St Andrews

ENERGY AND OVERHEATING SUMMARY

May 2021

ELEMENTA

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1 Executive Summary

Elementa Consulting have been commissioned by Anglo American PLC to produce an energy and overheating summary for the St Andrew's House refurbishment works in London (the proposed building).

The purpose of this summary is to demonstrate that the proposed renovation works show a meaningful reduction in energy savings and CO_2 reductions as part of the path to 'zero carbon' and that would qualify for the Camden Local Plan policies.

1.1 Energy Analysis

Energy modelling has been carried out following the GLA's and Camden Policies energy hierarchy. The energy hierarchy promotes a fabric first approach with energy efficient systems, decentralised energy and finally the use of renewable systems.

The energy analysis has shown that St Andrews House can achieve the following CO_2 savings by following these steps and with the use of SAP10 carbon factors;

1. Fabric improvements to glazing and roof will offer a 9% CO_2 reduction
2. The installation of ASHP (accounted as renewable technology) will offer a 53% CO_2 reduction

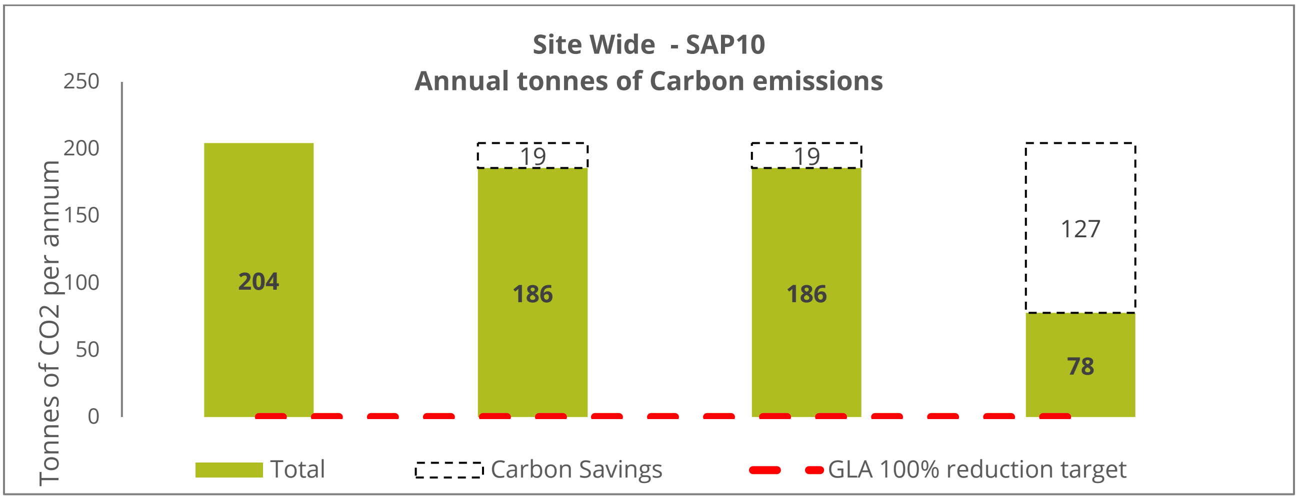
These improvements will offer a total of 62% CO_2 reduction from the existing building as it is currently in use without any renovations taking place. The following table and figures show the step-by-step savings and % of reductions.

Table 1.1, Regulated CO_2 savings for proposed renovation works

Regulated carbon dioxide savings	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	19	9%
Savings from renewable technology	108	53%
Total Cumulative Savings	127	62%

The proposed upgrades to the building show a CO_2 savings that would comply with Policy CC1 of the Camden Plan (2017), despite the addition of comfort cooling.

Figure 1.1, Regulated CO_2 savings for proposed renovation works following the Energy Hierarchy



1.2 Overheating Analysis

St Andrews House has followed the cooling hierarchy as set out in the London Plan (Policy SI4) and required by Camden Policy CC2. The hierarchy lists the following steps:

a. Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation, and the provision of green infrastructure.
b. Minimise internal heat generation through energy efficient design
c. Manage the heat within the building through exposed internal thermal mass and high ceilings
d. Provide passive ventilation
e. Provide mechanical ventilation
f. Provide active cooling systems

A CIBSE Technical Memorandum (TM) 59 overheating methodology was carried out following steps a. to e. as set above, and the results demonstrate that although all rooms satisfy Criterion A, all bedrooms fail Criterion B.

Due to the location of the building, set in a high density urban environment with minimum air movement to contribute to the benefits of natural ventilation, while the heat island effect radiating heat throughout the night-time hours, the building fails to meet Criterion B of the CIBSE TM59 methodology. Therefore, active cooling is recommended for the comfort of the residents of the aparthotel.

2 Introduction

Elementa Consulting have been commissioned by Anglo American PLC to produce an energy and overheating summary for the St Andrew's House refurbishment works in London (the proposed building).

The purpose of this summary is to demonstrate that the proposed renovation works although not required to meet the Camden Local Plan policies, show a meaningful reduction in energy savings and CO_2 reductions as part of the path to 'zero carbon' and that would qualify for the Camden policies.

2.1 Site description

During the Victorian age, the area around St. Andrews House were developed as part of a major Victoria Infrastructure project. Charterhouse Street was built 1869–75, at the expense of the City of London, as a route to the new Smithfield Market, with steps down to Saffron Hill, where St. Andrews House is located.

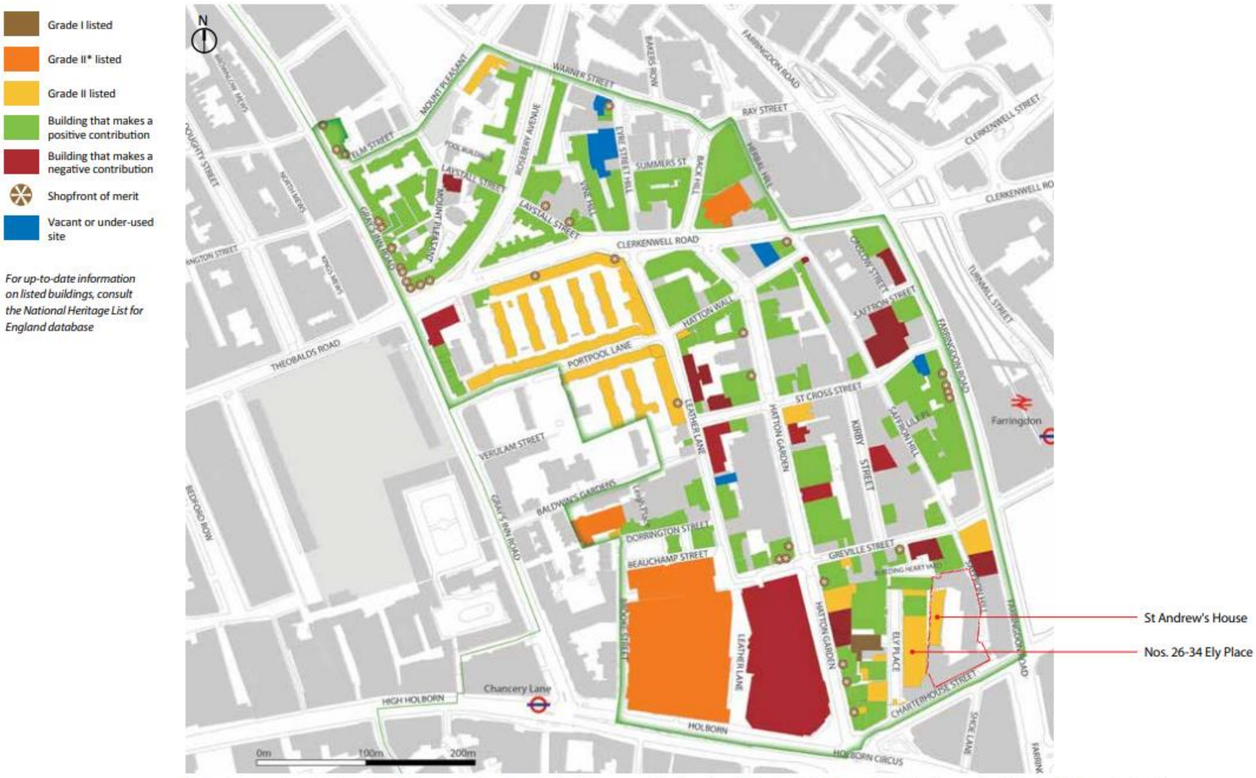
Figure 2.1, 1895 survey showing the site where St Andrews was built

1895 Ordnance Survey

St Andrew's House was built in 1875 by the City of London as 'industrial dwellings', i.e. low-rent housing for artisans. The City of London thus became the first local authority to build social housing.

St Andrew's House is a Grade II-listed building, and is within the Hatton Garden Conservation Area in the London Borough of Camden.

Figure 2.2, Image showing the buildings in the Hatton Garden's Conservation area that are Grade II listed in a yellow colour.



Designations map from The Hatton Garden Conservation Area Appraisal and Management Strategy Consultation Draft, 2016. The red line (added) approximately indicates the application site

2.2 The proposed renovation works

As part of the preservation of this Grade II listed building, renovation works have been required to satisfy energy savings but also occupant's comfort.

One of the requirements of the project brief is to provide the client with a sustainable building with a aspiration to 'zero carbon'. The proposed renovation works include;

1. Fabric upgrades to reduce the heat losses, such as additional roof insulation and secondary glazing added to the existing listed windows to improve the seals and air leakage rates.
2. Mechanical ventilation with heat recovery (MVHR) units will be included to each apartment.
3. The traditional gas fired equipment will be removed and replaced with an all-electric suite of air-source equipment which would provide all the buildings heating and cooling requirements.
4. A CO_2 ASHP will provide all domestic hot ware (DHW) requirements.

Figure 2.3 View of St Andrews House as presented in Aukett Swanke's report.

3 Policies and Requirements

The proposed building is Grade II listed. While the scope of the works does not require a full energy strategy and sustainability statement to be provided for planning submission; it is important for the project to demonstrate the benefits of the renovations, when compared against the Camden Local Plan (2017) policies.

3.1 Camden Local Plan

3.1.1 Policy CC1 Climate change mitigation

Policy CC1 states that the Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation. The policy targets:

a. to promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;

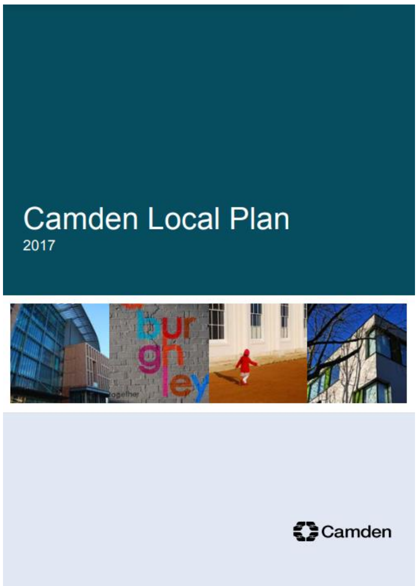
b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;

c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;

d. support and encourage sensitive energy efficiency improvements to existing buildings;

e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and

f. expect all developments to optimise resource efficiency.



For decentralised energy networks, the Policy promotes decentralised energy by:

g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;

h. protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and

i. requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.

3.1.2 Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change. All development should adopt appropriate climate change adaptation measures such as:

a. the protection of existing green spaces and promoting new appropriate green infrastructure;

b. not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;

c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and

d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

The Council will promote and measure sustainable design and construction by:

e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;

f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;

g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and

h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019

3.2 National Policy Drivers

3.2.1 UK climate Change Act

The Climate Change Act (2008) sets a legally binding target to reduce UK carbon emissions by 80% by 2050, against a 1990 baseline. The Committee on Climate Change advises the Government on the setting of binding 5-year carbon budgets on a pathway to achieving the 2050 target. The first four carbon budgets covering the period up to 2027 have been set in law. The current budget requires a 29% emissions reduction by 2017, while future budgets require reductions of 35% by 2020 and 50% by 2025.

The Act is the driver behind a framework of national strategy and policy documents such as the UK Low Carbon Transition Plan (2009) and previously anticipated zero carbon homes policy. These in turn have informed the development of local planning policy and updates to the Building Regulations.

3.2.2 National Planning Policy Framework

The National Planning Framework (NPPF) was published in February 2019, the relevant policies are set out below:

- 153. In determining planning applications, local planning authorities should expect new development to: a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.
- 154. When determining planning applications for renewable and low carbon development, local planning authorities should: a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and b) approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for

commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.

3.3 Building Regulations and SAP10

Part L of the Building Regulations in England sets standards for the energy performance of new and existing buildings; the current version is Part L 2013 with 2016 amendments.

At the end of November 2016 BEIS published a consultation on proposed changes to SAP 2012. On 24th July 2018 BRE published SAP 10 which provides an indication of the expected future carbon emission factors that will inform and potentially be adopted in any future update to Building Regulations. One of the key changes was the adjustment of the carbon factors of electricity and (to a lesser extent) natural gas, as shown in the table below:

Table 3.1, SAP2012 and SAP10 Carbon Factors

	SAP 2012/Part L 2013	**SAP 10**
Grid Electricity (kgCO_2/kWh)	0.519	**0.233**
Natural Gas (kgCO_2/kWh)	0.216	**0.210**

The results shown in the next section of this report present the CO_2 emissions based on SAP 10 carbon factors.

4 Energy Analysis

Although the proposed renovation is not required to meet the Camden Local Plan policies, the work that has been completed to demonstrate the energy and CO_2 reductions as an outcome of the proposed renovation works, has been provided in this section.

4.1 Methodology

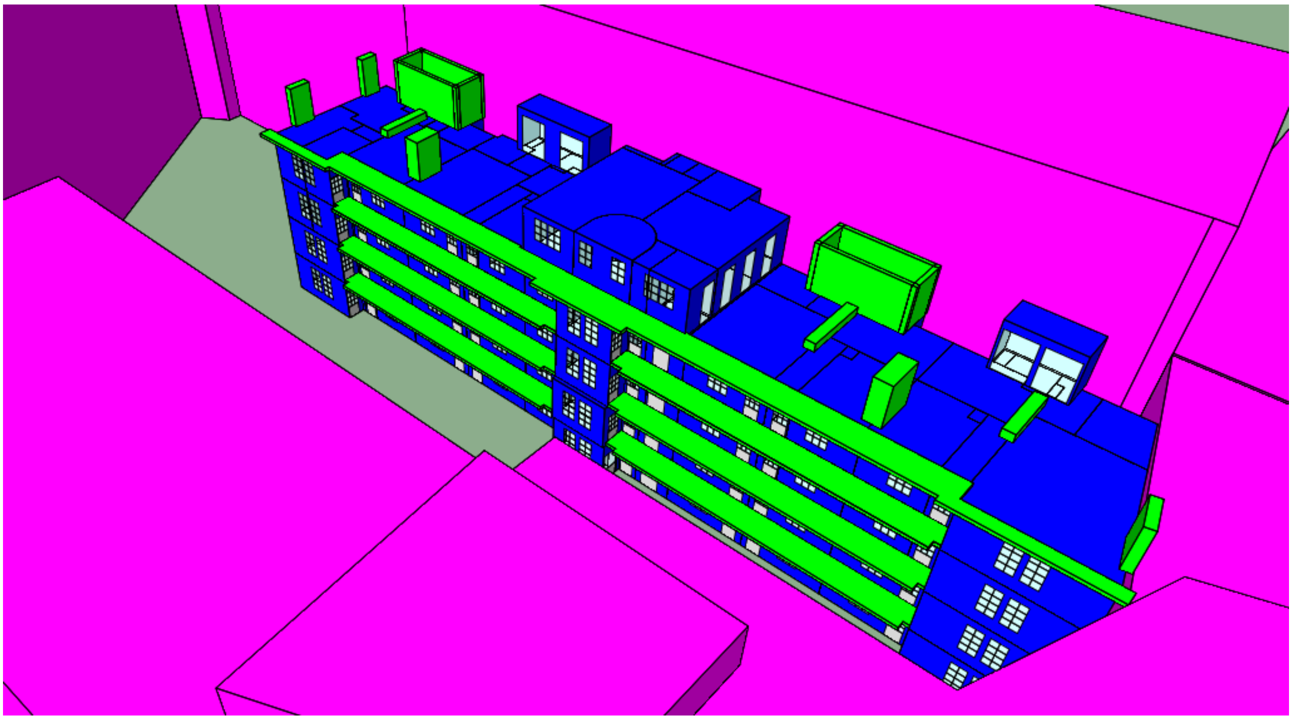
The existing building was modelled to establish the baseline regulated emissions. This was determined by the calculation of the Building Emission Rate (BER), using approved software in its existing form with the existing building envelope and systems. These results are compared against a revised model incorporating any fabric and system upgrades.

The VE compliance module of IES Virtual Environment version 2019 was used to model the existing building and establish the regulated Buildings Energy Rate (BER), which is used as the baseline.

Unregulated emissions from electricity use were estimated from the BRUKL output sheet, using the equipment load prediction.

The carbon emission reporting spreadsheet, introduced by the GLA in January 2019, was used to calculate the building carbon emissions using SAP 10 carbon factors.

Figure 4.1, Image of 3D model used for the energy assessment



4.2 Inputs and Assumptions

The building fabric assumed for the existing buildings is based on information provided by the design team and client. The following table list the existing and proposed fabric.

Table 4.1, Building fabric inputs for existing and proposed renovated building.

	Elements	Existing values for Listed building (Baseline)	Proposed values for Listed building
Opaque Elements	Wall U-Value (W/m^2.K)	1.64	1.64
	Ground/ Exposed Floor U-Value (W/m^2.K)	1.98	1.98
	Flat Roof U-Value (W/m^2.K)	0.24	0.18
	Pitched roof insulated at ceiling U-values (W/m^2.K)	2.44	0.18
	External Door U-Value (W/m^2.K)	2.2	2.20
Glazing Elements	frame factor	10%	10%
	Window / Glazed Door U-Value U-Value (W/m^2.K)	5.59 (single glazing)	2.97 (with secondary single glazing)
	Glazing G-Value	0.82	0.70
Air-Leakage	Air-Permeability (m^3/hr.m^2)	25	20

The following table lists the systems used for the existing and for the proposed renovated building.

Table 4.2, Building systems for existing and proposed renovated building.

	Elements	Existing systems for Listed building (Baseline)	Proposed systems for Listed building
Ventilation	Ventilation	Natural Ventilation with extracts in toilets	Mechanical Ventilation with Heat Recovery (MVHR) units
	Specific Fan Power (SFP)	0.6 W/l/s	1.8 W/l/s
	Terminal FCU SFP	n/a	0.3
	Heat Recovery	n/a	78%
Heating	Heating System	Gas Boiler	Electric HVRF
	Heating efficiency (as per lean case of ES)	82%	343%
	Distribution Efficiency for Heting system	90%	90%
Cooling	Cooling System	n/a	Electric HVRV with MVHR
	Cooling Efficiency (EER)	n/a	287%
	Distribution Efficiency for Cooling system	n/a	90%
DHW	DHW type	Gas Boiler	CO_2 ASHP

	DHW Efficiency	80%	344% @7°C, 388% @16°C
	Distribution Efficiency for DHW system	90%	90%
Lighting	Lighting efficacy	60 lm/cw	60 lm/cw
	Daylight areas - Dimming	None	None
	Daylight areas - Sensor controls	No back-sensor	No back-sensor
	Occupancy sensing	Manual Switching	Manual Switching

4.3 Energy consumption and Carbon Results

The regulated carbon emissions for the baseline of the proposed renovated building was calculated to be 204 tCO_2/year using SAP 10 carbon factors, as shown in the table below.

Unregulated emissions from small power and equipment are calculated to be 299 tCO_2/year.

Table 4.3, Baseline Carbon emissions using SAP10 carbon factors.

Carbon dioxide emissions (tonnes CO_2 per annum)	Regulated	Unregulated
Baseline – Existing Building	204	299
Be Lean – proposed fabric & improved gas boiler	186	299
Be Green – HVRF for space heating & DHW	78	299

This represents a saving of 127 tCO_2/year or 62% of baseline regulated emissions achieved by improving on Building Regulations emissions rate targets through fabric and low zero carbon technology, as shown in the table below.

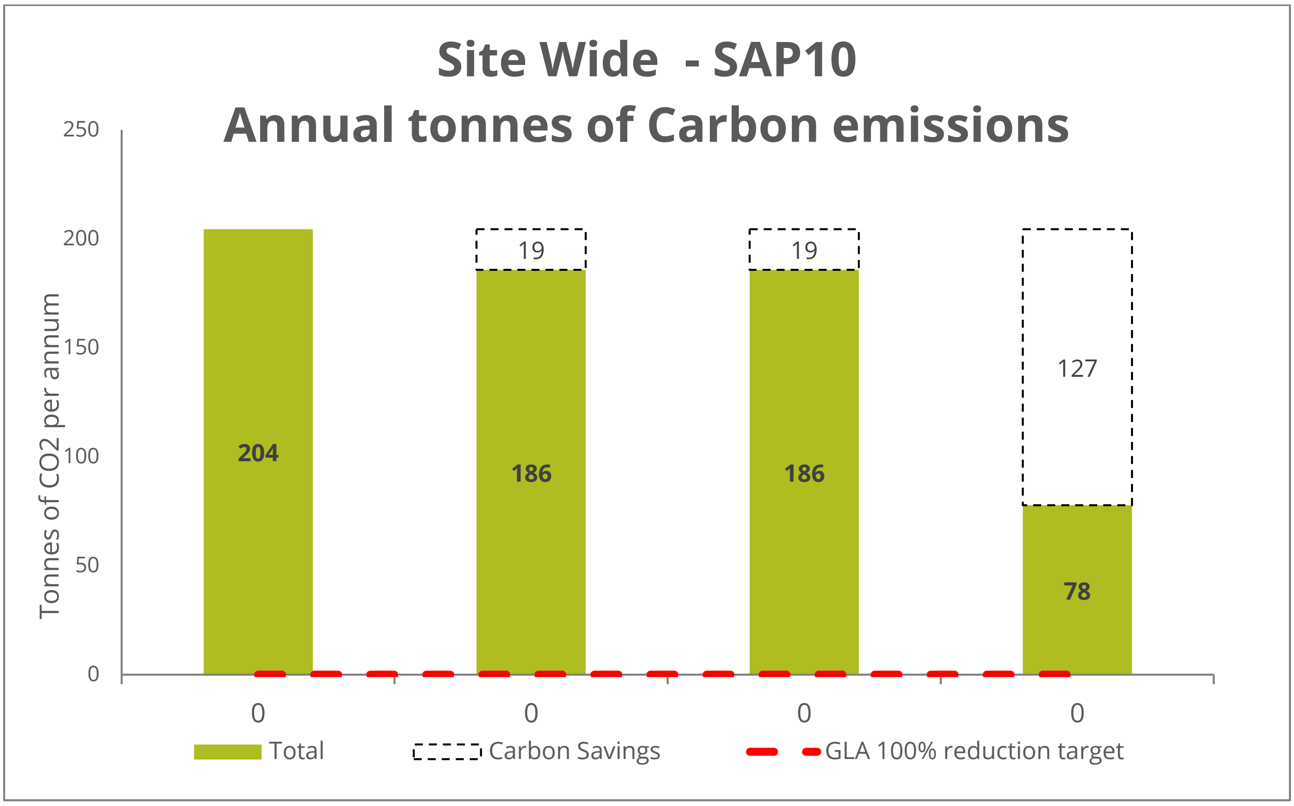
Table 4.4, Regulated CO_2 savings for proposed renovation works

Regulated carbon dioxide savings	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	19	9%
Savings from renewable technology	108	53%
Total Cumulative Savings	127	62%

The proposed upgrades to the building show a CO_2 savings that would comply with Policy CC1 of the Camden Plan (2017), despite the addition of comfort cooling.

The calculated carbon emissions and regulated savings at each stage of the energy hierarchy for the proposed renovations are also shown in the figure below.

Figure 4.2, Regulated CO_2 savings for proposed renovation works following the Energy Hierarchy



5 Overheating Analysis

This section highlights if there is any overheating risk identified in St. Andrews House.

5.1 The cooling Hierarchy

The cooling hierarchy sets out a six-level hierarchy of cooling, which is designed to maximise passive measures and to minimise the need for active cooling. Two typical floors of the proposed building will be assessed having no comfort cooling and therefore relying on mechanical ventilation via a MVHR unit and natural ventilation via the opening of windows, when needed. The overheating assessment will show the risk of overheating and if the proposed renovated building will require any active cooling, in order to mitigate the risk.

The London Plan (Policy SI4) lists the cooling hierarchy as set out below:

a. Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation, and the provision of green infrastructure.
b. Minimise internal heat generation through energy efficient design
c. Manage the heat within the building through exposed internal thermal mass and high ceilings
d. Provide passive ventilation
e. Provide mechanical ventilation
f. Provide active cooling systems

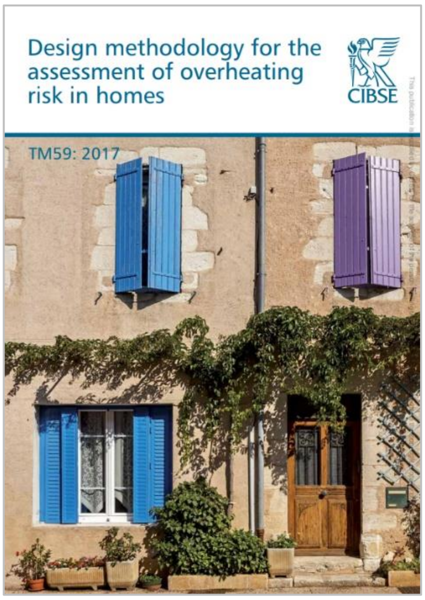
5.2 TM59 Overheating methodology

Consistent overheating in buildings affects the health and well-being of occupants and their productivity. Assessing overheating and thermal comfort is required to ensure free-running (naturally ventilated) buildings do not overheat and the need for comfort cooling is avoided.

The thermal comfort criteria for assessments within apartments that are predominantly naturally ventilated are defined in CIBSE TM59. Compliance is based on passing both of the following two criteria:

a) For living rooms, kitchens and bedrooms: the number of hours during which ΔT is greater than or equal to one degree (°K) during the period May to September inclusion shall not be more than 3 per cent of occupied hours. (The above design criterion is extracted from CIBSE TM52 Criterion 1: Hours of exceedance).

b) For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10pm to 7am shall not exceed 26°C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26°C will be recorded as a fail).



The Dynamic Thermal Modelling (DTM) software, Integrated Environmental Solutions' (IES) Virtual Environment software suite 2019, Version 2019.3.0.0, was used to create the 3-D model. Hourly simulations for a year were run as part of the thermal analysis using the London weather file

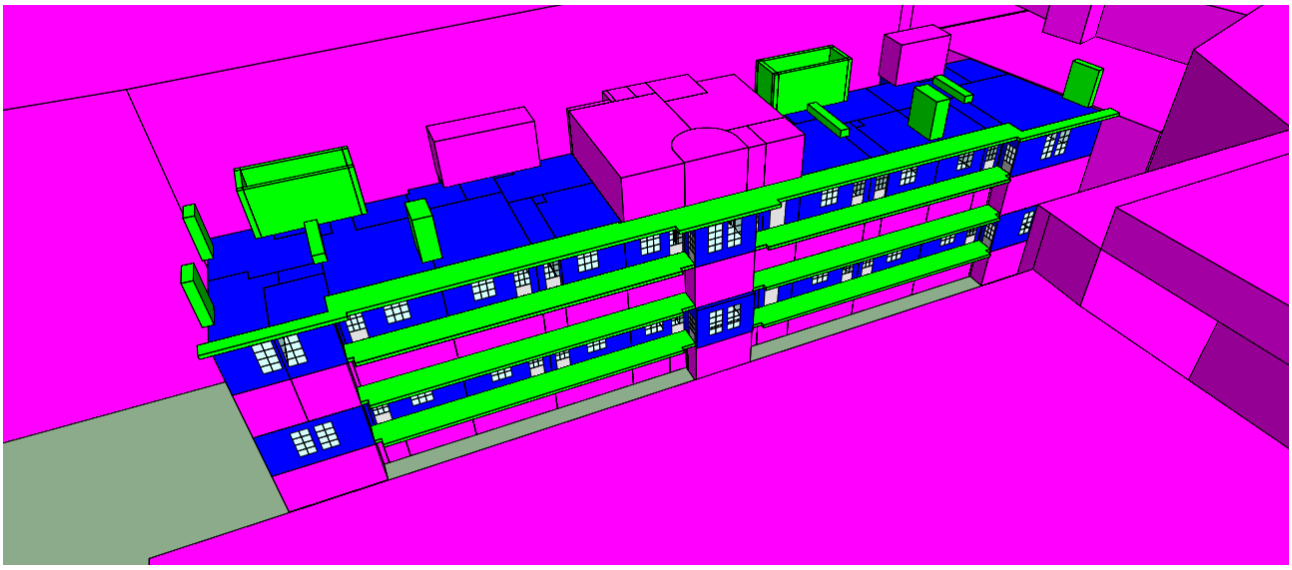
'LWC_DSY1_2020-50%' for the central London location of the proposed building, to produce the hourly results for assessment.

5.3 Inputs and assumptions

5.3.1 Tested units.

The entire 1st floor and 3rd floors were tested against the TM59 Overheating criteria. An image of the tested floors (in blue) can be visualised in the image below.

Figure 5.1, 3D image of model used in the TM59 overheating assessment



5.3.2 Construction u-values

The building fabric used in the assessment are in align with the values used for the proposed building as listed in the table below.

Table 5.1, Building fabric inputs for St. Andrews House.

	Elements	Existing fabric with roof and window upgrades
Opaque Elements	Wall U-Value (W/m².K)	1.64
	Ground/ Exposed Floor U-Value (W/m².K)	1.98
	Flat Roof U-Value (W/m².K)	0.18
	Pitched roof insulated at ceiling U-values (W/m².K)	0.18
	External Door U-Value (W/m².K)	2.20
Glazing Elements	frame factor	10%
	Window / Glazed Door U-Value U-Value (W/m².K)	2.97 (with secondary single glazing)
	Glazing G-Value	0.70
Other	Infiltration (ach)	0.100

5.3.3 Ventilation and window openings

Mechanical ventilation is proposed to serve all apartments. The following table list the minimum rates incorporated in the various options testes.

Table 5.2, Mechanical ventilation rates for proposed renovation works.

Mechanical ventilation rate in l/s	Base Case - Proposed Fabric no mechanical ventilation	Option 1 – including mechanical ventilation
1 bed ap.– living	0	8
1 bed ap. – bedroom	0	5
2 bed ap. – living	0	11
2 bed ap. – each bedroom	0	5
3 bed ap. – living	0	15
3 bed ap. – each bedroom	0	5

All windows given that are existing single glazed sash windows are considered to have a 50% available opening for ventilation when apartments are occupied. Occupancy is in line with the CIBSE TM59 methodology and is included in the next paragraph.

5.3.4 Occupancy & equipment

All occupancy, equipment and the profiles used in the TM59 analysis follow the CIBSE TM59 methodology and are listed in the table below.

Table 5.3, Internal gain for TM59 analysis.

Room types	Occupancy	Equipment
1 bed ap.– living rm/kitchen	1 person from 9am to 10pm	Peak load of 450W from 6pm to 8pm 200W from 8pm to 10pm 110 W from 9am to 6pm and from 10pm to 12pm Base load of 85W for the rest of the day
2 bed ap.– living rm/kitchen	2 people from 9am to 10pm	
3 bed ap.– living rm/kitchen	3 people from 9am to 10pm	
Double bedroom	2 people at 70% gains from 11 pm to 8 am 2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm 1 person at full gains in the bedroom from 9 am to 10 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during the sleeping hours
Single bedroom	1 person at 70% gains from 11 pm to 8 am 1 person at full gains from 8am to 11 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during the sleeping hours

5.4 TM59 Overheating results

Two scenarios have been tested for the TM59 overheating analysis;

1. Base case: Proposed building fabric with natural ventilation
2. Option 1: Proposed building fabric with natural ventilation and mechanical ventilation (MVHR)

The results for the two options are shown in the tables below. The results are colour coded with **green** representing a pass result and **red** a failed result.

5.4.1 Base Case Results

The results of the base case are listed in the table below.

Table 5.4, TM59 Base Case results

Room name	Criterion A (%Hrs Top.Tmax>=1K)	Criterion B (no of hours %Hrs >26°C)	TM59 Pass/Fail
L01_APART8_dining and lounge + kitchen	0.8	-	**Pass**
L01_APART8_bedroom	0.4	80	**Fail**
L01_APART9_dining and lounge + kitchen	0.5	-	**Pass**
L01_APART9_bedroom	0.3	54	**Fail**
L01_APART10_bedroom	0.2	53	**Fail**
L01_APART10_dining and lounge + kitchen	0.4	-	**Pass**
L01_APART11_bedroom	0.2	53	**Fail**
L01_APART11_dining and lounge + kitchen	0.4	-	**Pass**
L01_APART15_dining and lounge + kitchen	0.4	-	**Pass**
L01_APART16_dining and lounge + kitchen	0.4	-	**Pass**
L01_APART16_bedroom	0.2	51	**Fail**
L01_APART17_bedroom	0.3	62	**Fail**
L01_APART17_dining and lounge + kitchen	0.5	-	**Pass**
L01_APART13_lounge	0	-	**Pass**
L01_APART12_dining and lounge + kitchen	0.5	-	**Pass**
L01_APART12_bedroom	0.2	55	**Fail**
L01_APART15_bedroom	0.2	53	**Fail**
L01_APART14_bedroom	0.1	51	**Fail**
L01_APART14_dining and lounge + kitchen	0.4	-	**Pass**

L03_APART23_single bedroom 2	0.6	46	**Fail**
L03_APART23_single bedroom 1	0.5	90	**Fail**
L03_APART23_master bedroom	0.2	62	**Fail**
L03_APART23_kitchen	0.6	-	**Pass**
L03_APART23_dining and lounge	0.3	-	**Pass**
L03_APART24_kitchen	0.6	-	**Pass**
L03_APART24_dining and lounge	0.2	-	**Pass**
L03_APART24_master bedroom	0.1	62	**Fail**
L03_APART24_double bedroom	0.3	54	**Fail**
L03_APART25_master bedroom	0.2	62	**Fail**
L03_APART25_double bedroom	0.4	104	**Fail**
L03_APART25_kitchen	0.2	-	**Pass**
L03_APART25_dining and lounge	0.1	-	**Pass**
L03_APART26_kitchen	0.4	-	**Pass**
L03_APART26_dining and lounge	0.1	-	**Pass**
L03_APART26_master bedroom	0.1	53	**Fail**
L03_APART26_double bedroom	0.2	82	**Fail**
L03_APART27_double bedroom	0.3	87	**Fail**
L03_APART27_dining and lounge	0.3	-	**Pass**
L03_APART27_kitchen	0.6	-	**Pass**
L03_APART27_master bedroom	0.1	54	**Fail**

5.4.2 Option 1 Results

The results of Option 1 case are listed in the table below.

Table 5.5, TM59 Option 1 results

Room name	Criterion A (%Hrs Top.Tmax>=1K)	Criterion B (no of hours %Hrs >26°C)	TM59 Pass/Fail
L01_APART8_dining and lounge + kitchen	0.4	-	Pass
L01_APART8_bedroom	0.1	71	Fail
L01_APART9_dining and lounge + kitchen	0.2	-	Pass
L01_APART9_bedroom	0	51	Fail
L01_APART10_bedroom	0	49	Fail
L01_APART10_dining and lounge + kitchen	0.1	-	Pass
L01_APART11_bedroom	0	48	Fail
L01_APART11_dining and lounge + kitchen	0.1	-	Pass
L01_APART15_dining and lounge + kitchen	0.1	-	Pass
L01_APART16_dining and lounge + kitchen	0.1	-	Pass
L01_APART16_bedroom	0	47	Fail
L01_APART17_bedroom	0	58	Fail
L01_APART17_dining and lounge + kitchen	0.3	-	Pass
L01_APART13_lounge	0	-	Pass
L01_APART12_dining and lounge + kitchen	0.2	-	Pass
L01_APART12_bedroom	0	51	Fail
L01_APART15_bedroom	0	48	Fail
L01_APART14_bedroom	0	46	Fail
L01_APART14_dining and lounge + kitchen	0	-	Pass
L03_APART23_single bedroom 2	0.3	45	Fail
L03_APART23_single bedroom 1	0.2	80	Fail
L03_APART23_master bedroom	0	55	Fail
L03_APART23_kitchen	0.3	-	Pass
L03_APART23_dining and lounge	0	-	Pass
L03_APART24_kitchen	0.2	-	Pass

L03_APART24_dining and lounge	0	-	**Pass**
L03_APART24_master bedroom	0	49	**Fail**
L03_APART24_double bedroom	0	75	**Fail**
L03_APART25_master bedroom	0	57	**Fail**
L03_APART25_double bedroom	0	88	**Fail**
L03_APART25_kitchen	0	-	**Pass**
L03_APART25_dining and lounge	0	-	**Pass**
L03_APART26_kitchen	0.2	-	**Pass**
L03_APART26_dining and lounge	0	-	**Pass**
L03_APART26_master bedroom	0	50	**Fail**
L03_APART26_double bedroom	0	75	**Fail**
L03_APART27_double bedroom	0	78	**Fail**
L03_APART27_dining and lounge	0	-	**Pass**
L03_APART27_kitchen	0.3	-	**Pass**
L03_APART27_master bedroom	0	50	**Fail**

Due to the location of the building, set in such a high density urban environment with minimum wind to contribute to the benefits of natural ventilation, while the heat island effect radiating heat throughout the night time hours, the building fails to meet Criterion B of the CIBSE TM59 methodology. Therefore, active cooling is recommended for the comfort of the residents of the aparthotel.

5.5 Cooling demand estimated for the proposed renovated building

Although the existing building does not have any active cooling, the cooling load of the proposal has been minimised to its lowest levels as the design has followed the cooling hierarchy where possible.

The table below list the additional energy load that would be used for cooling through the proposed electric HVRF system.

Table 5.6, Cooling demand

	Efficiency of cooling system	Building cooling demand (area weighted) (MJ/m²)	Building cooling demand (area weighted) (kWh/m²)
Existing	0	0	0
Proposed	2.87 (SEER)	4.26	1.18

6 Conclusion

6.1 Energy Analysis

Energy modelling has been carried out following the GLA's and Camden Policies energy hierarchy. The energy hierarchy promotes a fabric first approach with energy efficient systems, decentralised energy and finally the use of renewable systems.

The energy analysis has shown that St Andrews House can achieve the following CO_2 savings by following these steps and with the use of SAP10 carbon factors;

1. Fabric improvements to glazing and roof will offer a 9% CO_2 reduction
2. The installation of ASHP (accounted as renewable technology) will offer a 53% CO_2 reduction

These improvements will offer a total of 62% CO_2 reduction from the existing building as it is currently in use without any renovations taking place.

6.2 Overheating Analysis

St Andrews House has followed the cooling hierarchy as set out in the London Plan (Policy SI4) and required by Camden Policy CC2. The hierarchy lists the following steps:

a. Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation, and the provision of green infrastructure.
b. Minimise internal heat generation through energy efficient design
c. Manage the heat within the building through exposed internal thermal mass and high ceilings
d. Provide passive ventilation
e. Provide mechanical ventilation
f. Provide active cooling systems

A CIBSE Technical Memorandum (TM) 59 overheating methodology was carried out following steps a. to e. as set above, and the results demonstrate that although all rooms satisfy Criterion A, all bedrooms fail Criterion B.

Due to the location of the building, set in a high density urban environment with minimum air movement to contribute to the benefits of natural ventilation, while the heat island effect radiating heat throughout the night-time hours, the building fails to meet Criterion B of the CIBSE TM59 methodology. Therefore, active cooling is recommended for the comfort of the residents of the aparthotel.