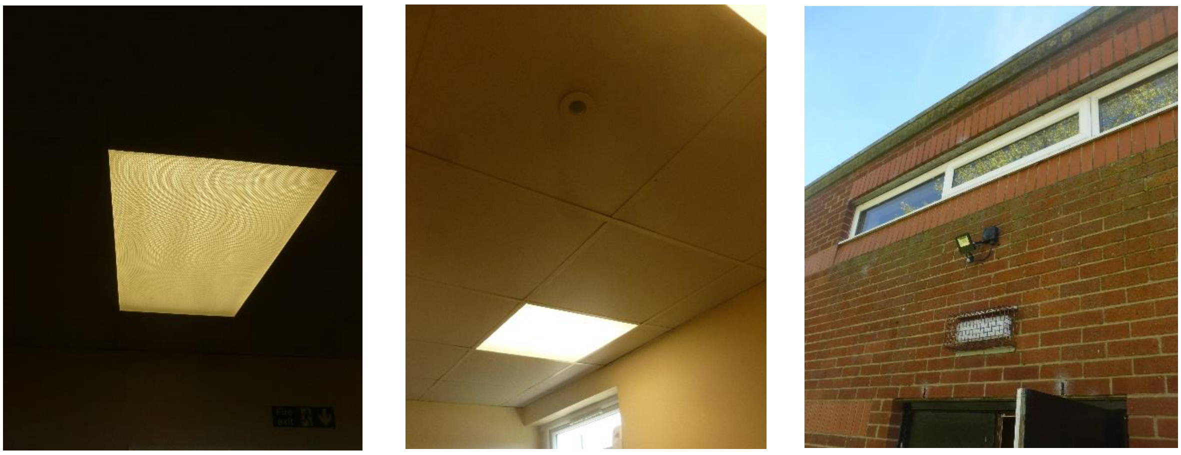

Figure 4 Lighting (left to right) – inefficient T8 fluorescents; efficient LEDs with PIR motion controls in toilets; external LED fitting with photocell

Small Power

- Computer equipment is generally modern and efficient and switched off when not in use.
- There is minimal kitchen equipment in place but fridges and microwaves are modern and serviced accordingly.

Analysis of Energy Consumption

Over the period April 2023 to April 2024 Clipstone Village Hall used 59,946 kWh of gas costing £4,262 and 6,389 kWh of electricity costing £1,753 (based on latest tariffs). This equates to annual carbon emissions of 12.11 tonnes.

Table 1 Energy consumption summary

Resource	kWh/yr	%	£/yr	%	tCO_2/yr	%
Gas	59,946	90	4,262	71	10.79	89
Electricity	6,389	10	1,753	29	1.32	11
Total	**66,335**	**100**	**6,015**	**100**	**12.11**	**100**

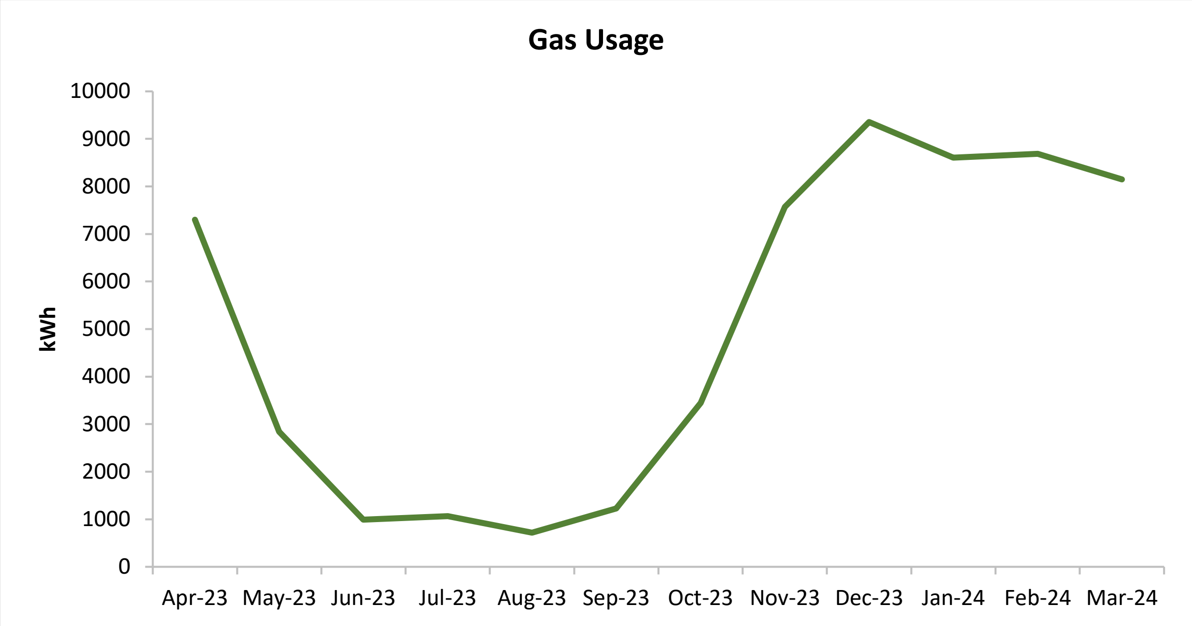

Figure 5 Gas consumption profile

The gas consumption profile in Figure 5 is indicative of a building using gas for heating; consumption peaks in winter when demand increases and drops in summer when demand is at its lowest. The consumption in summer is most likely attributed to hot water consumption.

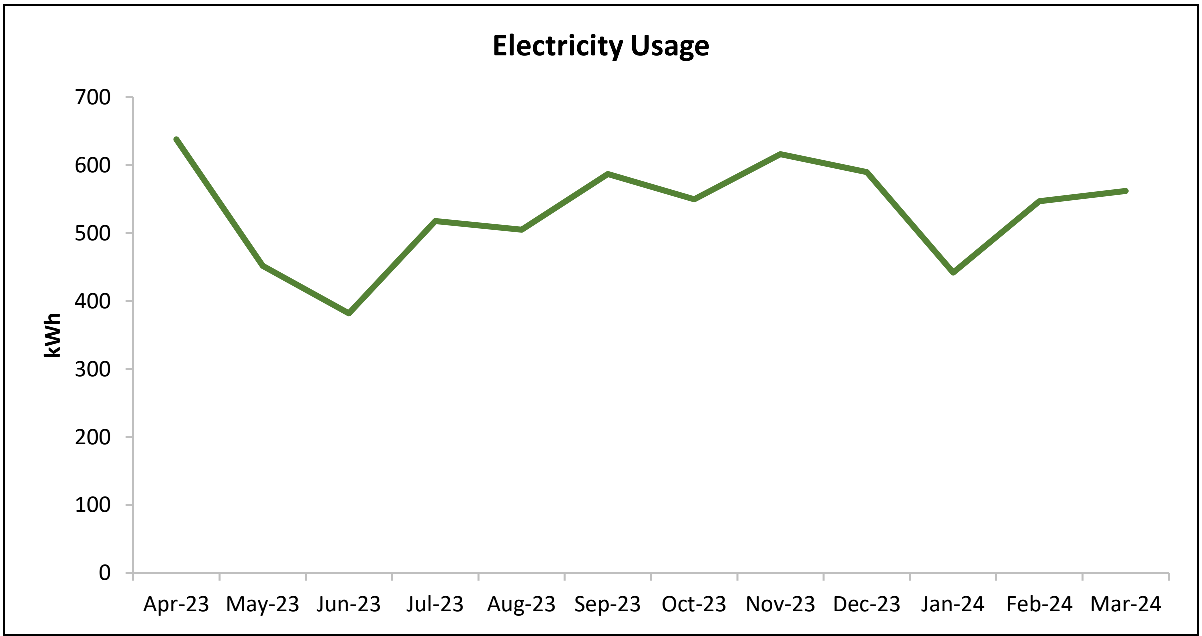

Figure 6 Electricity consumption profile

The electricity profile is less clear; consumption varies throughout the year and may represent when the building is being used most – an intensity metric such as number of bookings or £ bookings per kWh will provide a better illustration.

Benchmarks

Figure 7 compares this building's annual energy usage with a 'Typical' benchmark, set by CIBSE, of the same building category. The building uses less kWh/m²/year of gas and electricity compared to a building of this type in the UK, especially electricity.

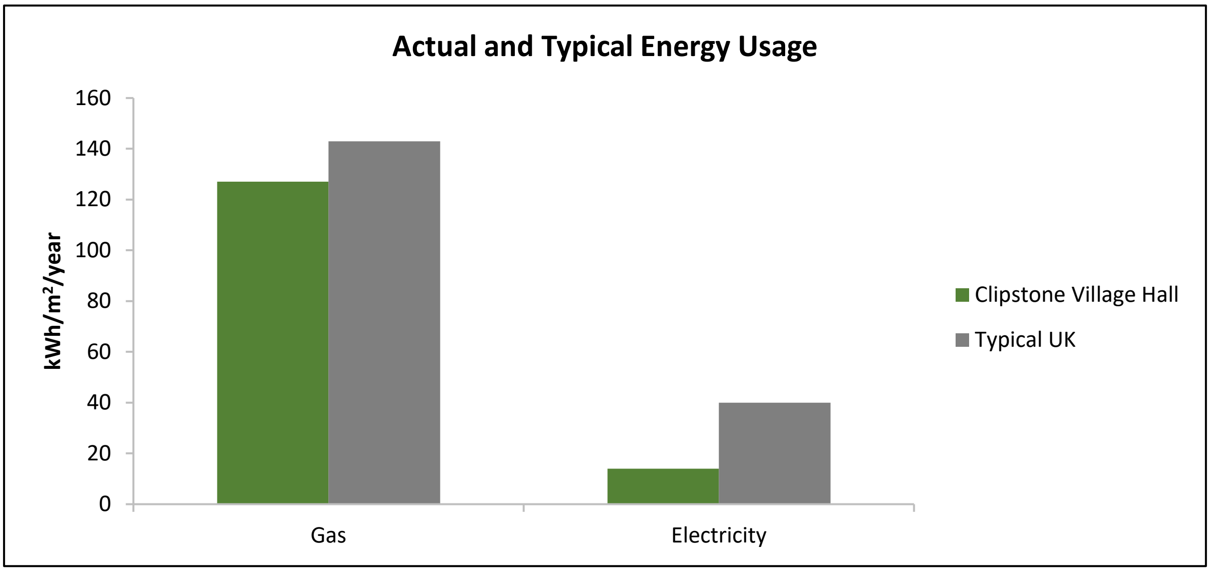

Figure 7 Benchmark comparisons

Degree Days

A degree day is a way of determining the heating requirements of a building; one Heating Degree Day (HDD) represents a fall in temperature 1° below a specified outdoor temperature, in this case 15.5°C. This is a general assumption that when the temperature falls below this figure there is a requirement for heating. Degree days are used to help calculate accurate benchmarks such as the one used above and to give an indication whether or a not a building is being over or under-heated at different times of the year.

The chart in Figure 8 sets the energy used on site against the number of degree days that were recorded over the course of the data range (April 2023 to April 2024).

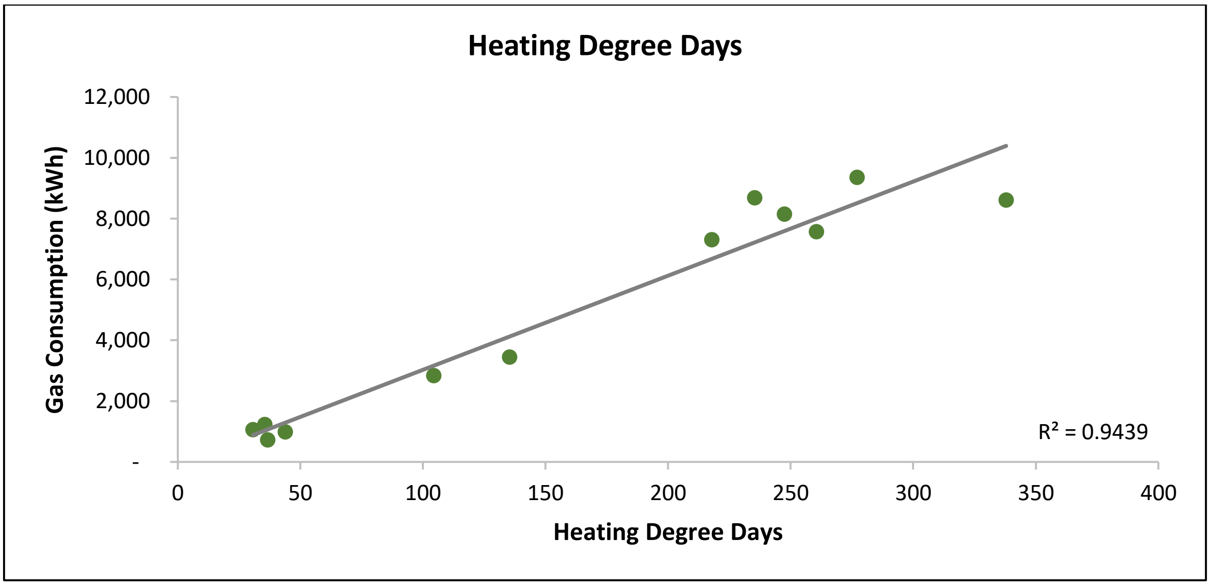

Figure 8 Degree day data

The R^2 value is a measure of how well correlated the gas consumption is with the heating degree days (HDD); the closer to 1 (on a scale of 0 and 1) the more correlated. A value greater than 0.75 indicates a reasonable correlation, above 0.9 very good and below 0.7 very poor.

The R^2 value of 0.9439 in this case indicates a very good correlation between gas consumption and HDD, suggesting that there is very good control of heating systems; this is largely because of the efforts of the building users rather than the systems themselves having good controls.

In general the building is performing better than the typical benchmark and the HDD analysis would suggest that the heating controls are very good, however electricity consumption is difficult to interpret. Ideally half hourly metering with out-of-range alarm systems should be set up to detect any discrepancies and act on them as they occur, particularly in situations where control of the building services is given to service users.

Energy Saving Recommendations

The table below contains projects which have the potential to achieve significant energy and carbon savings. The table shows the estimated capital cost of each project alongside an estimate of the potential energy saving. Savings estimated in the table are not necessarily cumulative as installing certain measures will reduce the impact of others.

Savings have been calculated using tariffs provided by the client of 7.11p/kWh for gas and 27.44p/kWh for electricity;

Table 2 Energy saving recommendations

Proposed Projects	Estimated Cost (£)	Estimated Annual Savings			Payback (years)
		£	tCO_2e	kWh	
Heating Controls	1,700	350	0.88	4,916	4.9
Suspended Ceiling & Insulation	3,053	708	1.79	9,953	4.3
Cavity Wall Insulation	828	699	1.77	9,831	1.2
Electric Hot Water Heaters	2,021	462	1.75	9,890	4.4
Boiler Replacements	8,033	552	1.40	7,761	14.6
Lighting Upgrade	1,740	1,074	0.81	3,913	1.6
Water Saving Taps	638	223	0.57	3,143	2.9
Solar PV	15,597	3,096	2.34	11,282	5.0

Heating Controls

The heating system is presently controlled by programmers which are temperamental and difficult to operate; the timers and thermostats frequently need adjusting for the hall depending upon how it is used (*i.e.* some hall bookings are active classes so require a lower heating demand) – in some instances hall users are given control of the heating system and there have been cases where heating has accidentally been left on overnight.

Upgrading the heating controls can save as much as 10% on gas consumption; but just as importantly in this situation is having controls that are easier to use and that can be used remotely via apps, allowing part time staff to operate the heating system without having to be in the building at late hours.

Advanced heating controls include optimum start/stop and weather compensators to reduce the amount of time that the heating needs to be on by ‘learning’ how quickly the building (and its zones) heats up and cools down in relation to outdoor ambient temperatures. A Building Management System (BMS) can also incorporate a booking system whereby temperature settings are automatically adjusted according to what group activity/hall usage is taking place, reducing having to manually alter temperatures every week (or more frequently if late bookings/changes occur).

Suspended Ceiling & Insulation

The offices have a suspended ceiling above them which has insulation above in places but does not appear to cover the entire area, as a result there will be significant rates of heat loss through the ceiling to the uninsulated roof above (approximately 25% of heat loss is through the roof), increasing heating demand in winter and cooling demand in summer.

Installing insulation above the office suspended ceiling grid would be a more cost effective option than insulating (or most likely, replacing) the roof itself. Insulative 600x600mm bags can be placed directly on top of the ceiling grid to reduce heat loss and heat demand.

The main hall has a vaulted ceiling; as a result the heating system is having to heat a far larger volume than in the offices, taking longer to reach setpoints thus consuming more energy. Installing a suspended ceiling in the hall will reduce the floor to ceiling height and may be restrictive for ball sports, however the majority of bookings would not be impacted. The suspended ceiling could then be insulated in the same way as the offices, significantly reducing heat demand. Costs and savings in Table 2 are based on installing insulation throughout the building, including the hall, but do not include installation of the suspended ceiling in the hall – consideration to the impact of the ceiling on hall users would have to be taken into account primarily.

Cavity Wall Insulation

The rear of the property has solid walls which will be expensive to insulate with very long paybacks, however the front of the building (the office side) has a cavity wall structure which, given its age and lack of retrofit evidence, is highly likely to be uninsulated. Given that approximately a third of heat loss in buildings is via the external walls, insulating these (or as much as practically possible), is highly recommended to reduce heat loss and demand.

Cavity wall insulation has low levels of disruption and can usually be completed within a day, compared with more expensive measures such as solid wall insulation. Solid wall insulation is worth considering for the rest of the building if budgets allow, however priority should be given to the walls that can be insulated more easily.

Electric Hot Water Heaters

The current gas-fired hot water system is not fit for purpose; return flow temperatures regularly struggle to reach the recommended 60°C required to avoid legionella issues and water points at the furthest end of the building (end of the run) take a long time to get suitably warm enough, wasting water and energy as a result. The system is ageing too so is likely to have a lower efficiency than when new, costing more to run.

The system could be replaced with a like-for-like gas-fired option with a higher efficiency and better pumps, however this may not necessarily solve the supply issues and could become more expensive to resolve. A more practical and cost-effective solution would be to remove the current system and replace with local stand-alone electric water heaters. These would have far shorter runs so would avoid supply issues and given how well insulated these devices are and how little electricity they would require for a building of this usage, savings would be achievable.

An installer would be able to provide exact figures; it is likely that a heater (located above the suspended ceiling grid with pipework dropping down) could supply the toilets, with a second heater supplying both the kitchen and adjacent caretakers sink.

Boiler Replacements

The boiler is ageing and is running at lower efficiencies than newer condensing models offer and as a result will be using more energy and costing more to run.

Until relatively recently the only option in such instances would be to replace the boiler with a like-for-like model, however as gas becomes a less secure energy source and with electricity becoming 'greener' (lower carbon factor; national grid electricity has a similar carbon factor to natural gas and will keep decreasing as more renewable energy is fed into the grid supply) as well as a likely switch of fossil fuel subsidies from gas to electricity, opting for alternatives such as heat pumps is an increasingly financially and environmentally viable option.

There are benefits to both heating system types; this report aims to provide the energy savings and associated costs, as well as pros and cons of gas boilers and air source heat pumps.

A gas-fired conventional condensing boiler (note a combi boiler would not necessarily be suitable given the hot water demand and the supply issues as highlighted previously) would be cheaper than a heat pump and provide greater financial savings based on current energy prices. A heat pump would provide greater carbon and energy savings but would not produce an annual financial saving because of the switch of fuel from relatively cheap gas to more expensive electricity, even taking the improvement in efficiency of a heat pump system. The savings in Table 2 are based on replacing the existing system with a conventional condensing gas-fired boiler, efficiency 95% (note savings do not take additional savings such as ongoing maintenance and lifetime cycle analysis into account).

Table 3 Condensing gas boiler vs air source heat pump comparison

	Condensing Gas Boiler	Air Source Heat Pump
Estimated Cost (£)	**8,033**	36,375
Estimated Annual Savings (£)	**552**	-241
Payback (Years)	**14.6**	-
tCO_2 Annual Savings	1.40	**6.03**
kWh Annual Savings	7,761	**35,539**

Lighting Upgrade

There is a mixture of lighting on site; the majority is fitted with modern LEDs on motion sensors, but some lights are fitted with older, inefficient fluorescents with minimal controls.

Replacing these remaining lights with LED equivalents and installing motion sensors where applicable will reduce energy consumption associated with older lights, as well as reducing running and ongoing maintenance costs given the longer lifetime of LEDs compared to fluorescents. Light output levels and quality will also increase, reducing sickness from flicker effects.

Water Saving Taps

Many of the fixtures around the buildings are outdated and using more water and energy to heat that water.

Replace taps, particularly to the hot flow, with aerated fittings and/or with push-stop fittings to reduce the amount of water being supplied to the user. Sensors can also be fitted as a more sophisticated measure. For the hot flow tap this will also reduce energy consumption as less water has to be heated. Costs include installing a matching cold water tap for aesthetics and water saving.

Solar PV

The site has a small wall-mounted solar thermal system installed to the south-east wall however this does not appear to be working. The building would benefit from having solar photovoltaic (PV) panels installed; these panels would significantly reduce electricity consumption on site, subject to structural checks and array location.

The south-west facing roof pitch (rear-facing) has minimal shading and is at a suitable ~15-30° angle, however the structure of this roof would need to be surveyed before committing to installing a system. Not all of the generated electricity from the system may be used and would have to be exported. It is advisable to avoid this option because of the cost implications (the Smart Export Guarantee offers very small payments which are not deemed worthwhile) and negative impact on the national grid and instead opt for battery storage as part of the install (this would be easier and far cheaper than attempting as a retrofit install), particularly given the late night usage of the building; further indicative annual savings of 4,513 kWh (£1,238; 0.93 tCO_2) are possible.