THHR_01-ACM-ZZ-XX-RP-Y-000019

AECOM

The Hillingdon Hospital Redevelopment

Energy Strategy

The Hillingdon Hospitals NHS Foundation Trust

April 2022

Quality information

Prepared by	Checked by	Verified by	Approved by
CMJ Graduate Consultant JC Graduate Consultant NS Senior Consultant	RB Principal Consultant	MA Technical Director	RM Director

Revision History

Revision	Revision date	Details	Authorized	Name	Position
00	01/04/2022	Draft	-	-	-
01	25/04/2022	Final	RM	RM	Director

Distribution List

# Hard Copies	PDF Required	Association / Company Name

Prepared for:

The Hillingdon Hospitals NHS Foundation Trust

Prepared by: AECOM Limited

AECOM Limited
Aldgate Tower
2 Leman Street
London E1 8FA
United Kingdom
aecom.com

Table of Contents

Figures

Tables

1. Executive Summary

1.1 Introduction

This energy strategy has been prepared by AECOM to accompany the hybrid planning application being submitted by the Applicant, The Hillingdon Hospitals NHS Foundation Trust, to the London Borough of Hillingdon (LBH). The proposal comprises of a full application for the new Hillingdon Hospital and multi-storey car park (hereafter referred to as the 'Hospital Redevelopment') and an outline application for a mixed-use development with a residential primary function (hereafter referred to as the 'Masterplan Development').

This document summarises the options considered during design of the Hospital Redevelopment and Masterplan Development (hereafter referred to as the 'Proposed Development') for reducing carbon emissions through energy efficiency measures, low carbon energy supply from decentralised sources and the integration of renewable energy technologies.

1.2 Development description

The Proposed Development comprises of:

1. **The 'Hospital Redevelopment':** A full application seeking planning permission for demolition of existing buildings and redevelopment of the site to provide the new Hillingdon Hospital, multi-storey car park and mobility hub, vehicle access, highway works, associated plant, generators, substation, new internal roads, landscaping and public open space, utilities, servicing area, surface car park/expansion space, and other works incidental to the Proposed Development.
2. **The 'Masterplan Development':** An outline planning application (all matters reserved, except for access) for the demolition of buildings and structures on the remaining site (Excluding the Grade II Furze and Tudor Centre) for a mixed-use development comprising residential (Class C3) and supporting Commercial, Business and Service uses (Class E), new pedestrian and vehicular access; public realm, amenity space, car and cycling parking.

The Hospital Redevelopment replacement hospital building has a gross internal area (GIA) of 79,603.6 m^2 across 8 storeys (including the ground floor). The western extent of the site incorporates a linked mobility hub and multi storey car park (MSCP) for 781 car spaces. The detailed development proposal also includes the provision of public realm in the form of a large central green open space at ground level, 161 ground level car parking spaces with the ability to cater for up to 14,000 m^2 of expansion space for future hospital expansion (if required) and new bus stop arrangements with improved connections to the hospital on Pield Heath Road.

The proposed hospital will predominantly be used for clinical purposes including accident and emergency (A&E), maternity and neonatal wards, outpatients, operating theatres, café and retail areas, facilities management, office space and plant space.

The Masterplan Development will have a residential GIA of 33,870 m^2 which comprises of 327 dwellings. Plots P01, P02 and P04 will be mixed use blocks with supporting provision of 800 m^2 of town centre uses (Use Class E) at ground floor level. The outline proposal also includes the provision of up to 302 car parking spaces, 515 cycle parking spaces, improved permeability and public access routes through the site and high-quality public realm with landscaped gardens throughout the site.

The proposed outline application will predominantly be residential with café and retail areas on the ground floor of each block.

For full details and the scope of the application, please refer to the Planning Statement and Design and Access Statement, submitted with the planning application.

1.3 Policy review

The Energy Strategy for the Proposed Development responds to national, regional and local planning policies, including but not limited to:

- National Planning Policy Framework (Ref. 1)
- UK Climate Change Act (Ref. 2)
- Net Zero Strategy: Build Back Greener (Ref. 5)
- Heat and Buildings Strategy (Ref. 4)
- Building Regulations Part L 'Conservation of fuel and power' (2013 with 2016 amendments) (Ref. 5)
- Standard Assessment Procedure (SAP) for Energy Rating of Dwellings Version 10 (Ref. 6)
- Standard Assessment Procedure 2012 9.92 (Ref. 9)
- Guidance on the Preparation of Energy Strategies (Ref. 7)
- Draft Energy Assessment Guidance (Ref. 8)
- The London Plan 2021 (Ref. 8)
- London Mayor's Air Quality Strategy (Ref. 10)
- Carbon Offset Funds (Ref. 17)
- The Local Plan Part 1 and 2 (Ref. 11, Ref. 12, Ref. 13)
- SPD 'Hillingdon Design and Accessibility Statement' (Ref. 14)
- SPD 'Planning Obligations' (Ref. 15)

1.4 Emission factors used

This Energy Strategy has been prepared using the SAP 10.0 CO_2 emission factors as outlined in the GLA Guidance on the Preparation of Energy Strategies (Ref. 7).

1.5 Full Application Hospital Building

1.5.1 Proposed energy strategy

The energy strategy for the Hospital Redevelopment is:

1. Energy efficient fabric and buildings services design.
2. A Ground Source Heat Pump (GSHP) system to provide base load heating and cooling.
3. An Air Source Heat Pump (ASHP) system to meet remaining heating, cooling and hot water demands.
4. An ambient loop system to act as a thermal store and maximise system efficiency.
5. A photovoltaic (PV) array on the roof of the hospital building and MSCP.

The carbon emissions at each stage in the energy hierarchy are summarised below.

Table 1 below shows the carbon baseline, and emissions and savings with the proposed energy strategy, at each step in the energy hierarchy. Calculations at this stage suggest this strategy would save 726.4 tCO_2/year, which is 31% of the baseline emissions of 2,324.0 tCO_2/year. This is also summarised in Table 1 and Table 2 below.

Table 1 Summary of carbon emissions after each stage of the energy hierarchy (Hospital Redevelopment)

	Carbon emissions for new buildings (tCO_2/year)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	2,324.0	2,187.1
After energy demand reduction	2,697.2	2,187.1
After heat network/CHP	2,697.2	2,187.1
After renewable energy	1,597.7	2,187.1

Table 2 Summary of regulated carbon savings from each stage of the energy hierarchy (Hospital Redevelopment)

	Regulated new-building carbon savings	
	(tCO_2/year)	**(%)**
Savings from energy demand reduction	-373.1	-16%
Savings from heat network/CHP	0.0	0%
Savings from renewable energy	1,099.5	47%
Total cumulative savings	**726.4**	**31%**

The shortfall in savings relative to a 100% saving target for non-domestic areas is 1,597.7 tCO_2/year, which is a cumulative total over 30 years of 47,930 tCO_2 that is expected to be addressed through offsetting.

This results in an estimated carbon offset payment of approximately £4,553,381, summarised in Table 3 and Figure 1 below. The Applicant is currently investigating a potential offset project(s) at the Mount Vernon site (part of The Hillingdon Hospitals NHS Trust Foundation estate). It may be possible for the Applicant to allocate some of the total carbon offsetting cost to project(s) at Mount Vernon. This is subject to further feasibility testing and is subject to agreement with LBH. Further details are provided in section 3.7.6 of this report.

Table 3 Summary of shortfall in regulated carbon savings (Hospital Redevelopment)

	Annual (tCO_2)	**Cumulative shortfall (tCO_2)**
Total Target Savings	2,324.0	-
Shortfall	1,597.7	47,930.3
Cash in-lieu contribution (£)	**-**	**£4,553,381**

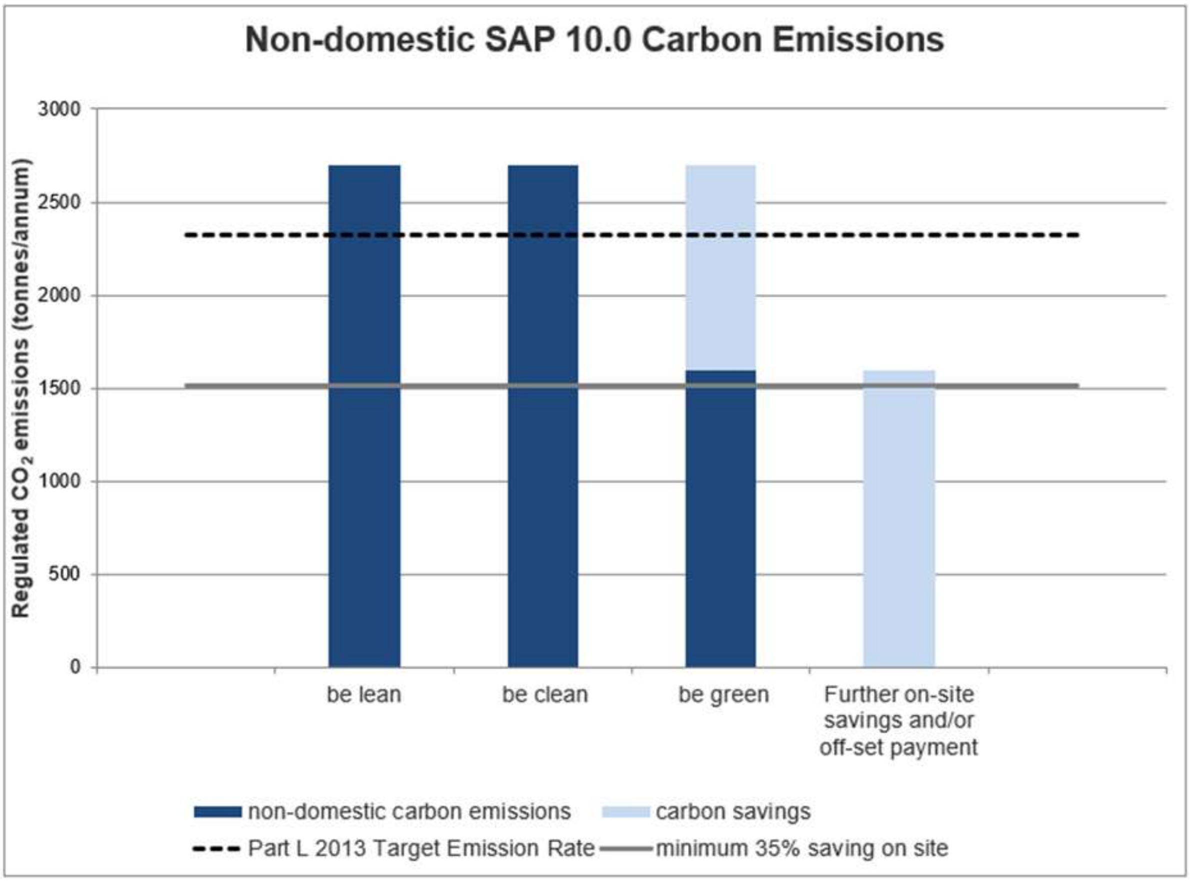

Figure 1 Proposed energy strategy: Energy Hierarchy carbon baseline, emissions and savings (Hospital Redevelopment)

1.5.2 Comparison with carbon saving targets

1.5.2.1 'Be Lean' target

GLA planning policy encourages on-site regulated carbon savings of 15% against the baseline from energy efficiency measures alone (the 'Be Lean' stage). The nature of a healthcare building makes these targets difficult to achieve. Primarily, this is due to the auxiliary energy required for fans and pumps and limitations in the modelling of energy required for domestic hot water (DHW).

The building is being designed to follow guidance in the Department of Health's Health Technical Memorandum 03-01: Specialised ventilation for healthcare premises (Ref. 18). The ventilation rates applied to the hospital building range from 6 AC/hr for general wards, to 10 AC/hr for operating theatres. The Building Regulations 2010 Part L national calculation methodology is not primarily designed for use on healthcare buildings. Higher air change rates are reflected in Part L models by the need to increase specific fan power of fans in the building. The notional fan powers for healthcare buildings do not reflect the requirements outlined in the Health Technical Memorandum, which need greater air change rates and therefore higher fan powers than, for example a good practice office building. Where air change rates range from 6 to 10 AC/hr in the Hospital Redevelopment in order to meet the HTM requirements, a typical office would require only 3 to 4 AC/hr to achieve best practice levels of fresh air. For this reason, fan powers for the proposed building are higher than expected in the notional building and result in a high energy use for auxiliary power. This places limitations on the regulated carbon savings which can be reported.

The notional building includes a number of set parameters on DHW that do not reflect the requirements for hospital buildings. The baseline building for Part L use a 95% efficient gas boiler with no storage losses and 5% distribution losses, effectively assuming that heating is provided by localised boilers close at the point of use. The 'Be Lean' case uses a 91% efficient gas boiler (the same as for space heating) and includes storage losses but no distribution losses. As the actual building is a large-scale hospital building, localised boilers for DHW are not practical and an ambient loop system is proposed to distribute heat at a very low 'ambient' temperature (35°C) before water to water heat pumps increase the temperature from the ambient loop for localised DHW. This results in a significant length of ambient loop distribution and secondary DWH pipework (and therefore surface area for heat loss) despite the pipework being highly insulated. The efficiency improvement of the ambient loop is not reflected in the 'Be Lean' stage, as the system cannot be applied to the model with a gas boiler, so the savings from the ambient loop system are instead reflected in the 'Be Green' stage. This methodology means that the as-modelled DHW carbon emissions at the 'Be Lean' stage are larger than for the baseline case, despite the Hospital Redevelopment using a highly efficient ambient loop system as a centralised building scale network with localised plant rooms.

Table 4 outlines energy uses across the Hospital Redevelopment as reported for the baseline and actual building for the 'Be Lean' stage in the BRUKL model in kW h/m^2/year. As shown, in excess of one half of the notional building energy consumption is from DHW and auxiliary power. Due to the air change requirements within the building and Part L DHW modelling limitations, there is limited scope to reduce auxiliary energy whilst meeting the performance required for healthcare buildings.

Table 4 Baseline and actual 'Be Lean' energy consumption and savings (Hospital Redevelopment)

	Space heating	DHW	Lighting	Auxiliary	Cooling	Total	Total (excluding DHW and auxiliary)
Baseline (kW h/m^2/year)	5.6	59.1	41.1	21.2	15.2	**142.2**	**61.9**
Actual (kW h/m^2/year)	3.9	95.0	29.7	27.5	10.7	**166.8**	**44.3**
Saving (kW h/m^2/year)	-1.7	+35.9	-11.4	+6.3	-4.5	**+24.6**	**-17.6**
Saving (%)	-30%	+61%	-28%	+30%	-30%	**+17%**	**-28%**

As shown in Table 4, energy demands for DHW of 59.1 kW h/m^2/year and auxiliary energy of 21.2 kW h/m^2/year make up more than one half of the total regulated energy demands of 142.2 kW h/m^2/year for the baseline. The air change (and therefore fan power) and DHW requirements in the building limit the overall savings available, as auxiliary energy and DHW forms a significant proportion of the overall energy use. Other energy uses in the building achieve energy consumption reductions of 30% for space heating, 28% for lighting and 30% for cooling, all in excess of 15%.

1.5.2.2 'Be Green' target

GLA planning policy encourages on-site regulated carbon savings of 35% against the baseline for the 'Be Green' stage. The nature of a healthcare building makes these targets difficult to achieve. Primarily, this is due to the auxiliary energy required for fans and pumps.

Table 5 outlines energy uses across the Hospital Redevelopment as reported for the baseline and actual building in the BRUKL model in kW h/m^2/year. As shown, approximately 15% of the notional building energy consumption is from auxiliary power. Due to the air change requirements within the building (outlined in Section 3.7.8.1 above), there is limited scope to reduce auxiliary energy whilst meeting the performance required for healthcare buildings.

Table 5 Baseline and actual 'Be Green' energy consumption and savings (Hospital Redevelopment)

	Space heating	DHW	Lighting	Auxiliary	Cooling	Total	Total (excluding auxiliary)
Baseline (kWh/m²/year)	5.6	59.1	41.1	21.2	15.2	**142.2**	**121.0**
Actual (kWh/m²/year)	1.1	27.6	29.7	27.5	10.7	**96.6**	**69.1**
Saving (kWh/m²/year)	-4.5	-31.5	-11.4	+6.3	-4.5	**-45.6**	**-51.9**
Saving (%)	-80%	-53%	-28%	+30%	-30%	**-32%**	**-43%**

As shown in Table 5, energy demands for auxiliary energy of 21.2 kW h/m²/year make up approximately 15% of the total regulated energy demands of 142.2 kW h/m²/year for the baseline. The air change (and therefore fan power) requirements in the building limit the overall savings available, as auxiliary energy forms a significant proportion of the overall energy use. Other energy uses in the building achieve energy consumption reductions of 80% for space heating, 53% for DHW (reflecting the benefits of the heat pumps and ambient loop system), 28% for lighting and 30% for cooling. Overall energy consumption reduction excluding auxiliary energy is in excess of 35%.

As reduction in auxiliary energy is not possible to achieve for the building type, and other energy uses in the building have been significantly reduced, the proposed building meets planning policy as far as possible within the constraints applied in the building performance requirements and modelling limitations.

1.6 Outline Application Masterplan

1.6.1 Proposed energy strategy

The energy strategy for the Proposed Development is:

1. Energy efficient fabric and buildings services design;
2. Heat pumps to meet remaining heating, cooling and hot water demands;
3. A Photovoltaic (PV) array on the roof of the buildings.

The carbon emissions at each stage in the energy hierarchy are summarised below. Figure 2 shows the carbon baseline, and emissions and savings with the proposed energy strategy, at each step in the energy hierarchy. Calculations at this stage suggest this strategy would save 253.6 tCO_2/year, which is 60% of the baseline emissions of 425.0 tCO_2/year. This is also summarised in Table 6 and Table 7 below.

Table 6 Carbon emissions after each stage of the energy hierarchy (Masterplan Development)

	Carbon emissions for new buildings (tCO_2/year)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	425.0	199.3
After energy demand reduction	380.3	199.3
After heat network/CHP	380.3	199.3
After renewable energy (PV and heat pumps)	171.4	199.3

Table 7 Regulated carbon savings from each stage of the energy hierarchy (Masterplan Development)

	Regulated new-building carbon savings	
	(tCO_2/year)	**(%)**
Savings from energy demand reduction	44.6	11%
Savings from heat network/CHP	0.0	0%
Savings from renewable energy (PV and heat pumps)	222.1	49%
Total cumulative savings	**253.6**	**60%**

The shortfall in savings relative to a 100% saving target for domestic and non-domestic areas (total areas in the Masterplan Development) based on the indicative calculations is 171.4 tCO_2/year, which is a cumulative total over 30 years of 5,141 tCO_2 that is expected to be addressed through offsetting. This results in an estimated payment to LBH of approximately £488,000. This is summarised in Table 50 and Figure 12. This is subject to agreement with LBH.

Table 8 Shortfall in regulated carbon savings (Masterplan Development)

	Annual (tCO_2)	Cumulative shortfall (tCO_2)
Total Target Savings	253.6	-
Shortfall	171.4	5,141.3
Cash in-lieu contribution (£)	**-**	**£488,000**

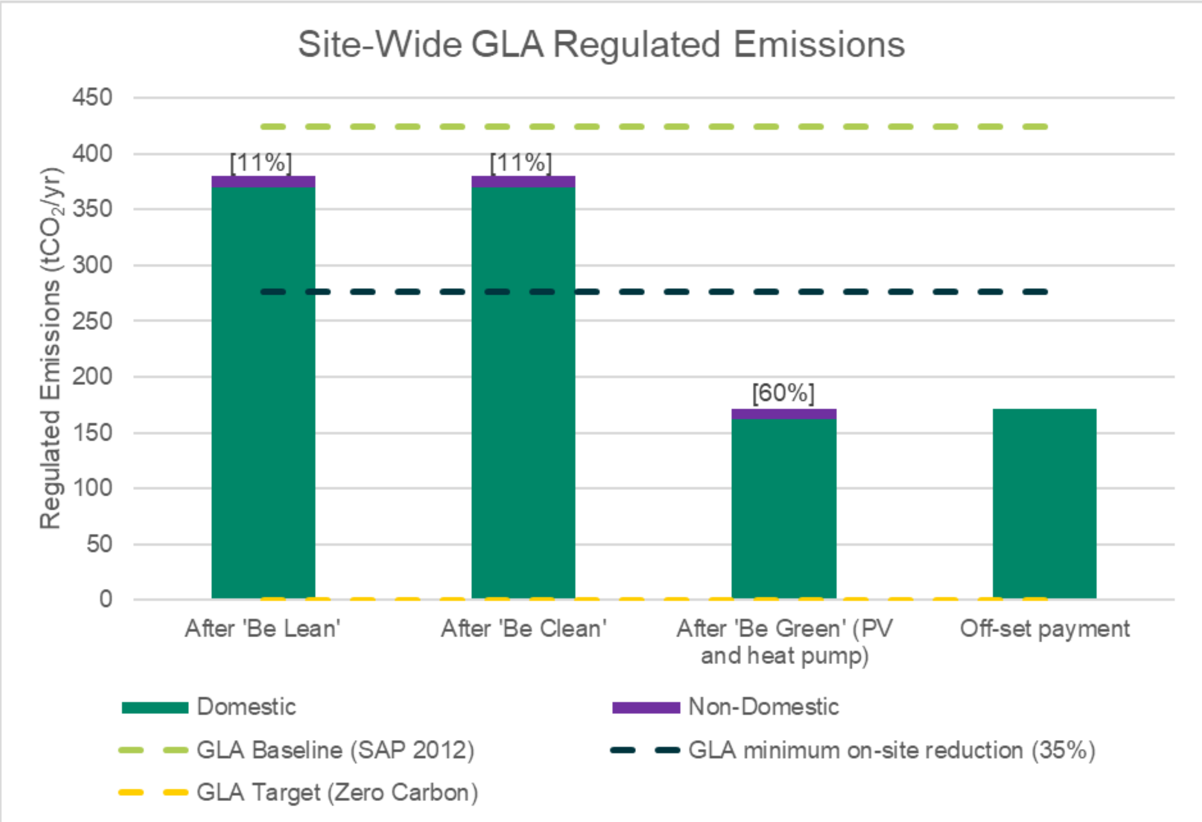

Figure 2 Proposed energy strategy: Energy Hierarchy carbon baseline, emissions and savings (Masterplan Development)

1.6.2 Comparison with carbon saving targets

The London Plan requires a minimum of 10% and 15% 'Be Lean' savings for the domestic and non-domestic element respectively. The energy strategy for the Masterplan development shows that this target can be met, with 'Be Lean' savings of 11% and 24% shown indicatively for the domestic and non-domestic.

The overall 35% on-site saving target is shown to be achievable for the Masterplan Development with an overall 60% presented. The domestic element shows a 65% saving and the non-domestic 35%, in line with London Plan Policy.

2. Introduction and background

This energy strategy has been prepared by AECOM to accompany hybrid planning application being submitted by the Applicant, The Hillingdon Hospitals NHS Foundation Trust, to the London Borough of Hillingdon (LBH). The proposal comprises of a new Hillingdon Hospital and multi-storey car park (hereafter referred to as the 'Hospital Redevelopment') and an outline application for a mixed-use development with a residential primary function (hereafter referred to as the 'Masterplan Development').

This document summarises the options considered during design of the Hospital Redevelopment and Masterplan Development (hereafter referred to as the 'Proposed Development') for reducing carbon emissions through energy efficiency measures, low carbon energy supply from decentralised sources and the integration of renewable energy technologies.

2.1 Development Description

The proposal comprises of:

1. **The 'Hospital Redevelopment'**: A full application seeking planning permission for demolition of existing buildings and redevelopment of the site to provide the new Hillingdon Hospital, multi-storey car park and mobility hub, vehicle access, highway works, associated plant, generators, substation, new internal roads, landscaping and public open space, utilities, servicing area, surface car park/expansion space, and other works incidental to the Proposed Development.
2. **The 'Masterplan Development'**: An outline planning application (all matters reserved, except for access) for the demolition of buildings and structures on the remaining site (Excluding the Grade II Furze and Tudor Centre) for a mixed-use development comprising residential (Class C3) and supporting Commercial, Business and Service uses (Class E), new pedestrian and vehicular access; public realm, amenity space, car and cycling parking.

The site of the Proposed Development is the site of the existing Hillingdon Hospital and is located to the south of Pield Heath Road, bound by Royal Lane to the west, and Colham Green Road to the east, hereafter referred to as the 'Site'. The new hospital is located within the footprint of existing Brunel Ward.

The Hospital Redevelopment replacement hospital building has a gross internal area (GIA) of 79,603.6 m^2 across 8 storeys (including the ground floor). The western extent of the site incorporates a linked mobility hub and multi storey car park (MSCP) for 781 car spaces. The detailed development proposal also includes the provision of public realm in the form of a large central green open space at ground level, 161 ground level car parking spaces with the ability to cater for up to 14,000 m^2 of expansion space for future hospital expansion (if required) and new bus stop arrangements with improved connections to the hospital on Pield Heath Road.

The proposed hospital will predominantly be used for clinical purposes including Accident and Emergency (A&E), maternity and neonatal wards, outpatients, operating theatres, café and retail areas, facilities management, office space and plant space.

The Masterplan Development will have a residential GIA of 33,870 m^2 which comprises of 327 dwellings. Plots P01, P02 and P04 will be mixed use blocks with supporting provision of 800 m^2 of town centre uses (Use Class E) at ground floor level. The outline proposal also includes the provision of up to 302 car parking spaces, 515 cycle parking spaces, improved permeability and public access routes through the site and high-quality public realm with landscaped gardens throughout the site.

The proposed outline application will predominantly be residential with café and retail areas on the ground floor of each block.

For full details and the scope of the application, please refer to the Planning Statement and Design and Access Statement (IBI Group), submitted with the planning application.

2.1.1 'Illustrative Masterplan'

As part of developing the Masterplan Development, an 'Illustrative Masterplan' has been utilised throughout the pre-application process to encapsulate one potential design for the Masterplan Development in accordance with the parameters. Please refer to the Design and Access Statement (IBI Group), submitted with the planning application.

This Illustrative Masterplan has been used as a vehicle to visualise the Applicant's ambitions for the Site. The Illustrative Masterplan has evolved from an understanding of the site context and the different requirements of the client and the different stakeholders with the ultimate objective of promoting the creation of a unique and responsive character.

The Illustrative Masterplan has resulted from a thorough assessment and evaluation of the site context and will serve three main purposes (see Design and Access Statement):

- *Vehicle for comment and consensus:*
    - *Throughout the pre-application stage with the London Borough of Hillingdon the Illustrative Masterplan has acted as a vehicle for comment, to identify differing views on the potential form and character of the proposed Masterplan. Those comments have been taken into account in the refining of the parameters for the Masterplan.*
- *Information source:*
    - *During the Masterplan design documentation stage, the Illustrative Masterplan has been used as a source of information to show the type of Development that could come forward in accordance with the parameters set by the Development Control Documents, being an illustration of the Development permitted by them. The Development to be permitted in accordance with the Development Control Documents, together with illustrations of this, is described in the Design and Access Statement.*
- *Representation of development control documents:*
    - *At the planning determination stage, the Illustrative Masterplan acts as a visual aid, providing a representation of the Masterplan in accordance with the Development Control Documents, and an illustration of how those documents fit together to set the parameters for future Reserved Matters Applications.*

2.1.2 The Design Code for the Masterplan Development

The Design Code is intended to help the interpretation of The Parameter Plans (including governance of aspects of use, layout, access, scale, character, landscape and appearance), Development Specification and Framework, and The Design and Access Statement, which support this Hybrid Planning Application. Compliance with The Design Code will ensure the delivery of a coherent high quality development. It provides framework within which architectural diversity can be achieved and where the public realm is an integrated element which provides continuity with the surrounding area.

The Design Code include a number of clauses which support the ongoing development of the energy strategy and are expected to impact the performance of the Masterplan Development. This includes several clauses which are expected to have co-benefits in supporting energy performance and delivery of measures set out in this energy strategy:

- ***Residential layout:***

    3.1.4 Housing developments should maximise the provision of dual aspect units into building design.

    3.1.5 Single aspect units should only be as far as possible and only acceptable if they are proven to be of high quality and in response to podium level car parks.

- ***Balconies:***

    3.1.14 Balconies must be designed only as projecting, and should be fully integrated within the composition of the building and the architectural detail of the facades.

    3.1.16 There must not be corner balconies.

    3.1.17 Balconies should not be less than 1.5 m deep in accordance with Hillingdon Design and Accessibility Statement with a minimum of 4 m^2.

- ***Roofscape:***

  3.2.40 The roof top should be treated as the fifth elevation and the design should integrate plant and other roof top equipment into the overall design concept.

  3.2.42 Roof top plant equipment must be concealed and housed within solid or perforated roof enclosures to ensure that the equipment is not visible from the street or neighbouring buildings. The exception is equipment such as communications devices which for technical reasons cannot be housed within an enclosure.

  3.2.47 There must be terraces and green roofs. Refer to section 3.3 Ecology for guidance on green and brown roofs.

- ***Circular economy and life carbon:***

  4.0.8 All proposals must adhere to all applicable national and London-wide design guidance, including but not limited to the following (subject to future revisions applicable at the time of the Reserved Matters Application):

  i. Whole life-cycle carbon assessments guidance;

  ii. Circular economy statement guidance.

- ***Code for Sustainable Homes:***

  4.0.13 Residential development must be assessed against the Code for Sustainable Homes.

  4.0.14 The development must achieve Level 4 of the Code as a minimum (or the equivalent level of any subsequently adopted national standard on sustainable design and construction).

- ***Climate response:***

  4.0.15 Designs should be in line with the waste hierarchy, by designing out waste, creating flexible spaces, and selecting materials for easy maintenance and end-of-life reuse and recycling.

  4.0.16 Designers should specify materials with lower environmental impacts and high reused or recycled content.

- ***Sunlight:***

  4.0.20 The massing of residential buildings should be controlled to allow good light penetration to all units and minimise any overshadowing. Building designs should promote sunlight in courtyard spaces. Light and views for the individual residential units and communal amenity space should be maximised.

  4.0.22 Habitable spaces within apartments should be located where good sunlight and daylight is provided.

  4.0.23 Where the Vertical Sky Component (VSC) is below 27% the windows should be increased in size and the layout of rooms should be developed considering the room limiting depth. The use of bright colour on the external elevation should be considered to improve results.

- ***Solar gain:***

  4.0.25 Design must mitigate solar gain for the south and west facing facades.

2.2 Policy Review

2.2.1 National Legislation and Policy Drivers

2.2.1.1 UK Climate Change Act

The UK Government has declared a Climate Emergency and has legislated, via the Climate Change Act 2008 (2050 Target Amendment Order 2019), to achieve net zero CO_2 emissions by 2050 at the latest (Ref. 2). This is the target considered necessary for the UK to play its equitable share in international efforts to keep a global temperature rise at less than 1.5^{o}C above pre-industrial levels. There is widespread scientific consensus that this is a necessary step to avoid catastrophic climate impacts for humanity.

The Act is the driver behind a framework of national strategy and policy documents including recent proposed updates to Part L of Building Regulations.

2.2.1.2 Net Zero Strategy: Build Back Greener

In October 2021 the UK Government published its Net Zero Strategy: Build Back Greener (Ref. 3) and Heat and Buildings Strategy (Ref. 4). These strategies lay out the following aims of relevance to the Proposed Development:

- Ensuring all new buildings in England are ready for Net Zero from 2025;
- Reducing demand through a fabric first approach – enforced through the Future Buildings Standard and Future Homes Standard;
- Supplying heat to buildings through future proofed low carbon solutions such as heat pumps; and
- Encouraging the use of renewables in conjunction with energy storage.

One of the primary ways in which the UK plans to deliver its net zero target is to decarbonise the UK's electricity grid and to shift heating away from fossil fuelled gas boilers to alternative heat pump solutions fuelled by low carbon electricity. The Net Zero Strategy includes a commitment by Government to decarbonise the power grid by 2035 and to look to rebalance energy prices, to make electricity prices cheaper relative to gas.

2.2.1.3 National Planning Policy Framework

The National Planning Policy Framework (NPPF) prescribes government planning policy and outlines the way in which this is to be applied (Ref. 1). The document sets out a framework for local plan development and illustrates national-scale policy aims.

> Para 152 of the NPPF states that:
>
> *"The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure."*
>
> Paragraph 155 states that:
>
> *"To help increase the use and supply of renewable and low carbon energy and heat, plans should:*
>
> *c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers".*

2.2.1.4 Building Regulations, Future Buildings Standard and Future Homes Standard

Part L of the Building Regulations in England is the key mechanism that prescribes standards for the energy performance of new buildings in the UK, based on metrics such as the estimated level of primary energy demand and CO_2 emissions. Approved Documents set out the measures required to comply with Building Regulations. Part L 2013 with 2016 amendments is the current version of the Approved Documents (Ref. 5).

At the end of November 2016, the Department for Business, Energy and Industrial Strategy (BEIS) published a consultation on proposed changes to SAP 2012 (v9.92) (Ref. 9). On 24th July 2018 the Building Research Establishment (BRE) published SAP 10.0 which provided an indication of the expected future carbon emission factors that will inform and potentially be adopted in future updates to Building Regulations (Ref. 6).

One of the key changes was the adjustment of the carbon factors of electricity and (to a lesser extent) natural gas, as shown in Table 9 below.

Table 9 Change in carbon factors between SAP 2012 and SAP 10.0

Fuel emission factors ($kgCO_2/kW$ h)	SAP 2012 (9.92)	SAP 10.0
Grid electricity	0.519	0.233
Natural gas	0.216	0.210

Notably, the grid electricity emission factor that could apply from 2018 to 2021 (0.233 $kgCO_2/kW$ h) is less than half of the one used in SAP 2012 (0.519 $kgCO_2/kW$ h). This reflects the rapid reduction in emissions from the UK national electricity grid. Were these updated emission factors to be adopted in a revised Part L of Building Regulations they would substantially change the reported savings for technologies that gain their carbon saving benefit from displacing grid electricity (e.g. PV and gas-fired combined heat and power (CHP)).

In October 2019, UK Government consulted on the introduction of a Future Buildings Standard and on an interim update to Part L of Building Regulations for non-domestic buildings, and Future Homes Standard and interim update to Part L of Building Regulations for domestic buildings, originally planned for 2020 but later proposed for 2021.

In January 2021 the Government published its response to the consultations, including its proposals for an interim update to Part L of the Building Regulations in 2021 ahead of the introduction of the Future Buildings Standard and Future Homes Standard in 2025.

The final version of the new Part L 2021 Approved Documents was published in December 2021 and will be adopted from the 15th June 2022.

The Approved Documents set out the performance of the notional building against which the 2021 targets will be set. For new buildings this is expected to deliver an average 31% CO_2 saving compared to the current 2013 standards. This improvement will be achieved through enhancements to the building fabric and services efficiency standards currently set in Part L 2013, in addition to the adoption of low-carbon heating and/or renewable generation technologies.

The new Part L 2021 and the accompanying National Calculation Method will introduce a substantial change to the CO_2 emissions associated with electricity use, with each unit of electricity now producing around 65% of the CO_2 emissions of an equivalent unit of gas. In the current Part L 2013 CO_2 emissions for unit of electricity were more than double those of gas. This means that electric based heating systems will have substantially lower CO_2 emissions than those based on gas boilers or gas fired combined heat and power (CHP) systems.

While the calculation software necessary to demonstrate compliance with Part L 2021 was not available while preparing the Application, the Proposed Development has been designed to enable compliance with both the current Part L 2013 and the expected 2021 update that will come into force in June 2021. It is noted that the transitional arrangement period for Part L 2013 applies only where both:

a) The developer has submitted a building/initial notice or deposited plans by June 2022; and

b) Commenced work on each individual building by June 2023.

Work on the Proposed Development is expected to be outside the window for transitional arrangements for Part L 2013. It is therefore expected that the Proposed Development will be required to be built in line with Part L 2021 standards and as such these standards have been an important consideration in developing the energy strategy for the Proposed Development.

The Government's consultation response also sets out initial timescales for the adoption of the Future Buildings Standard. The consultation for this will commence in 2023 to allow the introduction of necessary legislation in 2024, ahead of implementation in 2025.

2.2.2 Regional Policy Drivers

2.2.2.1 Greater London Authority (GLA)

Local planning policy is set within the context of London-wide policy and guidance. The following are identified as potentially relevant to the Proposed Development:

- The London Plan 2021 (Ref. 8)
- Draft Energy Assessment Guidance (Ref. 7)
- London Mayor's Air Quality Strategy (Ref. 10)
- Carbon Offset Funds (Ref. 17)

For energy purposes, the regional policy requires that the CO_2 emissions arising from developments are reduced in accordance with the Energy Hierarchy (the 'energy hierarchy') and make the fullest contribution to London's adaptation to climate change. All domestic and non-domestic developments should meet the 'zero carbon' target, which requires an on-site reduction in regulated CO_2 emissions of 35% against 2013 Building Regulations Part L and the remaining carbon emissions to be offset to 100%.

This energy strategy aims to follow GLA guidance on preparing energy assessments, which sets out "*how to prepare an energy assessment to accompany strategic planning applications... [and] demonstrate that climate change mitigation measures comply with London Plan energy policies".*

The following excerpts and summaries provide an outline of planning policy requirements with regard to energy and CO_2 emissions from the Proposed Development.

London Plan (2021) Policy SI 2 Minimising Greenhouse Gas Emissions

Policy SI 2 within the London Plan (Ref. 8) states:

A Major development should be net zero-carbon This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

1) be lean: use less energy and manage demand during operation

2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly

3) be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site

4) be seen: monitor, verify and report on energy performance.

B Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

C A minimum on-site reduction of at least 35 per cent beyond Building Regulations (REF) is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

1) through a cash in lieu contribution to the borough's carbon offset fund, or

2) off-site provided that an alternative proposal is identified and delivery is certain.

D Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.

E Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.

Policy SI 2 expects any shortfall in on-site carbon savings relative to the overall 'zero carbon' 100% target to be made up through offsetting. Arrangements for offsetting are the responsibility of the Local Planning Authority (LPA) (i.e. London Borough of Hillingdon (LBH)).

The GLA has issued guidance on carbon offset funds to LPAs, which includes options for cash in-lieu payments into a local offset fund or developments directly funding carbon reduction projects (Ref. 17). The guidance states *'If the GLA (or the LPA for non-referable planning applications) is satisfied that the development has maximised on-site reductions, but the development is still falling short of achieving net zero carbon, the developer is expected to make a cash-in-lieu contribution to the relevant LPA's carbon offsetting fund. Alternatively, the development can make up the shortfall off-site by funding a carbon reduction project directly, provided the LPA has approved this approach'*.

London Plan (2021) Policy SI 3 Energy Infrastructure

Policy SI 3 within the adopted London Plan (Ref. 8) states:

C Development Plans should:

Identify the need for, and suitable sites for, any necessary energy infrastructure requirements including energy centres, energy storage and upgrades to existing infrastructure

Identify existing heating and cooling networks, identify proposed locations for future heating and cooling networks and identify opportunities for expanding and inter-connecting existing networks as well as establishing new networks.

D Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system with the heat source for the communal heating system selected in accordance with the following heating hierarchy:

a) Connect to local existing or planned heat networks

b) Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)

c) Use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network); and

d) Use ultra-low NO_x gas boilers.

CHP and ultra-low NO_x gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of "Policy SI 1 Improving air quality" to ensure there is no significant impact on local air quality.

Where a heat network is planned but not yet in existence the development should be designed to allow for the cost-effective connection at a later date.

London Plan (2021) Policy SI 4 Managing Heat Risk

Policy SI 4 within the adopted London Plan (Ref. 8) states:

Development proposals should minimise adverse impacts on the urban heat island and should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

1) Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure;

2) Minimise internal heat generation through energy efficient design;

3) Manage the heat within the building through exposed internal thermal mass and high ceilings;

4) Provide passive ventilation;

5) Provide mechanical ventilation;

6) Provide active cooling systems.

GLA guidance on preparing energy assessments (Ref. 7) states that:

It is expected that dynamic thermal modelling of the overheating risk will be undertaken to support the energy assessment

The GLA guidance also includes guidance on how to apply the cooling hierarchy and the information required to be submitted as part of an energy strategy.

London Mayor's Air Quality Strategy

The Mayor's Air Quality Strategy was published in December 2010 (Ref. 10). It requires an emissions assessment of biomass boilers and biomass or gas-fired CHP to be included as part of an air quality assessment submitted with planning applications for new developments.

2.2.2.2 Local policy drivers

London Borough of Hillingdon (LBH)

Policy and guidance documents produced by LBH which are relevant to the development of the Energy Strategy for the Proposed Development comprise:

- The Local Plan: Part 1 – Strategic Policies 'LPP1' (Ref. 11)
- The Local Plan: Part 2 – Development Management Policies 'LLP2' (Ref. 12).
- The Local Plan: Part 2 – Site Allocations and Designations 'LLP2' (Ref. 13).
- SPD 'Hillingdon Design and Accessibility Statement' (Ref. 14)
- SPD 'Planning Obligations' (Ref. 15)

Local Plan Policy EM1 – Climate Change Adaptation and Mitigation

Policy EM1 clauses in The Local Plan: Part 1 are intended to ensure that climate change mitigation is addressed at every stage of the development process and appropriate adaptation measures are adopted, including*:*

- *Ensuring development meets the highest possible design standards whilst still retaining competitiveness within the market.*
- *Working with developers of major schemes to identify the opportunities to help provide efficiency initiatives that can benefit the existing building stock.*
- *Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.*
- *Targeting areas with high carbon emissions for additional reductions through low carbon strategies. These strategies will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.*
- *Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan. Identify opportunities for new sources of electricity generation including anaerobic digestion, hydroelectricity and a greater use of waste as a resource.*
- *Promoting new development to contribute to the upgrading of existing housing stock where appropriate.*
- *Promoting the inclusion of passive design measures to reduce the impacts of urban heat effects.*

Local Plan Policy BE1 – Built Environment

Local Plan Policy BE1 'Built Environment' includes that all new developments should:

> *Maximise the opportunities for all new homes to contribute to tackling and adapting to climate change and reducing emissions of local air quality pollutants. The Council will require all new development to achieve reductions in carbon dioxide emission in line with the London Plan targets through energy efficient design and effective use of low and zero carbon technologies. Where the required reduction from on-site renewable energy is not feasible within major developments, contributions off-site will be sought. The Council will seek to merge a suite of sustainable design goals, such as the use of SUDS, water efficiency, lifetime homes, and energy efficiency into a requirement measured against the Code for Sustainable Homes and BREEAM. These will be set out within the Hillingdon Local Plan: Part 2- Development Management Policies Local Development Document (LDD). All developments should be designed to make the most efficient use of natural resources whilst safeguarding historic assets, their settings and local amenity and include sustainable design and construction*

techniques to increase the re-use and recycling of construction, demolition and excavation waste and reduce the amount disposed to landfill.

Local Plan Policy EM11 – Sustainable Waste Management
Local Plan Policy EM11 'Sustainable Waste Management' includes:

The Council will follow the waste hierarchy by promoting the reduction of waste generation through measures such as bioremediation of soils and best practice in building construction. The Council will promote using waste as a resource and encouraging the re-use of materials and recycling. The Council will also support opportunities for energy recovery from waste and composting where appropriate. The Council will safeguard existing waste sites unless compensatory provision can be made.

Local Plan Policy DMEI 2 – Reducing Carbon Emissions
The Local Plan: Part 2 Development Management Policies 'LLP2' includes that:

A) All developments are required to make the fullest contribution to minimising carbon dioxide emissions in accordance with London Plan targets.

B) All major development proposals must be accompanied by an energy assessment showing how these reductions will be achieved.

C) Proposals that fail to take reasonable steps to achieve the required savings will be resisted. However, where it is clearly demonstrated that the targets for carbon emissions cannot be met onsite, the Council may approve the application and seek an off-site contribution to make up for the shortfall.

Local Plan Policy DMEI 3 – Decentralised Energy
The Local Plan: Part 2 Development Management Policies 'LLP2' includes that:

A) All major developments are required to be designed to be able to connect to a Decentralised Energy Network (DEN).

B) Major developments located within 500 metres of an existing DEN, and minor new-build developments located within 100 metres, will be required to connect to that network, including provision of the means to connect to that network and a reasonable financial contribution to the connection charge, unless a feasibility assessment demonstrates that connection is not reasonably possible.

C) Major developments located within 500 metres of a planned future DEN, which is considered by the Council likely to be operational within 3 years of a grant of planning permission, will be required to provide a means to connect to that network and developers shall provide a reasonable financial contribution for the future cost of connection and a commitment to connect via a legal agreement or contract, unless a feasibility assessment demonstrates that connection is not reasonably possible.

D) The Council will support the development of DENs and energy centres in principle, subject to meeting the wider policy requirements of this plan and in particular on design and air quality.

The Local Plan: Part 2 Site Allocations and Designations 'LLP2', SPDs 'Hillingdon Design and Accessibility Statement' and 'Planning Obligations' were reviewed and no additional planning requirements directly relevant to the energy strategy were identified in these documents.

2.2.3 Summary of key energy targets

The key energy targets relevant to the Proposed Development are summarised as follows:

- Ensure that efficiency standards are sufficient to meet Part L 2013 Target Emission Rates prior to any allowance for low carbon or renewable energy supply options. Target 15% savings from energy efficiency for non-domestic areas and 10% savings for domestic dwellings.
- Meet the GLA aspirations in regard to the heat hierarchy and delivery of heat network infrastructure.

- Achieve the ‘zero carbon’ 100% saving standard for domestic and non-domestic buildings by additional on-site savings and/or offsetting the remaining CO_2 emissions through contribution to offset funds.

2.3 Reporting carbon emissions

This document reports carbon emissions using SAP 10.0 fuel emission factors outlined in Section 1.4 above.

3. Hospital Redevelopment

3.1 Baseline CO_2 emissions and annual energy demand

3.1.1 Building energy modelling

The Hospital Redevelopment was modelled to establish baseline regulated carbon emissions. The GLA carbon emission reporting spreadsheet was used to find the building carbon emissions using SAP 10.0 carbon factors, which are applied in this energy strategy. As required in the GLA guidance on preparing energy statements, the baselines for all building areas assume a gas boiler is used to meet the heating and hot water demands of the Hospital Redevelopment. A copy of the GLA carbon reporting spreadsheet summary page is included in Appendix A and a full excel version has been submitted with this energy strategy.

The Virtual Environment (VE) Compliance module of Integrated Environmental Solutions (IES) Virtual Environment 7.0.13 was used to establish the regulated Target Emission Rate (TER) of the new-build non-domestic elements of "*a development that complies with Part L 2013 of the Building Regulations*", which is the baseline specified in GLA guidance on preparing energy assessments.

Unregulated emissions from electricity use for the Hospital Redevelopment were estimated using the equipment load prediction from the Building Regulations UK Part L (BRUKL) output sheet.

The treated floor area as modelled, the TER and resulting CO_2 emissions are set out in Table 10. Note that the definition of treated floor area for the purposes of Part L of the Building Regulations differs from the definitions of gross and net areas widely used for other purposes. For these reasons, the areas used for modelling will differ from the areas cited in other documents submitted as part of the planning application. The Design and Access Statement submitted with the planning application should be referred to for definitive gross and net areas for the Hospital Redevelopment.

Table 10 Modelled baseline carbon emissions (Hospital Redevelopment)

Use	Total Floor Area (m^2)	TER (SAP 10.0 emissions factors) ($kgCO_2/m^2/year$)	Carbon emissions ($tCO_2/year$)
Overall new-build	74,511.4	31.2	2,324.0

The BRUKL output document for the baseline building is included in Appendix B.

3.1.1.1 Carbon emissions baseline

The total regulated carbon emissions baseline for the Hospital Redevelopment was calculated to be 2,324.0 tCO_2/year. Additional unregulated emissions (e.g. from office equipment / appliances and similar plug-in loads) are calculated to be 2,187.1 tCO_2/year. Baseline emissions for the existing Site are summarised in Table 11.

Table 11 Baseline carbon emissions (Hospital Redevelopment)

	Site-wide carbon emissions ($tCO_2/year$)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	2,324.0	2,187.1

3.2 'Be Lean' – Energy demand reduction

3.2.1 General approach

GLA Guidance on the Preparation of Energy Strategies (Ref. 7) states that a new development should exceed Building Regulations requirements (Part L 2013) through demand reduction measures alone. Non-domestic areas should aim for a 15% improvement from energy efficiency measures, as proposed in the London Plan 2021 (Ref. 8). To this end, consideration has been given to the passive design of the buildings in the Hospital Redevelopment in order to target these requirements.

The passive design measures included in the proposed buildings are outlined in the Design and Access Statement, and include:

- Efficient building fabric with U-values optimised to reduce heating and cooling loads.
- Solar control glazing to optimise daylighting and thermal gains whilst minimising cooling demand.
- Service routes minimised to reduce heat loss.
- Solid panels and shading included in the building façade to manage solar gains.

Energy efficient equipment has also been proposed where practicable, including energy efficient lighting and ventilation systems. The BRUKL input document is included in Appendix C and confirms the full specifications used when modelling the savings from energy efficiency. All proposed values meet or exceed the Part L2A minimum values.

The approach taken to energy efficiency is to aim for a consistent incremental improvement across the majority of energy efficiency parameters, avoiding reliance on exceptionally demanding specifications for particular fabric or services elements, and retaining flexibility and scope for optimisation during detailed design. Consideration was also given to achieving a balance between reducing energy demands and the avoidance of overheating.

Despite the energy efficiency measures that have been incorporated in the Hospital Redevelopment, there are limitations for healthcare buildings which impact the savings calculated at the 'Be Lean' stage. These limitations relate to the auxiliary energy required for fans and pumps and limitations in the modelling of energy required for domestic hot water (DHW) and are detailed in section 3.2.1.2 below.

3.2.1.1 Carbon emissions – 'Be Lean'

Incorporating the energy efficiency measures summarised above, the regulated carbon emissions for the Hospital Redevelopment were calculated at the 'Be Lean' stage of the GLA energy hierarchy.

Incorporating the energy efficiency measures described above, the calculated regulated carbon emissions are 2,697.2 tCO_2/year for the Hospital Redevelopment using SAP 10.0 carbon factors, as shown in Table 12.

As summarised in Table 13 below, this represents an increase of 373.1 tCO_2/year or 16% from the baseline regulated emissions. Further details and explanation of this increase are provided below and in Table 14.

Table 12 Carbon emissions after demand reduction (SAP 10.0 carbon factors) (Hospital Redevelopment)

	Carbon emissions for new building (tCO_2/year)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	2,324.0	2,187.1
After energy demand reduction	2,697.2	2,187.1

Table 13 Regulated carbon savings from energy efficiency (SAP 10.0 carbon factors) (Hospital Redevelopment)

	Regulated new-build carbon savings	
	(tCO_2/year)	(%)
Savings from energy demand reduction	-373.1	-16%

3.2.1.2 Modelling and design limitations for hospital buildings – 'Be Lean'

GLA planning policy encourages on-site regulated carbon savings of 15% against the baseline from energy efficiency measures alone (the 'Be Lean' stage). The nature of a healthcare building makes these targets difficult to achieve. Primarily, this is due to the auxiliary energy required for fans and pumps and limitations in the modelling of energy required for domestic hot water (DHW).

The building is being designed to follow guidance in the Department of Health's Health Technical Memorandum 03-01: Specialised ventilation for healthcare premises (Ref. 18). The ventilation rates applied to the hospital building range from 6 AC/hr for general wards,

to 10 AC/hr for operating theatres. The Building Regulations 2010 Part L national calculation methodology is not primarily designed for use on healthcare buildings. Higher air change rates are reflected in Part L models by the need to increase specific fan power of fans in the building. The notional fan powers for healthcare buildings do not reflect the requirements outlined in the Health Technical Memorandum, which need greater air change rates and therefore higher fan powers than, for example a good practice office building. Where air change rates range from 6 to 10 AC/hr in the Hospital Redevelopment in order to meet the HTM requirements, a typical office would require only 3 to 4 AC/hr to achieve best practice levels of fresh air. For this reason, fan powers for the proposed building are higher than expected in the notional building and result in a high energy use for auxiliary power. This places limitations on the regulated carbon savings which can be reported.

The notional building includes a number of set parameters on DHW that do not reflect the requirements for hospital buildings. The baseline building for Part L use a 95% efficient gas boiler with no storage losses and 5% distribution losses, effectively assuming that heating is provided by localised boilers close at the point of use. The 'Be Lean' case uses a 91% efficient gas boiler (the same as for space heating) and includes storage losses but no distribution losses. As the actual building is a large-scale hospital building, localised boilers for DHW are not practical and an ambient loop system is proposed to distribute heat at a very low 'ambient' temperature (35°C) before water to water heat pumps increase the temperature from the ambient loop for localised DHW. This results in a significant length of ambient loop distribution and secondary DWH pipework (and therefore surface area for heat loss) despite the pipework being highly insulated. The efficiency improvement of the ambient loop is not reflected in the 'Be Lean' stage, as the system cannot be applied to the model with a gas boiler, so the savings from the ambient loop system are instead reflected in the 'Be Green' stage. This methodology means that the as-modelled DHW carbon emissions at the 'Be Lean' stage are larger than for the baseline case, despite the Hospital Redevelopment using a highly efficient ambient loop system as a centralised building scale network with localised plant rooms.

Table 14 outlines energy uses across the Hospital Redevelopment as reported for the baseline and actual building for the 'Be Lean' stage in the BRUKL model in kW h/m^2/year. As shown, in excess of one half of the notional building energy consumption is from DHW and auxiliary power. Due to the air change requirements within the building and Part L DHW modelling limitations, there is limited scope to reduce auxiliary energy whilst meeting the performance required for healthcare buildings.

Table 14 Baseline and actual 'Be Lean' energy consumption and savings (Hospital Redevelopment)

	Space heating	DHW	Lighting	Auxiliary	Cooling	Total	Total (excluding DHW and auxiliary)
Baseline (kW h/m²/year)	5.6	59.1	41.1	21.2	15.2	**142.2**	**61.9**
Actual (kW h/m²/year)	3.9	95.0	29.7	27.5	10.7	**166.8**	**44.3**
Saving (kW h/m²/year)	-1.7	+35.9	-11.4	+6.3	-4.5	**+24.6**	**-17.6**
Saving (%)	-30%	+61%	-28%	+30%	-30%	**+17%**	**-28%**

As shown in Table 14, energy demands for DHW of 59.1 kW h/m²/year and auxiliary energy of 21.2 kW h/m²/year make up more than one half of the total regulated energy demands of 142.2 kW h/m²/year for the baseline. The air change (and therefore fan power) and DHW requirements in the building limit the overall savings available, as auxiliary energy and DHW forms a significant proportion of the overall energy use. Other energy uses in the building achieve energy consumption reductions of 30% for space heating, 28% for lighting and 30% for cooling, all in excess of 15%.

3.3 Overheating risk analysis

In accordance with the GLA guidance on preparing energy assessments (Ref. 7), the overheating risk has been considered for the Hospital Redevelopment.

The Hospital Redevelopment is primarily a healthcare building with a mixture of clinical hospital and administrative spaces. Wherever practical, passive solutions to minimise heat and solar gains to reduce overheating have been considered. Many areas of the hospital building, for example operating theatres, are unsuitable for natural ventilation. In addition, HTM 03-01 (Ref. 18) sets ventilation rates ranging from 6 AC/hr for general wards, to 10 AC/hr for operating theatres. In order to meet the ventilation requirements for the building, a combination of spaces with mechanical cooling and spaces with mechanical ventilation only (delivering pre-treated 'tempered') air, are proposed.

The cooling hierarchy has been considered in order to reduce the cooling loads where possible, as outlined below:

1. **Minimising internal heat generation through energy efficient design:**
   - Where possible the heat distribution infrastructure within the proposed building has been designed to minimise pipe lengths.
   - Efficient lighting has been specified which incorporates dimming in the office areas where there is sufficient daylight.
2. **Reducing the amount of heat entering the building in summer:**
   - High performance solar control glazing has been specified which will reduce heat gains through windows.
   - Shading from window reveals and other architectural elements has been incorporated into the design.
   - Glazing ratios have been optimised to maximise daylight whilst limiting unwanted solar gains.
   - Large glazing areas are present only on the North-East facing facades to reduce peak solar gains during summer.
3. **Use of thermal mass and high ceilings to manage the heat within the building:**
   - The fabric specifications include a high level of insulation and air tightness which reduces the external conduction gains during summer months when the air temperature is high.
4. **Passive ventilation:**
   - As described above, the ventilation requirements for this building type which prevent openable windows being part of the building design.
5. **Mechanical ventilation:**
   - The building is mechanically ventilated, but the type of building means that it is expected by users that mechanical cooling will be included for some building areas. Where cooling plant is required, efficient plant is specified to reduce energy used for mechanical cooling.

3.3.1 Mechanically cooled areas

The measures described above, which form part of the design, have ensured that the cooling load in the Hospital Redevelopment is reduced as far as possible in line with the cooling hierarchy. However, as a result of the proposed 'tempered' air system and modelling limitations, it has not been possible for the 'actual' design of the building to reduce the cooling demand below the 'notional' building. The actual cooling demand exceeds the notional cooling demand across the spaces with mechanical cooling by approximately 3.6% (the actual is 191.7 MJ/m^2 compared with 185.1 MJ/m^2 for the notional). Table 15 below shows the notional and actual building cooling loads.

The building design includes mechanical ventilation which supplies 'tempered' air to occupied spaces. The tempered air will be conditioned to 20°C before being supplied to the spaces. The majority of spaces will be cooled using only this tempered supply air; but there are a number of room types (e.g.

operating theatres) with local mechanical cooling to supplement the tempered air. This is to avoid overheating in these spaces and provide room level temperature control for patients and staff. Temperature set points vary room by room depending on the activity in each space as assigned by the national calculation methodology (NCM) templates applied and typical cooling set points range between 23°C and 25°C across different rooms.

The tempered air system has been applied as a 'changeover mixed-mode' system in the Part L model as the closest suitable way to incorporate this element of the design. The modelling methodology and software does not allow for a tempered air system, which supplies conditioned air at a constant 20°C, to be accurately included, as the temperature of supply air is fixed by the NCM templates in a Part L simulation. By applying a 'changeover mixed-mode' system in the Part L model it increases the cooling set point in the room where it is applied, meaning the model will first use mechanical supply air only to maintain a comfortable temperature and then switch to mechanical cooling if this higher set point is exceeded. This means that the model effectively assumes that mechanical ventilation provides cooling until the cooling set point is reached in those spaces, at which point is initiates local mechanical cooling systems to ensure the set point is not exceeded.

Furthermore, the notional building model assumes that all spaces with tempered air systems are cooled with mechanical cooling at the standard set points and therefore the temperature difference between adjacent spaces is low. In the actual building model, the temperature difference between adjacent spaces could be much greater as a result of the tempered air approach, which results in higher internal conduction gains in rooms which are mechanically cooled from the surrounding tempered air only rooms. Despite internal heat gains from people and equipment remaining the same from notional to actual, and the lighting demands (therefore internal heat gains from lighting) being lower in the actual than the notional, these increased internal conduction gains contributes to a net increase in internal heat gains compared to the notional, leading to higher cooling demands.

Table 15 BRUKL notional and actual building cooling demands (Hospital Redevelopment)

	Area weighted average building cooling demand (MJ/m^2)	Total cooling demand (MJ/year)
Notional	185.1	13,795,395.3
Actual	191.7	14,280,804.3

3.3.2 Passively cooled areas

An Overheating Risk Analysis report has been produced for the Hospital Redevelopment (see the full report in Appendix E). The report has been prepared in accordance with the requirements of the GLA Draft Energy Assessment Guidance (Ref. 7) and focusses on the overheating risk of the non-cooled, occupied spaces in the Hospital Redevelopment, in accordance with the criteria set out in CIBSE TM52 guidance 'The limits of thermal comfort: Avoiding overheating in European buildings'.

The overheating risk analysis has been carried out against CIBSE TM52 as per the GLA guidance. Using the London Heathrow weather tape (DSY1), all non-cooled occupied rooms are found to pass the criteria in CIBSE TM52.

3.4 'Be Clean' – Decentralised energy

3.4.1 Decentralised heat networks

The London Plan 2021 (Ref. 8) expects developers to consider carbon savings which are achievable through decentralised energy networks. Policy SI3 confirms that major development proposals within Heat Network Priority Areas (which includes the site) should have a communal heating system. The heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

1. Connect to local existing or planned heat networks;
2. Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required);
3. Use low emission CHP (only where there is a case for CHP to enable the delivery of an area-wide heat network);
4. Use ultra-low NO_x gas boilers.

Relevant options for the Hospital Redevelopment are considered below in the context of these policies. The London Plan 2021 moves away from CHP as a preferred option as decarbonisation of grid electricity makes heat pump and other electric based technologies more favourable.

The current GLA guidance on preparing energy statements (Ref. 7) also outlines a hierarchy for selecting energy systems which can be summarised as follows:

1. Connection to an area wide heat network
2. Communal heating systems (Site wide or building level)
3. Individual heating systems.

The GLA guidance on preparing energy assessments recommendation that the SAP 10.0 carbon factors are used for energy strategies, as has been done in this report. This further demonstrates a move away from CHP technology and these influences have been reflected in this energy strategy.

3.4.1.1 Connection to existing or planned heat networks

The London Heat Map (Ref. 16) has been consulted in order to determine whether there are any existing or planned heat networks within the vicinity of the development. In the map extract in Figure 3 below, the site location is marked with a red star. The map shows that there are no existing heat networks in the vicinity of the Hospital Redevelopment (which would be shown in red if these were present). A proposed heat network between Hillingdon Hospital and Bishopshalt School is shown in orange.

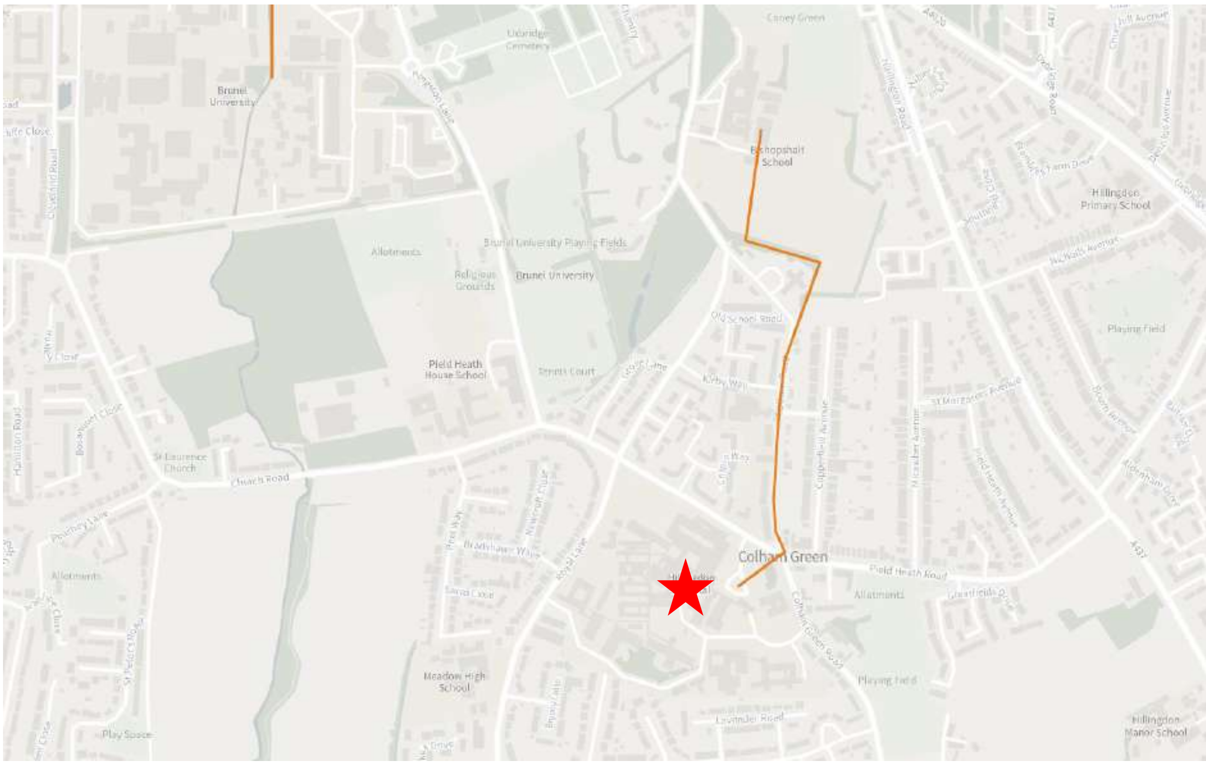

Figure 3 Extract from London Heat Map showing the proposed heat networks in orange (the site is shown with a red star)

Further investigation of nearby potential heat networks was undertaken, including discussions with LBH. LBH confirmed that the proposed heat network between the sites of Bishopshalt School and Hillingdon Hospital has not been developed. A copy of the correspondence with LBH is included in Appendix F.

AECOM were made aware of a potential local heat network by SSE on 24th February 2022, which is currently at the early feasibility stage. Further details of the potential network has been requested from SSE, but no further information has been received at the time of writing (see Appendix F for email correspondence). Further details are required in order to determine the feasibility of the Hospital Redevelopment (or Masterplan Development) connecting in the future. This is subject to SSE progressing the heat network project past the feasibility stage, the timing of the development of the network, the geographical extent of the network that is proposed (and distance that would be required to connect the Proposed Development), the heat source for the network (and its carbon intensity), as well as further technical details.

Due to the early stage of the heat network proposals and the lack of available information, connection to the network is not proposed at this stage. However, the Hospital Redevelopment will provide space for a plate heat exchanger, allowing it to connect to a district heating network in future if one is developed. This is discussed in more detail in Section 3.4.1.2.

3.4.1.2 Site-wide heat network

It is proposed that a building scale network is provided for the Hospital Redevelopment. A single heat network will serve the whole hospital development. Capped off connections will be provided to the retail units so that tenants can connect to the building heating and cooling network if they prefer. Tenants may be given the option to install their own air source heat pump systems if their use and demand requires this; however, the Hospital Redevelopment has the capacity and infrastructure in place to serve all heating and cooling demands on-site through the central systems should this be required.

In the MSCP there will only be a small heating and cooling load to serve the café. As the load will be nominal compared to the hospital it was deemed that there was no value in connecting the two buildings in a network as doing so would introduce additional system losses.

Figure 4 shows that space has been allocated for plate heat exchangers, within risers for pipework and to run pipes through the external wall in the Hospital Redevelopment design to facilitate connection to a potential future district heat network, in line with London Plan policy SI 3. The proposed building scale heating system allows for a single connection to serve the whole hospital building. Such a connection could be used to provide heating and hot water to the Hospital Redevelopment. The connection point is on the boundary of the building, allowing direct access to the exterior. Figure 4 shows that, for the Hospital Redevelopment, the space for the plate heat exchangers would be on level 7 with space allowed for within risers 7 and 10.

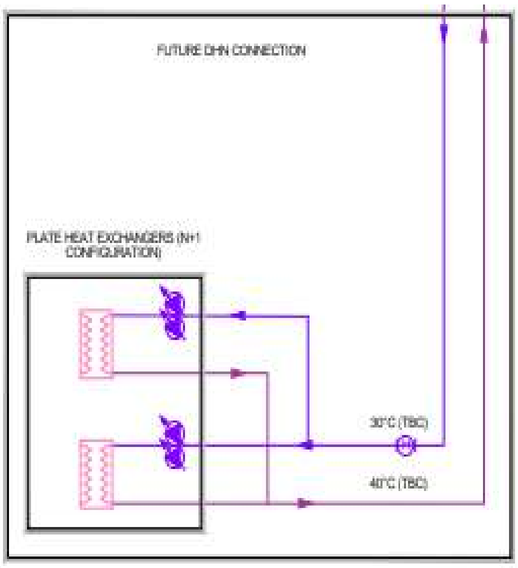

Figure 4 Space allocation for plate heat exchangers for district heating connection in the hospital building design schematic

Figure 5 Space allocation for plate heat exchangers (shown in red) and risers (shown in blue) for district heating connection in the hospital building level 7 floor layout

A building scale heating system is proposed for the Hospital Redevelopment. There are no localised or point of use heating systems proposed for this development. There are local plantrooms located at levels 3 and 5 with strategically located MEP risers to reduce distribution losses and limit energy consumption for fans and pumps.

3.4.1.3 Zero-emission or local secondary heat sources

AECOM investigated the availability of local secondary heat sources. One nearby potential heat source was identified – the Clinical Waste Incinerator at the existing Hillingdon Hospital (‘the incinerator’).

Incinerator

To the north of the site is an incinerator, (shown with a purple dot in Figure 6). The Hillingdon Hospitals NHS Foundation Trust, has confirmed that the incinerator is currently out of operation (since 2019) but previously supplied heat to the existing Hillingdon Hospital building, supplemented by gas boilers. Refurbishment of the incinerator is underway to extend the life of the clinical waste incinerator at the Hillingdon Hospital site. Recommissioning the plant started in July 2021. It is likely that the works will be completed around June 2022. The incinerator will continue to support the existing hospital for the duration of its remaining operation (approximately 7-10 years). The Hospital Redevelopment is likely to be completed in 2027 and the decant of the existing hospital buildings are likely to continue until approximately 2030. The incinerator repair/refurbishment does not form part of this planning application. Based on the timescales around the incinerator repair/refurbishment and the new hospital redevelopment/decant from existing hospital buildings, the new hospital redevelopment will not be connected to the incinerator. The incinerator will be decommissioned when the decant of the existing hospital buildings is complete, so the incinerator is not considered to be a viable heat source for either the Hospital Redevelopment or Masterplan Development.

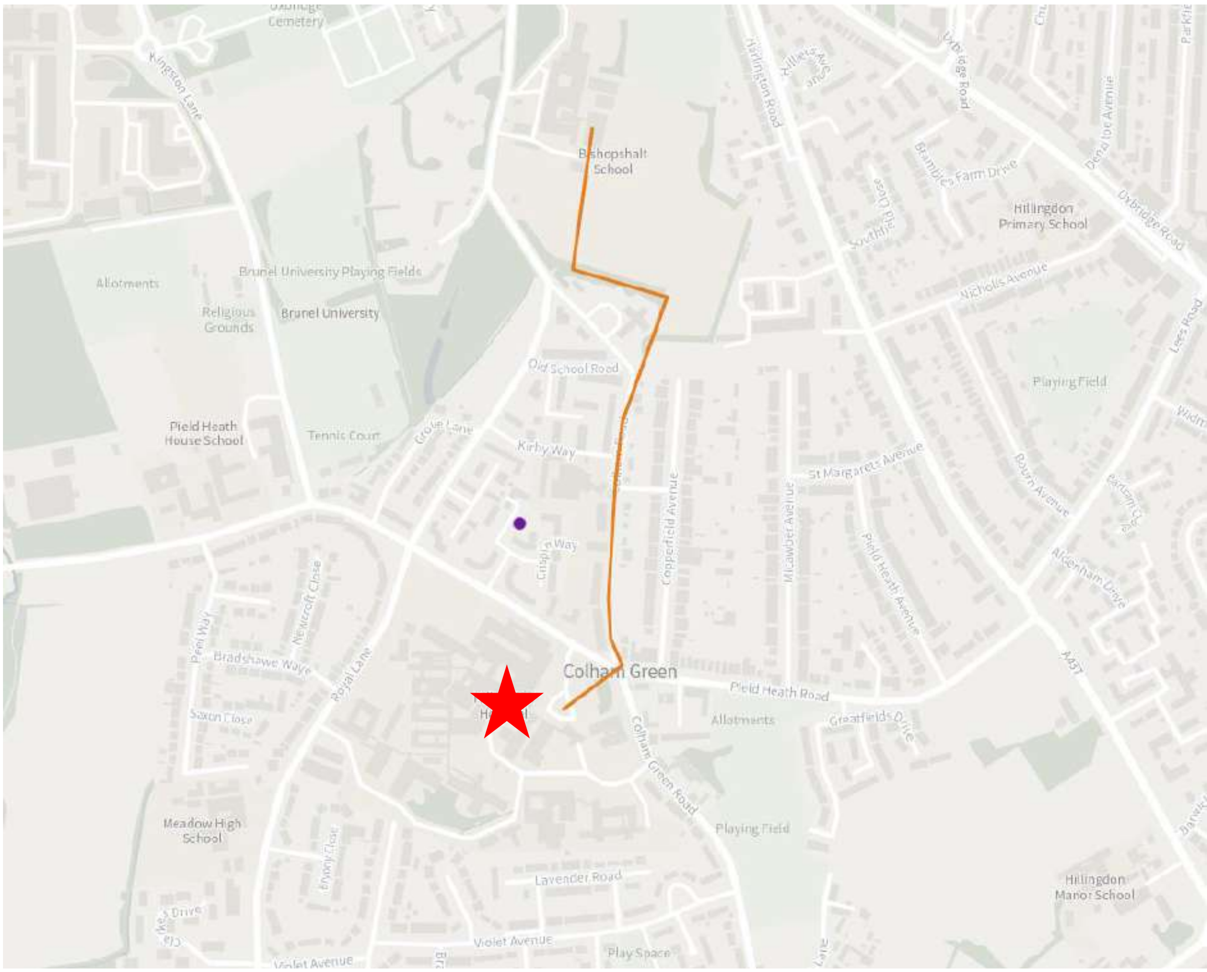

Figure 6 Extract from London Heat Map showing the proposed heat networks in orange and the incinerator in purple (the site is shown with a red star)

3.4.2 Air Quality

The impacts of the development on local air quality have been considered during design. The Hospital Redevelopment Site falls within Hillingdon Air Quality Management Area (AQMA). An Air Quality Assessment has been prepared for the Hospital Redevelopment and is submitted with the planning application and should be consulted for more detailed information on air quality. This includes an Air Quality Neutral Assessment of the Hospital Redevelopment.

No combustion on Site is proposed for the normal operation of the Hospital Redevelopment and this is expected to help to limit the negative impacts from the operation of the Hospital Redevelopment on local air quality. The air quality assessment model found that, during operation, the Hospital Redevelopment is predicted to have a negligible impact on local air quality [1].

The Air Quality Assessment concludes that; "*The Hospital Redevelopment is predicted to have a negligible impact on local air quality" and "The Hospital Redevelopment has a negligible impact at all existing receptor locations, in accordance with the IAQM/EPUK significance criteria. Overall, the Hospital Redevelopment operational traffic impacts on local air quality are considered to be not significant."*

3.4.3 'Be Clean' results summary

Connection to district heating networks or installation of on-site CHP systems is not proposed for this Site. Therefore, the carbon savings for this stage of the energy hierarchy remain the same as after the 'Be Lean' stage. For completeness, the carbon emissions and savings for this stage of the energy hierarchy are shown below.

3.4.3.1 Site carbon emissions – 'Be Clean'

After decentralised energy, the calculated regulated carbon emissions are 2,697.2 tCO_2/year for the Hospital Redevelopment, as shown in Table 16.

As summarised in Table 17, the Hospital Redevelopment achieved no carbon savings from CHP or district heat networks.

Table 16 Carbon emissions after district heating (Hospital Redevelopment)

	Carbon emissions (tCO_2/year)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	2,324.0	2,187.1
After energy demand reduction ('Be Lean')	2,697.2	2,187.1
After heat network/CHP ('Be Clean')	2,697.2	2,187.1

Table 17 Regulated carbon savings from district heating (Hospital Redevelopment)

	Regulated carbon savings	
	(tCO_2/year)	**(%)**
Savings from energy demand reduction	-373.1	-15%
Savings from heat network/CHP	0.0	0%

3.5 'Be Green' – Renewable Energy

This section provides a summary of the feasibility assessment carried out into the options for incorporating low and zero carbon energy technologies into the Hospital Redevelopment and details the system which will be adopted.

3.5.1 Technology options appraisal

3.5.1.1 Scope

The London Plan states that within the framework of the energy hierarchy (Policy SI 2), major development proposals should provide a reduction in expected carbon emissions through the use of on-site renewable energy generation, where feasible. This section summarises the appraisal of renewable options that has been undertaken for the Hospital Redevelopment. The following technologies were considered:

- Photovoltaics (PV);
- Solar thermal water heating;
- Ground source heat pumps (GSHP);
- Air source heat pumps (ASHP);
- Biomass heating; and
- Wind turbines.

3.5.1.2 Feasibility Assessment

Photovoltaics

AECOM considered the potential to install PV on the roofs of the Hospital Redevelopment. Avoiding overshadowing of a PV array is critical to its energy output, carbon savings, and cost-effectiveness, so the first step in assessing PV options for a site is to identify suitable unshaded locations to mount PV panels. Solar insolation modelling was undertaken for the proposed hospital buildings to find the most suitable locations for PV panels. An image of the modelling is shown in Figure 7. The modelling was completed on a previous design iteration of the concept design, but the building massing and orientation is similar to the chosen design and the results are therefore suitable to inform panel locations.

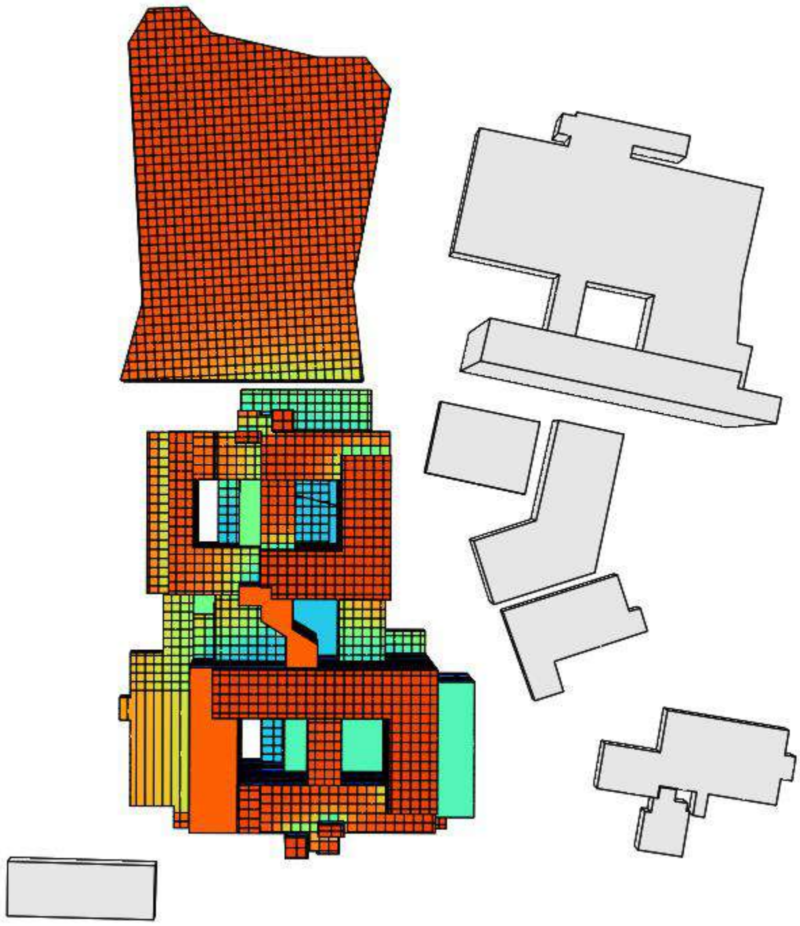

Figure 7 Solar insolation model outputs for the hospital building and MSCP (birds eye view)

The solar insolation modelling study has informed the locations for PV panels. The study supported an extensive area of PV panels for the largely unshaded MSCP roof and PV panels on the roof of the hospital building. Note that the concept design for the Hospital Redevelopment has changed from that shown in Figure 7 and the eastern roof levels which were previously proposed as being raised above the western roof areas are now at the same level, and shading of the western roof areas is reduced. Hence, the PV panels are proposed to be on frames situated on the western roof of both the hospital building and MSCP. Figure 8 and Figure 9 respectively show the proposed PV panel locations. The size, number and location of PV panels is indicative. The layout of PV panels is subject to further coordination.

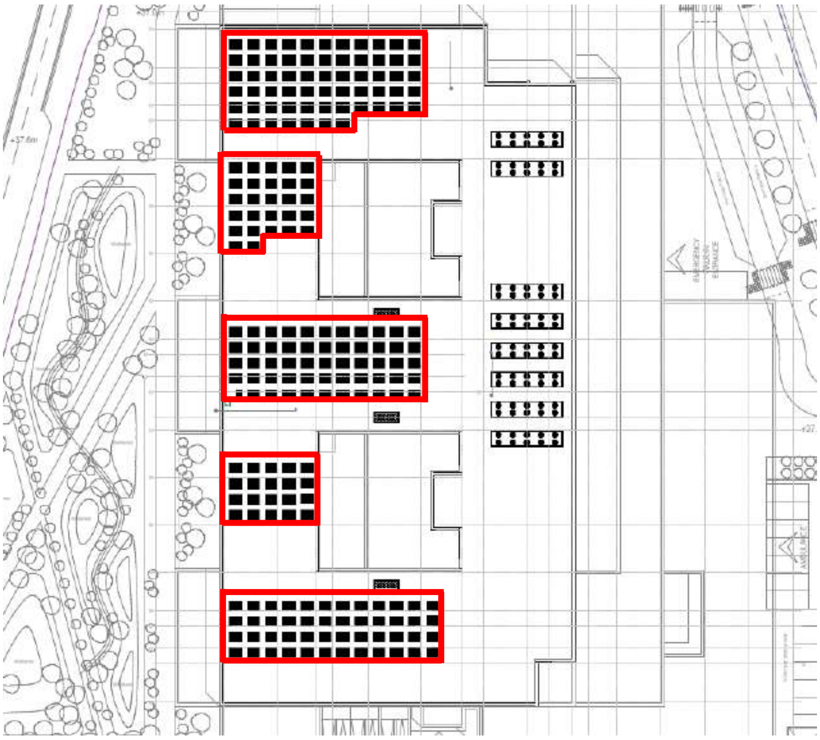

Figure 8 Proposed indicative PV panel array location on the new hospital building roof (shown in red)

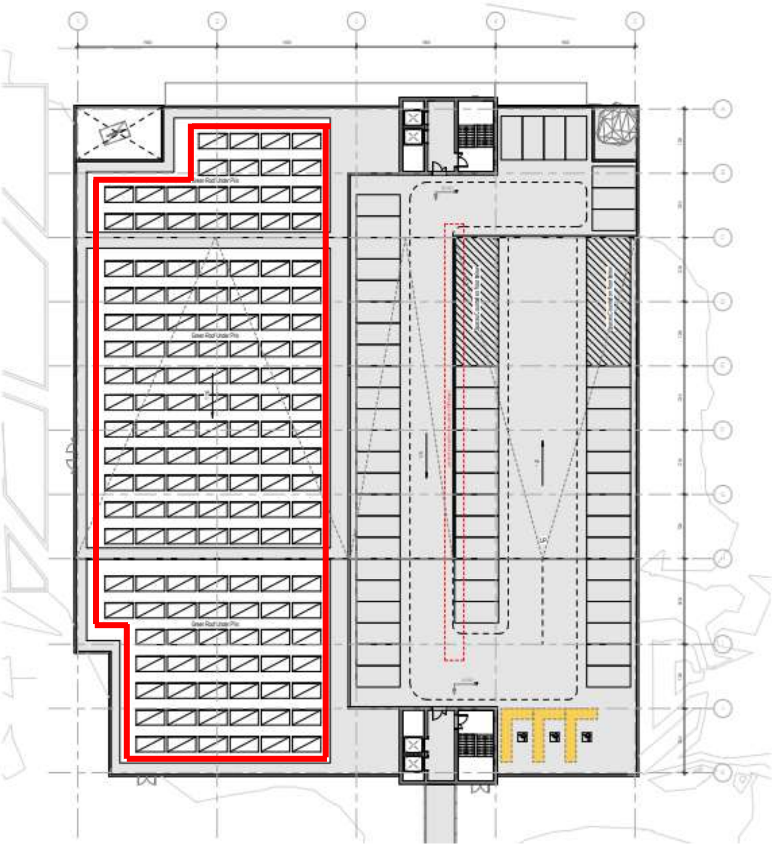

Figure 9 Proposed indicative PV panel array location on the MSCP roof (shown in red)

The location of the PV panels on the hospital roof is limited by plant location, the plant equipment is not suitable to have panels installed directly above them due to their requirement for flues or for unrestricted airflow. The potential area for PV panels on the MSCP is limited by parking spaces on the roof. To maximise the efficiency and output of the PV panels and allow for biodiversity benefits, PV panels are proposed to be mounted on top of green roofs for both the hospital and MSCP. To enable the green roofs to naturally flourish, spacing has been kept within the panels to allow adequate sun and water to penetrate the PV array.

It is estimated that the available roof areas identified could accommodate approximately 969 m^2 of PV panels, at an orientation of 212° from north.

The electricity generation of the Hospital Redevelopment was modelled using the Part L compliance software. The performance and assumptions of the proposed system are summarised in Table 18.

Table 18 Photovoltaics summary (Hospital Redevelopment)

Parameter	Value
PV module nominal efficiency (%)	20
Nominal cell temperature (NOCT) (°C)	42
Reference irradiance for NOCT (W/m^2)	1,000
Temperature coefficient for module efficiency (K^{-1})	0.36
Electrical conversion efficiency	95%
Panel surface area (m^2)	820 m^2 (Hospital Building) 149 m^2 (MSCP)
Model azimuth (° clockwise from north)	212
Inclination (° from horizontal)	10
Array size (kW_P)	148
Electricity generated (kW h/year)	163,464
Carbon savings (tCO_2/year)	38.1
Carbon savings (%)	1.6%

AECOM found that a PV array of approximately 969 m^2 of panel area could produce, 163,464 kW h of electricity per year, saving approximately 38.1 tCO_2/year.

Solar thermal water heating

PV has been proposed for the Hospital Redevelopment and solar thermal water heating would compete with PV for the available roof space with PV. As discussed later in this section, ground source and air source heat pumps are the primary LZC technology proposed for the Site and are to be used for water heating where possible.

Accommodating the inclusion of solar thermal collectors would also require additional infrastructure and plant space. As the site has a significant regulated and unregulated electricity load, it is judged that PV would be more suitable for this Hospital Redevelopment than solar thermal water heating.

It is considered that no further study of solar thermal water heating is warranted at this stage as PV is preferred over solar thermal water heating.

Heat pumps

Water source heat pumps

There are no significant bodies of water nearby to the site which could be used for water source heat pumps.

Ground source heat pumps

Ground source heat pump (GSHP) technology could be used to provide heating and cooling to the proposed building. AECOM investigated the potential to incorporate GSHP technology into the Hospital Redevelopment. Open loop GSHP was investigated however it was deemed that the system would add risk to the Hospital Redevelopment due to impacts on project programme, uncertainty around groundwater flows and the availability of groundwater as a secure heat source into the future, particularly in the context of the large energy demands for the hospital building. An on-site borehole investigation would be required to understand the groundwater flows beneath the Site. These investigations combined with the time and uncertainty around securing a license from the Environment Agency for extraction of groundwater were deemed a significant risk for the Hospital Redevelopment. Furthermore, closed loop GSHP was deemed a viable option and therefore open loop GSHP has not been investigated further.

Closed loop GSHP systems were investigated by AECOM for their potential to provide heating and cooling to the building. Absorber loops could be installed under the building as access to the ground will be available during construction. AECOM undertook a desktop study to determine the approximate heating and cooling which could be provided by a GSHP system which used piles under the building. Preliminary estimates indicate that the ground under the Hospital Redevelopment could accommodate approximately 300 boreholes. Figure 10 shows the proposed borehole layout. Final quantity and locations of boreholes will be dependent upon ground conditions which will be determined by a borehole specialist.

A preliminary assessment of the heat capacity of closed loop GSHP at the Site estimated that approximately 4.1 MW heating and 3.8 MW cooling capacity may be available based on approximately 300 boreholes and 45-50 W/m (length of pile). This estimate has been validated by GSHP manufacturers with experience installing GSHP systems in the local area and is a conservative estimate of capacity. A copy of the preliminary GSHP assessment is in Appendix G. Further investigation of ground conditions and detailed modelling using more realistic loads than the Part L estimates used in the initial assessment will be undertaken post-planning during the detailed design stage. The savings from the combined heat pump systems, including GSHP, are shown in Table 19 below.

Figure 10 Proposed borehole layout under the building shown by the pink highlight – approximately 160 boreholes below the hospital building (south) and 140 below the MSCP (north)

Air source heat pumps

Air source heat pumps (ASHPs) were considered by AECOM as a technology that could work alongside the GSHP to negate the use of gas-fired boilers to meet peak heating demands. Reversible systems were considered which would be able to provide both heating and cooling to the Hospital Redevelopment. Figure 11 shows the proposed location of the ASHP plant on the roof of the building.

AECOM modelled the carbon savings from ASHP systems which could meet the remaining heating and cooling demand for the Hospital Redevelopment that would not be met by GSHP. It is proposed that an additional 2.7 MW of capacity would be required for air source heat pumps (ASHPs). The following specifications are proposed for the ASHP systems:

- The heat pump system will comply with the minimum performance standards set out in the Enhanced Capital Allowance (ECA) product criteria.
- The system will comply with the relevant issues outlined in the Microgeneration Certification Scheme Heat Pump Certification Requirements document.
- End-users will be supplied with information to control and operate the heating system.
- The system will utilise a low temperature supply. The supply temperature is to be confirmed during the detailed design stage. The aim will be to minimise the supply temperature to increase the system efficiency.
- The performance of the system will be monitored post-construction to ensure the predicted performance.

The savings from the combined heat pump systems, including ASHP, are shown in Table 19 below.

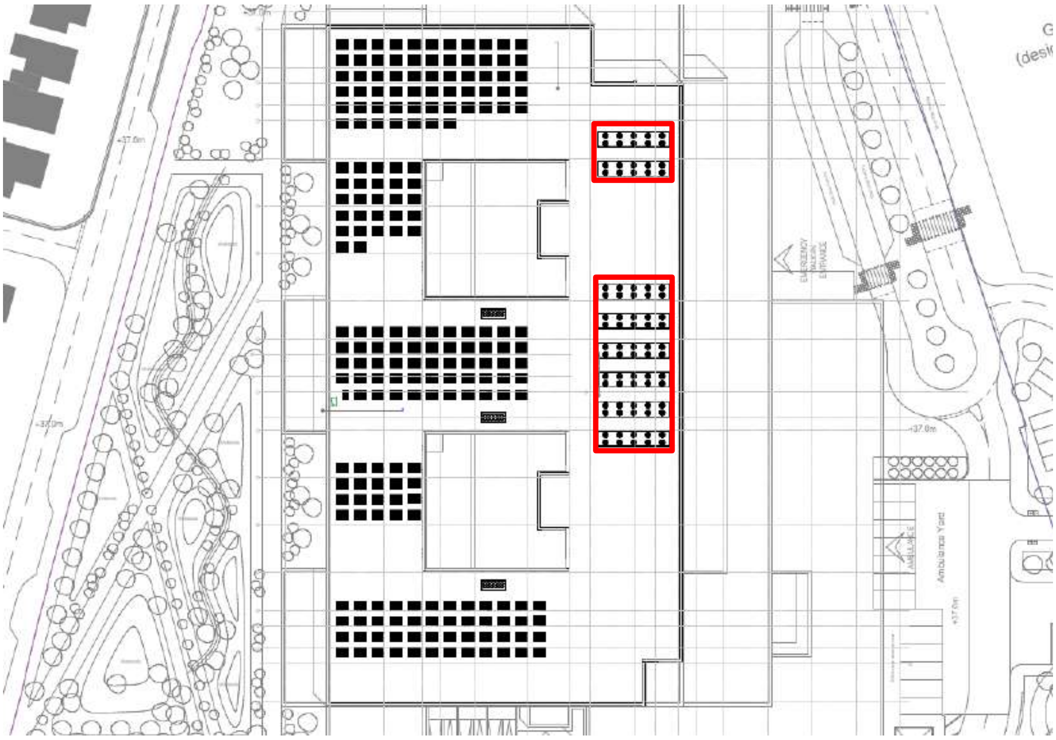

Figure 11 Proposed indicative reversible air source heat pump equipment (shown in red)

Ambient loop, heat recovery and water to water heat pumps

An ambient loop system is proposed to distribute very low ‘ambient’ temperature (35°C) heat around the hospital building to water-to-water heat pumps, which will increase the temperature to 70°C for use for space heating and DHW, and to avoid legionella contamination. GSHP or ASHP systems are not capable of such temperatures without an additional second stage heat pump system or direct electric top up which would lower overall hot water energy efficiency.

In addition to the heat from the GSHPs and ASHPs, heat recovered from waste heat from various local cooling systems will also be fed into the ambient loop. A dynamic simulation of the ambient loop system, heat sources (GSHPs, ASHPs and heat recovery) and water to water source heat pumps has been undertaken using hourly data for a whole year to calculate the seasonal coefficient of performance (SCoP) for heating of the combined system (detailed in Appendix C). The seasonal energy efficiency ratio (SEER) is based on the details provided by equipment manufacturers at a 40/60 split (40% GSHP and 60% ASHP).

The dynamic simulation is based on parameters provided by the mechanical engineers based on available equipment. Full details of the efficiencies modelled, including distribution losses assumed for the heating and cooling systems in the building are included in Appendix C. Representative data sheets for the heat pumps used to provide efficiencies used in the above calculations and in turn used for Part L calculations are provided in Appendix D.

The dynamic simulation assumes that the CoP of the GSHP remains constant at 4.5 (as deep ground temperatures tend to have much lower temperature variations throughout the year) but the CoP of the ASHP varies with outside temperature between a CoP of 3.10 at -5°C and 6.43 at 30°C. The usage split of GSHPs and ASHPs varies throughout the year based on whichever system is most efficient at the time. The set of WSHPs used to increase the temperature to 70°C for use in space heating and DHW have a CoP of 4.01. When the external temperature is high, heat recovered from cooling system will be used to provide space heating and DHW in other areas of the building where required in the first instance, with ASHPs providing additional capacity where required. When the external temperature is low, the GSHPs will provide the heating as they will have a higher CoP. A summary of the overall SCoP for the ambient loop is shown in Table 19. Further investigation will be carried out to ensure the contribution of GHSP to the ambient loop is optimised to ensure that the extraction of heat and coolth from the ground is balanced.

Table 19 Heat pump and ambient loop performance information (Hospital Redevelopment)

Parameter	Value
GSHP CoP (heating)	4.50
GSHP SEER (cooling)	6.67
ASHP CoP (heating)	3.00
ASHP SEER (cooling)	4.82
Water to water source heat pump CoP (heating only)	4.01
Total overall SCoP (heating)	**3.15**
Total overall SEER (cooling)	**5.56**

Thermal stores will be optimised during detailed design to increase system efficiency. For the DHW system, stores of 16,000 litres and 20 litres are proposed to store hot water for the hospital building and MSCP, respectively. The ambient loop system will also act as a thermal store for the hospital building. Thermal stores are also proposed to reduce the peak chiller demand and maximise efficiency.

Heat pump carbon savings

Adding the ASHP, GSHP, water to water heat pumps and ambient loop systems as described above into the energy modelling for the site, the energy and carbon savings were calculated using the BER calculated before and after the incorporation of the heat pumps. Current modelling that the usage split of GSHPs and ASHPs will vary throughout the year based on whichever is most efficient at the time. The calculated carbon savings from heat pumps for the Hospital Redevelopment is shown in Table 20.

Table 20 Heat pump carbon savings (Hospital Redevelopment)

Parameter	Value
CO_2 savings from heat pumps (tCO_2/year) (SAP 10.0)	1,061.4
CO_2 savings from heat pumps (%) (SAP 10.0)	45.7%

AECOM found that using a combination of GSHP and ASHP systems to meet the heating and cooling demand for the development could save approximately 1,061.4 tCO_2/year.

Biomass heating

Biomass heating is expected to have unacceptable local air quality impacts. In addition, the site does not have sufficient space for storage of the required fuel and deliveries to the site would generate unnecessary vehicle journeys onto already congested central London roads. Based on the above, AECOM judged that no further investigation of biomass heating was warranted.

Wind turbines

A general guide is that to make operational and financial sense micro-wind systems need to be sited in locations with an annual average wind speed of at least 5 m/s. This condition is rarely met in urban areas, however for completeness, AECOM checked whether this condition is met on the site.

Research into micro wind turbines in urban areas by BRE suggests that a scaling factor should be applied to the wind resource assumed to be available in urban areas to account for urban ‘roughness’ that reduces the effective available wind resource. The BRE report measured the scaling factor for 5 locations in Manchester (-40%), Portsmouth (-10%) and Wick (-13%). It was assumed that the results for Manchester are the closest match for conditions in London. Due to the cubic relationship between wind speed and wind turbine power output, a 40% reduction in effective wind speed translates into an ~80% reduction in annual energy supply. The -40% scaling factor was applied to Site wind speeds before assessing the wind resource against the rule of thumb.

The Windspeed Database maintained by the former Department of Energy and Climate Change was not available at the time of compiling this report, so another site in London previously assessed by AECOM was used as a proxy for this Site. The unmodified database results and the results scaled to account for urban roughness are shown in Table 21.

Table 21 Windspeed database query results (Hospital Redevelopment)

Height above ground level	Annual average wind speed (unmodified)	Annual average wind speed (scaling factor -40%)
45m	5.9	3.54
25m	5.4	3.24
10m	4.6	2.76

The hub height of a turbine installed on the site would be somewhere in the order of 100 m above ground level. Using linear interpolation, the scaled annual average wind speed at that hub height could be somewhere around 4.8 m/s.

It is likely that a wind turbine located on this Site would have unacceptable visual impacts. In any case, the scaled available wind resource falls short of the levels considered necessary to make such systems sensible. On this basis AECOM judged that no further assessment of wind turbine feasibility was warranted.

3.5.2 Carbon emissions – ‘Be Green’

Ground source heat pumps, air source heat pumps and photovoltaic panels are proposed for the site. The carbon savings from the inclusion of renewable technologies (for the ‘Be Green’ stage of the energy hierarchy) are summarised in this section.

Incorporating the heat pump and PV technology described above, the calculated regulated carbon emissions for the Hospital Redevelopment are 1,597.7 tCO_2/year, as shown in Table 22.

As summarised in Table 23 below, this represents a saving of 1,099.5 tCO_2/year or 47% of baseline regulated emissions achieved by installing renewable technologies on Site.

Table 22 Carbon emissions after renewable energy (Hospital Redevelopment)

	Carbon emissions for new buildings (tCO_2/year)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	2,324.0	2,187.1
After energy demand reduction	2,697.2	2,187.1
After heat network/CHP	2,697.2	2,187.1
After renewable energy	1,597.7	2,187.1

Table 23 Regulated carbon savings from renewable energy (Hospital Redevelopment)

	Regulated non-domestic carbon savings	
	(tCO_2/year)	(%)
Savings from energy demand reduction	-373.1	-16%
Savings from heat network/CHP	0.0	0%
Savings from renewable energy	1,099.5	47%

3.5.3 Energy monitoring – ‘Be Seen’

This section sets out how the Applicant plans to monitor, report on and share energy performance so that energy use can be better understood and managed on an on-going basis, in line with the ‘Be Seen’ element of the London Plan energy hierarchy.

3.5.3.1 Commitments

The ‘Be Seen’ energy monitoring guidance published by the GLA sets out the expectations of the Applicant regarding response to the ‘Be Seen’ requirements. The guidance sets out the process and responsibilities with regard to the policy requirements, including the requirement to report to GLA estimates for energy use using the ‘Be Seen’ spreadsheet not later than 4 weeks after planning approval has been granted.

The Applicant will complete the ‘Be Seen’ spreadsheet, post submission, in line with GLA requirements and will include:

- The required contextual information on the scheme,
- Predicted building energy use,
- Renewable energy, and
- Expected carbon emissions.

The metrics recorded within the GLA 'Be Seen' spreadsheet at planning stage will build upon the Building Regulations compliance modelling undertaken to support this energy strategy document and reflect the figures reported in the supporting GLA Carbon Emissions Reporting Spreadsheet.

It is important to recognise that GLA Guidance on Preparation of Energy Statements requires baseline energy demands and calculated savings to be based on the calculation methods set out in Part L of Building Regulations. These calculation methods are designed for Building Regulations compliance purposes, they are not intended to provide an accurate assessment of the building's expected performance in use. It would not be expected that the metered energy use for the Hospital Redevelopment would align with the energy demand calculations set out in this energy strategy. This is because Building Regulations' calculations assume standard occupancy patterns for generic building uses. The actual occupancy patterns and equipment loads in buildings would be expected to differ from these generic profiles depending on the individual occupant and the equipment they install.

3.5.3.2 'Be Seen' summary

The Applicant will submit the 'Be Seen' reporting spreadsheet to GLA via the dedicated planning-stage webform after planning submission in line with London Plan Policy SI 2 and GLA 'Be Seen' Energy Monitoring Guidance.

A metering strategy to support the 'Be Seen' policy will be developed during the detailed design for the Hospital Redevelopment.

3.6 Flexibility and peak energy demand

The London Plan 2021 policies SI 2 and SI 3 encourage developments to minimise both annual and peak energy demand. This section outlines the measures taken to reduce peak energy demand and increase energy flexibility in the Hospital Redevelopment.

Table 24 outlines the site-wide peak demand, capacity, and flexibility potential for the Hospital Redevelopment.

Table 24 Summary of site-wide peak demand, capacity and flexibility potential (Hospital Redevelopment)

	Electrical	Heat	Enabled through…
Estimate peak demand (MW)	8.4	Note 2	Realistic estimates of demand profiles and peak demand. Note 1
Available capacity (MW)	9.5	N/A	Early engagement with the DNO or IDNO to establish available capacity. Note 3
Flexibility potential (MW)	0.2	N/A	Modelling of flexibility using demand profiles. Note 4
Revised peak demand (MW)	8.2	N/A	Revision to peak demand considering available capacity, engagement with third parties and flexibility potential. Note 5
Percentage flexibility predicted (%)	2.5%	N/A	Calculations from flexibility potential as a proportion of peak demand.

Notes:

1.The current estimated load analysis by AECOM has indicated that the peak electrical load will be approximately 7.3 MVA (~6.4 MW at 0.95 Power Factor) for the hospital building. The multi-storey car park (MSCP), including EV charging with load limiting, will be approximately 1.5 MVA (~1.4 MW at 0.95 Power Factor). The total combined estimate for the Hospital Redevelopment is 8.8 MVA (~8.4 MW at 0.95 Power Factor), based on an all-electric building with none of the proposed enhancements.

2. As the Hospital Redevelopment is designed to produce heat from electricity, the heating figures are not relevant and heat demand is included in the electrical demand column – in line with the GLA guidance document.

3. Through discussions with UKPN, it has been established that up to 10 MVA (~9.5 MW at 0.95 Power Factor) is available to supply the Hospital Redevelopment. This would cover the 8.8 MVA estimated currently for the hospital building and MSCP, with an additional 1.2 MVA capacity for future growth.

4. Flexibility potential has been calculated including thermal inertia of thermal stores to reduce peak GSHP and ASHP demand, and PV contribution.

5. The current basis of design for the Hospital Redevelopment is 8.8 MVA (~8.4 MW at 0.95 Power Factor). As a result of the measures proposed in note 4 a reduction of 2.5% to the peak demand has been estimated.

A number of measures are included in the building to reduce peak energy demand. Passive design measures as outlined in previous sections reduce overall energy demands, in turn reducing peak demand. In addition, a number of additional measures further reduce peak demand. These are summarised in Table 25.

Table 25 Summary of peak demand flexibility interventions (Hospital Redevelopment)

Flexibility achieved through	Yes/No	Details
Electrical energy storage (kW h) capacity	No	No electrical energy storage is proposed.
Heat energy storage (kW h) capacity	Yes	Ambient loop provides heat storage capacity, reducing the number of GSHP and ASHP systems required to meet the peak demand. Heat recovered from waste heat from various local cooling systems will be fed into the ambient loop, reducing the demand for heat supplied by GSHP and ASHP during times that local cooling is required. DHW storage is included allowing hot water to be generated gradually, further contributing to reducing peak demands.
Renewable energy generation (load matching)	Yes	Photovoltaic (PV) panels on the roof help meet the peak electrical demand of the building, reducing the draw from the network. Use of heat pumps over direct electrical systems reduce the peak demands for electricity to provide heating. Efficiencies of heating and cooling systems will be maximised to reduce annual and peak energy demand.
Gateway to enable automated demand response	No	Not considered appropriate for a healthcare facility.
Smart systems integration (e.g. smart charge points for EV, gateway etc.)	TBC	The building and its systems will be controlled by an integrated Smart network, with the ability for electrical and control systems to “talk” to each other. As this is developed through the post-planning detailed design stages, consideration will be given as to how the (maximum) demand from the utility network can be reduced without compromising the resilience and performance of the building.

3.7 Conclusion

3.7.1 Baseline

The Hospital Redevelopment was modelled to establish baseline regulated carbon emissions. The GLA carbon emission reporting spreadsheet was used to calculate the building carbon emissions using SAP 10.0 carbon factors, which are used in this energy strategy. As required in the GLA guidance on preparing energy statements, the baselines for all building areas assume a gas boiler is used to meet the heating and hot water demands.

An estimate of unregulated electricity use and the associated carbon emissions was also made.

The regulated baseline carbon emissions were calculated to be 2,324.0 tCO_2/year. The site-wide unregulated emissions were calculated to be 2,187.1 tCO_2/year.

3.7.2 'Be Lean' – Energy demand reduction

The passive design measures included in the proposed building are outlined in the Design and Access Statement which is submitted in support of the planning application and summarised in Section 3.2. The Hospital Redevelopment meets and exceeds Criterion 1 of Building Regulations Part L 2013 (BER ≤ TER) through energy efficiency measures alone. This means that carbon savings from any LZC technologies will be additional to those secured through Building Regulations.

The approach taken to energy efficiency is to aim for a consistent incremental improvement across the majority of energy efficiency parameters, avoiding reliance on exceptionally demanding specifications for particular fabric or services elements, and retaining flexibility and scope for optimisation during detailed design. Consideration was also given to achieving a balance between reducing energy demands and the avoidance of overheating.

Based on the proposed fabric and energy efficiency measures, the regulated carbon emissions were calculated to be 2,697.2 tCO_2/year. This represents an increase from the baseline of 16%. The reasons for this increase despite the good building fabric and services specifications are outlined in Section 3.7.8.1.

3.7.3 'Be Clean' – District heating

A review of the London Heat Map indicates that there are no existing district heat networks near to the site. Further investigation found there are two potential networks close to the site. However, the network between Bishopshalt school and Hillingdon hospital was confirmed to have never been built by The London Borough of Hillingdon. The SSE potential network is still in the feasibility stage, so no further information is available at the time of producing this energy statement.

The design of the proposed Hospital Redevelopment plant will allow for connection to a district heat network in future if one is developed and plant space for plate heat exchangers has been considered and included in the design.

On-site CHP was dismissed as an option on this Site due to concerns over the impact on local air quality and the less-favourable carbon emissions calculated when using SAP 10.0 carbon factors.

As no connection to a district heating network or on-site CHP system is proposed, no carbon savings are reported from the 'Be Clean' stage of the energy hierarchy.

3.7.4 'Be Green' - Renewable energy generation

A feasibility assessment of low and zero carbon technology options for the site found ASHP, GSHP and PV panels to be suitable for the Site. Other technologies were ruled out due to site constraints, air quality and access issues or incompatibility with the preferred options. Water source heat pumps were dismissed as there are no significant bodies of water nearby to the site. Both GSHPs and ASHPs are required to meet the entire Hospital Redevelopment load.

A combination of ground and air source heat pumps are proposed to provide heating and cooling to the building. The hot water demand will be met by water to water heat pumps which will increase the hot water temperature provided by the ASHP and GSHP system. Calculations at this stage suggest that the proposed heat pump systems could save approximately 1,061.4 tCO_2/year, which is 45.7% of regulated baseline emissions.

An area of roof suitable for approximately 969 m^2 of PV panels was identified on the proposed building. It was calculated that a PV array on this roof area could supply approximately 163,464 kW h of electricity to the office areas per year, with a carbon saving of 38.1 tCO_2/year, which is 1.6% of baseline regulated emissions.

The regulated carbon emissions after the 'Be Green' stage of the energy hierarchy were calculated to be 1,597.7 tCO_2/year.

The above emissions represent a saving against the baseline of 47% from the 'Be Green' stage of the energy hierarchy.

3.7.5 Energy monitoring – 'Be Seen'

It is proposed to install comprehensive monitoring and metering systems within the building to measure the actual energy and carbon performance. These operational demands will be reported to the Mayor for at least five years via an online portal. An energy metering strategy will be developed in accordance with the GLA 'Be Seen' guidance.

3.7.6 Carbon offsetting

In order to meet the GLA carbon reduction target of 100% of baseline regulated emissions for non-residential developments, it will be necessary to offset the residual regulated carbon emissions. Over a 30-year period it is estimated that the cumulative shortfall for non-domestic areas (all areas of the Hospital Redevelopment) would be 47,930 tCO_2. This would result in an estimated payment of approximately £4,553,381 at the GLA carbon offset price of £95/tonne.

The Applicant is currently investigating a potential offset project(s) at the Mount Vernon site (part of The Hillingdon Hospitals NHS Trust Foundation estate), subject to further feasibility testing. If a viable project(s) is confirmed, it may be possible for the Applicant to allocate up to approximately £3,000,000 of the total carbon offsetting cost to a project(s) at Mount Vernon over a number of years, with the remainder paid through a cash-in-lieu contribution to the LBH carbon offsetting fund. If a project(s) at Mount Vernon is viable, the Applicant would propose that the project(s) is linked to the financial equivalence of the offset, rather than the carbon equivalence, in accordance with GLA guidance (Ref. 17). If a project(s) is not viable at Mount Vernon, the Applicant would propose that the total carbon offset cost is paid through a cash-in-lieu contribution to the LBH carbon offsetting fund.

3.7.7 Proposed energy strategy

The proposed energy strategy for the Hospital Redevelopment is:

1. Energy efficient fabric and buildings services design;
2. A GSHP system to provide base load heating and cooling;
3. An ASHP system to meet remaining heating, cooling and hot water demands;
4. An ambient loop system to act as a thermal store and maximise system efficiency;
5. A PV array on the roof of the buildings.

The carbon emissions at each stage in the energy hierarchy are summarised below.

Table 26 shows the carbon baseline, and emissions and savings with the proposed energy strategy, at each step in the energy hierarchy. Calculations at this stage suggest this strategy would save 726.4 tCO_2/year, which is 31% of the baseline emissions of 2,324.0 tCO_2/year. This is also summarised in Table 26 and Table 27 .

Table 26 Carbon emissions after each stage of the energy hierarchy (Hospital Redevelopment)

	Carbon emissions for new buildings (tCO_2/year)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	2,324.0	2,187.1
After energy demand reduction	2,697.2	2,187.1
After heat network/CHP	2,697.2	2,187.1
After renewable energy	1,597.7	2,187.1

Table 27 Regulated carbon savings from each stage of the energy hierarchy (Hospital Redevelopment)

	Regulated new-building carbon savings	
	(tCO_2/year)	(%)
Savings from energy demand reduction	-373.1	-16%
Savings from heat network/CHP	0.0	0%
Savings from renewable energy	1,099.5	47%
Total cumulative savings	**726.4**	**31%**

The shortfall in savings relative to the 'zero carbon' 100% regulated emission saving target for non-domestic areas is 1,597.7 tCO_2/year, which is a cumulative total over 30 years of 47,930 tCO_2 that is expected to be addressed through offsetting. This results in an estimated carbon offset payment of approximately £4,553,381. This is summarised in Table 28 and Figure 12.

The Applicant is currently investigating a potential offset project(s) at the Mount Vernon site (part of The Hillingdon Hospitals NHS Trust Foundation estate). It may be possible for the Applicant to allocate some of the total carbon offsetting cost to project(s) at Mount Vernon. This is subject to further feasibility testing and is subject to agreement with LBH. Further details are provided in section 3.7.6 of this report.

Table 28 Shortfall in regulated carbon savings (Hospital Redevelopment)

	Annual (tCO_2)	Cumulative shortfall (tCO_2)
Total Target Savings	2,324.0	-
Shortfall	1,597.7	47,930.3
Cash in-lieu contribution (£)	**-**	**£4,553,381**

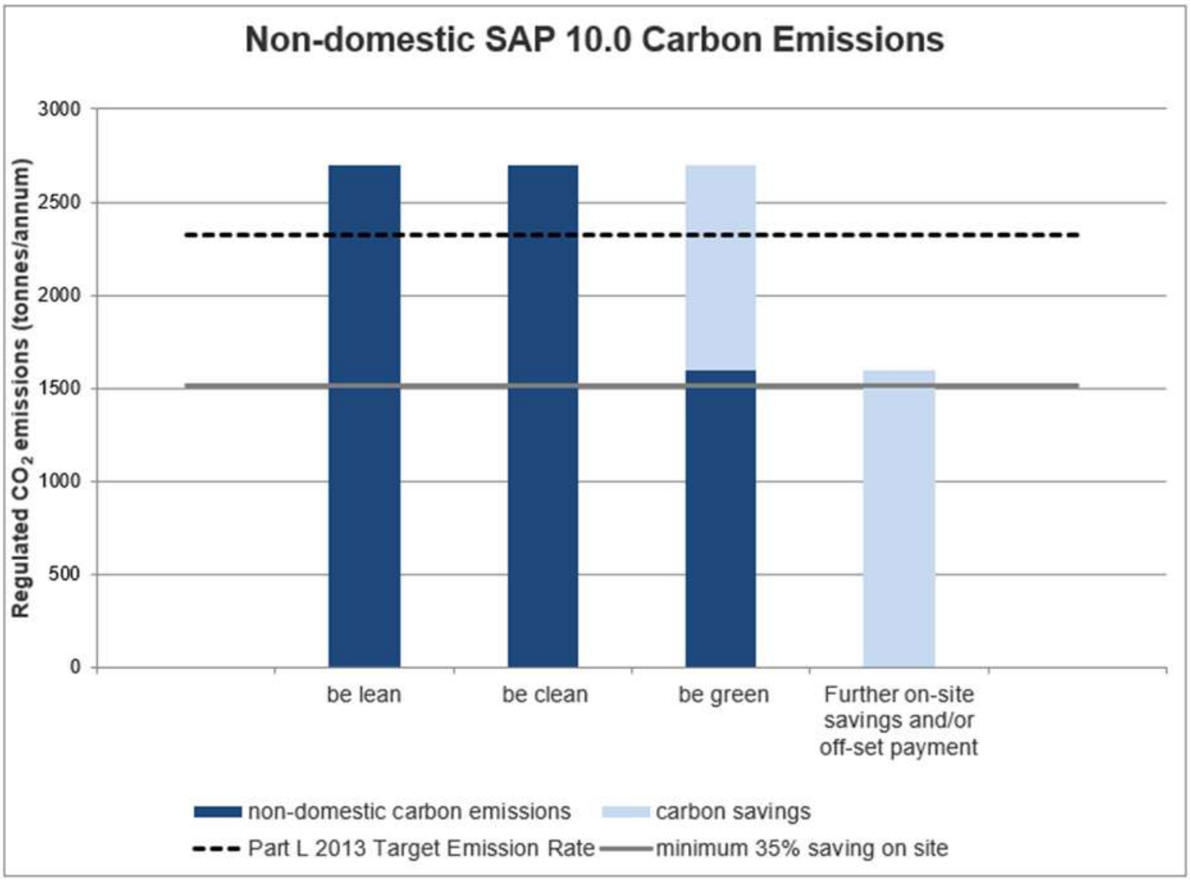

Figure 12 Proposed energy strategy: Energy Hierarchy CO_2 baseline, emissions and savings (Hospital Redevelopment)

3.7.8 Comparison with carbon saving targets

3.7.8.1 'Be Lean' target

GLA planning policy encourages on-site regulated carbon savings of 15% against the baseline from energy efficiency measures alone (the 'Be Lean' stage). The nature of a healthcare building makes these targets difficult to achieve. Primarily, this is due to the auxiliary energy required for fans and pumps and limitations in the modelling of energy required for domestic hot water (DHW).

The building is being designed to follow guidance in the Department of Health's Health Technical Memorandum 03-01: Specialised ventilation for healthcare premises (Ref. 18). The ventilation rates applied to the hospital building range from 6 AC/hr for general wards, to 10 AC/hr for operating theatres. The Building Regulations 2010 Part L national calculation methodology is not primarily designed for use on healthcare buildings. Higher air change rates are reflected in Part L models by the need to increase specific fan power of fans in the building. The notional fan powers for healthcare buildings do not reflect the requirements outlined in the Health Technical Memorandum, which need greater air change rates and therefore higher fan powers than, for example a good practice office building. Where air change rates range from 6 to 10 AC/hr in the Hospital Redevelopment in order to meet the HTM requirements, a typical office would require only 3 to 4 AC/hr to achieve best practice levels of fresh air. For this reason, fan powers for the proposed building are higher than expected in the notional building and result in a high energy use for auxiliary power. This places limitations on the regulated carbon savings which can be reported.

The notional building includes a number of set parameters on DHW that do not reflect the requirements for hospital buildings. The baseline building for Part L use a 95% efficient gas boiler with no storage losses and 5% distribution losses, effectively assuming that heating is provided by localised boilers close at the point of use. The 'Be Lean' case uses a 91% efficient gas boiler (the same as for space heating) and includes storage losses but no distribution losses. As the actual building is a large-scale hospital building, localised boilers for DHW are not practical and an ambient loop system is proposed to distribute heat at a very low 'ambient' temperature (35°C) before water to water heat pumps increase the temperature from the ambient loop for localised DHW. This results in a significant length of ambient loop distribution and secondary DWH pipework (and therefore surface area for heat loss) despite the pipework being highly insulated. The efficiency improvement of the ambient loop is not reflected in the 'Be Lean' stage, as the system cannot be applied to the model with a gas boiler, so the savings from the ambient loop system are instead reflected in the 'Be Green' stage. This methodology means that the as-modelled DHW carbon emissions at the 'Be Lean' stage are larger than for the baseline case, despite the Hospital Redevelopment using a highly efficient ambient loop system as a centralised building scale network with localised plant rooms.

Table 29 outlines energy uses across the Hospital Redevelopment as reported for the baseline and actual building for the 'Be Lean' stage in the BRUKL model in kW h/m²/year. As shown, in excess of one half of the notional building energy consumption is from DHW and auxiliary power. Due to the air change requirements within the building and Part L DHW modelling limitations, there is limited scope to reduce auxiliary energy whilst meeting the performance required for healthcare buildings.

Table 29 Baseline and actual 'Be Lean' energy consumption and savings (Hospital Redevelopment)

	Space heating	DHW	Lighting	Auxiliary	Cooling	Total	Total (excluding DHW and auxiliary)
Baseline (kW h/m²/year)	5.6	59.1	41.1	21.2	15.2	**142.2**	**61.9**
Actual (kW h/m²/year)	3.9	95.0	29.7	27.5	10.7	**166.8**	**44.3**
Saving (kW h/m²/year)	-1.7	+35.9	-11.4	+6.3	-4.5	**+24.6**	**-17.6**
Saving (%)	-30%	+61%	-28%	+30%	-30%	**+17%**	**-28%**

As shown in Table 30, energy demands for DHW of 59.1 kW h/m²/year and auxiliary energy of 21.2 kWh/m²/year make up more than one half of the total regulated energy demands of 142.2 kW h/m²/year for the baseline. The air change (and therefore fan power) and DHW requirements in the building limit the overall savings available, as auxiliary energy and DHW forms a significant proportion of the overall energy use. Other energy uses in the building achieve energy consumption reductions of 30% for space heating, 28% for lighting and 30% for cooling.

3.7.8.2 'Be Green' target

GLA planning policy encourages on-site regulated carbon savings of 35% against the baseline for the 'Be Green' stage. The nature of a healthcare building makes these targets difficult to achieve. Primarily, this is due to the auxiliary energy required for fans and pumps.

Table 30 outlines energy uses across the Hospital Redevelopment as reported for the baseline and actual building in the BRUKL model in kW h/m²/year. As shown, approximately 15% of the notional building energy consumption is from auxiliary power. Due to the air change requirements within the building (outlined in Section 3.7.8.1 above), there is limited scope to reduce auxiliary energy whilst meeting the performance required for healthcare buildings.

Table 30 Baseline and actual 'Be Green' energy consumption and savings (Hospital Redevelopment)

	Space heating	DHW	Lighting	Auxiliary	Cooling	Total	Total (excluding auxiliary)
Baseline (kW h/m²/year)	5.6	59.1	41.1	21.2	15.2	**142.2**	**121.0**
Actual (kW h/m²/year)	1.1	27.6	29.7	27.5	10.7	**96.6**	**69.1**
Saving (kW h/m²/year)	-4.5	-31.5	-11.4	+6.3	-4.5	**-45.6**	**-51.9**
Saving (%)	-80%	-53%	-28%	+30%	-30%	**-32%**	**-43%**

As shown in Table 30, energy demands for auxiliary energy of 21.2 kW h/m²/year make up approximately 15% of the total regulated energy demands of 142.2 kW h/m²/year for the baseline. The air change (and therefore fan power) requirements in the building limit the overall savings available, as auxiliary energy forms a significant proportion of the overall energy use. Other energy uses in the building achieve energy consumption reductions of 80% for space heating, 53% for DHW (reflecting the benefits of the heat pumps and ambient loop system), 28% for lighting and 30% for cooling.

As reduction in auxiliary energy is not possible to achieve for the building type, and other energy uses in the building have been significantly reduced, the proposed building meets planning policy as far as possible within the constraints applied in the building performance requirements.

4. Masterplan Development

4.1 Baseline CO_2 emissions and annual energy demand

4.1.1 Building energy modelling

The Masterplan Development was modelled to establish baseline regulated carbon emissions. The GLA carbon emission reporting spreadsheet was used to find the building carbon emissions using SAP 10.0 carbon factors, which are applied in this energy strategy. As required in the GLA guidance on preparing energy statements, the baselines for all building areas assume a gas boiler is used to meet the heating and hot water demands of the Masterplan Development. A copy of the GLA carbon reporting spreadsheet summary page is included in Appendix A and a full excel version has been submitted with this energy strategy.

The use types for the Masterplan Development are:

- Up to 327 residential units (Use Class C3), equating to a SAP energy modelled area of 25,237 m^2.
- Up to 800 m^2 town centre uses (Use Class E), energy modelled as non-SAP activities.

4.1.2 Domestic energy modelling

The Elmhurst Design SAP software was used to model the energy demands of a representative sample of dwellings in Part L 2013, based on indicative typologies for London dwellings. The modelling exercise provided the Target Emission Rate (TER) for each sample unit modelled as well as the projected demands for space heating and domestic hot water.

A total of 17 units have been modelled which characteristically represent the wider scheme and from which the energy performance of the scheme has been estimated. The sample set of models have been selected based on the indicative split of typologies, dwelling sizes, locations and aspects across the Illustrative Masterplan. The sample model selection is detailed in Table 31 below.

Table 31 Representative dwelling units used in modelling energy use (Masterplan Development)

Type	Unit Reference	Model Total Floor Area (m^2)	Number of Units	Total Area Represented by Model (m^2)
1	1B - Flat - G - S	50.2	14	699
2	1B - Flat - M - S	50.2	42	2,096
3	1B - Flat - T - S	50.2	14	699
4	1B - Flat - G - D	52	6	316
5	1B - Flat - M - D	52	18	949
6	1B - Flat - T - D	52	6	316
7	2B - Flat - G - S	70	3	235
8	2B - Flat - M - S	70	10	706
9	2B - Flat - T - S	70	3	235
10	2B - Flat - G - D	71.8	21	1,478
11	2B - Flat - M - D	71.8	62	4,434
12	2B - Flat - T - D	71.8	21	1,478
13	3B - Flat - G - D	90.9	12	1,105
14	3B - Flat - M - D	90.9	36	3,315
15	3B - Flat - T - D	90.9	12	1,105
16	3B - House - MT	111.54	44	4,855
17	3B - House - ET	111.54	11	1,214

Ref: Number of bed – dwelling type (Ground, Mid, Top, End Terrace Mid Terrace – aspect (single, dual)

The modelled baseline CO_2 emissions for the dwellings are detailed in Table 32.

Table 32 Domestic modelled baseline carbon emissions (Masterplan Development)

Use	Total Floor Area [m^2]	TER (SAP 10.0 emissions factors) [$kgCO_2/m^2/year$]	Carbon emissions [$tCO_2/year$]
Domestic dwellings	23,237	16.30	411.3

4.1.3 Non-domestic energy modelling

Approved dynamic simulation software (IES VE 2019) has been used to determine the Target Emission Rates (TER) for the non-domestic elements of the Masterplan Development. An indicative typology has been used to determine the estimated carbon emissions associated with the non-domestic element. These have been used to determine compliance with Part L2A 2013 and to then calculate the potential CO_2 emission reductions for the measures considered as part of the energy strategy development.

One non-domestic units has been considered to represent the town centre element of the Masterplan development. This unit is Town Centre (Class E) use type. The energy model is described within Table 33 below.

Table 33 Representative non-domestic units used in modelling energy use (Masterplan Development)

Building Unit/Use Type	Model Total Floor Area (m^2)	Total Area Represented by Model (m^2)
Commercial	147.8	800

The carbon emissions associated with the non-domestic element of the development is relatively small and represents 3% of the total development baseline CO_2 emissions. The total baseline CO_2 emissions for the non-domestic areas are detailed in Table 34 below.

Table 34 Non-domestic modelled baseline carbon emissions (Masterplan Development)

Use	Total Floor Area (m^2)	TER (SAP 10.0 emissions factors) ($kgCO_2/m^2/year$)	Carbon emissions ($tCO_2/year$)
Non-domestic	800	35.4	13.6

4.1.4 Unregulated energy uses

For the purposes of responding to the Mayor of London's energy policies, the total CO_2 emissions were calculated for the Proposed Development, including unregulated emissions not accounted for within the standard calculation methods for demonstrating compliance with Part L of Building Regulations.

Policy SI 2 of the London Plan (March 2021) includes a requirement that major development proposals should calculate and minimise CO_2 emissions from any other part of the development, including plant or equipment, that is not covered by Building Regulations, i.e. unregulated emissions.

The unregulated CO_2 emissions reported in this document have been determined as follows:

- For the domestic areas of the development, unregulated emissions have been estimated based on the BREDEM methodology; and
- For the non-domestic areas of the development, unregulated emissions have been estimated in line with Building Regulations Part L2A methodology.

4.1.5 Total development emissions

The following section provides a summary of the calculated baseline CO_2 emissions for the Illustrative Masterplan using SAP 10.0 emission factors.

The total regulated carbon emissions baseline for the existing buildings on the site was calculated to be 425 tCO_2/year. Additional unregulated emissions (e.g. from office equipment / appliances and similar plug-in loads) are calculated to be 199.3 tCO_2/year. Baseline emissions for the Masterplan Development are summarised in Table 35.

Table 35 Total site baseline carbon emissions (Masterplan Development)

	Site-wide carbon emissions (tCO_2/year)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	425	199.3

4.2 'Be Lean' – Energy demand reduction

4.2.1 General approach

This section outlines proposals for reducing CO_2 emissions from the buildings beyond the standard required by Building Regulations Part L 2013 through fabric and energy efficiency measures, before considering low and zero carbon energy supply options.

4.2.1.1 Domestic

Fabric and Energy Efficiency Approach

Consideration has been given to the passive design, fabric and services of the buildings, including the following key measures:

- Orientation and layout of the dwellings;
- High-performance U-values for the building fabric;
- High levels of air tightness; and
- High efficiency lighting and ventilation systems including heat recovery.

Orientation and Layout

The predominant orientation of dwelling facades within the Illustrative Masterplan is east to west. The buildings are well spaced and avoid significant over shading, helping to deliver satisfactory average daylight factors for the majority of habitable rooms, whilst also reducing energy demand for heating and lighting. The opportunity to provide dual aspect dwellings has been maximised in the Illustrative Masterplan, aiding daylight, sunlight, cross ventilation and reducing necessity for cooling. The provision of dual aspect units is expected to be safeguarded for the scheme through design development through the clauses set out by the Design Codes as detailed in Section 2.1.2.

Proposed Specifications

A high standard of fabric performance is proposed with the aim of exceeding the Part L 2013 through energy efficiency measures alone and targeting the 10% reduction required for dwellings by Policy SI 2 of the London Plan. The proposed specification will undergo further refinement as the design progresses and the final specification will be confirmed at Reserved Matters Application (RMA) stage. Table 36 shows the proposed fabric and energy efficiency specification for the dwellings.

Table 36 Fabric and energy efficiency specification for dwellings (Masterplan Development)

Element	Unit of Measurement	Proposed Specification
External Wall U-value	W/m^2 K	0.18
Party Wall U-value	W/m^2 K	0.0
Floor U-value	W/m^2 K	0.11
Roof U-value	W/m^2 K	0.11
Windows U-value	W/m^2 K	1.25
Windows g-value	-	0.47
Doors U-value	W/m^2 K	1.40
Air Permeability	m^3/m^2 h@50Pa	3.0
Thermal Mass Parameter	kJ/m^2 K	250
Thermal Bridging	Assumed ACD for sill, jamb and corner junctions. Modelled lintel junctions with Ψ = 0.10W/(m K). Default remaining junctions.	

Dwelling Fabric Energy Efficiency (DFEE)

The DFEE is a Part L1A (2013) compliance assessment designed to compare the fabric thermal performance with that of the notional building. The benchmark is known as the Target Fabric Energy Efficiency (TFEE), therefore, the area weighted average of both must result in DFEE ≤ TFEE. The specification has been set to exceed this requirement as demonstrated by the results in Table 37.

Table 37 Development area-weighted average TFEE and DFEE (Masterplan Development)

Fabric Energy Efficiency (FEE)	Development area-weighted average (kW h/m^2)
Target (TFEE)	51.28
Dwelling (DFEE)	47.05

Heating, Ventilation and Cooling

For the purposes of calculating the 'Be Lean' CO_2 emissions savings from the outlined energy efficiency measures, the dwellings are assumed to be served by communal gas boilers which are similar to the heat source defined for the baseline. This allows a comparative benchmark to be drawn.

All dwellings are proposed to incorporate highly efficient mechanical ventilation systems with heat recovery (MVHR) to provide sufficient background air change rates. During the heating season, the MVHR will reduce space heating demand by recovering heat from the background ventilation exhaust air. Subject to acoustic constraints, all dwellings will have openable windows to provide natural purge ventilation.

The current proposals respond to the Illustrative Masterplan as set out in Section 2.1.1, the ventilation and cooling strategies are expected to be developed further at RMA stage to respond to sensitivities to noise and orientation.

Lighting

100% low energy fixed lighting is proposed for use within the dwellings. All external lighting where supplied will be energy efficient with PIR, daylight and time-clock controls.

Smart Energy and Flexibility

Smart meters and sub metering will ensure data is being monitored and can be used to address the performance gap and provide data to the GLA to support the 'Be Seen' policy. The provision of smart metering devices will be largely dependent upon the energy supplier and the ability to disseminate data throughout the development. The metering strategy will be developed during detailed design for the RMA.

The use of smart meters coupled with smart-appliances and equipment will also be considered for the Masterplan Development at RMA stage. These technologies can be used to provide demand side response, for example allowing the running of some equipment at lower capacity during times of peak demand. This flexibility can reduce energy costs and reduce reliance on the grid during peak times, both a benefit to the national grid and end user in line with planning policy on energy poverty. As the design progresses, we will review the application of these systems for all homes. In addition. control systems will be designed with full flexibility and using open communication protocols to allow for any future integration of smart systems.

4.2.1.2 Non-domestic

Fabric and energy efficiency approach

Consideration has been given to the passive design, fabric and services of the buildings, including the following key measures:

- High-performance U-values for the building fabric;
- High levels of air tightness; and
- High efficiency lighting and ventilation systems including heat recovery.

Proposed Specifications

A high standard of fabric performance is proposed with the aim of exceeding Part L 2013 through energy efficiency measures alone and targeting the 15% reduction required for non-domestic development by Policy SI 2 of the London Plan.

Table 38 shows the proposed fabric and energy efficiency specification for the non-domestic areas, which will undergo further refinements as the design progresses.

Table 38 Fabric and energy efficiency specification for non-domestic areas (Masterplan Development)

Element	Unit of Measurement	Proposed Specification (Town Centre (E))
External Wall U-value	W/m²K	0.18
Floor U-value	W/m²K	0.13
Roof U-value	W/m²K	N/A (GF units)
Windows U-value	W/m²K	1.2
Windows g-value	-	0.43
Doors U-value	W/m²K	N/A
Air Permeability	m³/m²h@50Pa	3.0

Heating, Ventilation and Cooling

The non-domestic units of the Masterplan Development are to be delivered as “shell only” units, therefore the energy modelling has been undertaken with an indicative assumption of the systems which could reasonably be installed to these units.

For the purposes of calculating the ‘Be Lean’ CO_2 emissions savings from the outlined energy efficiency measures, the non-domestic spaces are assumed to have the specification outlined in Table 39.

Table 39 Heating, ventilation and cooling specification for non-domestic areas (Masterplan Development)

Element	System Specification
Heating	Heating provided by fan coil unit via gas boiler, Gross Seasonal Efficiency: 91%
Domestic Hot Water	Point of use, Electric Heating Efficiency: 100%
Ventilation	AHU Heating and Cooling
Cooling	SEER variable refrigerant flow (VRF): 3.5
Auxiliary	Variable speed multiple pressure sensors

Lighting

The non-domestic units of the Masterplan Development are to be delivered as shell only, therefore there is no internal fixed lighting proposed for these spaces.

For the purposes of the energy modelling undertaken to support this energy strategy a lighting specification has been assumed in line with best practice to indicate the system which may be expected to be installed at fit out. The specification will include low-energy lighting and occupancy controls in accordance with best practice guidance and as a minimum to meet Part L regulations.

Smart Energy and Flexibility

The use of smart meters has not been precluded and if installed will display total power consumption, figures for cost and CO_2 emissions, and comparison of energy use on a daily, weekly or monthly basis.

4.2.1.3 Carbon emissions – ‘Be Lean’

The benefit of the energy efficiency measures as described above has been assessed through energy modelling of the domestic dwellings and non-domestic spaces following the methodology as set out in Section 4.1.

When extrapolated across the whole Site, the proposed measures achieve an estimated reduction in regulated CO_2 emissions of 44.6 tonnes for the Illustrative Masterplan using SAP 10.0 CO_2 emission factors. This is equivalent to a 11% reduction in regulated CO_2 emissions against the Part L baseline, as shown in Table 42. A 10% reduction is achieved against the Part L base line for the dwellings (Table 40) and a 24% reduction is achieved for the non-domestic units (Table 41).

The ‘Be Lean’ results have been assessed against the requirements of London Plan Policy SI 2. As illustrated by Table 40 and Table 41 both the domestic and non-domestic areas of the development are expected to exceed the required CO_2 emissions savings of 10% and 15% respectively, based on the proposed specifications set out in Sections 4.2.1.1 and 4.2.1.2.

Table 40 Dwelling CO_2 savings following the 'Be Lean' reduction measures (SAP 10.0) (Masterplan Development)

	Regulated CO_2 Emissions (tCO_2/year)	CO_2 emissions savings for each element of the energy hierarchy	Cumulative regulated CO_2 emissions savings
Baseline (Part L 2013)	411.3	-	-
After 'Be Lean'	370.0	11%	11%

Table 41 Non-domestic CO_2 savings following the 'Be Lean' reduction measures (SAP 10.0) (Masterplan Development)

	Regulated CO_2 Emissions (tCO_2/year)	CO_2 emissions savings for each element of the energy hierarchy	Cumulative regulated CO_2 emissions savings
Baseline (Part L 2013)	13.6	-	-
After 'Be Lean'	10.4	24%	24%

Table 42 Total site-wide CO_2 savings following the 'Be Lean' reduction measures (SAP 10.0) (Masterplan Development)

	Regulated CO_2 Emissions (tCO_2/year)	CO_2 emissions savings for each element of the energy hierarchy	Cumulative regulated CO_2 emissions savings
Baseline (Part L 2013)	425.0	-	-
After 'Be Lean'	380.3	11%	11%

4.3 Overheating risk analysis

This section outlines the measures included in the design to minimise the cooling demand and reduce the risk of overheating in buildings within the Masterplan Development.

4.3.1 Overheating analysis

A strategy to reduce the risk of overheating within both the dwellings and non-domestic units has been developed from the outset in line with the cooling hierarchy of London Plan “Policy SI 4 Managing Heat Risk”.

In line with the GLA’s requirements for Outline applications, the Good Homes Alliance Early Stage Overheating Risk Tool has been completed by the design team to ensure the risk of overheating is minimised through early design stages. The purpose of the assessment is to identify the baseline risk of the development at an early stage in order to determine the need for mitigation measures to reduce the risk of overheating. The tool comprises a scoresheet of 14 questions against which a score is allocated based on a range of factors including geographical and local context, site characteristics, scheme characteristics and dwelling design, and solar heat gains and ventilation.

The assessment is split into two sets of seven questions each; those which increase the likelihood of overheating and those which reduce the likelihood of overheating. Based upon the scheme’s performance against each of these areas a sum is calculated for factors contributing to overheating from which the sum of mitigating factors is subtracted.

A score of less than 8 represents a low risk of overheating with minimal specific intervention required. A score between 8 and 12 represents a medium risk of overheating where design changes to reduce risk and/or mitigating features should be incorporated. A score of 12 or more represents a high risk of overheating where design changes to reduce risk and mitigating features must be incorporated. For developments scoring 8 or above, a detailed assessment is advised, for example CIBSE TM59 modelling to inform the strategic approach.

The Early Stage Overheating Risk Tool has returned a site-wide score of 19 which represents a high risk of overheating. The score for contributing factors totals 20 which primarily results from variables relating to the site and its location which remain fixed. The score for mitigating factors totals 1, which is not significant enough to lower the risk level.

A limitation of the Early Stage Overheating Risk Tool is that it has been completed for the site as a whole including units, which may show higher risk characteristics. There are some factors which preclude scoring due to the development of the site as a vacant lot, for example shading from mature trees and tall buildings, where the latter is restricted also through the parameter plans. Where the Illustrative Masterplan design demonstrates a glazing ratio of 30% throughout, the tool does not allow any score for mitigation to be obtained from external shading features.

It is important to note that the GHA Overheating Risk Tool is a simplified tool to identify a development’s risk profile at the early design stage and to recommend appropriate next steps to reduce the risk of overheating during detailed design. The tool is not intended to determine whether mitigation measures will be sufficient to reduce overheating risk. Instead, the tool recommends that dynamic thermal modelling, using the CIBSE TM59 methodology, is undertaken at detailed design to ensure that appropriate mitigation measures are incorporated to reduce the risk of overheating. In line with GLA guidance for outline planning applications, the CIBSE TM59 modelling will be undertaken during detailed design at the RMA stage. It is expected that detailed design stage development and dynamic thermal modelling will continue to inform the design strategy to reduce overheating risk.

The completed risk assessment can be found in Appendix H, with further detail justifying the score achieved at each risk-factor stage.

4.3.2 Overheating strategy

GLA guidance confirms that detailed overheating modelling is not expected for an outline application, and instead requires that applicant commit to undertaking dynamic overheating modelling at the RMA stage.

A set of key recommendations have been developed which have informed the energy specification and assisted in developing the response to the cooling hierarchy. These are detailed in Sections 4.2.1.1 for domestic dwellings and 4.2.1.2 for non-domestic uses, and include:

- Designing for a high mechanical ventilation rate in the summer.
- Specification of a low g-value to balance desirable solar gains in winter and unwanted gains in summer.
- Specification of efficient services and appliances to limit internal gains.
- Provision of openable windows, subject to acoustic constraints.

This energy strategy is based upon an Illustrative Masterplan that could be delivered within the parameters of the outline application. It is possible that the Parameter Plans and Design Codes may be fulfilled in different ways to those presented in the Illustrative Masterplan. In line with GLA Energy Assessment Guidance, detailed overheating analysis has not yet been undertaken at this outline application stage. It is proposed that dynamic overheating modelling in line with CIBSE TM59 and TM49 is undertaken for the domestic development at the RMA stage.

4.3.3 Cooling hierarchy

A strategy has been developed which applies the elements of the cooling hierarchy, the following measures are proposed to reduce the risk of overheating within the dwellings and limit active cooling within the non-domestic units.

1. ***Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and provision of green infrastructure:***
    - *Domestic:* The glazing ratios of the dwellings should be no greater than 25% of floor area across the dwelling types of the site to minimise risk of overheating while allowing optimum levels of daylighting.
    - *All areas:* High efficiency fabric is specified to limit solar gains in the summer and mitigate overheating risk. Window details will be designed to maximise local shading through the use of deep reveals, shading from balconies and from surrounding buildings as set out in the Design Codes. Solar control glazing with a g-value of 0.43 has also been assumed based on the indicative overheating modelling undertaken.
2. ***Minimise internal heat generation through energy efficient design:***
    - *All areas:* Low energy lighting and high efficiency mechanical plant are proposed to the dwellings to minimise internal gains. It is expected that low energy lighting will be installed to the non-domestic units as part of the fit-out. Losses from the secondary distribution pipework will be minimised across the site to 15% as recommended by CIBSE CP1.
3. ***Manage the heat within the building through exposed thermal mass and high ceilings:***
    - *Domestic:* Depending on the proposed fit-out to the domestic dwellings, there could be potential for exposed thermal mass.
    - *Non-domestic:* Depending on the proposed fit-out to the shell only non-domestic units, there could be potential for exposed thermal mass.
4. ***Provide passive ventilation:***
    - *Domestic:* Passive ventilation in the dwellings subject to acoustic constraints, this will be supported by the MVHR system with summer bypass.
    - *Non-domestic:* Purge ventilation is to be delivered to these units via the installed MVHR unit.
5. ***Provide mechanical ventilation:***
    - *All areas:* Mechanical Ventilation with Heat Recovery (MVHR) with summer bypass is currently proposed to all areas to support delivery of required ventilation rates subject to detailed design.

6. Provide active cooling systems:

- *Domestic:* No active cooling is currently proposed to the dwellings. A need for active cooling to be installed may be identified through detailed design should noise impact impose constraints on window openings. Efforts will be made in line with the earlier stages in the hierarchy to avoid the need for mechanical cooling whilst avoiding overheating.

- *Non-domestic:* Comfort cooling via a fan coil unit is proposed to the non-domestic spaces to assist in regulating indoor temperatures. As the non-domestic spaces are to be delivered as shell only units, the mechanical specification set out in this energy strategy document is indicative of the systems which would reasonably be expected to be installed to these units.

4.3.4 Overheating and cooling summary

A strategy to reduce the risk of overheating within the Proposed Development was put in place from the outset and in-line with the cooling hierarchy of London Plan Policy SI 4 Managing Heat Risk. In line with GLA Energy Assessment Guidance, detailed overheating analysis has not yet been undertaken at this outline application stage. It is proposed that dynamic overheating modelling in line with CIBSE TM59 and TM49 is undertaken for the domestic development at the RMA stage.

As detailed above, cooling via a fan coil unit is proposed to the non-domestic spaces only to assist in regulating internal comfort temperatures. At this stage the specification is indicative of the systems which may reasonably be expected to be installed to the shell only non-domestic units. Dynamic thermal modelling will be undertaken at detailed stage to determine the notional cooling target and actual performance. The cooling demands are sensitive to the level of glazing proposed within the units and are therefore unknown at this stage.

4.4 ‘Be Clean’ – Decentralised energy

This section assesses opportunities for reducing CO_2 emissions using decentralised energy generation such as connection to district heating networks and the use of combined heat and power (CHP). London Plan “Policy SI 3 Energy Infrastructure” states that major development proposals within Heat Network Priority Areas should have communal heating, with the heat source selected in line with the following hierarchy:

- Connect to existing or planned heat networks;
- Use net-zero emission or local secondary heat sources;
- Use low-emission combined heat and power (CHP); or
- Use ultra-low NO_x gas boilers.

4.4.1 Decentralised heat networks

4.4.1.1 Connection to existing or planned heat networks

The first step of the energy infrastructure policy is to investigate the potential for connecting the development to an existing or planned heat network system. Section 3.4.1.1 of the Hospital Redevelopment Chapter of this energy strategy includes a summary of investigations into existing and planned heat network systems. Based on these investigations it not proposed that the Masterplan Development will connect to an existing or planned heat network system.

4.4.1.2 Site-wide heat network

The dwellings of the Masterplan Development, at this stage, are predicted to use communal heat pump systems. There are no economies of scale benefit to centralising heat pumps, therefore creating a site-wide network only increases system losses and reduces overall system efficiency. It is therefore proposed to design a building scale networks. This also reduces issues with surrounding ownership for the individual buildings. Space will be allocated in the buildings of the Masterplan Development for plant and services (plate heat exchanger, duct and risers) with sleeves through the external walls to future-proof for a connection to potential local district heat networks in future.

4.4.1.3 Zero-emission or local secondary heat sources

AECOM investigated the availability of local secondary heat sources. Section 3.4.1.3 of the Hospital Redevelopment section of this energy strategy includes a summary of investigations, including the clinical waste incinerator at the existing Hillingdon Hospital. Based on these investigations it not proposed that the Masterplan Development will connect to the clinical waste incinerator.

4.4.2 Air Quality

No combustion on Site is proposed for the normal operation of the Masterplan Development and this is expected to help to limit the negative impacts from the operation of the development on local air quality. This will be supported by an air quality assessment at the RMA stage.

4.4.3 ‘Be Clean’ results summary

Connection to district heating networks or installation of on-site CHP systems is not proposed for the Masterplan Development. Therefore, the carbon savings for this stage of the energy hierarchy remain the same as after the ‘Be Lean’ stage. For completeness, the carbon emissions and savings for this stage of the energy hierarchy are shown below.

4.4.3.1 Site carbon emissions – ‘Be Clean’

After decentralised energy, the calculated regulated carbon emissions remain the same as after the ‘Be Lean’ stage at 425.0 tCO_2/year for the Masterplan Development, as shown in Table 43.

As summarised in Table 43 and Table 44, the Masterplan Development achieved no carbon savings from CHP or district heat networks.

Table 43 Carbon emissions after district heating (Masterplan Development)

	Carbon emissions (tCO_2/year)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	425.0	199.3
After energy demand reduction ('Be Lean')	380.3	199.3
After heat network/CHP ('Be Clean')	380.3	199.3

Table 44 Regulated carbon savings from district heating (Masterplan Development)

	Regulated carbon savings	
	(tCO_2/year)	**(%)**
Savings from energy demand reduction	44.6	11%
Savings from heat network/CHP	0.0	0%

4.5 'Be Green' – Renewable Energy

This section assesses opportunities for reducing carbon emissions using renewable energy technologies.

4.5.1 Technology options appraisal

4.5.1.1 Scope

The London Plan states that within the framework of the energy hierarchy (Policy SI 2), major development proposals should provide a reduction in expected carbon emissions through the use of on-site renewable energy generation, where feasible. This section summarises the appraisal of renewable options that has been undertaken for the Masterplan Development. The following technologies were considered:

- Photovoltaics (PV).
- Solar thermal water heating.
- Heat pumps.
- Biomass heating.
- Wind turbines.

4.5.1.2 Feasibility assessment

Photovoltaics

Solar photovoltaics (PV) are proposed for the Masterplan Development. A combined PV/green roof system is currently being considered. 25% of the areas shown for extensive green roofs in Figure 13 are assumed to be reserved for PV. This provides an indicative roof area available for panels based of 1,166 m^2. It has been estimated that 164 kW_p could be accommodated on theses green roofs from typical PV provision. It should be noted that detailed overshading analysis has not been undertaken at this stage. Indicative estimates of the system size and energy generated are provided in Table 45 below, based on a 30° pitch and South West/East orientation.

Figure 13 Extract of open space plan showing extensive green roof areas for PV panels (up to 25% of extensive green roof with PV panels) for the Masterplan Development

Table 45 Indicative PV provision (Masterplan Development)

	Domestic Installation	Non-Domestic Installation	Total
System size (kW_p)	159	5	164 kW_p
Energy generated (MWh/year)	131	4	135 MW h/year
Estimated panel area (m^2)	1,130	36	1,166 m^2

AECOM found that a PV array of approximately 1,166 m^2 of panel area could produce, 135 MWh of electricity per year, saving approximately 31.4 tCO_2/year.

Solar thermal water heating

PV has been proposed for the Masterplan Development and solar thermal water heating would compete with PV for the available roof space with PV. As discussed later in this section, heat pumps are the primary LZC technology proposed for this Site and are to be used for water heating where possible.

Accommodating the inclusion of solar thermal collectors would also require additional infrastructure and plant space. As the site has a significant regulated and unregulated electricity load, it is judged that PV would be more suitable for Masterplan Development than solar thermal water heating.

It is considered that no further study of solar thermal water heating is warranted at this stage as PV is preferred over solar thermal water heating.

Heat pumps

Heat pumps are effective at reducing CO_2 emissions and are well suited to domestic and non-domestic applications. It is therefore proposed that a communal heat pump system(s) will deliver space heating and domestic hot water to each of the domestic dwellings and individual split system VRF units will deliver space heating to each of the non-domestic spaces within the development.

For the domestic dwellings, a communal heat pump of SCoP of 2.5 has been assumed, typical for an ASHP. This has been chosen from past project experience and further modelling will be undertaken at the detailed design stage. ASHPs have been assumed at this stage as a worst case scenario in terms of system efficiency, however, ground source heat pumps will also be considered at detailed design stage to provide heating to the system.

For the non-domestic spaces, a VRF heating unit with a SCoP of 3.0 has been assumed for the purposes of the energy modelling to support this energy strategy. As set out in Section 4.2.1.2, the VRF system will also be expected to serve the cooling load, with a seasonal energy efficiency rating (SEER) of 3.5. Where these areas are to be delivered as shell only, the system specified is indicative only of what may be expected to be installed based on typology and best practice.

Biomass heating

Biomass heating is expected to have unacceptable local air quality impacts. In addition, the Site does not have sufficient space for storage of the required fuel and deliveries to the site would generate unnecessary vehicle journeys onto already congested central London roads. Based on the above, AECOM judged that no further investigation of biomass heating was warranted.

Wind turbines

A general guide is that to make operational and financial sense micro-wind systems need to be sited in locations with an annual average wind speed of at least 5 m/s. This condition is rarely met in urban areas, however for completeness, AECOM checked whether this condition is met on the site. The hub height of a turbine installed on the site would be somewhere in the order of 100 m above ground level. Using linear interpolation, the scaled annual average wind speed at that hub height could be somewhere around 4.8 m/s (this method is detailed in section 3.7.4 and Table 21 in the Hospital Redevelopment section of this report). Based on this assessment, AECOM judged that no further investigation of wind turbines was warranted.

4.5.2 Carbon emissions – ‘Be Green’

Heat pumps and PV panels are proposed for the Masterplan Development. The carbon savings from the inclusion of renewable technologies (for the ‘Be Green’ stage of the energy hierarchy) are summarised in this section.

Incorporating the heat pump and PV technology described above, the calculated regulated carbon emissions for the Masterplan Development are 171.4 tCO_2/year, as shown in Table 46.

As summarised in Table 47 below, this represents a saving of 208.9 tCO_2/year or 49% improvement from the baseline regulated emissions achieved by installing renewable technologies on Site.

Table 46 Carbon emissions after renewable energy (Masterplan Development)

	Carbon emissions for new buildings (tCO_2/year)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	425.0	199.3
After energy demand reduction	380.3	199.3
After heat network/CHP	380.3	199.3
After renewable energy (heat pumps)	202.8	199.3
After renewable energy (PV)	171.4	199.3

Table 47 Regulated carbon savings from renewable energy (Masterplan Development)

	Regulated new-building carbon savings	
	(tCO_2/year)	(%)
Savings from energy demand reduction	44.6	11%
Savings from heat network/CHP	0.0	0%
Savings from renewable energy (heat pumps)	177.5	42%
Savings from renewable energy (PV)	31.4	7%

4.5.3 Energy monitoring – 'Be Seen'

This section sets out how the Applicant plans to monitor, report on and share energy performance so that energy use can be better understood and managed on an on-going basis, in line with the 'Be Seen' element of the London Plan energy hierarchy.

4.5.3.1 Commitments

The 'Be Seen' energy monitoring guidance published by the GLA sets out the expectations of the Applicant regarding response to the 'Be Seen' requirements. The guidance sets out the process and responsibilities with regard to the policy requirements, including the requirement to report to GLA estimates for energy use using the 'Be Seen' spreadsheet not later than 4 weeks after planning approval has been granted.

The Applicant will complete the 'Be Seen' spreadsheet, post submission, in line with GLA requirements and will include:

- The required contextual information on the scheme,
- Predicted building energy use,
- Renewable energy, and
- Expected carbon emissions.

The metrics recorded within the GLA ‘Be Seen’ spreadsheet at planning stage will build upon the Building Regulations compliance modelling undertaken to support this energy strategy document and reflect the figures reported in the supporting GLA carbon emissions reporting spreadsheet.

It is important to recognise that GLA Guidance on Preparation of Energy Statements requires baseline energy demands and calculated savings to be based on the calculation methods set out in Part L of Building Regulations. These calculation methods are designed for Building Regulations compliance purposes, they are not intended to provide an accurate assessment of the building’s expected performance in use. It would not be expected that the metered energy use for the proposed development would align with the energy demand calculations set out in this Energy Strategy. This is because Building Regulations calculations assume standard occupancy patterns for generic building uses. The actual occupancy patterns and equipment loads in buildings would be expected to differ from these generic profiles depending on the individual occupant and the equipment they install.

4.5.3.2 ‘Be Seen’ summary

The Applicant will submit the ‘Be Seen’ reporting spreadsheet to GLA via the dedicated planning-stage webform after planning submission in line with London Plan Policy SI 2 and GLA ‘Be Seen’ Energy Monitoring Guidance.

A metering strategy to support the ‘Be Seen’ policy will be developed during detailed design for the RMA stage. The Applicant will explore the potential to provide bulk metering on the incoming electricity supply to each building and bulk heat meters for the heat networks within each building. This would potentially enable annual energy demands to be monitored at least at a block level. The use of smart appliances and smart meters is not precluded by the application which if installed will also ensure energy can be monitored and provided remotely.

4.6 Flexibility and peak energy demand

The London Plan sets out a requirement for all major developments to minimise both annual and peak energy demand in accordance with the energy hierarchy. This seeks to reduce demands on London's energy networks as the electricity grid decarbonises and a transition is made away from the use of fossil fuels.

4.6.1 Strategy

Peak loads are proposed to be managed on-site through the use of building level communal heat pumps, with the provision included for future connection to a district heating network. This will manage to peak loads with diversity being incorporated into the design of the system and a level of storage being provided within the communal network. This network should be designed to good practice standards such as CP1 in line with London Plan policy, ensuring losses within the network are minimised.

The use of renewable energy generating technology across the Masterplan Development to meet 'Be Green' policy targets is expected to further reduce the peak electrical load from the grid. 164kWp capacity of PV panels are proposed which would contribute to reducing the peak electrical load at during day-time peaks.

The Masterplan Development has sought to reduce its peak electrical demand as required by London Plan Policy SI 2 Minimising greenhouse gas emissions and Policy SI 3 Energy infrastructure.

4.6.2 Carbon offsetting

In order to meet the GLA carbon reduction target of 100% of baseline regulated emissions for domestic and non-domestic developments, it will be necessary to offset the residual regulated carbon emissions through a cash-in-lieu contribution to the LBH carbon offsetting fund. Over a 30-year period it is estimated that the cumulative shortfall for domestic and non-domestic areas (all areas of the Masterplan Development) would be 5,141.3 tCO_2. This would result in an estimated payment of approximately £488,419 at the GLA carbon offset price of £95/tonne. This figure will be reviewed at RMA stage when a finalised specification and design for the Masterplan Development is confirmed.

4.7 Conclusion

This energy strategy describes the assessment of options considered for reducing CO_2 emissions through energy efficiency measures, the efficient supply of heat and the use of on-site renewable energy technologies, and the approach to reducing cooling demands and the risk of overheating, having regard to the characteristics of the site and the local environment.

The following sections set out how the Masterplan Development has been designed in order to comply with current policy.

4.7.1 'Be Lean' – Energy demand reduction

A summary of the strategy for the 'Be Lean' stage of the energy hierarchy is as follows:

- A high standard of fabric and energy efficiency is being specified to reduce energy demand, CO_2 emissions and running costs for residents.
- The fabric proposal includes highly insulated walls, floor and roofs, efficient glazing and high levels of air tightness.
- The building services will include efficient lights, hot water storage and mechanical ventilation with heat recovery.
- The results demonstrate that the Part L 2013 target emissions (baseline) can be exceeded through the proposed energy efficiency measures.

4.7.2 'Be Clean' – District heating

A summary of the strategy for the 'Be Clean' stage of the energy hierarchy is as follows:

- Space will be allocated for plant and services (plate heat exchanger, duct and risers) with sleeves through the external walls to future-proof for a connection to potential local district heat networks in future.
- There are no CO_2 emission savings reported from CHP or district heat networks for the 'Be Clean' stage.

4.7.3 'Be Green' - Renewable energy generation

A summary of the strategy for the 'Be Green' stage of the energy hierarchy is as follows:

- Solar photovoltaic (PV) panels will be incorporated in the roofs of the buildings.
- Communal heat pumps are expected to be installed for the domestic dwellings and individual split system VRF heat pumps for the non-domestic units.

4.7.4 Energy monitoring – 'Be Seen'

A summary of the strategy for the 'Be Seen' stage of the energy hierarchy is as follows:

- A suitable metering strategy will be developed to record energy consumption and generation (PV) upon occupation of the Masterplan Development.
- The Applicant has proposed to monitor and report the energy consumption and generation as required by the GLA.

4.7.5 Carbon offsetting

A summary of the strategy for carbon offsetting is as follows:

- On-site measures have been maximised in relation to the development constraints.
- The shortfall to achieving the target of zero-carbon will be met by making an offset payment made to the Local Authority's carbon offset fund.
- It is understood that the carbon offset rate will be £95/tonne.

4.7.6 Overall energy strategy

The carbon emissions at each stage in the energy hierarchy are summarised below.

Figure 14 shows the carbon baseline, and emissions and savings with the proposed energy strategy, at each step in the energy hierarchy. Calculations at this stage suggest this strategy would save 253.6 tCO_2/year, which is 60% of the baseline emissions of 425.0 tCO_2/year. This is also summarised in Table 48 and Table 49.

Table 48 Carbon emissions after each stage of the energy hierarchy (Masterplan Development)

	Carbon emissions for new buildings (tCO_2/year)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	425.0	199.3
After energy demand reduction	380.3	199.3
After heat network/CHP	380.3	199.3
After renewable energy (heat pumps)	202.8	199.3
After renewable energy (PV)	171.4	199.3

Table 49 Regulated carbon savings from each stage of the energy hierarchy (Masterplan Development)

	Regulated new-building carbon savings	
	(tCO_2/year)	**(%)**
Savings from energy demand reduction	44.6	11%
Savings from heat network/CHP	0.0	0%
Savings from renewable energy (PV and heat pumps)	208.9	49%
Total cumulative savings	**253.6**	**60%**

The shortfall in savings relative to a 100% saving target for domestic and non-domestic areas (total areas in the Masterplan Development) based on the indicative calculations is 171.4 tCO_2/year, which is a cumulative total over 30 years of 5,141.3 tCO_2 that is expected to be addressed through offsetting. This results in an estimated payment to LBH of approximately £488,419. This is summarised in Table 50 and Figure 12. This is subject to agreement with LBH.

Table 50 Shortfall in regulated carbon savings (Masterplan Development)

	Annual (tCO_2)	Cumulative shortfall (tCO_2)
Total Target Savings	253.6	-
Shortfall	171.4	5,141.3
Cash in-lieu contribution (£)	**-**	**£488,419**

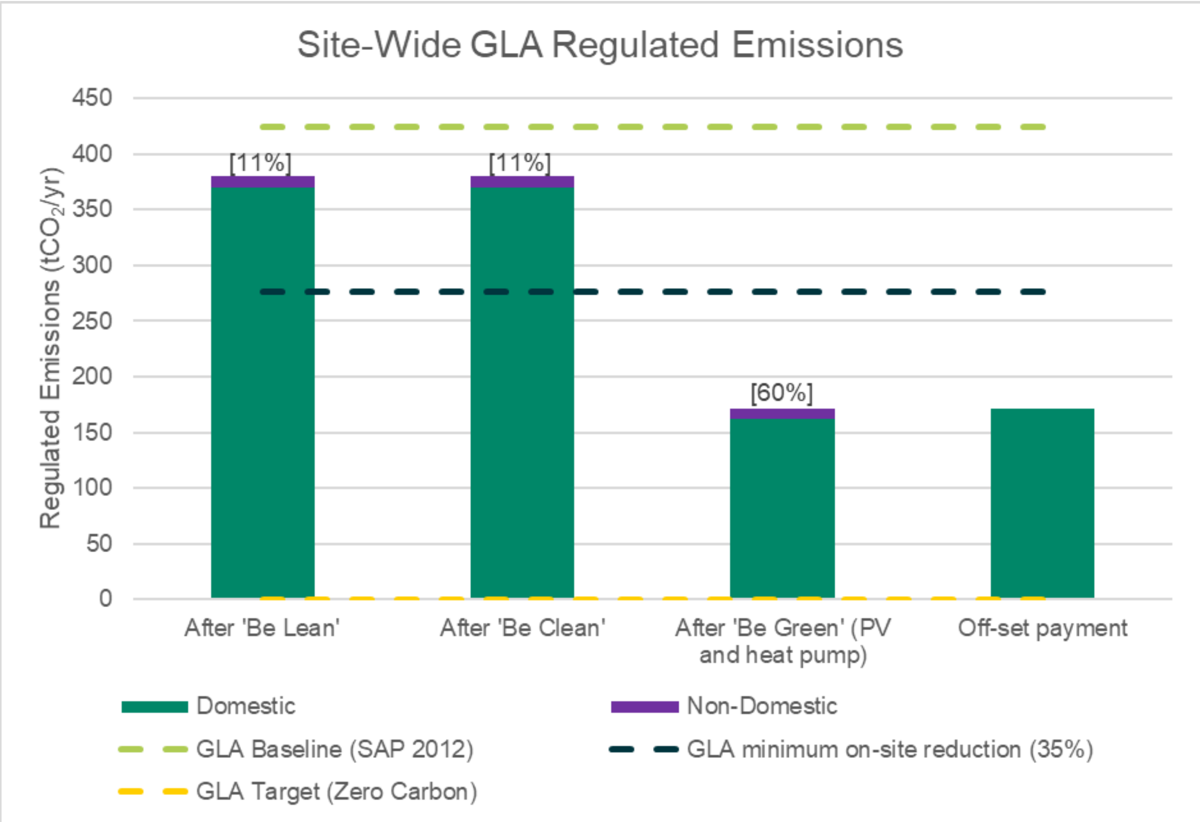

Figure 14 Proposed energy strategy: Energy Hierarchy carbon baseline, emissions and savings (Masterplan Development)

4.7.7 Comparison with carbon saving targets

The London Plan requires a minimum of 10% and 15% 'Be Lean' savings for the domestic and non-domestic element respectively. The energy strategy for the Masterplan Development shows that this target can be met, with 'Be Lean' savings of 11% and 24% shown indicatively for the domestic and non-domestic.

The overall 35% on-site saving target is shown to be achievable for the Masterplan Development with an overall 60% presented. The domestic element shows a 65% saving and the non-domestic 35%, in line with London Plan Policy. Detailed analysis will be undertaken during detailed design at the RMA stage. The analysis for the Masterplan Development indicates that the London Plan Policy savings may be achieved at the RMA stage.

5. References

Ref. 1. Ministry of Housing, Communities and Local Government, National Planning Policy Framework (July 2021).
Ref. 2. Her Majesty's Government, UK Climate Change Act (November 2008).
Ref. 3. Her Majesty’s Government, Net Zero Strategy: Build Back Greener (October 2021).
Ref. 4. Her Majesty’s Government, Heat and Buildings Strategy (October 2021).
Ref. 5. Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government, Building Regulations Part L ‘Conservation of fuel and power’ (2013, as amended in 2016).
Ref. 6. Building Research Establishment, Standard Assessment Procedure for Energy Rating of Dwellings Version 10 (July 2018).
Ref. 7. Greater London Authority, Draft Energy Assessment Guidance (April 2020).
Ref. 8. Greater London Authority, The London Plan 2021 (March 2021).
Ref. 9. Building Research Establishment, Standard Assessment Procedure 2012 9.92 (2012).
Ref. 10. Greater London Authority, London Mayor’s Air Quality Strategy (December 2010).
Ref. 11. London Borough of Hillingdon, The Local Plan: Part 1 – Strategic Policies “LPP1” (November 2012).
Ref. 12. London Borough of Hillingdon, Development Management Policies ‘LLP2’ (January 2020).
Ref. 13. London Borough of Hillingdon, Site Allocations and Designations ‘LLP2’ (January 2020).
Ref. 14. London Borough of Hillingdon, Supplementary Planning Document ‘Hillingdon Design and Accessibility Statement’ (April 2006).
Ref. 15. London Borough of Hillingdon, Supplementary Planning Document ‘Planning Obligations’ (July 2014).
Ref. 16. Greater London Authority, London Heat Map (July 2019). Accessed on 21st March 2022 at https://maps.london.gov.uk/heatmap
Ref. 17. Greater London Authority, Carbon Offset Funds (October 2018)
Ref. 18. Department of Health, HTM 03-01 Specialised ventilation for healthcare buildings (May 2021).

Appendix A GLA Carbon Reporting Spreadsheets

A.1 Hospital Redevelopment GLA Carbon Reporting Spreadsheet

A Microsoft Excel version of the report spreadsheet is also provided.

SAP 2012 Performance

Domestic

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	0.0	
After energy demand reduction (be lean)	0.0	
After heat network connection (be clean)	0.0	
After renewable energy (be green)	0.0	

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	0.0	0%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	0.0	0%
Cumulative on site savings	**0.0**	**0%**
Annual savings from off-set payment	0.0	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**0**	-
Cash in-lieu contribution (£)	**0**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

Non-domestic

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	3,961.8	4,871.7
After energy demand reduction (be lean)	4,151.5	4,871.7
After heat network connection (be clean)	4,151.5	4,871.7
After renewable energy (be green)	3,558.8	4,871.7

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	-189.8	-5%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	592.8	15%
Total Cumulative Savings	**403.0**	**10%**
Annual savings from off-set payment	3,558.8	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**106,763**	-
Cash in-lieu contribution (£)	**10,142,511**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

SITE-WIDE

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	3,961.8		
Be lean	4,151.5	-189.8	-5%
Be clean	4,151.5	0.0	0%
Be green	3,558.8	592.8	15%
Total Savings	-	403.0	10%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**106,763.3**	-

SAP 10.0 Performance

Domestic

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	0.0	
After energy demand reduction (be lean)	0.0	
After heat network connection (be clean)	0.0	
After renewable energy (be green)	0.0	

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: Savings from energy demand reduction	0.0	0%
Be clean: Savings from heat network	0.0	0%
Be green: Savings from renewable energy	0.0	0%
Cumulative on site savings	**0.0**	**0%**
Annual savings from off-set payment	0.0	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**0**	-
Cash in-lieu contribution (£)	**0**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

Non-domestic

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	2,324.0	2,187.1
After energy demand reduction (be lean)	2,697.2	2,187.1
After heat network connection (be clean)	2,697.2	2,187.1
After renewable energy (be green)	1,597.7	2,187.1

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	-373.1	-16%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	1,099.5	47%
Total Cumulative Savings	**726.4**	**31%**
Annual savings from off-set payment	1,597.7	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**47,930**	-
Cash in-lieu contribution (£)*	**4,553,381**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

SITE-WIDE

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	2,324.0		
Be lean	2,697.2	-373.1	-16%
Be clean	2,697.2	0.0	0%
Be green	1,597.7	1,099.5	47%
Total Savings	-	726.4	31%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**47,930.3**	-

A.2 Masterplan Development GLA Carbon Reporting Spreadsheet

A Microsoft Excel version of the report spreadsheet is also provided.

SAP 2012 Performance

Domestic

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	460.5	436.4
After energy demand reduction (be lean)	434.7	436.4
After heat network connection (be clean)	434.7	436.4
After renewable energy (be green)	362.1	436.4

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	25.8	6%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	72.6	16%
Cumulative on site savings	**98.4**	**21%**
Annual savings from off-set payment	362.1	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**10,863**	-
Cash in-lieu contribution (£)	**1,031,997**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

Non-domestic

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	28.3	7.5
After energy demand reduction (be lean)	22.1	7.5
After heat network connection (be clean)	22.1	7.5
After renewable energy (be green)	19.6	7.5

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	6.2	22%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	2.5	9%
Total Cumulative Savings	**8.7**	**31%**
Annual savings from off-set payment	19.6	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**589**	-
Cash in-lieu contribution (£)	**55,941**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

SITE-WIDE

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	488.8		
Be lean	456.8	32.0	7%
Be clean	456.8	0.0	0%
Be green	381.7	75.1	15%
Total Savings	-	107.0	22%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**11,452.0**	-

SAP 10.0 Performance

Domestic

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	411.3	195.9
After energy demand reduction (be lean)	370.0	195.9
After heat network connection (be clean)	370.0	195.9
After renewable energy (be green)	162.6	195.9

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: Savings from energy demand reduction	41.3	10%
Be clean: Savings from heat network	0.0	0%
Be green: Savings from renewable energy	207.4	50%
Cumulative on site savings	**248.7**	**60%**
Annual savings from off-set payment	162.6	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**4,877**	-
Cash in-lieu contribution (£)	**463,305**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

Non-domestic

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	13.6	3.4
After energy demand reduction (be lean)	10.4	3.4
After heat network connection (be clean)	10.4	3.4
After renewable energy (be green)	8.8	3.4

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	3.3	24%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	1.5	11%
Total Cumulative Savings	**4.8**	**35%**
Annual savings from off-set payment	8.8	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**264**	-
Cash in-lieu contribution (£)*	**25,114**	

*carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development Information' tab

SITE-WIDE

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	425.0		
Be lean	380.3	44.6	11%
Be clean	380.3	0.0	0%
Be green	171.4	208.9	49%
Total Savings	-	253.6	60%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**5,141.3**	-

Appendix B BRUKL output documents for Hospital Redevelopment

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Hillingdon Hospital_GLA Baseline_Be Lean

As designed

Date: Wed Mar 30 17:01:10 2022

Administrative information

Building Details

Address: London,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.13

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.13

BRUKL compliance check version: v5.6.b.0

Certifier details

Name: AECOM Ltd.

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

The building does not comply with England Building Regulations Part L 2013

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	53.2
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	53.2
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	55.7
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.15	0.15	00000007:Surf[0]
Floor	0.25	0.15	0.15	00000007:Surf[6]
Roof	0.25	0.13	0.13	0000002F:Surf[0]
Windows***, roof windows, and rooflights	2.2	0.63	1.6	0100015C:Surf[3]
Personnel doors	2.2	1.11	2.2	0100015C:Surf[4]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	1

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Gas_Radiant panels, air cooling, MV [COP=0.91, SFP=1.5]

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	4.12	0	1.5	0.78
Standard value	0.91*	3.2	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

2- Gas_Radiant panels, NV or E only [COP=0.91]

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	0.8	0	-
Standard value	0.91*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

3- Gas_Radiant panels, Duct Coil, MV [COP=0.91, SEER=5.56, NEER=4.12, SFP=1.5]

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	4.12	0	1.5	0.78
Standard value	0.91*	3.2	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

4- Gas_FCU [COP=0.91, SEER=5.56, NEER=4.12, SFP=1.5]

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	4.12	0	1.5	0.78
Standard value	0.91*	3.2	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

5- Gas_Duct Coil, DX Unit, MV [COP=0.91, SEER=5.56, NEER=4.12, SFP=1.5]

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	4.12	0	0	0.78
Standard value	0.91*	2.6	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

6- Gas_Air heating & cooling, MV [COP=0.91, SEER=5.56, NEER=4.12, SFP=1.5]

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	4.12	0	1.5	0.78
Standard value	0.91*	3.2	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

7- Gas_FCU heating & cooling, E [COP=0.91, SEER=5.56, NEER=4.12, TSFP=0.4]

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	4.12	0	0	0.78
Standard value	0.91*	2.6	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

8- Gas_Radiant panels, DX Unit, MV [COP=0.91, SEER=5.56, NEER=4.12, SFP=1.5]

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	4.12	0	0	0.78
Standard value	0.91*	2.6	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

9- Gas_Radiant panels, FCU [COP=0.91, SEER=5.56, NEER=4.12, SFP=1.5, TSFP=0.4]

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	4.12	0	1.5	0.78
Standard value	0.91*	3.2	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

10- Gas_Car Park DX heating & cooling, MV [COP=0.91, EER=2.6, SFP=1.5] (Copy)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	2.6	0	0	-
Standard value	0.91*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

"No HWS in project, or hot water is provided by HVAC system"

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
00_A. WC 011	-	-	0.4	-	-	-	-	-	-	-	N/A
00_Bev Bay	-	-	0.4	-	-	-	-	-	-	-	N/A
00_Cafe	-	-	-	-	-	-	-	0.2	-	-	N/A
00_CT Control	-	-	-	-	-	-	-	0.2	-	-	N/A
00_CT Scanner	-	-	-	1.5	-	-	-	-	-	-	N/A
00_D.U. 008	-	-	0.4	-	-	-	-	-	-	-	N/A
00_Decont Zones	-	-	0.4	-	-	-	-	-	-	-	N/A
00_Eq. Store 001	-	-	0.4	-	-	-	-	-	-	-	N/A
00_Eq. Store 005	-	-	0.4	-	-	-	-	-	-	-	N/A
00_IT HUB 001	-	-	-	1.5	-	-	-	-	-	-	N/A
00_IT HUB 002	-	-	-	1.5	-	-	-	-	-	-	N/A
00_IT HUB 003	-	-	-	1.5	-	-	-	-	-	-	N/A
00_IT HUB 004	-	-	-	1.5	-	-	-	-	-	-	N/A
00_IT HUB 005	-	-	-	1.5	-	-	-	-	-	-	N/A
00_Kitchen/Bev Bay	-	-	-	0.4	-	-	-	-	-	-	N/A
00_Lounge W Seating/10	-	-	-	-	-	-	-	0.2	-	-	N/A
00_MDT Room 001	-	-	-	-	-	-	-	0.2	-	-	N/A
00_MDT Room 002	-	-	-	-	-	-	-	0.2	-	-	N/A
00_MDT Room 003	-	-	-	-	-	-	-	0.2	-	-	N/A
00_MDT Room 004	-	-	-	-	-	-	-	0.2	-	-	N/A
00_MDT Room 005	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Milk Kitchen	-	-	-	0.4	-	-	-	-	-	-	N/A
00_Nappy Change	-	-	0.4	-	-	-	-	-	-	-	N/A
00_PoCT 001	-	-	0.4	-	-	-	-	-	-	-	N/A
00_PoCT 002	-	-	0.4	-	-	-	-	-	-	-	N/A
00_PoCT 003	-	-	0.4	-	-	-	-	-	-	-	N/A
00_PoCT 004	-	-	0.4	-	-	-	-	-	-	-	N/A
00_PoCT 006	-	-	0.4	-	-	-	-	-	-	-	N/A
00_PoCT 007	-	-	0.4	-	-	-	-	-	-	-	N/A
00_PoCT 008	-	-	0.4	-	-	-	-	-	-	-	N/A
00_PoCT 009	-	-	0.4	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
00_Seminar ED Floor	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Staff Change 003	-	-	0.4	-	-	-	-	-	-	-	N/A
00_Staff Change 004	-	-	0.4	-	-	-	-	-	-	-	N/A
00_Store 003	-	-	0.4	-	-	-	-	-	-	-	N/A
00_Unit Pantry 001	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Unit Pantry 002	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Unit Pantry 003	-	-	-	-	-	-	-	0.2	-	-	N/A
00_WC 003	-	-	0.4	-	-	-	-	-	-	-	N/A
00_WC 014	-	-	0.4	-	-	-	-	-	-	-	N/A
01_A. WC 010	-	-	0.4	-	-	-	-	-	-	-	N/A
01_Bev Bay 002	-	-	0.4	-	-	-	-	-	-	-	N/A
01_C/E Large/MDT 001	-	-	-	-	-	-	-	0.2	-	-	N/A
01_C/E Large/MDT 002	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Coffee Shop	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Coffee Shop Seating 001	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Coffee Shop Seating 002	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Control 001	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Control 002	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Control 003	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Control 004	-	-	-	-	-	-	-	0.2	-	-	N/A
01_CT Control 001	-	-	-	-	-	-	-	0.2	-	-	N/A
01_CT Control 002	-	-	-	-	-	-	-	0.2	-	-	N/A
01_CT Scanner 001	-	-	-	1.5	-	-	-	-	-	-	N/A
01_CT Scanner 002	-	-	-	1.5	-	-	-	-	-	-	N/A
01_CT Scanner 003	-	-	-	1.5	-	-	-	-	-	-	N/A
01_CT Scanner 004	-	-	-	1.5	-	-	-	-	-	-	N/A
01_Foot wash/Shoe storage	-	-	0.4	-	-	-	-	-	-	-	N/A
01_ICC (Incident Coordination Centre)	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Imaging: Fluoro	-	-	-	1.5	-	-	-	-	-	-	N/A
01_Imaging: Gamma	-	-	-	1.5	-	-	-	-	-	-	N/A
01_Imaging: IR	-	-	-	1.5	-	-	-	-	-	-	N/A
01_IT HUB 001	-	-	-	1.5	-	-	-	-	-	-	N/A
01_IT HUB 002	-	-	-	1.5	-	-	-	-	-	-	N/A
01_IT HUB 003	-	-	-	1.5	-	-	-	-	-	-	N/A
01_IT HUB 004	-	-	-	1.5	-	-	-	-	-	-	N/A
01_IT HUB 005	-	-	-	1.5	-	-	-	-	-	-	N/A
01_IT HUB 006	-	-	-	1.5	-	-	-	-	-	-	N/A
01_IT HUB 007	-	-	-	1.5	-	-	-	-	-	-	N/A
01_Meeting Room	-	-	-	-	-	-	-	0.2	-	-	N/A
01_MRI 001	-	-	-	1.5	-	-	-	-	-	-	N/A
01_MRI 002	-	-	-	1.5	-	-	-	-	-	-	N/A
01_MRI 003	-	-	-	1.5	-	-	-	-	-	-	N/A
01_Pat Change 024	-	-	0.4	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
01_Radioactive open/closed sources	-	-	0.4	-	-	-	-	-	-	-	N/A
01_Seminar/MDT 001	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Seminar/MDT 002	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Shop 001	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Shop 002	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Store: Equipment 003	-	-	0.4	-	-	-	-	-	-	-	N/A
01_Store: Equipment (Shared)	-	-	0.4	-	-	-	-	-	-	-	N/A
01_Unit Pantry 001	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Unit Pantry 002	-	-	-	-	-	-	-	0.2	-	-	N/A
01_WC: Staff 001	-	-	0.4	-	-	-	-	-	-	-	N/A
02_Cold room	-	-	-	1.5	-	-	-	-	-	-	N/A
02_D.U. 002	-	-	0.4	-	-	-	-	-	-	-	N/A
02_D.U. 003	-	-	0.4	-	-	-	-	-	-	-	N/A
02_D.U. 004	-	-	0.4	-	-	-	-	-	-	-	N/A
02_D.U. 006	-	-	0.4	-	-	-	-	-	-	-	N/A
02_D.U. 007	-	-	0.4	-	-	-	-	-	-	-	N/A
02_Disposal 002	-	-	0.4	-	-	-	-	-	-	-	N/A
02_Disposal 007	-	-	0.4	-	-	-	-	-	-	-	N/A
02_Gas St. 001	-	-	0.4	-	-	-	-	-	-	-	N/A
02_Gas St. 002	-	-	0.4	-	-	-	-	-	-	-	N/A
02_IT HUB 001	-	-	-	1.5	-	-	-	-	-	-	N/A
02_IT HUB 002	-	-	-	1.5	-	-	-	-	-	-	N/A
02_IT HUB 003	-	-	-	1.5	-	-	-	-	-	-	N/A
02_IT HUB 004	-	-	-	1.5	-	-	-	-	-	-	N/A
02_IT HUB 005	-	-	-	1.5	-	-	-	-	-	-	N/A
02_IT HUB 006	-	-	-	1.5	-	-	-	-	-	-	N/A
02_MDT Room 001	-	-	-	-	-	-	-	0.2	-	-	N/A
02_MDT Room 002	-	-	-	-	-	-	-	0.2	-	-	N/A
02_MDT Room 003	-	-	-	-	-	-	-	0.2	-	-	N/A
02_MDT Room 004	-	-	-	-	-	-	-	0.2	-	-	N/A
02_PoCT 001	-	-	0.4	-	-	-	-	-	-	-	N/A
02_PoCT 002	-	-	0.4	-	-	-	-	-	-	-	N/A
02_PoCT 003	-	-	0.4	-	-	-	-	-	-	-	N/A
02_Seminar 002	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Seminar 003	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Shower 001	-	-	0.4	-	-	-	-	-	-	-	N/A
02_Shower 004	-	-	0.4	-	-	-	-	-	-	-	N/A
02_Staff Change 001	-	-	0.4	-	-	-	-	-	-	-	N/A
02_Staff Change 004	-	-	0.4	-	-	-	-	-	-	-	N/A
02_Staff Rest (Combined)	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Store: scrubs	-	-	0.4	-	-	-	-	-	-	-	N/A
02_Unit Pantry 001	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Unit Pantry 002	-	-	-	-	-	-	-	0.2	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
02_Unit Pantry 003	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Unit Pantry 004	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Unit Pantry 005	-	-	-	-	-	-	-	0.2	-	-	N/A
02_UPS 001	-	-	-	1.5	-	-	-	-	-	-	N/A
02_UPS 002	-	-	-	1.5	-	-	-	-	-	-	N/A
02_UPS 003	-	-	-	1.5	-	-	-	-	-	-	N/A
02_UPS 004	-	-	-	1.5	-	-	-	-	-	-	N/A
02_UPS 005	-	-	-	1.5	-	-	-	-	-	-	N/A
02_UPS 006	-	-	-	1.5	-	-	-	-	-	-	N/A
02_UPS 007	-	-	-	1.5	-	-	-	-	-	-	N/A
03_Eq. Store 007	-	-	0.4	-	-	-	-	-	-	-	N/A
03_Eq. Store 009	-	-	0.4	-	-	-	-	-	-	-	N/A
03_Housekeeping 002	-	-	0.4	-	-	-	-	-	-	-	N/A
03_IT HUB 001	-	-	-	1.5	-	-	-	-	-	-	N/A
03_IT HUB 002	-	-	-	1.5	-	-	-	-	-	-	N/A
03_IT HUB 003	-	-	-	1.5	-	-	-	-	-	-	N/A
03_IT HUB 004	-	-	-	1.5	-	-	-	-	-	-	N/A
03_Lockers 001	-	-	0.4	-	-	-	-	-	-	-	N/A
03_MDT Room 001	-	-	-	-	-	-	-	0.2	-	-	N/A
03_MDT Room 002	-	-	-	-	-	-	-	0.2	-	-	N/A
03_MDT Room 003	-	-	-	-	-	-	-	0.2	-	-	N/A
03_MDT Room 004	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Pantry/Kitchen 001	-	-	0.4	-	-	-	-	-	-	-	N/A
03_Pantry/Kitchen 002	-	-	-	0.4	-	-	-	-	-	-	N/A
03_Pantry/Kitchen 003	-	-	-	0.4	-	-	-	-	-	-	N/A
03_Seminar	-	-	-	-	-	-	-	0.2	-	-	N/A
03_SERVER ROOM	-	-	-	1.5	-	-	-	-	-	-	N/A
03_Unit Pantry 001	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Unit Pantry 002	-	-	-	-	-	-	-	0.2	-	-	N/A
04_IT HUB 001	-	-	-	1.5	-	-	-	-	-	-	N/A
04_IT HUB 002	-	-	-	1.5	-	-	-	-	-	-	N/A
04_IT HUB 003	-	-	-	1.5	-	-	-	-	-	-	N/A
04_PoCT 001	-	-	0.4	-	-	-	-	-	-	-	N/A
04_PoCT 003	-	-	0.4	-	-	-	-	-	-	-	N/A
04_PoCT 004	-	-	0.4	-	-	-	-	-	-	-	N/A
04_Seminar 001	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Seminar 002	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Unit Pantry 004	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Unit Pantry 001	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Unit Pantry 002	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Unit Pantry 003	-	-	-	-	-	-	-	0.2	-	-	N/A
04_WC 005	-	-	0.4	-	-	-	-	-	-	-	N/A
04_WC 006	-	-	0.4	-	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
05_A. WC 002	-	-	0.4	-	-	-	-	-	-	-	N/A
05_IT HUB 001	-	-	-	1.5	-	-	-	-	-	-	N/A
05_IT HUB 002	-	-	-	1.5	-	-	-	-	-	-	N/A
05_IT HUB 003	-	-	-	1.5	-	-	-	-	-	-	N/A
05_IT HUB 004	-	-	-	1.5	-	-	-	-	-	-	N/A
05_IT HUB 005	-	-	-	1.5	-	-	-	-	-	-	N/A
05_Lockers 003	-	-	0.4	-	-	-	-	-	-	-	N/A
05_MDT Room 001	-	-	-	-	-	-	-	0.2	-	-	N/A
05_MDT Room 002	-	-	-	-	-	-	-	0.2	-	-	N/A
05_MDT Room 003	-	-	-	-	-	-	-	0.2	-	-	N/A
05_MDT Room 004	-	-	-	-	-	-	-	0.2	-	-	N/A
05_MDT Room 005	-	-	-	-	-	-	-	0.2	-	-	N/A
05_MDT Room 006	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Physio office: 6 workstations	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Staff Change 001	-	-	0.4	-	-	-	-	-	-	-	N/A
05_Store 003	-	-	0.4	-	-	-	-	-	-	-	N/A
05_Store 004	-	-	0.4	-	-	-	-	-	-	-	N/A
05_Unit Pantry 001	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Unit Pantry 002	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Unit Pantry 003	-	-	-	-	-	-	-	0.2	-	-	N/A
05_WC 013	-	-	0.4	-	-	-	-	-	-	-	N/A
06_Corridor 009	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Food Court Seating	-	-	-	-	-	-	-	0.2	-	-	N/A
06_IT HUB 001	-	-	-	1.5	-	-	-	-	-	-	N/A
06_IT HUB 002	-	-	-	1.5	-	-	-	-	-	-	N/A
06_IT HUB 003	-	-	-	1.5	-	-	-	-	-	-	N/A
06_Lockers 001	-	-	0.4	-	-	-	-	-	-	-	N/A
06_MDT Room 001	-	-	-	-	-	-	-	0.2	-	-	N/A
06_MDT Room 002	-	-	-	-	-	-	-	0.2	-	-	N/A
06_MDT Room 003	-	-	-	-	-	-	-	0.2	-	-	N/A
06_MDT Room 004	-	-	-	-	-	-	-	0.2	-	-	N/A
06_MDT Room 005	-	-	-	-	-	-	-	0.2	-	-	N/A
06_MDT Room 006	-	-	-	-	-	-	-	0.2	-	-	N/A
06_MDT Room 007	-	-	-	-	-	-	-	0.2	-	-	N/A
06_MDT Room 008	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Meeting Room 001	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Meeting Room 002	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Meeting Room 003	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Open Plan for 14 people 001	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Open Plan for 14 people 002	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Open Plan for 6 people	-	-	-	-	-	-	-	0.2	-	-	N/A
06_POD	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Therapy Office: 6 workstations 002	-	-	-	-	-	-	-	0.2	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
06_Unit Pantry 001	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Unit Pantry 002	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Unit Pantry 003	-	-	-	-	-	-	-	0.2	-	-	N/A
07_Decontamination Room: Inc Bed Washer		-	0.4	-	-	-	-	-	-	-	N/A
07_IT Hub 001	-	-	-	1.5	-	-	-	-	-	-	N/A
07_IT Hub 002	-	-	-	1.5	-	-	-	-	-	-	N/A
07_IT Store	-	-	-	1.5	-	-	-	-	-	-	N/A
07_Library/Decontamination	-	-	0.4	-	-	-	-	-	-	-	N/A
07_Store	-	-	0.4	-	-	-	-	-	-	-	N/A
07_Store: Beds	-	-	0.4	-	-	-	-	-	-	-	N/A
B1_Bev Bay	-	-	0.4	-	-	-	-	-	-	-	N/A
B1_Central Consumables St	-	-	0.4	-	-	-	-	-	-	-	N/A
B1_Cleaning Equipment St	-	-	0.4	-	-	-	-	-	-	-	N/A
B1_Clinical Trials St.	-	-	0.4	-	-	-	-	-	-	-	N/A
B1_Cold St.	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_Controlled Drugs	-	-	0.4	-	-	-	-	-	-	-	N/A
B1_Distribution St.	-	-	0.4	-	-	-	-	-	-	-	N/A
B1_Dry Goods St	-	-	0.4	-	-	-	-	-	-	-	N/A
B1_IT HUB 001	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_IT HUB 002	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_IT HUB 003	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_IT HUB 004	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_IT HUB 005	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_IT HUB 006	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 003	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 004	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 005	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 006	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 008	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 009	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 010	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 011	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 013	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 014	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 015	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 016	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 017	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 018	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 019	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 020	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 021	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 023	-	-	-	1.5	-	-	-	-	-	-	N/A
B1_MEP PLANT 024	-	-	-	1.5	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
B1_Micro Fibre Laundry	-	-	0.4	-	-	-	-	-	-	-	N/A
B1_Patient Handling/Body Store	-	-	0.4	-	-	-	-	-	-	-	N/A
B1_Shower: Staff 001	-	-	0.4	-	-	-	-	-	-	-	N/A
B1_Staff Change 001	-	-	0.4	-	-	-	-	-	-	-	N/A
B1_Staff Change 002	-	-	0.4	-	-	-	-	-	-	-	N/A
B1_Washing Room	-	-	0.4	-	-	-	-	-	-	-	N/A
CP_00_Cafe	-	-	-	1.5	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00_4 Bed Bay 001	-	78	-	451
00_4 Bed Bay 002	-	78	-	452
00_4 Bed Bay 003	-	77	-	438
00_4 Bed Bay 004	-	77	-	435
00_4 Bed Bay 005	-	77	-	456
00_4 Bed Bay 006	-	77	-	437
00_4 Bed Bay 007	-	77	-	434
00_4 Bed Bay 008	-	77	-	435
00_4 Bed Bay 009	-	77	-	438
00_A. WC 001	-	134	-	30
00_A. WC 002	-	134	-	37
00_A. WC 003	-	132	-	41
00_A. WC 004	-	134	-	41
00_A. WC 005	-	134	-	32
00_A. WC 006	-	134	-	39
00_A. WC 007	-	134	-	31
00_A. WC 008	-	134	-	37
00_A. WC 009	-	134	-	37
00_A. WC 010	-	134	-	32
00_A. WC 011	-	122	-	52
00_A. WC 012	-	134	-	37
00_A. WC 013	-	134	-	31
00_A. WC 014	-	134	-	38
00_A. WC 015	-	134	-	36
00_A. WC 016	-	134	-	34
00_A. WC 017	-	132	-	45
00_A. WC 018	-	134	-	38
00_A. WC 019	-	121	-	48
00_A. WC 020	-	134	-	36
00_A. WC 021	-	123	-	47
00_A. WC 022	-	122	-	47
00_A. WC 023	-	131	-	43

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00_A. WC 024	-	134	-	39
00_A. WC 025	-	134	-	35
00_A. WC/Shower 001	-	112	-	41
00_A. WC/Shower 002	-	111	-	40
00_A. WC/Shower 003	-	131	-	26
00_A. WC/Shower 004	-	116	-	38
00_A. WC/Shower 005	-	117	-	37
00_A. WC/Shower 006	-	131	-	22
00_A. WC/Shower 007	-	131	-	31
00_A. WC/Shower 008	-	131	-	25
00_A. WC/Shower 009	-	131	-	21
00_A. WC/Shower 010	-	131	-	24
00_A. WC/Shower 011	-	131	-	24
00_A. WC/Shower 012	-	130	-	31
00_A. WC/Shower 013	-	131	-	22
00_A. WC 026	-	134	-	37
00_Adult Resus 001	-	137	-	216
00_Adult Resus 002	-	137	-	214
00_Adult Resus 003	-	135	-	227
00_Adult Resus 004	-	137	-	218
00_Adult Resus 005	-	135	-	224
00_Adult Resus 006	-	137	-	216
00_Amb. Triage/Transfer 001	-	202	-	51
00_Amb. Triage/Transfer 002	-	202	-	51
00_Amb. Triage/Transfer 003	-	205	-	50
00_Amb. Triage/Transfer 004	-	199	-	52
00_Amb. Triage/Transfer 005	-	199	-	52
00_Amb. Triage/Transfer 006	-	205	-	50
00_Ambulance Entry	-	99	-	97
00_Ambulance Stock St.	141	-	-	51
00_Baby Feed	-	128	-	68
00_BED/FM Lift Lobby 001	-	92	-	186
00_BED/FM Lift Lobby 002	-	91	-	190
00_BED/FM Lift Lobby 003	-	92	-	187
00_BED/FM Lift Lobby 004	-	92	-	186
00_Beds: Single Room 001	-	149	-	92
00_Beds: Single Room 002	-	149	-	92
00_Beds: Single Room 003	-	149	-	92
00_Beds: Single Room 004	-	148	-	94
00_Bev Bay	-	188	-	6
00_Bev Bay (Staff)	-	155	-	20
00_Bier View	199	-	-	52
00_Breast Feed	-	130	-	67

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00_Buggy Park	102	-	-	33
00_C.U. 001	118	-	-	60
00_C.U. 002	98	-	-	99
00_C.U. 003	110	-	-	71
00_C.U. 004	98	-	-	83
00_C.U. 005	102	-	-	77
00_C.U. 006	115	-	-	68
00_C.U. 007	95	-	-	88
00_C.U. 008	94	-	-	92
00_C.U. 009	94	-	-	92
00_C.U. 010	112	-	-	63
00_C.U. 011	125	-	-	50
00_C.U. (P Tube)	133	-	-	47
00_C.U./Prep 001	147	-	-	40
00_C.U./Prep 002	118	-	-	60
00_C.U./Prep 003	101	-	-	82
00_Cafe	-	85	-	365
00_Cashier Office	154	-	-	110
00_CE/Treat 001	-	171	-	122
00_CE/Treat 002	-	170	-	120
00_CE/Treat 003	-	171	-	119
00_CE/Treat 004	-	175	-	116
00_Changing Places: Disabled Adults	-	92	-	82
00_Child Wait	-	98	60	213
00_Circulation 001	-	76	-	442
00_Circulation 002	-	79	-	509
00_Circulation 003	-	101	-	95
00_Circulation 004	-	76	-	411
00_Circulation 005	-	83	-	296
00_Circulation 006	-	92	-	134
00_Circulation 007	-	91	-	138
00_Circulation 008	-	76	-	552
00_Cleaners 001	150	-	-	29
00_Cleaners 002	135	-	-	34
00_Cleaners 003	144	-	-	38
00_Cleaners 004	121	-	-	42
00_Cleaners 005	119	-	-	44
00_Cleaners 006	166	-	-	24
00_Cleaners 007	145	-	-	30
00_Corridor 001	-	81	-	389
00_Corridor 002	-	96	-	261
00_Corridor 003	-	87	-	478
00_Corridor 004	-	88	-	750

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00_Corridor 005	-	75	-	250
00_Corridor 006	-	84	-	835
00_Corridor 007	-	90	-	796
00_Corridor 008	-	100	-	198
00_Corridor 009	-	188	-	16
00_Corridor 010	-	82	-	237
00_Corridor 011	-	85	-	786
00_Corridor 012	-	73	-	410
00_Corridor 013	-	101	-	157
00_Corridor 014	-	86	-	1019
00_Corridor 015	-	109	-	99
00_Corridor 016	-	87	-	468
00_Corridor 017	-	96	-	331
00_Corridor 018	-	84	-	844
00_Corridor 019	-	188	-	13
00_Corridor 020	-	85	-	520
00_Corridor 021	-	86	-	909
00_Corridor 022	-	83	-	342
00_Corridor 023	-	86	-	958
00_Corridor 024	-	100	-	122
00_Corridor 025	-	72	-	356
00_Corridor 026	-	83	-	680
00_Corridor 027	-	88	-	495
00_Corridor 028	-	87	-	1071
00_CT Control	148	-	-	107
00_CT Scanner	-	117	-	622
00_D.B. 001	176	-	-	17
00_D.B. 002	176	-	-	15
00_D.B. 003	176	-	-	13
00_D.B. 004	176	-	-	16
00_D.B. 005	176	-	-	17
00_D.B. 006	176	-	-	12
00_D.B. 007	176	-	-	16
00_D.B. 008	176	-	-	13
00_D.B. 009	176	-	-	12
00_D.B. 010	176	-	-	12
00_D.B. 011	176	-	-	12
00_D.B. 012	176	-	-	15
00_D.B. 013	176	-	-	12
00_D.U. 001	145	-	-	43
00_D.U. 002	119	-	-	59
00_D.U. 003	120	-	-	62
00_D.U. 004	131	-	-	47

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00_D.U. 005	120	-	-	56
00_D.U. 006	128	-	-	50
00_D.U. 007	132	-	-	46
00_D.U. 008	135	-	-	47
00_D.U. 009	137	-	-	44
00_D.U. 010	131	-	-	47
00_D.U. 011	117	-	-	60
00_D.U. 012	110	-	-	66
00_D.U./Sluice	94	-	-	92
00_Decon. Lobby	-	188	-	25
00_Decont Zones	-	93	-	86
00_Decontamination Suits Store	94	-	-	94
00_Dis. WC/Nappy Change 001	-	134	-	40
00_Dis. WC/Nappy Change 002	-	120	-	48
00_Disposal 001	141	-	-	42
00_Disposal 002	131	-	-	50
00_Disposal 003	134	-	-	49
00_Disposal 004	119	-	-	57
00_Disposal 005	126	-	-	57
00_DON/DOFF area	-	135	-	31
00_Draught Lobby	-	100	-	95
00_E-Triage 001	-	293	-	21
00_E-Triage 002	-	293	-	20
00_E-Triage 003	-	293	-	21
00_Ensuite 001	-	131	-	28
00_Ensuite 002	-	131	-	28
00_Ensuite 003	-	131	-	27
00_Ensuite 004	-	124	-	34
00_Ensuite 005	-	131	-	28
00_Ensuite 006	-	131	-	27
00_Ensuite 007	-	131	-	28
00_Ensuite 008	-	131	-	28
00_Ensuite 009	-	131	-	28
00_Ensuite 010	-	131	-	59
00_Ensuite 011	-	131	-	28
00_Ensuite 012	-	131	-	28
00_Ensuite 013	-	131	-	29
00_Ensuite 014	-	131	-	28
00_Ensuite 015	-	131	-	30
00_Ensuite 016	-	131	-	29
00_Ensuite 017	-	131	-	29
00_Ensuite 018	-	131	-	29
00_Ensuite 019	-	131	-	29

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00_Ensuite 020	-	131	-	29
00_Ensuite 021	-	131	-	27
00_Ensuite 022	-	131	-	28
00_Ensuite 023	-	131	-	29
00_Ensuite 024	-	131	-	28
00_Ensuite 025	-	131	-	29
00_Ensuite 026	-	131	-	30
00_Ensuite 027	-	131	-	28
00_Ensuite 028	-	131	-	30
00_Ensuite 029	-	131	-	30
00_Ensuite 030	-	131	-	29
00_Ensuite 031	-	131	-	30
00_Ensuite 032	-	131	-	28
00_Ensuite 033	-	131	-	28
00_Ensuite 034	-	131	-	28
00_Ensuite 035	-	131	-	27
00_Ensuite 036	-	131	-	27
00_Ensuite 037	-	131	-	28
00_Ensuite 038	-	131	-	27
00_Ensuite 039	-	131	-	30
00_Ensuite 040	-	131	-	27
00_Ensuite 041	-	131	-	30
00_Ensuite 042	-	131	-	29
00_Ensuite 043	-	131	-	28
00_Ensuite 044	-	129	-	31
00_Ensuite 045	-	131	-	28
00_Ensuite 046	-	131	-	30
00_Ensuite 047	-	131	-	29
00_Ensuite 048	-	131	-	28
00_Ensuite 049	-	131	-	28
00_Ensuite 050	-	131	-	29
00_Ensuite 051	-	131	-	29
00_Ensuite 052	-	131	-	30
00_Ensuite 053	-	131	-	29
00_Entrace Lobby	-	97	-	101
00_Entrance Concourse/Waiting 001	-	79	60	773
00_Entrance Concourse/Waiting 002	-	71	60	278
00_Entrance Concourse/Waiting 003	-	71	60	82
00_Entrance Concourse/Waiting 004	-	78	60	3031
00_Eq. Store 001	138	-	-	63
00_Eq. Bay 001	124	-	-	17
00_Eq. Bay 002	131	-	-	6
00_Eq. Bay 003	131	-	-	6

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00_Eq. Bay 004	142	-	-	25
00_Eq. Store 002	127	-	-	51
00_Eq. Store 003	116	-	-	78
00_Eq. Store 004	118	-	-	64
00_Eq. Store 005	125	-	-	56
00_Eq. Store 006	122	-	-	74
00_Exam (Decontamination)	-	152	-	160
00_Exam/Treat 001	-	173	-	117
00_Exam/Treat 002	-	170	-	122
00_Exam/Treat 003	-	176	-	118
00_Exam/Treat 004	-	173	-	123
00_Exam/Treat 005	-	174	-	116
00_Exam/Treat 006	-	171	-	121
00_Exam/Treat 007	-	175	-	121
00_Exam/Treat 008	-	177	-	116
00_Exam/Treat 009	-	174	-	116
00_Exam/Treat 010	-	174	-	116
00_Exam/Treat 011	-	175	-	114
00_Exam/Treat 012	-	176	-	118
00_Exam/Treat 013	-	163	-	138
00_Exam/Treat 014	-	176	-	112
00_Exam/Treat 015	-	175	-	121
00_Exam/Treat 016	-	176	-	113
00_Exam/Treat 017	-	170	-	122
00_Exam/Treat 018	-	174	-	116
00_Exam/Treat 019	-	173	-	123
00_Exam/Treat 020	-	173	-	123
00_Exam/Treat 021	-	173	-	117
00_Exam/Treat 022	-	183	-	121
00_Exam/Treat 023	-	169	-	132
00_Exam/Treat 024	-	175	-	116
00_Exam/Treat 025	-	174	-	116
00_Exam/Treat 026	-	176	-	118
00_Exam/Treat 027	-	189	-	128
00_Exam/Treat 028	-	182	-	121
00_Exam/Treat 029	-	176	-	113
00_Exam/Treat 030	-	173	-	116
00_Exam/Treat 031	-	173	-	117
00_Exam/Treat 032	-	173	-	116
00_Exam/Treat 033	-	193	-	124
00_Exam/Treat 034	-	182	-	121
00_Exam/Treat 035	-	175	-	121
00_Exam/Treat 036	-	182	-	123

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
00_Exam/Treat 037	-	180	-	115
00_Exam/Treat 038	-	180	-	115
00_Exam/Treat 039	-	162	-	135
00_Exam/Treat 040	-	168	-	129
00_Exam/Treat 041	-	173	-	123
00_Exam/Treat 042	-	177	-	116
00_Exam/Treat 043	-	167	-	131
00_Exam/Treat 044	-	173	-	117
00_Exam/Treat 045	-	170	-	122
00_Exam/Treat 046	-	176	-	119
00_Exam/Treat 047	-	173	-	117
00_Exam/Treat 048	-	171	-	121
00_Exam/Treat 049	-	177	-	112
00_Exam/Treat 050	-	179	-	114
00_Exam/Treat 051	-	173	-	117
00_Exam/Treat 052	-	167	-	131
00_Exam/Treat: Mental Health 001	-	171	-	121
00_Exam/Treat: Mental Health 002	-	171	-	121
00_Exam/Treat: Spec Diags 001	-	172	-	119
00_Exam/Treat: Spec Diags 002	-	171	-	134
00_Exam/Treat: Spec Diags 003	-	171	-	157
00_Exam/Treat: Spec Diags 004	-	170	-	122
00_Exam/Treat: Spec Diags 005	-	158	-	147
00_Exam/Treat: Specialist Diahs - Gynae	-	152	-	158
00_Exam/Treat: US 001	-	159	-	146
00_Exam/Treat: US 002	-	160	-	144
00_Floor Coord.n Hub	152	-	-	94
00_HDU/Larger Bed 001	-	149	-	92
00_HDU/Larger Bed 002	-	149	-	92
00_HUB/Office	177	-	-	77
00_HUB/Reception	-	188	60	90
00_Interview 001	163	-	-	81
00_Interview 002	196	-	-	59
00_Interview 003	197	-	-	59
00_Interview 004	195	-	-	60
00_Interview 005	192	-	-	64
00_Interview 006	169	-	-	78
00_Interview 007	202	-	-	56
00_Interview 008	162	-	-	82
00_Interview 009	162	-	-	84
00_Interview 010	232	-	-	46
00_Interview 011	205	-	-	55
00_Interview 012	170	-	-	77

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
00_Interview 013	208	-	-	53
00_Interview 014	231	-	-	43
00_Interview 015	195	-	-	63
00_Interview 016	164	-	-	80
00_Interview 017	191	-	-	61
00_Interview 018	182	-	-	66
00_Iso Lobby 001	-	188	-	24
00_Iso Lobby 002	-	187	-	29
00_Iso Lobby 002	-	188	-	25
00_Iso Lobby 003	-	188	-	24
00_Iso Lobby 004	-	174	-	32
00_Iso Lobby 005	-	188	-	23
00_Iso Lobby 006	-	188	-	27
00_IT HUB 001	330	-	-	55
00_IT HUB 002	276	-	-	82
00_IT HUB 003	274	-	-	83
00_IT HUB 004	385	-	-	43
00_IT HUB 005	285	-	-	75
00_Kitchen/Bev Bay	-	134	-	151
00_Linen 001	138	-	-	34
00_Linen 002	167	-	-	20
00_Linen 003	167	-	-	11
00_Linen 004	167	-	-	20
00_Linen 005	165	-	-	25
00_Linen 006	167	-	-	21
00_Linen 007	167	-	-	15
00_Linen 008	167	-	-	33
00_Linen 009	152	-	-	28
00_Linen 010	140	-	-	33
00_Linen 011	167	-	-	24
00_Linen bay	167	-	-	23
00_Lobby 001	-	115	-	68
00_Lobby 002	-	150	-	61
00_Lounge W Seating/6 001	-	108	60	259
00_Lounge W Seating/6 002	-	108	60	259
00_Lounge W Seating/6 003	-	107	60	266
00_Lounge W Seating/6 004	-	107	60	266
00_Lounge W Seating/10	-	99	60	336
00_Lounge W Seating/6 005	-	110	60	280
00_MDT Room 001	133	-	-	108
00_MDT Room 002	130	-	-	112
00_MDT Room 003	102	-	-	233
00_MDT Room 004	151	-	-	103

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00_MDT Room 005	133	-	-	107
00_Med Gas Bottles St	167	-	-	53
00_Med. room	-	175	-	117
00_Milk Kitchen	-	177	-	53
00_Nappy Change	-	122	-	52
00_Office 001	195	-	-	57
00_Office 002	205	-	-	53
00_Office 003	153	-	-	100
00_Office 004	206	-	-	55
00_Office 005	212	-	-	53
00_Office 006	170	-	-	97
00_Office 007	167	-	-	82
00_Office 008	178	-	-	106
00_Office 009	184	-	-	68
00_Office 010	211	-	-	52
00_Office 011	126	-	-	228
00_Office 012	159	-	-	89
00_Office 013	189	-	-	62
00_Office (Patch Team)	137	-	-	119
00_Office - managers	195	-	-	65
00_Office Complaints	146	-	-	106
00_Office Pals	147	-	-	104
00_Office: Open Plan	123	-	-	265
00_Pat Change 001	-	147	-	21
00_Pat Change 002	-	137	-	33
00_Pat Change 003	-	147	-	18
00_Pat. WC 001	-	134	-	23
00_Pat. WC 002	-	134	-	24
00_PEAD RESUS 001	-	144	-	185
00_PEAD RESUS 002	-	145	-	179
00_Phleb bay	-	254	-	58
00_Photo Pass Room	171	-	-	73
00_Plaster	-	163	-	134
00_Play	-	105	60	180
00_PoCT 001	216	-	-	51
00_PoCT 002	223	-	-	24
00_PoCT 003	196	-	-	60
00_PoCT 004	166	-	-	88
00_PoCT 005	223	-	-	44
00_PoCT 006	191	-	-	62
00_PoCT 007	223	-	-	42
00_PoCT 008	207	-	-	54
00_PoCT 009	176	-	-	70

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00_Police/Security Room	179	-	-	72
00_PTS Office	134	-	-	134
00_Radiology Report	138	-	-	119
00_Recep/Wait	-	102	60	194
00_Reception 001	-	139	60	95
00_Reception 002	-	180	60	62
00_Reception 003	-	128	60	65
00_Reception 004	-	118	60	214
00_Reception/Office	-	170	60	111
00_Reception/Wait	-	96	60	483
00_Recliners	-	132	-	349
00_Resus Bay 001	-	271	-	7
00_Resus Bay 002	-	293	-	8
00_Security Change	211	-	-	55
00_Security Office	172	-	-	72
00_Security Room: CCTV	142	-	-	135
00_Seminar	-	140	-	139
00_Seminar ED Floor	-	148	-	119
00_Shared Treat	-	175	-	114
00_Single Bedroom 001	-	158	-	101
00_Single Bedroom 002	-	157	-	101
00_Single Bedroom 003	-	157	-	102
00_Single Bedroom 004	-	156	-	103
00_Single Bedroom 005	-	158	-	101
00_Single Bedroom 006	-	156	-	102
00_Single Bedroom 007	-	155	-	104
00_Single Bedroom 008	-	157	-	101
00_Single Bedroom 009	-	156	-	102
00_Single Bedroom 010	-	157	-	101
00_Single Bedroom 011	-	155	-	102
00_Single Bedroom 012	-	155	-	103
00_Single Bedroom 013	-	155	-	104
00_Single Bedroom 014	-	155	-	103
00_Single Bedroom 015	-	155	-	102
00_Single Bedroom 016	-	157	-	102
00_Single Bedroom 017	-	157	-	102
00_Single Bedroom 018	-	155	-	103
00_Single Bedroom 019	-	153	-	107
00_Single Bedroom 020	-	155	-	103
00_Single Bedroom 021	-	156	-	101
00_Single Bedroom 022	-	156	-	102
00_Single Bedroom 023	-	155	-	103
00_Single Bedroom 024	-	152	-	108

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
00_Single Bedroom 025	-	155	-	103
00_Single Bedroom 026	-	154	-	104
00_Single Bedroom 027	-	154	-	103
00_Single Bedroom 028	-	155	-	103
00_Single Bedroom 029	-	155	-	103
00_Single Bedroom 030	-	155	-	104
00_Single Bedroom 031	-	155	-	103
00_Single Bedroom 032	-	156	-	102
00_Single Bedroom 033	-	155	-	102
00_Single Bedroom 034	-	155	-	104
00_Single Bedroom 035	-	154	-	104
00_Single Bedroom 036	-	158	-	100
00_Single Bedroom 037	-	156	-	102
00_Single Bedroom 038	-	154	-	104
00_Single Bedroom 039	-	157	-	102
00_Single Bedroom 040	-	157	-	101
00_Single Bedroom 041	-	156	-	103
00_Single Bedroom 042	-	155	-	89
00_Sister Office	192	-	-	69
00_Staff Base 001	-	86	-	81
00_Staff Base 002	-	78	-	127
00_Staff Base 003	-	72	-	76
00_Staff Base 004	-	71	-	119
00_Staff Base 005	-	90	-	84
00_Staff Base 006	-	71	-	112
00_Staff Base 007	-	136	-	79
00_Staff Base 008	-	92	-	70
00_Staff Base 009	-	99	-	56
00_Staff Base 010	-	89	-	240
00_Staff Base 011	-	72	-	158
00_Staff Base 012	-	95	-	55
00_Staff Base 013	-	90	-	57
00_Staff Base - Gynae	-	77	-	66
00_Staff Base with Pneumt Tube 001	-	201	-	41
00_Staff Base with Pneumt Tube 002	-	86	-	108
00_Staff Base with Pneumt Tube 003	-	92	-	69
00_Staff Change 001	-	68	-	160
00_Staff Change 002	-	69	-	158
00_Staff Change 003	-	65	-	156
00_Staff Change 004	-	70	-	127
00_Staff Change 005	-	75	-	117
00_Staff Rest 001	122	-	-	132
00_Staff Rest002	136	-	-	113

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
00_Staff Rest/Bev 001	88	-	-	467
00_Staff Rest/Bev 002	100	-	-	376
00_Staff WC 001	-	63	-	189
00_Staff WC 002	-	65	-	174
00_Stair A	-	69	-	154
00_Stair C 001	-	71	-	162
00_Stair C 002	-	72	-	160
00_Stair D	-	71	-	147
00_Sterile Supply/Eq. Store 001	89	-	-	78
00_Sterile Supply/Eq. Store 002	98	-	-	208
00_Store 001	167	-	-	29
00_Store 002	163	-	-	36
00_Store 003	89	-	-	79
00_Store 004	167	-	-	30
00_Store 005	167	-	-	27
00_Store 006	100	-	-	83
00_Store: Decontam Tent Suites	167	-	-	29
00_Streaming 001	-	293	-	43
00_Streaming 002	-	293	-	24
00_Streaming 003	-	293	-	43
00_Streaming 004	-	212	-	45
00_Sub-Wait	-	139	60	150
00_T.D. 001	167	-	-	16
00_T.D. 002	167	-	-	17
00_T.D. 003	167	-	-	18
00_T.D. 004	159	-	-	13
00_Transport Wait (Inc Transport Liason)	-	94	60	319
00_Treat/Plaster	-	166	-	131
00_Treat: Procedures 001	-	147	-	176
00_Treat: Procedures 002	-	146	-	177
00_Treatment 001	-	178	-	112
00_Treatment 002	-	169	-	127
00_Treatment (2-sided) 001	-	162	-	136
00_Treatment (2-sided) 002	-	167	-	127
00_Treatment: Proc	-	145	-	181
00_Treatment: Procedures - Gynae	-	154	-	152
00_Treatment: Specialist Diags 001	-	164	-	135
00_Treatment: Specialist Diags 002	-	179	-	108
00_Triage	-	160	-	143
00_Triage/Streaming 001	-	210	-	56
00_Triage/Streaming 002	-	214	-	54
00_Triage/Streaming 003	-	214	-	54
00_Triage/Streaming 004	-	210	-	56

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00_Trolley Hold	92	-	-	45
00_Ultrasound	-	150	-	290
00_Unit Office	164	-	-	79
00_Unit Pantry 001	139	-	-	46
00_Unit Pantry 002	94	-	-	91
00_Unit Pantry 003	115	-	-	63
00_Visitor Lift Lobby 001	-	108	-	136
00_Visitor Lift Lobby 002	-	109	-	132
00_Visitor Lift Lobby 003	-	108	-	137
00_Wait 001	-	192	60	79
00_Wait 002	-	74	60	247
00_Wait 003	-	81	60	148
00_Wait 004	-	89	60	346
00_Wait 005	-	134	60	88
00_Waiting: 15 places 001	-	103	60	281
00_Waiting; 15 places002	-	80	60	398
00_Waiting: 4 places	-	105	60	91
00_Waiting: 5 places	-	90	60	160
00_Waiting: Bed Bay 001	-	74	60	146
00_Waiting: Bed Bay 002	-	141	60	131
00_Waiting: Bed Bay 003	-	92	60	129
00_Waiting: Bed Bay 004	-	91	60	146
00_Waiting: Bed Bay 005	-	92	60	127
00_Waiting: Bed Bay 006	-	91	60	146
00_WC 001	-	134	-	28
00_WC 002	-	134	-	30
00_WC 003	-	76	-	111
00_WC 004	-	134	-	25
00_WC 005	-	134	-	31
00_WC 006	-	134	-	29
00_WC 007	-	134	-	30
00_WC 008	-	134	-	34
00_WC 009	-	134	-	28
00_WC 010	-	134	-	31
00_WC 011	-	134	-	27
00_WC 012	-	134	-	31
00_WC 013	-	134	-	29
00_WC 014	-	75	-	115
00_WC 015	-	134	-	35
00_WC 016	-	134	-	32
00_WC 017	-	134	-	30
00_WC Staff	-	134	-	33
00_WC/Shower 001	-	113	-	39