University College London Hospitals Charity

Macdonald Buchanan House - Patients Facilities - Cotton Rooms 5th and 6th Floor

Energy Strategy Report

Issue 01 | November 2012

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Executive Summary

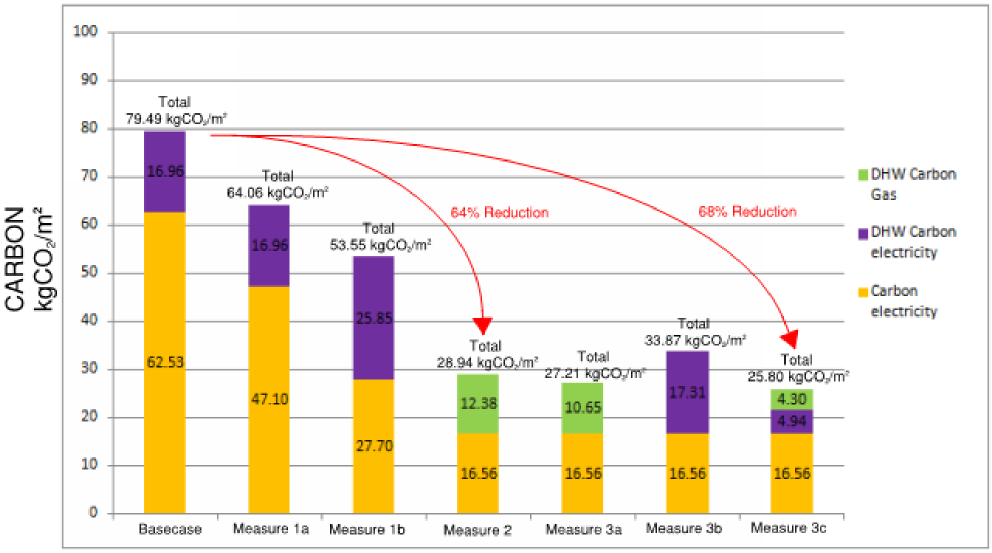
This statement has been prepared to support the planning application submitted on behalf of UCLH - University College London Hospital - for the change of use of the fifth and sixth floor of Buchanan House from residential apartments to hotel rooms. The building had originally been set to change from serviced apartments to residential apartments, but under the new ownership of UCLH the apartments have been converted to hotel rooms for hospital patients.

Residential apartments were located on the upper two floors of an existing building which includes office and retail premises on the lower floors. This report is a record of the total improvements undertaken to these two floors which were split in two phases:

- Building fabric improvements in 2011 and
- Engineering systems in 2012

The analysis records the carbon footprint improvements in the two hotel floors based on the architectural and engineering design, taking into account constraints of the existing building and in line with the previous energy strategy carried out for Kensington Commercial Property Investments Ltd.

The solutions which were taken forward into design and construction were to increase the insulation levels of the existing building, to replace the original direct electric heating system with a more efficient heat pump system and to provide cooling and ventilation (Measure 2 in the graph below).



Benchmarked against the original systems, this should produce an approximate 64% improvement on CO_2 emissions over the base case of changing the use of the apartments with no remedial measures carried out.

1 Introduction

This report outlines the energy strategy developed for the UCLH hotel accommodation in Buchanan House to address the energy and sustainability requirements of the London Borough of Camden.

It records the change of use of two floors of residential apartments to Hotel accommodation for patients of the UCLH at 170 Tottenham Court Road, London, and entrance off University Street. The old residential units contain 11 duplex apartments.

This report therefore, sets out on the energy measures affecting the hotel elements only.

The approach to the energy strategy is to follow the Mayor’s energy hierarchy:

2 Planning Background:

2.1 The Mayor’s Energy Hierarchy

In the Energy Strategy the Mayor has defined an ‘Energy Hierarchy’ (presented below) to help guide decisions about which energy measures are appropriate in particular circumstances. When each stage of the Hierarchy is applied in turn to an activity, it will help ensure that London’s energy need is met in the most efficient way:

- *Use less energy (Be lean)*
- *Use renewable energy (Be green)*
- *Supply energy efficiently (Be clean)*

It is therefore important for energy efficiency as well as renewable energy to be considered in each new development in London. This means that the buildings will use less energy and therefore need to use a smaller amount of renewable energy to supply the same proportion of the site’s needs.

2.2 London Borough of Camden Policy

The adopted Camden Replacement Unitary Development Plan (2006) includes Policy SD9 which advises that:

Policy SD9 – Resources and energy

A – Air Quality

Where the Council considers that development could potentially cause significant harm to air quality, applicants will be required to submit an air quality assessment. The Council will not grant planning permission for development that would significantly harm air quality, unless mitigation measures are adopted to reduce the impact to acceptable levels.

B – Water

In considering proposals for development, the Council will need to be satisfied that adequate provision can be made for water supply and waste treatment. The Council will only grant planning permission for development that is considers is sited and designed in a manner that does not cause harm to the water environment, water quality or drainage systems and prevents or mitigates flooding. The council will require developers to include measures to conserve water and where appropriate incorporate Sustainable Urban Drainage Systems.

C – Use of energy and resources

The Council will seek developments to demonstrate the energy demand of their proposals and how they would generate a proportion of the site's electricity and heating needs from renewable wherever feasible. The Council may use conditions or planning obligations to secure recycling of materials on site and/or use of recycled aggregates in major schemes.

2.3 Policy Assessment Overview

For Item A, the hotel users are provided with heating and cooling using air source heat pump, which will not impact the existing air quality. The local air quality has been improved as the existing boiler installation is being removed as part of the refurbishment works being carried out on the rest of the building. A smaller gas fired calorifier has been added to generate domestic hot water.

For Item B – Only the existing drainage system and connections to the sewer have been reused so that additional drainage was not required.

The design elements that address Item C are discussed in more detail in this report.

3 Base-case Energy Demand and CO_2 Emissions

In order to establish the base-case conditions of the existing building type, IES thermal modelling programme has been used to model the building and then apply residential patterns and conditions to the space. This is in order to keep the size of space consistent with all comparisons made later in the report. The floor area of four bedrooms and a corridor on the fifth and sixth floor was modelled. The simulation will provide the base-case CO_2 emissions for the old building, which can be used to quantify how the change of use will improve the building performance. The figure below shows the area that has been modelled in IES across the fifth and sixth floor of the building.

Figure 1 The proposed building plan

The following assumptions have been applied to the model for the base-case conditions.

Fabric

As the new scheme is included within an existing building, certain assumptions have been made with regards to the current performance of the building fabric.

	U- Value: (W/m²K)
Solid walls	1.7
Glazing	3.0
Roofs	1.42
Ground floors and basements	1.42
Glazing g-value	0.5

Figure 2 - Assumptions with regards to existing thermal performance

Systems

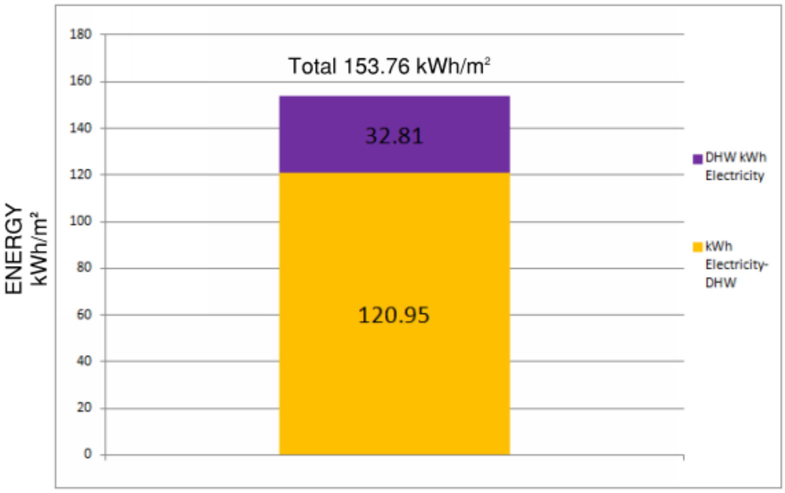
The old heating system was an electric warm-air heating system with no heat recovery.

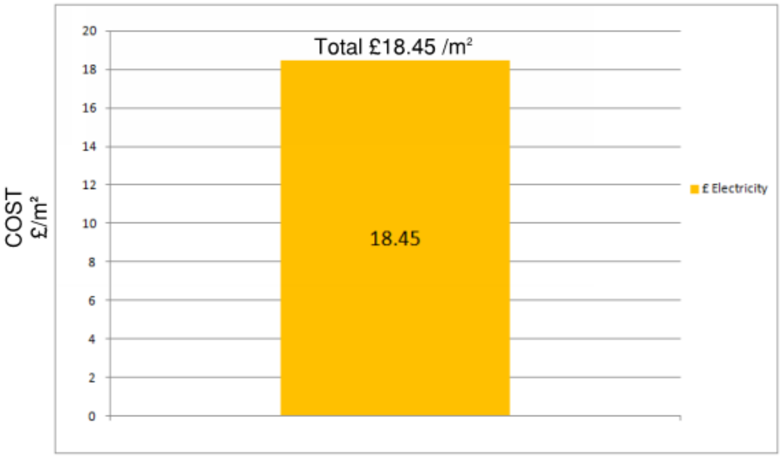
There was also no mechanical cooling available.

Domestic hot water was provided from an electric hot water cylinder.

3.1 Summary

The eight rooms across the two floors were modelled in IES and each room was defined as a residential studio apartment, the circulation space in between was also defined appropriately. The corresponding heat loads and profiles were applied to each space, which are covered in detail in appendix A of this report. The following results have been extracted from the thermal energy model for the base-case.





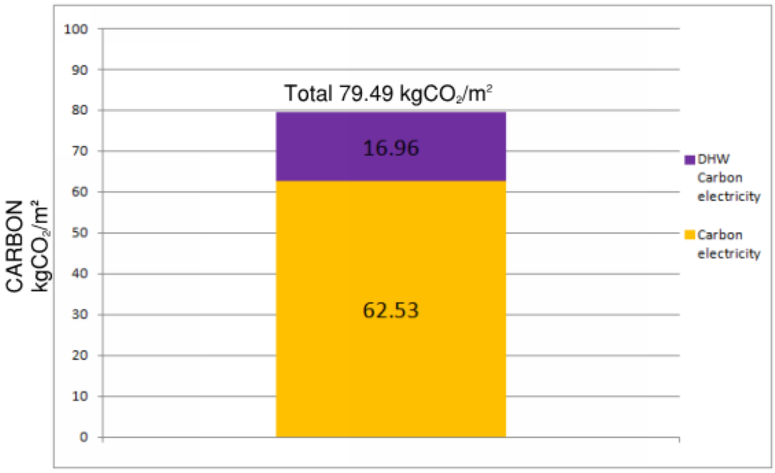


Figure 3 Base-case results

Extrapolating this unit rate figure to the area of the remaining apartments, the total annual estimated CO_2 emissions would be approximately 107tCO_2/yr for the existing building.

4 Sustainable Design & Construction (Reducing Carbon Emissions)

It is proposed to follow the Mayor's hierarchy for reducing carbon emissions. This involves:

- Reducing energy consumption though architectural passive design.
- Using low energy technologies and efficient building systems
- Assessing the feasibility of incorporating on-site renewables.

4.1 Passive Measures

As part of the change of use, a significant step to reducing energy demand was to improve the fabric of the existing building. With regards to this, the roof of the building was resurfaced to meet current Part L minimums as much as was practicable. Windows were also improved to meet Part L minimum thermal performance standards. It should be noted that the replacing of the existing single glazing with double glazing, was undertaken during the first part of the works in 2011.

Fabric Improvements

The improvements in U-values from the existing condition are as follows:

	U- Value Current: (W/m^2K)	**Refurbished U-values (W/m^2K)**
Solid walls	1.7	As before
Glazing	3.0	2.0
Roofs	1.42	0.25
Glazing g-value	0.5	0.5

Figure 4 - Improvements to façade

4.2 Energy efficient building systems

Enhancing the fabric performance of the building will reduce the energy and CO_2 emissions considerably. However, further improvements have also been undertaken.

The previous heat system was a very inefficient Electric Warm Air system; two options to improve this would be:

1. Replace with direct electric heating.
2. Replace with VRF- variable refrigerant flow heating and cooling.

Due to its efficiency and financial savings for a small area, VRF heating has been chosen. As the new floors will become hotel accommodation for patients, cooling had been requested as well. VRF can offer both heating and cooling in one system, reducing complexities and maintenance. Previously air to water heat pumps were suggested to replace the existing electric warm air system but due to the change from residential to hotel accommodation, this system would no longer be suitable for the proposed building usage.

Further to this, the possibility of renewable technologies has been explored.

4.3 Renewable technologies

In line with the London Plan requirements, the feasibility of renewable energy technologies were considered; where possible.

Certain technologies were discounted immediately. For instance, there is not a viable river source and therefore micro-hydro has been discounted. The anaerobic digestion of waste (kitchen and/or other organic) was discounted owing to the need to provide open spaces to the residents of the site; such an installation would also require a large land-take and is not feasible.

Bio-mass boilers were discounted due to the constraints of the existing building on the need for large spatial requirements for the fuel store.

Of the more conventional technologies, large scale wind turbines were discounted on the grounds of the physical restrictions of the site which would preclude the use of a turbine in the 100s of kilowatt range. Photovoltaics mounted vertically were not considered as the integration of these into an existing façade is not going to be feasible.

The use of an aquifer to provide heating and cooling was discounted as it would require substantial works to the existing foundations and could not be justified.

The table below summarises which technologies were considered appropriate for further investigation.

Item	System	For possible use?	Notes
1	Large scale wind turbines	No	The locality precludes the inclusion of large scale wind turbines in terms of physical constraints.
2	Building Mounted turbines	No	The urban environment would mean that little generation would be produced due to local topographic influences on wind strength and direction reducing efficiency of the turbines. The existing building structure was not intended to take on the additional wind loads.
3	PV Roof Mounted	No	Roof mounted PV generation can be considered, though available roof area is significantly limited due to the existing physical constraints, location of MEP plant, access, skylights and façade cleaning equipment. These leave a minimal free area on the roof which will be utilised for the mechanical plant required for the refurbishment of 1st, 2nd and 4th floor. PV panels on the roof have been excluded on the basis of limited roof area and high capital cost.
4	PV Façade mounted	No	Constraints of existing façade do not make this a feasible solution.
5	Solar thermal panels	Yes	Solar thermal panels mounted can be considered, though available roof area is significantly limited due to the existing physical constraints, location of MEP plant, access, skylights and façade cleaning equipment. These leave a minimal free area on the roof which will be utilised for the mechanical plant required for the refurbishment of 1st, 2nd and 4th floor.
6	Bio-mass boilers	No	The physical constraints of the existing building rule out bio-mass due to the large spatial requirements for the fuel store.
7	GSHP	No	The existing building means that it is not feasible to bring boring equipment into the basement and provide new boreholes.
8.	ASHP	Yes	An air source heat pump is considered a renewable technology in Camden. This can be an efficient option to generate low temperature hot and chilled

			water for heating and cooling respectively.

Figure 5 Summary of renewable technologies considered

4.4 System appraisal

The use of many renewable technologies was discounted due to the constraints of the existing building and the site. However two options were identified as being potentially feasible.

- Solar thermal panels
- Air source heat pumps for heating and cooling

Air source heat pumps were selected to generate low temperature hot water to serve the fan coils in the hotel rooms as well as the heating coils in the fresh air handling unit. The heat pumps were also used to generate chilled water to feed the fan coil units. It has been estimated by the manufacturers that the COP in heating mode will be 3.94 and in cooling mode 3.50.

Solar thermal panels were also considered and compared with the use of air source heat pump for information purposes. A combination of solar thermal panel along with air source heat pump was investigated, as well. It should be noted that there is hardly any area on the roof for the installation of solar thermal panels.

5 Summary

Considering the new improvements, six options were run in thermal modelling to compare the energy consumptions and CO_2 emissions associated with each option.

The summary table shows all the options undertaken:

	Building Type & Corresponding Profiles	Fabric/ Building Elements	Building Systems	Renewables
Base-case	Residential Studio Apartment	Thermal performance unchanged	Electric Heater for heating and DHW.(no heat recovery) No cooling	None
Measure 1a	Residential Studio Apartment	Thermal performance **Upgraded**	Electric Heater for heating and DHW.(no heat recovery) No cooling	None
Measure 1b	**Hotel Rooms**	Thermal performance **Upgraded**	Electric Heater for heating and DHW.(no heat recovery) No cooling	None
Measure 2	**Hotel Rooms**	Thermal performance **Upgraded**	**Air source heat pump for heating & cooling.** **Gas boilers for DHW**	None
Measure 3a	**Hotel Rooms**	Thermal performance **Upgraded**	**Air source heat pump for heating & cooling.** **Gas boilers for DHW**	**Solar thermal panels to generate a part of the DHW**
Measure 3b	**Hotel Rooms**	Thermal performance **Upgraded**	**Air source heat pump for heating & cooling.** **Air source heat pump for DHW**	**Solar thermal panels to generate a part of the DHW.**
Measure 3c	**Hotel Rooms**	Thermal performance **Upgraded**	**Air source heat pump for heating &**	**Air source heat pump to generate**

			cooling. **Gas Boilers for DHW**	**part of the DHW**

Figure 6 Summary of proposed measures assessed

Based on the measures discussed previously, the reductions in annual energy consumption, energy costs, CO_2 emissions can be demonstrated as follows:

Figure 7 Estimated improvements to energy consumption, costs & CO_2 emissions

The improvements have progressively decreased energy consumption, cost and carbon emissions, however introducing of renewable technology in measure 3a,b & c has only had a marginally impact (4 % improvement) on CO_2 emissions when comparing it with solely using gas boilers for DHW, as shown in measure 2. Considering the capital costs of solar thermal panels and air source heat pumps and the comparatively small CO_2 savings they have, solar thermal technology was not taken forward.

The improvements lied in the fabric improvements, the systems high efficiencies and the air source heat pumps performance and hence measure 2 was the scheme which was carried through. This scheme has demonstrated an approximate reduction of 64% over the base case, a significant reduction which we believe, meets Greater London Authority and London Borough of Camden policy requirements.

Appendix A

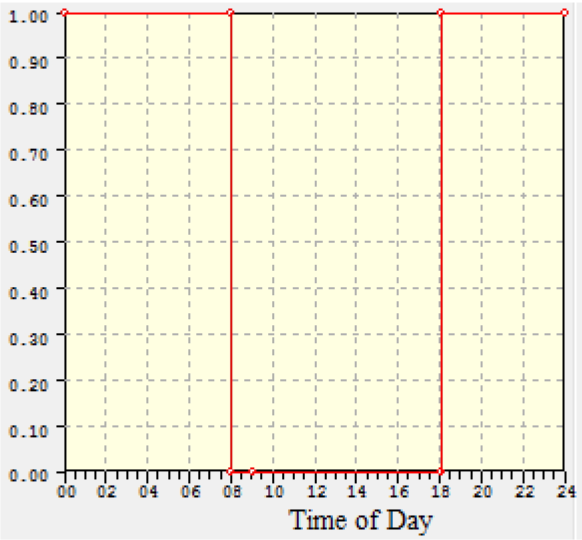
Residential Profiles and loads - Base case & measure 1a

A1 Residential Profiles and loads - Base case & measure 1a

Occupancy:

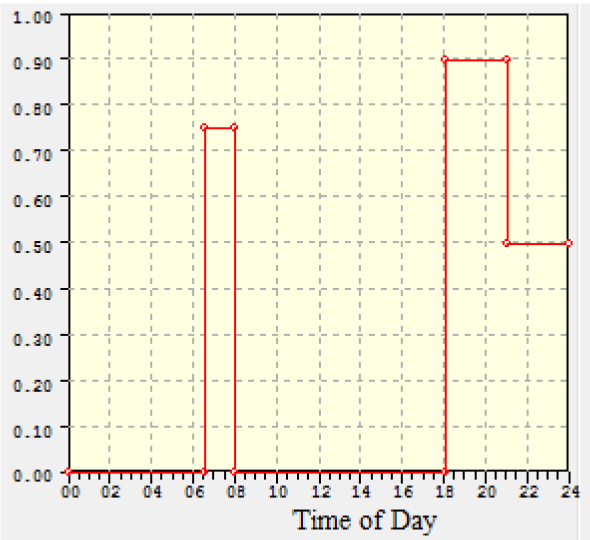
The rooms are set as residential apartments with 2 people residing in each apartment. The profile below shows the time in which the residents are home every day of the year regardless of weekend activity.

The Y axis is a percentage of the occupancy in each apartment, 1 represents 2 people in the apartment at that time of the day



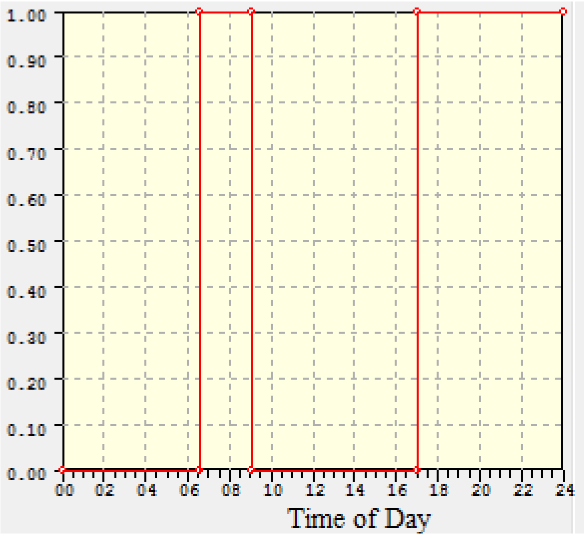
Equipment & Lighting Profiles:

The profiles for the equipment and lighting are defined below where the y axis is a percentage of the maximum equipment and lighting loads.



System Profiles

The assumption for the residential buildings has been that heating would be based on a timer, hence the heating profile is as below:



The domestic hot water profile is linked to occupancy.

Appendix B

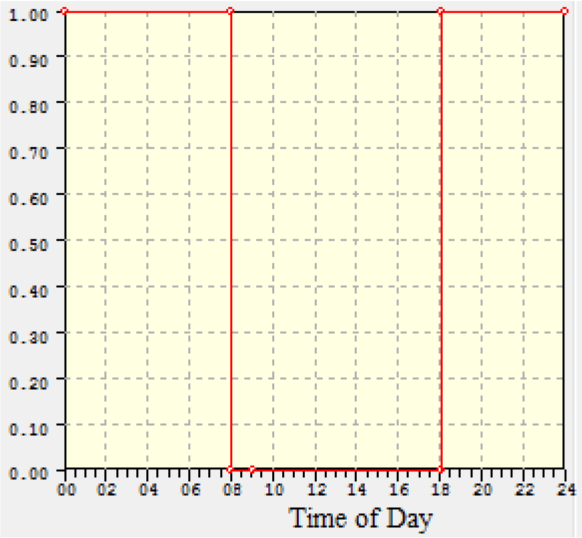
Hotel Accommodation Profiles and loads- Measure 1b,2, 3a-c

B1 Hotel Accommodation Profiles and loads-Measure 1b,2, 3a-c

Occupancy:

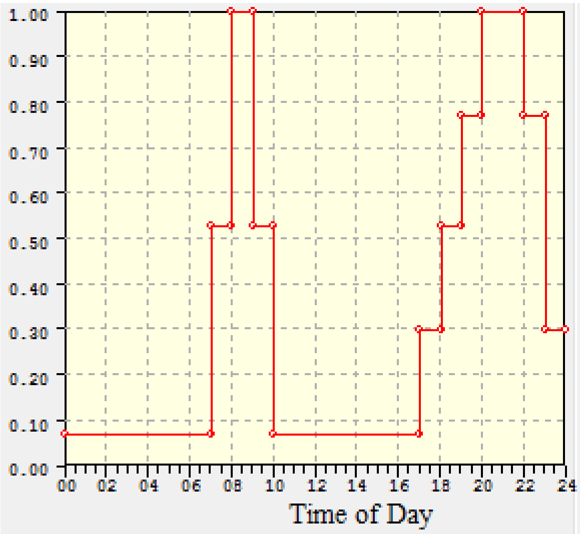
Each of the rooms in the hotel are based on 2 people sharing one room. The diagram below shows the time in which the guests are occupying the hotel room every day of the year regardless of weekend activity. It is the same profile as seen for the residential apartments in the base-case.

The Y axis is a percentage of the occupancy in each hotel room, 1 represents 2 people in the hotel room at that time of the day, whereas 0 will indicate the hotel room is vacant.



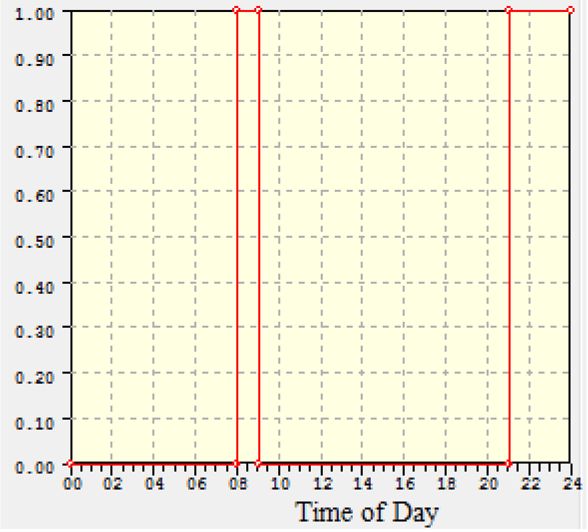
Equipment Profiles

The equipment profile is defined below where the y axis is the percentage of the maximum equipment load for each hotel room. These follow the NCM guide for en-suite bedrooms and are applied every day of the year to each room.



Lighting Profiles

The equipment profile is defined below where the y axis is the percentage of the maximum lighting load for a room. These follow the NCM guide for en-suite bedrooms and are applied every day of the year to each room.



System Profiles

All systems are linked to occupancy as the hotel room card when placed in the correct slot will activate all heating and cooling needed for the room, hence if the room is vacant then the systems will not operate.