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ENERGY AUDIT OBSERVATIONS AND RECOMMENDATIONS

9196 - CECIL SHARP HOUSE

14/09/2018 *by Andy Love,*

XCO2 have undertaken an Energy Audit of Cecil Sharp House to identify opportunities for energy savings and the future use and configuration of the building. The audit was undertaken in line with guidance set out by ASHRAE for Level 2 Energy Audits, BS EN 16247-1 Energy Audits: General Requirements and BS EN 16247-2 Energy Audits: Buildings.

This design note sets out the Observations and Recommendations from the Energy Audit Wednesday 1st August 2018 ahead of distributing a wider report providing the full Energy Audit and Feasibility Study document.

INTRODUCTION

Cecil Sharp House in London is the Grade II listed Headquarters for the English Folk Dance and Song Society, built in 1929-30. The building was partly rebuilt in 1949-1951 after damage received from the war. The Society are currently requesting funding to complete the first phase of a long-term plan which aims to upgrade facilities at the Cecil Sharp House; this is by improving the quality and scope of the venues to hire and making the existing mechanical and electrical infrastructure more efficient, thus improving the revenue streams. The first phase of works looks to:

1. Upgrade inefficient mechanical and electrical installations to save on energy consumption and free-up space.
2. Consolidate the bar and café into one area making it more space efficient and appealing, bringing in more revenue.
3. Expand and improve venues available for hire increasing revenue.

However, in the meanwhile, a further purpose is to understand where improvements can be adopted now and for the immediate future, to reduce energy bills; therefore, an Energy Audit has been carried out; this report sets out the findings of the Energy Audit, noting our Observations, Recommendations and the Feasibility of developing a refurbishment strategy to reduce energy cost, improve comfort and suit the proposed layout of the refurbished building.

The building operates all year round but has a significant drop of occupation in the summer period; this study was carried out during the summer period[1].

[1] It is advised that a similar assessment of energy consumption be carried out for different seasonal periods to assess the different occupation and behavioural changes

KEY SPACES

The building includes a basement and ground floor to second floor. A list of the key spaces is set out below:

Basement
- Café break-out area
- Bar area and Kitchen
- Archive Rooms
- Cold Room and Condenser Room (in male toilets)
- Boiler room
- Meter room
- One large classroom (~130m^2)
- One smaller classroom (~66m^2)
- Private office (~25m^2)

Ground Floor
- Entrance Hall and Reception
- Main Hall: three-storey (~355m^2)
- Library (~65m^2)

First Floor
- Two classrooms (~39m^2 and ~32 m^2)
- Office (~16m^2)
- Sound Library and Audio-Visual Room (~14m^2)

Second Floor
- AHU room[2]
- Tank room
- Two offices (~58m^2 and ~17.6m^2)

CURRENT ENERGY PERFORMANCE

A review has been undertaken of the available energy data for the Cecil Sharp House building to gauge the overall consumption as well as patterns and trends.

The current energy consumption is split between natural gas, electricity and water use:

- 121MWh electricity consumption;
- 294MWh natural gas consumption; and
- 1412 m^3 water consumption[3].

The current on-site CO_2 emissions for electricity and natural gas use from the building are approximately 126tonnesCO_2/year[4].

The electricity and gas usage of the building have been logged on a half-hourly to hourly basis using manual meter readings for two separate days in August (Tuesday 7th August and Thursday 30th August) under different occupation conditions. As the study has been carried out under summer conditions under low occupancy, the gas consumption information inadequate; this is because the space heating, provided via gas boilers, was switched off during the periods when meter readings were taken.

The electrical base load of the building when unoccupied seems to be low at approximately 1kW-3kW, signifying that there is likely a good regime for switching off lighting, fans and equipment over night by staff. The overnight base load

[2] The Main Hall hip roof includes a large part of the AHU distribution duct work. It is insulated at ceiling level
[3] Water consumption improvements and recommendations are omitted from this study
[4] Assuming a 0.512kgCO_2/kWh and 0.216kgCO_2/kWh carbon factor for electricity and natural gas respectively

is therefore contributing approximately £500-£1,300 to the electricity bills. The base load overnight is normally a contribution of fridges, freezers, condensers, HVAC equipment and computers (left-on).[5]

When the building is occupied the base load appears to increase to around 8kW for the two days assessed (at low occupancy). This base load contributes approximately £5,000/year to the electricity bills. The base load in the day is normally a contribution of all the above mentioned with the addition of the AHU, pumps, lighting, fans, computers, audio and kitchen equipment.

The metering data for Tuesday 7th August seems to suggest that there was a significant event between 10.30am-12pm that increased the base load from 9kW-17kW. It would be worth considering further investigation into this event to understand the reasoning. Initial assumptions are that the kitchen equipment was all on at once (preparing for lunch time) along with a potential increased occupation in the main hall, but this will need to be verified. Should this be from the kitchen equipment it may be worth considering how the kitchen is operated at low occupancy periods i.e. during summer could the café be serving 'cold-plates' only? The 8kW increase at this time, if a regular event over the year, could be contributing £500 towards the electricity bills.

Thursday 30th August was notable for in the evening a concert was held (assumed in the main hall); therefore, the AHU and/or lighting load was likely increased during the period of 6.30pm-10.30pm an approximate electrical load increase of approximately 7kW; if it is assumed that concerts occur four/five times weekly this translates to an approximate £700-£900/year electricity energy bill.

General observations from the metering:

- The electricity consumption seems heavily dependent on the occupational period; as the daily occupational pattern is irregular.
- Evening uses nearly double the electricity consumption of the building.
- Morning uses seem to significantly increase the overall building electricity load.
    - Perhaps this is associated to the existing kitchen uses.

[5] In the case of Cecil Sharp House dehumidification is also a contributor

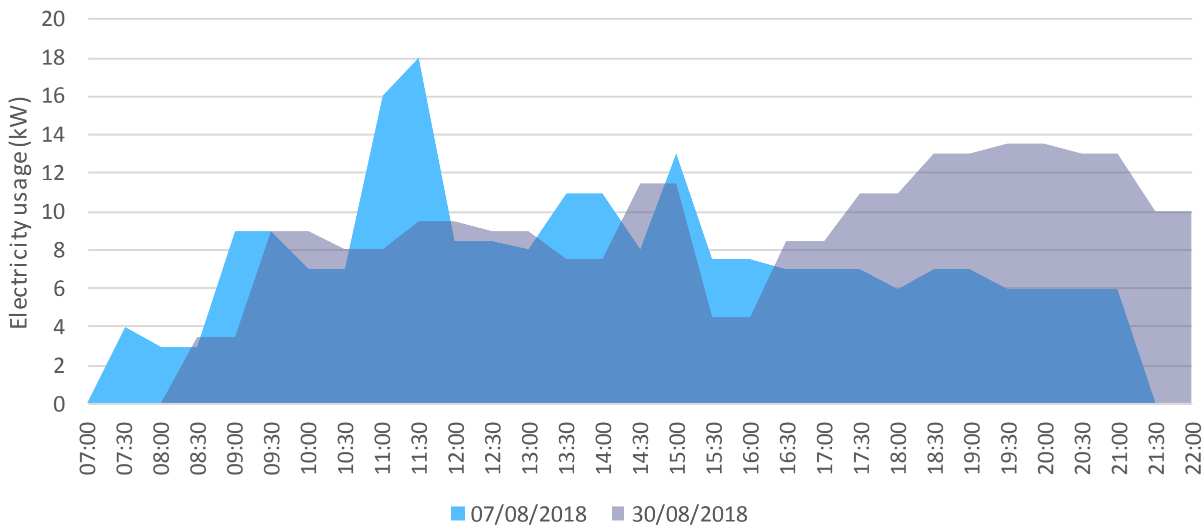

Figure 1: Typical mid-week daily electricity use under summer conditions (Tuesday 7th August and Thursday 30th August)

ENERGY PERFORMANCE OBSERVATIONS

The main observations from the daily energy consumption breakdown are:

- The electricity consumption seems heavily dependent on the occupational period; as the daily occupational pattern is irregular.
- Evening uses nearly double the electricity consumption of the building.
- Morning uses seem to significantly increase the overall building electricity load.
  - Perhaps this is associated to the existing kitchen uses.
- When occupation of a building is intermittent it tends to be prudent to design zonal Heating Ventilation and Air Conditioning (HVAC) systems with local control; this can improve user control and reduce unnecessary heat losses along distribution pipework.

BENCHMARKING

Comparatively to other similar building uses including; Community Centres, Social Clubs, Offices (naturally ventilated), Dry Sports Centres and Schools/Seasonal Buildings, Cecil Sharp House has both a larger electricity and a gas consumption.

Based on the benchmarks, the building's energy bills are upwards of approximately £14,000[6] larger than what would

The energy bills for the 2017 year have been provided and came to approximately £23,400:

- 121,132 kWh electricity consumption equating to approximately £14,500 per annum.
- 294,000 kWh natural gas consumption equating to approximately £8,800 per annum.

In comparison to the benchmarks, Cecil Sharp House seems to be underperforming. On average, Cecil Sharp House is consuming 100MWh natural gas consumption and 49MWh electricity consumption when compared to the CIBSE benchmarks and on average this is £9K over the expected energy bills.

A comparison of the energy benchmarks is set out in Figure 2 with a comparison of energy bills in Figure 3.

[6] Approximate figure based on average; £0.03/kWh natural gas price and £0.12/kWh electricity price

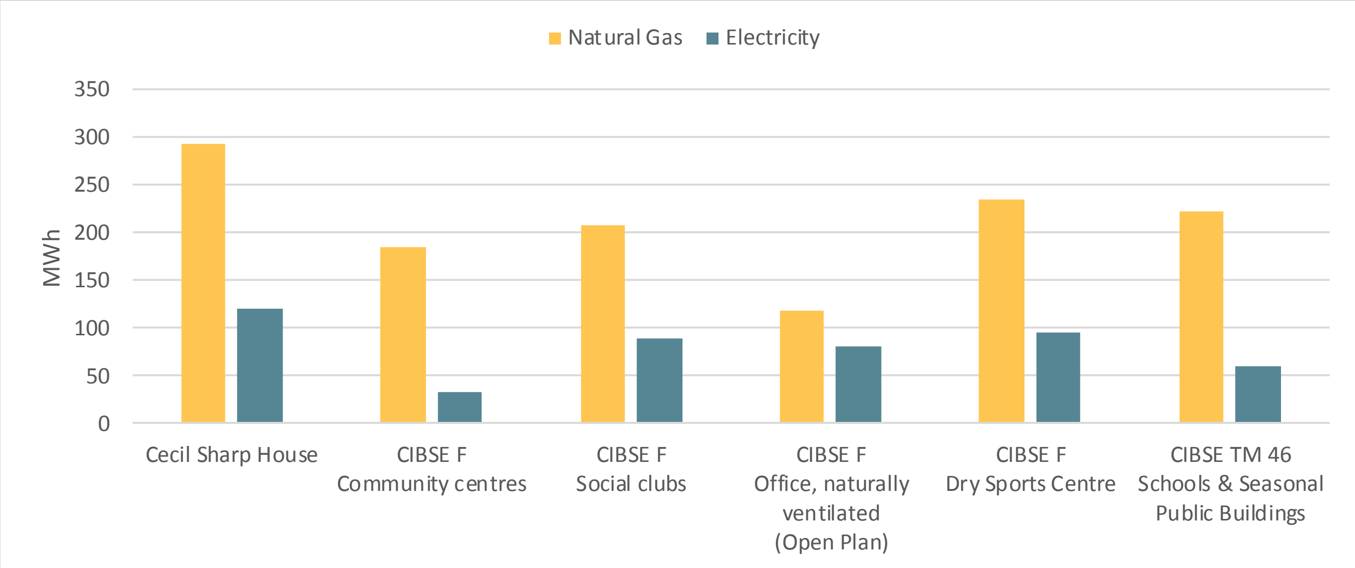

Figure 2: CIBSE F and CIBSE TM46 benchmark comparisons for natural gas and electricity use in existing buildings

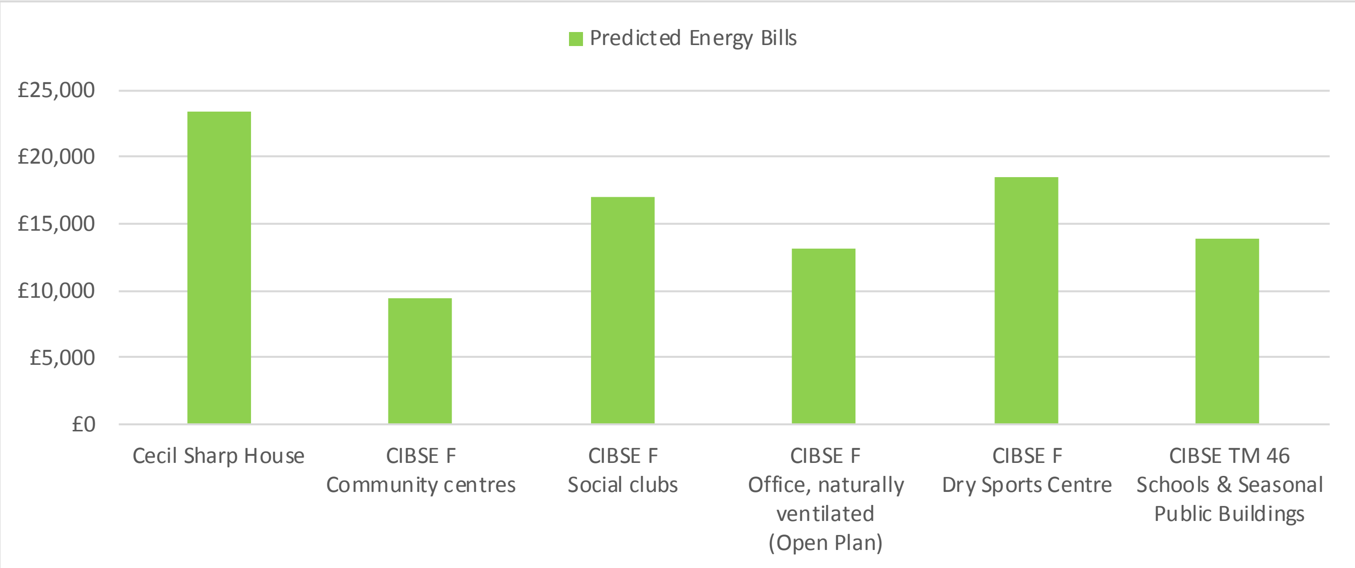

Figure 3: CIBSE F and CIBSE TM46 benchmark comparative energy bill costs

be commonly expected of an existing building with the same Net Internal Area (NIA) assuming ‘Good Practice’[7]:

- £1.8k - £5.3k natural gas increase against benchmark.
- £3.1k - £10.6k electricity increase against benchmarks.

[7] Good Practice Guide GPG287: The design team’s guide to environmentally smart buildings

OBSERVATIONS & RECOMMENDATIONS

Considering this, the following sections split the observations and recommendations arising from the audit between; strategic, quick wins and detailed considerations. This enables full consideration to be given to what is recommended whilst still recognising the context in which the recommendation sits. For example, some detailed recommendations may no longer be applicable if certain strategic recommendations are followed. To aid clarity the recommendations are split by system where applicable.

HIGH LEVEL STRATEGIC CONSIDERATIONS

High Level Strategic observations have led to recommendations that require either a fundamental change to the current systems and/or operating practices within the building or would need to be rolled out over an extended period to avoid unnecessary production down-time. Each recommendation should be considered in isolation and, given that they are only outlined here on a high-level basis, is likely to require a significant amount of work to implement. In some cases, it would be advisable to bring on board more specialist expertise and it is likely that the implementation of each recommendation would necessitate consideration as a stand-alone project within the ongoing environmental performance enhancement works.

To assess the future life of the plant items and distribution networks in a building it is necessary to consider its condition, performance and maintenance record, to establish if the plant item is at the end or nearing the end of its recommended lifespan. This would normally be assessed by the following measures:

- visual inspections of the physical condition and the plant's operation;
- assess whether the plant is performing to an appropriate performance standard;
- review the date of equipment as well as service and maintenance records.

Engineers may assume that once plant has reached the age indicated by the economic life factor it should be replaced. This is not necessarily the case and may lead to premature and unnecessary replacement. CIBSE Guide M provides 'Indicative life expectancy factors'[8]. Beyond the recommendations detailed, it is worth noting that the guidance from CIBSE Guide M would suggest that a large proportion of the installed systems at Cecil Sharp House are nearing or have passed their respective life expectancy. As an example, closed pipework systems for copper have an estimated lifespan of 45 years whereas galvanised steel has 35 years; commissioning valves usually require replacement after 25 years. With completely new systems requiring replacement, strategic recommendations become viable. It should be noted that there were little asset specific documentations available and no specific design standards for new equipment were available for review. Therefore, it was not possible to assess remaining asset life or any specific recommendations for replacement.

S: As previously noted the recommendations made within the following table necessitate further detailed consideration in order to ensure they are technically and functionally viable, and without undue adverse impact on production. However, from the observations made it is likely that all would be feasible considerations and would offer potential for significant energy savings and/or environmental performance improvement.

It should be noted that implementation of the above may negate some of the detailed.

QUICK-WINS

Quick-win observations have led to simple recommendations that neither require a fundamental change to the current systems nor require extensive detailed changes. In most cases it is deemed that in-house facilities management can execute the recommendations, with minimum requirement for outside expertise alongside minimal investment. Most 'quick wins' identified are deemed as best-practice by the associated design guidance and are recommended as initial simple measures to provide improvements to the systems.

[8] Appendix 13.A1: Indicative life expectancy factors CIBSE GUIDE M

Q: The recommendations made in the following table does not compel detailed consideration and are considered to not have a major impact on the ongoing running of the building; instead most recommendations can be rolled out during day-time hours and/or at weekends outside of production hours. Each observation would provide energy savings to differing degrees of magnitude, but collectively the energy savings could be significant.

With the payback period being short for 'quick wins' it is still considered worthwhile implementing the recommendations found in this table within the interim period before more strategic/detailed recommendations are considered or executed; however, the energy savings accrued from some 'quick wins' will become irrelevant if/when the detailed/strategic recommendations are implemented.

DETAILED CONSIDERATIONS

Detailed observations have led to recommendations that would require a detailed review with remedial works to the existing design rather than a complete strategic change. In some instances, the detailed recommendations would require rigorous design work, a longer period of delivery or detailed analysis of the existing set-up.

In some cases, it would be advisable to bring on board specialist expertise and it is likely that the implementation of each recommendation would demand a level of prior on-site measuring that does not currently exist. The recommendations that incorporate a level of detailed design would require ongoing monitoring to establish existing system load profiles prior to implementation.

Where observations are followed by [*], detailed design calculations are required which extend beyond the scope of an audit report.

The various observations and recommendations for the HVAC systems are detailed in *Table 1* below. Several of these points relate to operation or maintenance procedures, which were not available for review, therefore the recommendations suggested may already be considered within said procedures or could be additionally incorporated as part of existing maintenance contracts.

Where the recommendations have been included with a * symbol it should be noted that the savings and costs for doing the work are reliant on specialist input beyond the scope of this audit.

D: As previously noted the recommendations made in the table below necessitate design considerations with additional monitoring equipment and/or specialist expertise; however, from the observations made it is likely that all would be feasible considerations and would offer potential for significant energy savings and/or environmental performance improvement.

Table 1: Observations of the site visit 1st August 2018

Item	Ranking	Area/Zone	Observation
1	D	General/Building fabric	It was noted within the interview with Rosie that there were a number of hot and cold spots distributed across the building where the thermal comfort levels were poor, notably a corner in the second floor offices that suffers from poor thermal comfort in peak summer and winter conditions; likely to do with poor insulation and/or leaky facade.
2	D	General/LTHW	Hot water flow and return pipework is uninsulated in many areas, insulation should provide an easy win for reducing heat losses and also reduce the overheating in spaces. Where there is insulation on the hot water flow and return the insulation appears to be of poor quality from the readings taken via the heat gun (37degrees for insulated and 50degrees for uninsulated)
3	D	Meter Room/LTHW	In the electrical meter room it was noticed that some lengths of LTHW F&R pipes had insulation wrapped together rather than individually cased, This is typically done by contractors to save time and cost but what it means is there is heat transfer between the 2 pipes reducing efficiency in the heating distribution system.

Item	Ranking	Area/Zone	Observation
4	D	General/LZC	The building has a large roof area and/or exposure to sunlight hours in the car-park area facing south east that provides opportunity for installation of solar renewable technologies.
5	D	General/General	General strategy for HVAC seems to be heating via radiators and natural ventilation from openable windows. There is no mechanical ventilation or cooling provision for the general spaces; therefore, there are many electric fans distributed around the building. The main hall is provided with a large AHU unit.
6	D	Boiler Room/LTHW	Main space heating boilers and pumps were switched off as it was summer conditions with low occupation - but insulation seemed old/missing on some valves and distribution pipework
7	D	Cold room/Cooling	The cold room where the drinks are stored had mould formation on the ceiling which would be an indicator of infiltration to the space and wastage of cooling energy. Ideally cold rooms would be via proprietary walk in fridge/freezer type equipment but they can also be retrofit with insulation panels mounted on walls to reduce heat transfer to adjacent spaces.
8	D	Boiler Room/Calorifier	The calorifier was cold to touch
9	D	Cold room (circulation area)/Cooling	The small room next to the cold room had 2 fridges and 1 freezer in an unventilated space, even under baseline conditions (i.e. where the fridge/freezer is doing very limited work as the temperature set point has been reached) the room was still very warm. When these units are loaded up with room temperature bottles the units will go in to full work mode and the heat build-up is expected to be considerable. The units will also have to work a lot harder as the efficiency will drop off quite significantly as the room temperature rises. This is located against an external wall with a door and a window.
10	D	Cold Room / Men's Toilet /Cooling	The external condenser for the cold room was located in the store room within the men’s toilet, this room was very hot with temperature readings at 40-45degrees. The design ambient conditions for this unit are 32degrees.
11	D	General/Heating	Several areas where lagging on LTHW is missing or ineffective in circulation areas and pipework leading to radiators / toilet areas.
12	D	General/Maintenance	Old pipework runs were found in some areas of the building that may lead to unnecessary heat loss/air leakage for example LTHW pipework found in the meter room.
13	D	General/Cooling	Electric fans found in most occupied spaces. Users within the spaces seem to be given little control over extreme temperatures - due to no cooling and old controls for radiators (iron-cast radiators?) - User interactive control systems and achieving ‘perceived control’ are important for the long-term success of a building and these issues require careful consideration at an early stage in the design. Occupants often feel more comfortable when there is a general perception of being in control. This can be as important as having objectively good comfort conditions. An effective response does not always require good and well placed individual controls. A skilled and committed building manager with a well-configured BMS can give similar results in response to a telephone request.

Item	Ranking	Area/Zone	Observation
14	D	General/Lighting	Inefficient lighting and poor lighting controls noted throughout the building.
15	D	General/Heating	As the site visit was conducted in summer there was little understanding of what the winter space heating strategy. Are all radiators left on? Do teachers have control or are TRVs locked?
16	Q	Library/Archive Rooms/Dehumidification	The library and archive rooms are using air dehumidifiers to improve the air quality but what is required is fresh air in the space. The air quality is noticeably poor as you enter the room and ventilation is required.
17	Q	Meter Room/Ventilation	The room where the gas meter room is located in had a redundant uninsulated extract duct connected to an external louvre; this may be for ventilating the meter which is normally required based on British Standards and gas regulations.
18	Q	General/General	The management team seem keen and knowledgeable of where energy savings could be made across the building; however, it appears that the building is maintenance-led rather than energy saving led. i.e. fixing broken lights and/or systems rather than a clear energy saving strategy being adopted.
19	Q	Office/Maintenance	The O&Ms are very generic with maintenance procedures referencing incorrect equipment (i.e. humidifier pumps). This would lead to assume that a regular/thorough maintenance regime has not been followed.
20	Q	General/Building fabric	Several areas were found where duct work was redundant or there was clear penetration through the brickwork to the outside, had gaps or branches open to the air in turn leading to heat being wasted to the outside.
21	Q	General/Maintenance	Clear consistent labelling is lacking on a large proportion of the distribution pipe work, particularly at high level and in risers. Some initial banding has been carried out in the boiler room .
22	Q	Cool room/Cooling	The cool room was showing a temperature of -19degC. The space did not feel this cold. It is unclear where the temperature sensor for the cool room has been placed.
23	Q	General/General	A general observation that the building is generally old and most HVAC systems seem outdated and are likely beyond the recommended life expectancy as per CIBSE Guide M.
24	Q	Café/Lights	Café lights on in all areas even where unoccupied. Natural daylight is very poor in this area.
25	Q	Café/Kitchen equipment	Although occupancy was low in the summer it appeared that kitchen staff were operating most if not all the equipment; these are energy intensive units.
26	Q	Café/Water	It was noted that the water fountain was stuck and water was flowing even without anyone using it
27	Q	Circulation /Lights	Lights seemed on in most circulation areas and WC areas, suggesting a significant part of the base load stems from the lights throughout the building being switched on.
28	Q	General/Maintenance	There did not seem to be a rigorous process for recording faults, maintenance checks etc
29	Q	General/Monitoring	There does not seem like that there is a process for monitoring the energy demand and equipment on-site or off-site. Metering is by hand only and therefore any faults or distinct changes in the consumption of energy is difficult to monitor.
30	Q	Office/Lighting/Equipment	Equipment left on in office including lighting when not in use
31	Q	Meter Rooms/Monitoring	For this study manual meter readings were taken only for a few day periods.

Item	Ranking	Area/Zone	Observation
32	Q	Toilets/Lighting	WC lights left on
33	S	Private Office/Ventilation	The position of the new kitchen is likely to be located in the private office space on the east side. In terms of provision for ventilation (kitchen extract and make-up air) there are windows which are expected can be penetrated through but it is expected that the duct work up and locate the ventilation plant somewhere near the roof to avoid odour and noise issues at ground level. The room height may also be an issue as it appears to be approx. 2.5-2.7m which if full cooking facilities are desired (similar to that of a commercial restaurant) could be an issue.
34	S	Boiler Room/Heating	The boiler room contained 2 No gas boilers, 2 no primary LTHW pumps, 2 no secondary pumps and a direct gas fired hot water heater. The no1 gas boiler shows signs of corrosion on the exterior and would be worth having a service booked to verify the running efficiency. The system setup is quite strange as typically we would design an indirect fired hot water calorifier fed from the 2no gas boilers. Not only would this reduce cost but there would be a backup for the hot water (there are 2no boilers). As it stands if the direct gas fired hot water heater failed they would loss all hot water to the building.
35	S	Main auditorium/Ventilation	The main auditorium is served by an AHU located on the top level. Extract is extracted from low level and supply is at high level.
36	S	Kitchen/Café/Electric heating	Kitchen heaters appear to be electric driven rather than via the general heating system which could be less efficient and more expensive to run
37	S	AHU room/Ventilation	The AHU is located in a very confined space with the distribution ductwork located in a ceiling void area above the auditorium. The AHU is split in to 2 sections; supply and exhaust. There is a heating coil located on the supply side to temper the air in winter/heating conditions and a panel filter section for air filtration. The exhaust section is ducted externally through the roof but is also connected to the incoming side of the supply side of the AHU for mix mode/ full recirculation mode. The design philosophy appears to be a full fresh air AHU in summer conditions, predominantly recirculation with fresh air at minimal levels during the winter and mix mode during mid-season. This would require the AHU to have motorised dampers on the exhaust ductwork and the recirculation ductwork connected via controls to a CO2 sensor mounted a minimum of 2 locations (at working plane) within the auditorium to give an average reading. From our observations there are no motorised dampers and the manual dampers are both in the open position. The LTHW connections are controlled via a 3port valve, which would indicated a constant flow LTHW circuit.
38	S	Café/Ventilation	There is likely to be heat build-up within the restaurant/café area in the existing use and future use that could be recovered and displaced elsewhere.
39	S	General/Heating	With the heating systems being old and inefficient, there is a risk that heating systems may turn faulty and/or internal climate will feel uncomfortable within high occupied spaces.
40	S	Boiler Room/Heating	Gas boilers are old and probably sit outside the recommended lifetime noted within CIBSE Guide M

Table 2: Recommendation descriptions for Cecil Sharp House to improve energy efficiency

Item	Ranking	Recommendation
1	D	Appoint consultant to model the existing and proposed building using dynamic software to carry out an assessment of the building fabric Provide thermal comfort modelling of the building by assessing the solar gains, internal gains and conduction gains of each space to suitably re-design the building with improved building fabric & correctly sized HVAC systems
2	D	Install or replace lagging
3	D	Insulate pipework individually to avoid heat transfer
4	D	Investigate the opportunity for providing solar PV panels (may be issues with installing on the roof due to the heritage status of the building and location within the surrounding Primrose Hill conservation area). The car-park may be provided with a shelter along with PV panels to the roof of this.
5	D	Appoint Mechanical and Electrical Engineers to carry out load calculations and detailed design Identify existing building load so that future HVAC systems can be selected correctly.
6	D	Add extra insulation, further reducing distribution losses, with typical payback periods of less than 3 years. Valves and storage vessels should always be insulated. This site's LTHW distribution may even be running purely to maintain the distribution losses in winter (it is unclear if this is the case and will need to be verified in winter). In these circumstances the distribution losses of central systems need to be distinguished from the end use.
7	D	Investigate the opportunity for insulating the space to reduce the cooling load and/or the introduction of a designated walk-in fridge/freezers.
8	D	Understand demand and work out if storage/DHW system large enough for existing demand/future demand post-refurbishment.
9	D	If a high level extract fan was located where the window is and a low level intake louver located in the door, the units will work a lot more efficiently.
10	D	To improve the efficiency it would be recommended that either the condenser is located externally or mechanical ventilation is introduced to reduce the internal temperature of the room. Quotes have already been received for the labour and material costs.
11	D	install or replace lagging
12	D	Remove old/unused plant equipment to avoid confusion and reduce energy demand.
13	D	Seasonal schedule settings - Set temperature range to avoid extreme temperatures (21°C - 24°C in winter) If cooling is to be provided under the refurbishment then designated set-points to be included (i.e. 19°C - 22°C in summer)
14	D	Replace/improve the efficiency of the existing lighting strategy
15	D	Use metering data to understand the best settings for programming the heating, and when to switch on lights. Re-evaluate the schedules for heating the class rooms when the space is unoccupied. The boiler set temperatures could be revised to avoid high return temperatures.

Item	Ranking	Recommendation
16	Q	Large window areas have been boarded up which could be utilised as louvers for fresh air. If the library and archive rooms are moved then natural ventilation may be used for the spaces rather than dehumidifiers; the humidity will need to be verified by an engineer during any future re-design.
17	Q	It should be considered that the duct work be capped off at the external connection point as this could lead to additional heat loss/gains; however, it should be identified if this room is being ventilated by this method.
18	Q	Make sure that the member of staff from the maintenance team are recording the cyclical checks/upgrades to plant and services they are making. Determined who should be responsible for energy management in each department, how energy consumption is reviewed, recorded and analysed, monitoring and target setting, investment, planning and maintenance. Establish responsibility for control settings, review and adjustment. Provide training to the maintenance team regarding the optimisation of controls to AC units and vent
19	Q	Have an overhaul of the maintenance procedures.
20	Q	Maintenance to do a walk-around identifying holes to the façade and infill where appropriate i.e. seal the building to improve air-tightness and reduce further heat loss
21	Q	This will help with any further remedial works or future updates to the heat network
22	Q	Ensure that the temperature sensor is in a position representative of the variable to be measured, in this case temperature and take care that the sensor is screened from direct radiation, particularly sunlight.
23	Q	Many older buildings have potentially good natural light and ventilation, but may suffer problems such as: - excessive heat losses through the walls, windows and roof - excessive solar gains if the building is overglazed - high infiltration losses and draughts, plus cold radiant effects in winter for staff near windows – particularly if perimeter heating is not fitted - poorly located and or poorly operating services - poorly positioned and inadequate controls - inadequate briefing or supervision of fit-out designers and contractors whose installations have compromised energy-efficient operation. If available, the findings of staff surveys may help identify specific weaknesses, and will help to establish the refurbishment requirements. A condition survey should address the fabric, the services and the achieved conditions. Try to identify, retain and develop the good features while eliminating or minimising the bad ones.

Item	Ranking	Recommendation
24	Q	Arrange partitioning and layout to make best use of natural lighting and building services either in the current state or with future improvements. Ensure that staff and cleaners practice a 'switch-it-off' policy and re-evaluate lighting policy Can lights be switched off in areas at low occupancy periods of the day? Factors influencing the selection of a lighting control system include: the expected occupancy pattern the availability of daylight the desired level of control sophistication the capital cost of the system versus potential savings need to accommodate changes in the building or use patterns.
25	Q	Identify if a strict cold-food policy should be adopted in the summer/low-occupancy periods; this will reduce the requirement for the kitchen to be using all ovens and grills. It is advised that the procedure for kitchen equipment being switched off be revised. Kitchen equipment such as grills and gantry lights should be switched off during low periods of occupancy. Doors to cooled cellar spaces could be checked for gaps and either infilled or replaced to reduce the cellar cooling load and/or restaurant heating load. The cellar lights were left on continuously whilst on inspection. It is advised that the RM proceeds with checks around the kitchen and restaurant to switch off equipment and lighting that is not required at low occupancy times (i.e. after breakfast).
26	Q	Fix faulty water fountain
27	Q	Ensure that staff and cleaners practice a 'switch-it-off' policy and re-evaluate lighting policy Can lights be switched off in areas at low occupancy periods of the day? People are good at judging whether they need the lights on. Do not switch lights on or increase brightness automatically unless this is essential for safety, or appropriate for managed areas. People are not good at switching lights off. Try to provide automatic switch-off, but... People do not like being plunged into darkness. Where possible lights should be dimmed down, or a warning given. There should be readily accessible local override switches. People dislike automatic systems which distract them or do not do what they want. Automatic switching or stepped dimming is best done at fixed times rather than at seemingly random intervals. Occupancy detectors should be positioned to avoid nuisance triggering. Local controls should be accessible and their operation intuitive. Switches should be close to the point of decision and their operation clear. Individual requirements differ. Given the choice, users select a wide range of illuminance levels. Lower levels are often chosen for work with computer screens; people with less acute eyesight or more exacting work may need additional task lighting.
28	Q	Make sure that the member of staff(s) from the maintenance team is(are) recording the cyclical checks/upgrades to plant and services they are making. Determine who should be responsible for energy management in each department, how energy consumption is reviewed, recorded and analysed, monitoring and target setting, investment, planning and maintenance.

Item	Ranking	Recommendation
29	Q	Introduce M&T procedures with regular summary reporting to senior management; especially when there is the chance for doing so post-refurbishment. Add sub-metering to the key equipment: Space Heating Boilers Direct Fired Water Heaters Chillers AHU In the meanwhile, use night surveys (or low occupancy surveys) to establish whether consumption is sensible and related to occupancy (base load); use time switches to switch-off equipment when not required (in general).
30	Q	Switch off non-essential office equipment when not in use
31	Q	To further establish base loads and to size equipment correctly to avoid oversizing future pipework and HVAC systems, carry out further metering days at different occupational periods, including; - High and low occupation summer (weekday) - High and low occupation winter (weekday) - High and low occupation summer (weekend) - High and low occupation winter (weekend)
32	Q	As part of the WC cleaning checks the lighting should be switched off if the space is deemed unoccupied. Alternatively, provision of PIR sensors to automatically control the WC lights should be considered.
33	S	Provide a full design of the kitchen extract and ventilation rates.
34	S	Strategic change: upgrade the boiler systems to allow for resilience. Furthermore, make sure that the no2 gas boiler is also being used so that no.2 is not always in slave mode. It is likely that boiler no1 is operating at a lower efficiency than boiler no2 due to corrosion and heat loss. Enforce a regime for switching over the boilers from primary to secondary to allow both to have similar running hours. For any future works being carried out to the heating system re-assesss the building load. If boiler no2 is never switching on it means the system is oversized.
35	S	An investigation into the distribution would be recommended as we would proposed to switch the strategy to a displacement ventilation system that would significantly improve effectiveness and efficiency.
36	S	Tapping into the existing LTHW network should be considered when the bar area is relocated and the café area refurbished. Gradually decommission and take away any electric heating panels throughout the building and replace with more efficient systems.
37	S	It would be recommended to upgrade this to a variable volume system with variable frequency drives and changing the 3 port valves to 2 port valves. This would require a full recommissioning of the system.
38	S	Install an MVHR system exclusively for the restaurant. Specialist input required: Consider localised ventilation for this area by installing an MVHR system exclusively for the restaurant with controls/sensors allowing for vent during occupied periods only. The recovered heat may then be distributed elsewhere.
39	S	Consider changing heating system to ASHPs when refurbishing the building and relocating the bar area; these can then also be placed in cooling mode for significantly high summer temps to avoid electric fan uses and complaints from occupants. Specialist input required: Air source heat pumps (ASHP) might be viable in the future as alternative systems to LTHW
40	S	Consider a complete replacement of boilers

ASSESSMENT OF OPPORTUNITIES

If all quantified quick-win and detailed recommendations are followed, then there is the opportunity to save approximately **£2,700 per year** equalling an energy reduction of **36.8MWh per year** (based on an initial investment of approximately £11,500) – this relates to a payback period of approximately 4 years.

If the quantified strategic recommendations are followed, then there is the opportunity to save approximately **£1,000 per year** equalling an energy reduction of **8.7MWh per year** (based on an initial investment of approximately £2,200) – this relates to a payback period of approximately 2 years[9].

When including the RE:FIT lighting upgrade programme a total £25,000 investment could increase the annual quick-win and detailed consideration savings to £4,400 per year, but increase the payback period to approximately 5 years.

When including the RE:FIT gas-boiler replacement programme a total £76,300 investment could increase the annual high- level strategic consideration savings to £4,200 per year, but increase the payback period to 18.2 years.

For the low cost/low risk 'quick win' measures and some detailed recommendations simple methods of appraisal are generally acceptable for predicting energy savings. However, appraisals of strategic and most detailed investments should usually take account of interest rates, inflation, project life and risk.

The crudest way of assessing the cost-effectiveness of recommendations is by calculating a simple payback period based on time taken of the initial capital expenditure against the savings in energy cost. In general, this method should be used for 'quick wins' and some detailed recommendations that generally provide a return within five years. Some detailed recommendations could fall within the five-year return category. More detailed and strategic implementation plans should only use such a simple method for assessing payback to be a steer for choosing between alternative recommendation solutions.

In general, large scale energy saving projects need significant supervision to an extent that an independent project manager may be required. One effective method is the rolling programme in which savings from the first energy saving measures are reinvested to produce further savings; generally called 'revolving funds'. Part of the initial investment can sometimes be raised by capitalising fuel cost savings from good maintenance and industry best practice measures that need little to no capital expenditure. The 'revolving fund' approach has limitations in that once the measures with short payback periods are achieved, measures with longer payback periods often do not meet internal approval requirements. In the case of the Cecil Sharp House, there are potential savings to be made with a large amount of the existing distribution systems nearing the end of their lifespan.

As an alternative, an aggregated approach can be taken when applying a few retrofit measures with varying payback periods, that otherwise would not be considered economically viable on their own, can be implemented as their payback periods are offset by measures with shorter returns.

ASSUMPTIONS

For this study, simple payback was considered given the speculative nature of the initial capital costs. An energy cost rate of £0.12/kWh & £0.03/kWh and carbon factor of 0.519 & 0.216 was used for electricity and natural gas use respectively.

[9] Energy savings from strategic changes should be considered independently from quick-wins and detailed recommendations

ANALYSIS

Table 3: Operational savings from implementing recommendations

Ref	Recommendation	Operational Savings			Capital Cost	Payback	Complexity
		Energy	Emissions	Cost savings			
		MWh/year	tCO2/year	£/year			
A	Omit use of electric fans across building	1.5	0.8	£200	-	Less than a year	LOW
B	Improve lagging	10	2.1	£300	£4,300	14 years	LOW
C	Supply and Install Extraction & Fresh Air Supply into Condensing Room	5.5	2.8	£600	£1,100	2 years	LOW
D	Relocate refrigeration Plant to New Cellar Room	8.7	4.4	£1,000	£2,200	2 years	MED
E	Take out humidifiers (bring in fresh air)	3.0	1.5	£350	-	Less than a year	LOW
F	Provide PV panels to building/car park (assuming array size: 10m^2)	1.5	0.8	£250	£3,000	12 years	MED
G	Provide extract fan to bottle fridge room next to cold room	1.2	0.6	£150	£650	4.5 years	MED
H	RE:FIT Programme Lighting Upgrades	15	7.7	£1,700	£13,400	8 years	MED
I	RE:FIT Boiler Replacement	51	11	£3,150	£74,150	23.5 years	HIGH
J	AHU to have motorised dampers on the exhaust ductwork and the recirculation ductwork connected via controls to a CO2 sensor mounted a minimum of two locations (at working plane) within the auditorium to give an average reading.	14	4.5	£590	Further investigation required	>15 years	HIGH