Manor Road / Richmond

Energy Strategy

Hoare Lea

February 2019

Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
01	14/12/2018	Draft planning report for team comments	L. Wille	A. Duckworth	T. Spurrier
02	17/01/2019	Draft planning report for legal review	L. Wille	T. Spurrier	T. Spurrier
03	06/02/2019	Planning issue	L. Wille	T. Spurrier	T. Spurrier

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Contents.

1. Executive Summary

The Application
This Energy Strategy has been prepared by Hoare Lea on behalf of Avanton Richmond Development Ltd ('the Applicant') in support of the planning application for the development at Manor Road ('the Proposed Development') within the London Borough of Richmond Upon Thames ('LBR').

The Proposed Development will provide new homes (including affordable homes) and commercial areas.

Policies & Drivers
This document summarises the pertinent policies and requirements applicable to the Proposed Development. Of these, the principal target is to achieve 'zero carbon' for the new build residential aspects, corresponding to a 100% reduction in regulated CO_2 emissions beyond the requirements of the Building Regulations Part L (2013), and a 35% reduction for commercial areas, as set out in the London Plan (2016) and set out in the LBR Local Plan (2018). The commercial areas are required to meet BREEAM New Construction 'Excellent' standard (where feasible).

Approach
A sample of dwellings of the Proposed Development have been assessed using Part L1A approved SAP methodology. Non-residential spaces have been modelled using Part L compliant software. This has provided the basis for the analysis of the designed building and the consideration of all applicable passive design, energy efficiency and Low or Zero Carbon (LZC) technologies.

The assessment makes use of the Mayor of London's Energy Hierarchy Be lean – Be Clean – Be Green, and the cooling hierarchy from the London Plan (2016).

In line with current GLA guidance, carbon emission reductions have been calculated using the carbon factors set out in the draft SAP10 guidance.

1.1 Be Lean – Passive Design & Energy Efficient Measures

Passive design measures to be implemented at the Proposed Development include:

- Efficient building fabric and air tight construction, minimising heat losses and heat gains
- Optimised glazing performance to ensure good daylight to the spaces whilst limiting solar gains.
- Efficient space heating systems with zonal, programmable and thermostatic controls, with separate programmer for hot water.
- Efficient low-energy lighting throughout all dwellings. External and communal lighting will be coupled to daylight and presence detection sensors to minimise unnecessary use.
- Efficient mechanical ventilation with heat recovery which will limit the need for space heating in winter months, aid the mitigation of high internal temperatures in summer months, and maintain good indoor air quality.
- Appropriately insulated pipework and ductwork (and air sealing to ductwork) to minimise losses and gains.
- Variable speed pumps and fans to minimise energy consumption for distribution of services

1.2 Be Clean – Infrastructure & Low-Carbon Supply of Energy

The "Be Clean" stage encourages developments to supply energy as cleanly as possible. An assessment of the energy networks in the area has been undertaken but has shown there are no networks in close vicinity to the Proposed Development. Further, it has been estimated that connecting to district energy may lead to increased carbon emissions of up to 47 tonnes CO_2/year for the development. Moreover, the combined amount of ASHP required would not fit in one single rooftop location on-site. For these reasons, it is not proposed to provide a centralised energy centre for the development. Space allocation has been made, and a potential route identified, for potential future connection to a district energy system, should a viable option become available in the vicinity of the site in future.

1.3 Be Green – On-site Renewable Energy Generation

The inclusion of on-site renewable energy generation has been assessed, and it is proposed to implement Air Source Heat Pumps (ASHP) and PVs in the design. This is expected to result in significant carbon emission reductions of up to 40% compared to the Part L 2013 'gas boiler baseline'.

1.4 Overall Carbon Dioxide Emissions Reduction

The development as proposed will deliver buildings which are very energy efficient, resulting in a reduction in energy and carbon consumed by the site. It will target improvements over what is required by the Building Regulations.

The CO_2 emissions reductions are presented separately for residential and non-residential areas, as outlined in section 9 of the GLA guidance on preparing energy assessments.

1.5 Dwellings

Table 1 outlines the anticipated CO_2 emissions reductions and carbon offset payment. The combined on-site savings and zero carbon target shortfall is used to calculate a total carbon offset payment of £451,800.

New Build Dwellings	Regulated Carbon Dioxide Emission Savings (tonnes CO_2/yr)	
	Regulated	Unregulated
Baseline: Part L 2013 Building Regulations with SAP 10 carbon factors	385	198
After energy demand reduction (Be Lean)	359	198
After heat network / CHP (Be Clean)	359	198
After renewable energy (Be Green)	251	198
	Regulated domestic carbon dioxide savings	
	(tonnes CO_2/yr)	(%)
Savings from energy demand reduction	25	7%
Savings from heat network / CHP	0	0%
Savings from renewable energy	109	28%
Cumulative on site savings	134	35%
Annual savings from offset payment	251	-
Dwellings offset Payment Rate (£/tCO_2)	£1,800	
Total Offset Payment	£451,800	

Table 1: Dwellings Summary of regulated carbon emissions saving and carbon offset payment.

1.6 Retail areas

Table 2 (overleaf) outlines the anticipated CO_2 emissions reductions and carbon offset payment. The on-site target is used to confirm that no carbon offset payment is expected for these retail areas.

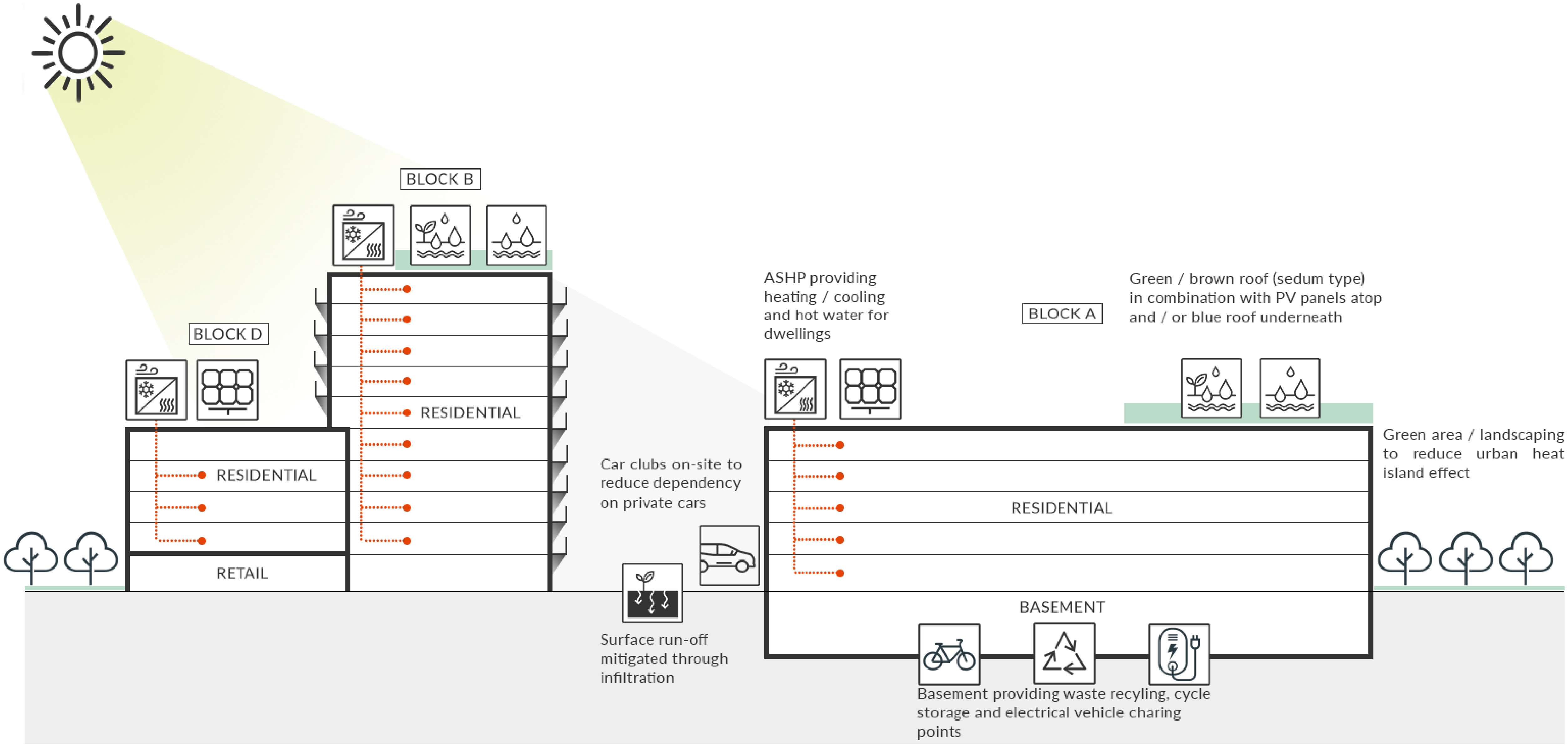
New Build Retail	Regulated Carbon Dioxide Emission Savings (tonnes CO_2/yr)	
	Regulated	Unregulated
Baseline: Part L 2013 Building Regulations with SAP 10 carbon factors	10	6
After energy demand reduction (Be Lean)	8	6
After heat network / CHP (Be Clean)	8	6
After renewable energy (Be Green)	6	6
	Regulated non-domestic carbon dioxide savings	
	(tonnes CO_2/yr)	(%)
Savings from energy demand reduction	2	22%
Savings from heat network / CHP	0	0%
Savings from renewable energy	3	24%
Cumulative on site savings	5	46%
Total target savings	4	35%
Shortfall	N/A	-
Dwellings offset Payment Rate (£/tCO_2)	£1,800	
Total Offset Payment	£0	

Table 2: Retail Summary of regulated carbon emissions saving and carbon offset payment.

Figure 1: Comparison of regulated carbon emissions saving and carbon offset payment.

1.7 Environmental Assessment Methods

In line with LBR Local Plan (2018) Policy 22, proposals for commercial areas will be required to meet BREEAM New Construction (NC) 'Excellent' standard (where feasible). It is the intention of the design team to meet the minimum standards for 'Excellent'. Please refer to the sustainability statement, submitted in support of this planning application, for further information.



ASHP providing heating / cooling and hot water for dwellings

Green / brown roof (sedum type) in combination with PV panels atop and / or blue roof underneath

Green area / landscaping to reduce urban heat island effect

Car clubs on-site to reduce dependency on private cars

Surface run-off mitigated through infiltration

Basement providing waste recyling, cycle storage and electrical vehicle charing points

Figure 16: Energy Strategy diagram overview

2. Introduction

2.1 The Application

This document is submitted in support of an application for planning permission concerning the Proposed Development at Manor Road, Richmond.

2.2 Development Description and Site Context

Demolition of existing buildings and structures and comprehensive residential-led redevelopment of four buildings of between four and nine storeys to provide 385 residential units (Class C3), flexible retail /community / office uses (Classes A1, A2, A3, D2, B1), provision of car and cycle parking, landscaping, public and private open spaces and all other necessary enabling works.

2.3 Approach

This Energy Strategy follows the Mayor's energy hierarchy: 'Be Lean, Be Clean, Be Green'. This hierarchy shall be the guiding ethos behind decisions regarding the energy performance of the building.

The Proposed Development is assessed as follows:

- New build residential areas - Building Regulations Part L1A 2013: Conservation of Fuel and Power in New Dwellings. These elements have been modelled using SAP v9.92.
- New build commercial areas. Building Regulations Part L2A 2013: Conservation of Fuel and Power in New Buildings other than Dwellings. These elements have been modelled using IES v. 2018.
- In line with current GLA guidance, carbon emission reductions have been calculated using the carbon factors set out in the draft SAP10 guidance.

2.4 Definitions and Limitations

Definitions

The following definitions should be understood throughout this statement:

- Energy demand – the 'room-side' amount of energy which must be inputted to a space to achieve comfortable conditions. In the context of space heating for example, this is the amount of heat which is emitted by a radiator, or other heat delivery mechanism.
- Energy requirement – the 'system-side' requirement for energy (fuel). In the context of a space heating system using a gas boiler, this is the amount of energy combusted (e.g. gas) to generate useful heat (i.e. to meet the energy demand).
- Regulated CO_2 emissions – the CO_2 emissions resulting from the combustion of fuel, or 'consumption' of electricity from the grid, associated with regulated energy uses (those covered by Part L of the Building Regulations).

2.5 Limitations

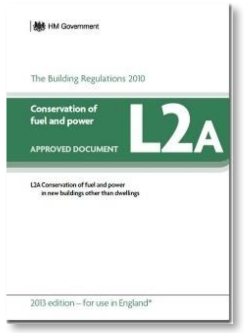
The appraisals within this strategy are based on Part L calculation methodology and should not be understood as a predictive assessment of likely future energy requirements or otherwise. Occupants may operate their systems differently, and / or the weather may be different from the assumptions made by Part L approved calculation methods, leading to differing energy requirements.

Figure 2 Site Location.

3. Regulatory and Policy Context

3.1 The Building Regulations

Building Regulations Part L1A and L2A 2013 edition, incorporating 2016 amendments


HM Government
The Building Regulations 2010
Conservation of fuel and power
APPROVED DOCUMENT
L2A
L2A Conservation of fuel and power in new buildings other than dwellings
2013 edition – for use in England*

Part L1A applies to new dwellings, and Part L2A applies to new buildings other than dwellings.

The requirements are:

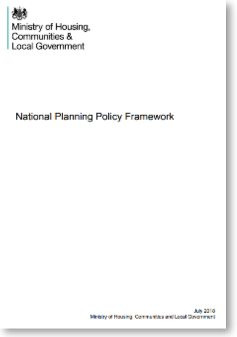
Criterion One of the Building Regulations Part L (2013) requires that the building as designed is not anticipated to generate CO_2 emissions in excess of that set by a Target Emission Rate (TER) calculated in accordance with the approved National Calculation Methodology (NCM).

Criterion Two places upper limits on the efficiency of controlled fittings and services.

Criterion Three requires that dwellings limit the effect of heat gains in summer, and that non-dwellings are not subject to excessive solar gains. This is demonstrated using the procedure given in the National Calculation Methodology.

3.2 Planning Policy

National Planning Policy Framework, July 2018


Ministry of Housing, Communities & Local Government
National Planning Policy Framework
July 2018

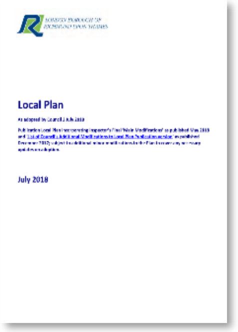
The Revised NPPF came into force in July 2018, and replaces the previous NPPF. It sets out the government's strategy on the delivery of sustainable development through the planning system. It places responsibility for policy making with the Local Authority, who shall communicate their policies through local core strategy documents and other supplementary planning guidance documents. Updates focus on:

- Promoting high quality design of new homes and places
- Stronger protection for the environment
- Building the right number of homes in the right places
- Greater responsibility and accountability for housing delivery from councils and developers.

The NPPF states a presumption in favour of sustainable development, defined as:

"Plans should positively seek opportunities to meet the development needs of their area, and be sufficiently flexible to adapt to rapid change and strategic policies should, as a minimum provide for objectively assessed needs for housing and other uses, as well as any needs that cannot be met within neighbouring areas."

London Borough Richmond upon Thames Local Plan, July 2018


Local Plan
July 2018

The LBR Local Plan details local policies which are applicable to the proposed development.

Policy LP 22 states:

- "Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to complete the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.
- Proposals for commercial areas greater than 100 sqm will be required to meet BREEAM New Construction 'Excellent' standard (where feasible).
- All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy."

The London Plan, March 2015 (subsequent minor updates in 2016)


MAYOR OF LONDON
THE LONDON PLAN

The London Plan is the overall strategic plan for London, and it sets out a fully integrated economic, environmental, transport and social framework for the development of the capital to 2031. It forms part of the development plan for Greater London. The first London Plan was published in 2004 with the latest version published in March 2015. One of the main objectives of the London Plan is to improve the environment and reduce climate change by reducing CO_2 emissions and heat loss from new developments

Policy 5.2 Minimising carbon dioxide emissions sets a 'Zero Carbon' target reduction in CO_2 emissions for new build 'Residential Buildings'. The energy assessment SPG defines 'Zero Carbon' homes as those where the residential element of the application achieves at least 35% CO_2 emissions reduction on-site, with the remainder achieved by a combination of off-site measures and a cash in lieu payment (currently set at £1,800 per tonne of CO_2 of remaining emissions to achieve a total reduction of 100%).

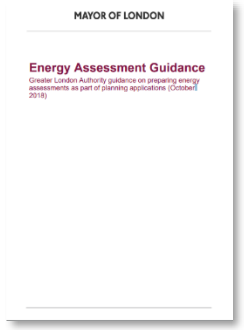
The London Plan – Draft showing Minor Suggested Changes, August 2018


MAYOR OF LONDON
THE LONDON PLAN
THE SPATIAL DEVELOPMENT STRATEGY FOR GREATER LONDON
DRAFT FOR PUBLIC CONSULTATION
DECEMBER 2017

A draft of the proposed new London Plan has been published for consultation. The policies are yet to be adopted, and as such have not been incorporated into the proposals laid out within this document. The notable policy carbon emission changes include non-residential target will be uplifted to 'zero carbon' – i.e. 100% reduction in CO_2 emissions for regulated energy uses. Of this target, 35% reduction should be achieved from on-site measures, and 10-15% from passive design and energy efficiency measures (residential and non-residential areas respectively) . Any shortfall is still expected to be made up by a cash-in-lieu payment. The plan also sets targets and policies for further sustainability measures such as:

- Improving Air Quality
- Energy infrastructure
- Managing heat risk
- Water infrastructure
- Reducing waste
- Aggregates.

GLA Energy Assessment Guidance, October 2018


MAYOR OF LONDON
Energy Assessment Guidance
Greater London Authority guidance on preparing energy assessments as part of planning applications (October 2018)

The GLA's guidance to preparing energy assessments sets out a methodology to follow for all developments submitted for planning applications in London. Headline targets are:

- Buildings are compared to a 'gas boiler baseline' with set efficiencies for plant
- As of January 2019, new development applications are encouraged to use the updated carbon emission factors set out in the draft SAP10 documentation.

The GLA state: *'This will ensure that the assessment of new developments better reflects the actual carbon emissions associated with their expected operation. This approach will remain in place until Government adopts new Building Regulations with updated emission factors. The timeline for this has not been confirmed but Part L is expected to be consulted on by early 2019. See section 5 for further details'.*

4. Part L Approach and Methodology

4.1 Approach

This strategy outlines how the Proposed Development could have a reduced effect on climate change by reducing CO_2 emissions associated with energy use in buildings.

Figure 3 outlines the route followed by the Proposed Development when reducing CO_2 emissions and defines the structure of this statement.

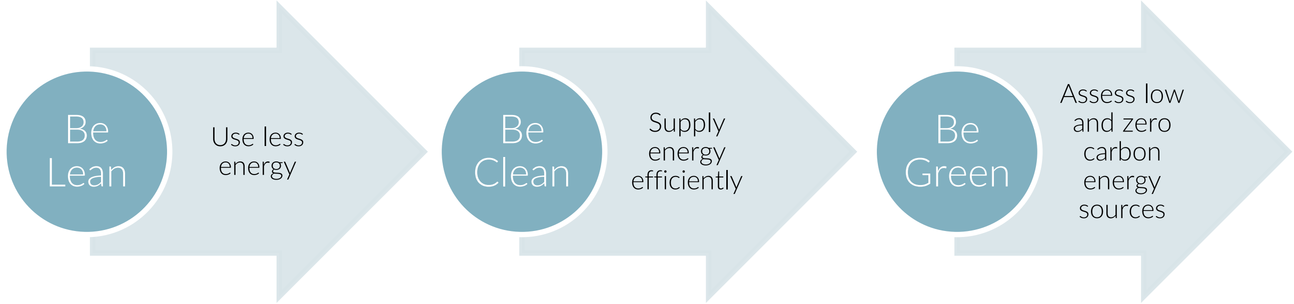


Figure 3 The Energy Hierarchy

The strategic approach to the design of the proposed development has been to maximise the energy efficiency of the development through the incorporation of passive design led solutions during the construction process, with the integration of low carbon technology to maximise reduction of carbon emissions from the development.

Further reductions are ensured through the specification of high-efficiency building services to limit losses in energy supply, storage and distribution.

After the inclusion of passive design and energy efficiency measures, various options have been investigated to reduce CO_2 emissions associated with energy supply. The feasibility of LZC technologies has been investigated in line with the policy aspirations.

4.2 Methodology

The areas outlined in Table 3 have been used to undertake the appraisals described within this strategy. Please note that these areas refer to conditioned spaces only and exclude the basement car park, energy centres and other non-conditioned spaces that are not subject to the CO_2 emissions calculations of Part L of the building regulations.

Use	Gross Internal Area (m^2)
Residential (C3)	27,680
Commercial (A1/A3/B1)	480

Table 3: Anticipated Area Schedule.

Calculations demonstrating the energy requirements and associated CO_2 emissions have been modelled as follows:

- New Build Residential - Building Regulations Part L1A 2013: Conservation of Fuel and Power in New Dwellings. A sample of dwellings have been modelled using SAP v9.92 methodology.
- New build commercial areas. Building Regulations Part L2A 2013: Conservation of Fuel and Power in New Buildings other than Dwellings. These elements have been modelled using IES v. 2018.
- In line with current GLA guidance, carbon emission reductions have been calculated using the carbon factors set out in the draft SAP10 guidance.

The following carbon factors were used to convert the energy consumption figures into CO_2 emissions for the Proposed Development, in line with current GLA Energy Assessment Guidance.

Fuel	Emissions Factor ($kgCO_2/kWh$)
Gas	0.210
Electricity	0.233

Table 4 Draft SAP 10 CO_2 Emission Factors.

5. Energy Strategy

The following sections outline considerations of the passive design and energy efficiency measures that have been proposed at Manor Road, Richmond. The measures are described as follows:

Figure 4 The Proposed Development at Manor Road.

5.1 Be Lean – Passive Design Strategy

Passive design measures are those which reduce the demand for energy within buildings, without consuming energy in the process.

These are the most effective and robust measures for reducing CO_2 emissions as the performance of the solutions, for example wall insulation, is unlikely to deteriorate significantly with time, or be subject to change by future property owners.

The following passive design measures will be incorporated in the proposed development design:

Thermal Insulation

To minimise the demand for space heating, where new build elements are incorporated these will target an improvement upon the Part L 2013 minimum standards.

Fabric Air Permeability

Fabric air permeability is a measure of the volume of air that can penetrate through the fabric of a building, leading to ventilation heat loss and gain. High air permeability can lead to uncomfortable drafts and increase the demand for space heating in winter, and space cooling in summer, when the air-flow works in reverse i.e. cool air escaping from the building.

The development will target an air permeability rate of $3m^3/h.m^2$ at 50Pa for all buildings. This is a 70% reduction beyond that required by Building Regulations Part L 2013.

Glazing - Energy & Light Transmittance

The apartments will have glazing which will be high specification. Solar gains are beneficial in winter months as a means of reducing the need for active heating to maintain comfortable internal temperatures. However, in summer months excessive solar gains can, if not properly managed, lead to overheating and increased cooling load.

5.2 Be Lean - Limiting the Effect of Heat Gains in Summer Months

Cooling Hierarchy

The London Plan Policy 5.9 (Overheating and Cooling) requests that developments should reduce potential overheating risks and reliance on air conditioning systems. A ‘cooling hierarchy’ is provided and the Proposed Development will seek to follow this hierarchy. This is in line with LBR Local Plan LP 20.

The London Plan cooling hierarchy has been followed to limit the effects of heat gains in summer, prior to the incorporation of active cooling. Please refer to section 7 for further detail of this assessment.

Summary of Mitigation Measures

The following mitigation methods will be implemented at the Proposed Development.

Reduction of internal heat gains

Internal heat gains will be reduced by energy efficient design measures such as:

- Use of energy efficient lighting (such as LED or compact fluorescent) with low heat output.
- Reduced water circulation temperatures, and insulation added to pipework to minimise circulation heat loss
- High levels of insulation and low fabric air permeability which will retain cool air during the summer months

Reduction of solar ingress

Glazing g-value is linked to light transmittance. For lower g-values, it is likely that the visible light transmittance of the glass is reduced, due to the inclusion of reflective outer surfaces or tints to control solar energy transmittance.

The g-values for the windows will be set based on a combination of aesthetic properties and overall building performance. It is currently expected that a g-value of 0.4 will be used for all glazing

Managing heat

It is being assessed to incorporate thermal mass to living ceilings in the form of phase change plasterboard which, coupled with windows opened at night, will help to reduce high temperatures in the daytime, as the phase change material acts as a ‘coolth-sink’. This approach will be firmed up in the coming design stages, to assess which apartments will gain the greatest benefit from this approach (preference given to those apartments that are not provided with cooling, and which are showing failure to comply with TM59 Criterion 1).

Ventilation and cooling

All apartments will have openable windows to enable occupants to purge air from apartments, in line with Building Regulations Part F.

Cooling will also be implemented to a proportion of apartments, with preference given to those apartments at risk of experiencing excessive noise from external sources.

5.3 Be Lean - Energy Efficiency Measures

Energy efficiency measures are those which seek to service the demand for energy (i.e. the remaining demand after implementation of passive design measures) in the most efficient way.

All areas will be conditioned using building-by-building systems.

Heating

Heating of the Proposed Development will be served by Air Source Heat Pumps (ASHP) on a block-by-block basis.

The dwellings within each building will connect to the rooftop ASHPs via Heat Interface Units (HIU) (Figure 5).

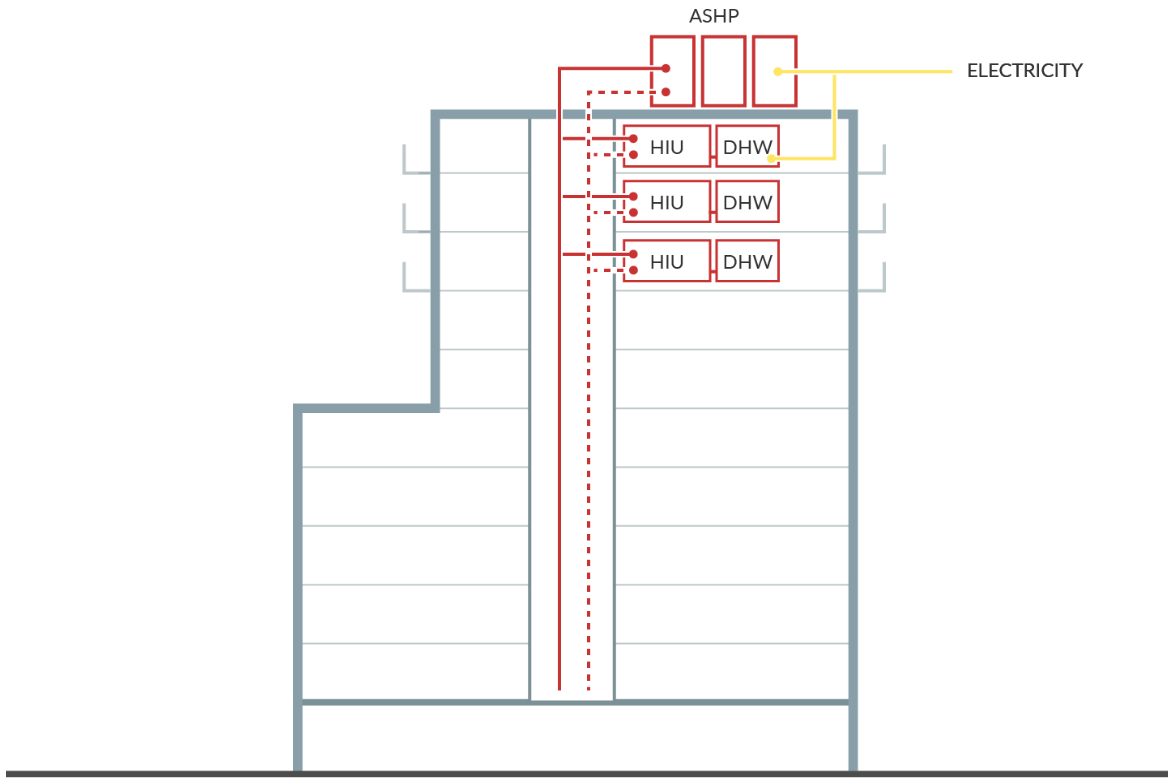


Figure 5: Indicative sketch showing servicing strategy for this type of system.

HIUs will be insulated in accordance with the guidelines in the Building Regulations and the Mayor of London's District Heating Manual for London (2013). This will maximise system efficiency by reducing as far as practically possible the heat loss from the pipework.

A means to connect the heat networks for each building to a wider district heat network will also be provided to allow for future connection should this be technically, economically and legally viable to do.

All Low Temperature Hot Water (LTHW) network and primary pipework will be insulated to maximise system efficiency and guard against excessive distribution heat loss.

Whilst capped connections to the energy centre will be provided, the fit-out of the commercial areas will be the responsibility of the incoming tenants. The tenants will be required to implement highly efficient systems in line with the standards outlined in the Non-Domestic Building Services Compliance Guide (2013) as a minimum. Sufficient plant space will be provided for each tenants to install their own plant. Commercial tenants will be required to achieve four credits under BREEAM 2018 Ene 01 '*Reduction of energy use and carbon emissions*', in order to achieve the target rating of 'Excellent, and thus it is expected that improvements over the Part L minimum standards will be required.

Hot Water

Hot water for the dwellings will be delivered via the ASHPs, with electric immersion top-up provided in a tank in each apartment.

For retail units, it is anticipated that point of use electric water heaters will be used, and these areas have been modelled based on this assumption. The point of use system will minimise the heat losses in distribution pipework. It also means that, storage losses will be minimal compared with large stored volumes of water at high temperatures.

The Proposed Development will feature water efficient fixtures and fittings including WCs with low flush volume and flow reducers in the taps of wash hand basins and on showers and as a minimum, meet the optional performance stipulations within the Building Regulations Part G (2013), as required by LBR Local Plan Policy LP 22, which requires all dwellings to achieve maximum water consumption of 110 litres per person per day (including allowances of 5 litres or less per day for external water consumption).

Space Cooling

Space cooling is proposed for a proportion of apartments at the Proposed Development, with preference given to those apartments at risk of experiencing excessive noise from external sources. It is anticipated that the fit-out of the commercial units will incorporate cooling, and these have been modelled as such. However this would be a tenant design specification.

Lighting

High-efficiency lighting systems will be installed wherever possible, and as a minimum meet the performance stipulations within the Non-Domestic Building Services Compliance Guide (2013). In addition, the use of lighting controls such as occupancy detection shall be installed in communal areas where possible, to further reduce the use of electric lighting.

The implementation of efficient lighting will not only reduce energy requirement and CO_2 emissions associated with lighting, but will also aid in minimising the energy requirement associated with cooling.

Ventilation

The Proposed Development will be provided with high-efficiency localised mechanical ventilation with heat recovery. Mechanical ventilation is an important addition to the building services to maintain good indoor air quality by providing fresh air to all spaces and extracting stale air. Coupled to a heat exchanger, the warmth in extracted air can be recovered and delivered to the supply air. In this mode, the ventilation system reduces space heating and cooling demand.

To reduce the electrical energy associated with fans, for areas in the Proposed Development with supply and extract, low specific fan powers will be targeted. It is recommended that boosted ventilation and summer bypass will also be incorporated.

Pipework & Ductwork Insulation

All distribution pipework will be insulated in accordance with the requirements of the Building Regulations, as a minimum.

This will serve to minimise heat gains and losses to / from distribution pipework, and maximise system efficiency. Careful attention will be paid to insulating joints, valves and knuckles to minimise standing heat losses. Ductwork will also be insulated to minimise heat gains and losses, and will be of suitable construction to minimise air leakage. Rigid duct work will be used as preference, to avoid inefficiencies from convoluted flexible duct runs.

Due to the nature of ASHP system design, the distribution temperatures will be lower than would be the case for a 'conventional' gas-fired boiler system. This will in turn help to reduce energy losses from distribution.

Operation & Maintenance Manuals
In accordance with the requirements of the Building Regulations detailed Operation and Maintenance (O&M) manuals will be provided to managers of the Proposed Development.

The guides will provide both an overview of the systems and their intended operation, and relevant engineering details of the installations.

Unregulated Energy
Unregulated energy includes small power electricity use (computers, plug in devices, washing machines, refrigeration) and catering energy consumption.

It is anticipated that the proportion of unregulated energy would gain in significance when compared to regulated energy as each revision of Building Regulations Part L comes into force and regulated energy is reduced.

It is therefore foreseeable that energy efficiency and the rising cost of energy would play an increasing role when future building users are deciding which appliances to purchase and the frequency of their use. However, it is not possible at present to quantify the extent of this potential reduction.

Given the uncertainty, measures to educate the future building users on how they can reduce their equipment energy use would be encouraged. This can be provided in the form of building user guides and tenant fit-out guides. The guidance measures detailed within these types of documents would consider:

- Use of A / A+ rated white goods
- Energy star rated computers and flat screen monitors, and Voltage optimization and power factor correction.

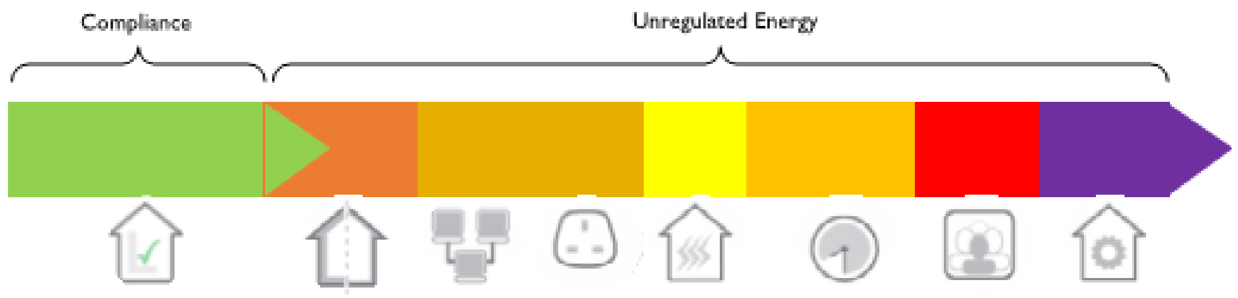


Figure 6: Regulated Energy and Unregulated Emissions Summary.

Summary of Passive Design & Energy Efficiency Measures

Table 5 summarises the passive design and energy efficiency measures for the Proposed Development. As the commercial units are being developed to shell only, but targeting BREEAM excellent (i.e. 4 credits under Ene 01, BREEAM NC 2018) the inputs in Table 5 are aligned to an estimate of what would be required in terms of the tenant fit-out for these spaces.

	Parameter	Dwellings	Commercial areas
Passive Design	Roof U-value (W/m^2.K)	0.16	-
	External Wall U-value (W/m^2.K)	0.15	0.15
	Floor U-value (W/m^2.K)	0.13	0.13
	Party Wall U-value (W/m^2.K)	0.00 (fully filled cavity with effective edge sealing)	-
	Sheltered Wall U-value (W/m^2.K)	0 (fully filled cavity with effective edge sealing)	N/A
	Window U-value (W/m^2.K)	1.4	1.4
	Glazing g-value	0.4	0.4-0.6
	Fabric Air Permeability ((m^3/m^2.h) at 50 Pa)	3.0	3.0
	Thermal Bridging	Default values used everywhere except for lintels, where the 'approved construction details' ψ-value of 0.3 W/m.K was used	10% addition made
	Other measures	N/A	Awning included over all glazed areas: – 1.5m depth – 45 degree angle
Energy Efficiency	Space Heating	Building-by-building ASHP system (total 180% efficiency) with Heat Interface Units (HIU) per dwelling coupled to hot water systems and radiators.	Variable Refrigerant Flow (VRF) system with COP = 5
	Hot Water	Served from ASHP, with electric top-up. Water efficient fixtures and fittings to minimise water demand. HIU with minimal heat loss	Electric point of use 10% distribution losses.
	Space Cooling	Cooling provided by ASHP in a proportion of apartments, with preference given to those apartments at risk of experiencing excessive noise from external sources. Cooling SEER = 4.05; SCOP = 3.5	SEER 5.0
	Lighting	High efficiency lighting. Daylight and presence detection in common areas.	Target efficacy of 90 luminaire lumens per circuit Watt. Display Lighting is 80 lamp lumens per circuit Watt.
	Ventilation	MVHR with specific fan power 0.55 W/l.s (average) with Heat Recovery of 90% or better.	Target SFP of 1.6W/l/s and HR of 80%
	Metering & Controls	Zonal, programmable thermostatic controls for heating. Separate programmable control for hot water. Electricity meter and heat meter with potential link to energy display device.	To be provided in accordance with the requirements of the Building Regulations.
	Pipework & Ductwork Insulation	To be provided in accordance with the requirements of the Building Regulations.	To be provided in accordance with the requirements of the Building Regulations.
	Variable Speed Pumping	To be provided.	To be provided.
	O&M Manuals	Systems overview and detailed descriptions in plain and clear English.	To be provided in accordance with the requirements of the Building Regulations.

Table 5: Summary of Passive Design & Energy Efficiency Measures.

5.3.1 Be Lean - Energy Requirement & CO$_2$ Emissions appraisal

The following is an appraisal of the anticipated energy requirements and resultant CO$_2$ emissions that could arise as a result of the Proposed Development, after the inclusion of the passive design and energy efficiency measures described above.

The appraisal has been based on approved calculation methodology and should not be understood as a predictive assessment as occupants may operate their systems differently, and / or the weather may be different from the assumptions made within the calculations.

Regulated sources of energy requirement are those controlled by the Building Regulations, as follows:

- space heating
- hot water
- space cooling
- lighting
- auxiliary (combining fans, pumps and controls)

As outlined in Figure 7 the majority of the regulated energy requirement, approximately 79%, is as a result of thermal energy requirements (domestic hot water and space heating), of which hot water is the most significant contributor.

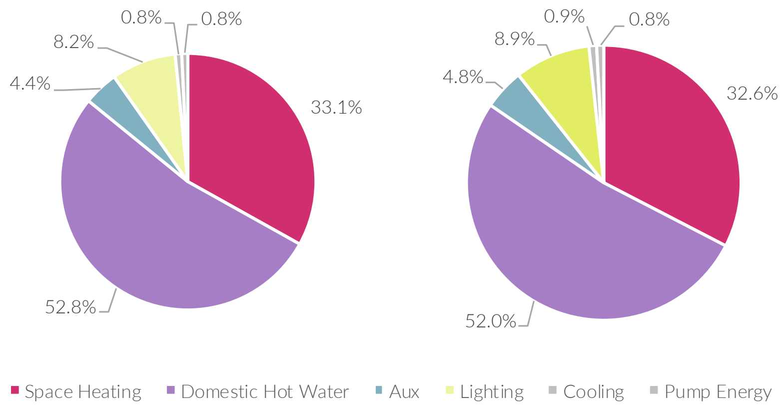


Figure 7: A breakdown of the anticipated annual regulated energy requirement (left) and CO_2 emissions (right) by service and space use for the development.

The results presented below are based on Building Regulations Part L1A 2013 compliance modelling carried out on a sample of new build dwellings. The results have been applied to all the residential areas of the Proposed Development. The calculations demonstrating the energy requirements and associated CO_2 emissions for dwellings have been carried out using Building Regulations Part L1A approved SAP 2012 v9.92 methodology.

The results demonstrate that, based on the measures listed in section 4.3 above, before the implementation of 'be clean' or 'be green' measures, the development is expected to meet the requirements of the Part L2013 'baseline'.

The annual regulated energy requirement of the new build elements of the Proposed Development is summarised in Table 6.

The Proposed Development is thus expected to achieve Part L 2013 compliance via Be Lean measures, i.e. prior to the consideration of any LZC technologies.

Tables 6&7 provide an indicative breakdown of anticipated energy requirements and CO_2 emissions by service for each space use.

Table 8 provides a comparison of the notional and actual building cooling requirements for the areas modelled at this stage, and reveals that anticipated cooling of the actual building is expected to be below the notional building requirements.

Parameters	Energy Consumption		Regulated CO_2 Emissions	
	MWh/yr	% Reduction	tCO_2/yr	% Reduction
Part L 2013 'Baseline'	1,876	-	395	-
'Be Lean'	1,727	8%	367	7%

Table 6: Summary of Be Lean Regulated Energy Requirements and Associated CO_2 Emissions.

Space Use	Regulated Energy Consumption						Unregulated
	Heating	Cooling	Auxiliary	Lighting	Hot Water	Total	
	kWh/yr	kWh/yr	kWh/yr	kWh/yr	kWh/yr	kWh/yr	kWh/yr
Residential areas (C3)	569,600	11,500	81,200	124,100	916,200	1,702,600	885,600
Commercial areas (A1/A3/B1)	5,500	2,800	8,200	18,100	900	35,500	9,700
Total	575,100	14,300	89,400	142,200	917,200	1,738,100	895,300

Table 7: Anticipated Regulated Energy Requirements

Space Use	Regulated Carbon Emissions						Unregulated
	Heating	Cooling	Auxiliary	Lighting	Hot Water	Total	
	$kgCO_2$/yr	$kgCO_2$/yr	$kgCO_2$/yr	$kgCO_2$/yr	$kgCO_2$/yr	$kgCO_2$/yr	$kgCO_2$/yr
Residential areas (C3)	119,600	2,700	18,900	28,900	192,400	362,500	206,300
Commercial areas (A1/A3/B1)	1,100	700	1,900	4,200	200	8,100	2,300
Total	120,800	3,300	20,800	33,100	192,600	370,600	208,600

Table 8: Anticipated Regulated CO_2 Emissions

Space use	Residential areas (C3)	Commercial areas (A1/A3/B1)
	kWh/m^2	kWh/m^2
Notional Building Cooling	0	5.88
Actual Building Cooling	0.41	8.82

Table 9: Summary of Anticipated Cooling Requirement

	Target Fabric Energy Efficiency (MWh/m^2.year)	Design Fabric Energy Efficiency (MWh/m^2.year)	Improvement (%)
Residential units area-weighted average	38.8	37.1	-

5.4 Be Clean

The following sections detail considerations of the infrastructure and low-carbon energy supply measures that have been considered.

Decentralised Energy Networks (DEN)

The Proposed Development is not within an 'Opportunity Area' for the implementation of a decentralised energy network, but does lie within an area of moderate to high heat density, as identified by the London Heat Map (http://www.londonheatmap.org.uk). The nearest "Potential Network" is a significant distance away (cannot be seen in overview below), and so is not thought to represent a viable energy source for this scheme.

Figure 8 Extract from London Heat Map

Technology Appraisal

This section considers the relative merits of providing a stand-alone on-site DEN served by a dedicated energy centre with centralised plant.

Combined Heat and Power (CHP)

Changes to the carbon factors of grid electricity have meant that previously favoured systems such as Combined Heat and Power (CHP) are becoming much less carbon efficient. In fact, CHP systems are now expected to lead to greater carbon emissions than conventional gas-fired boilers due to their lower efficiency. Electric systems are far more likely to achieve substantial carbon emission savings. Please refer to Figure 9.

Further, CHP engines are an on-site source of pollutants which may adversely affect the local air quality.

CHP is therefore not proposed for this development.

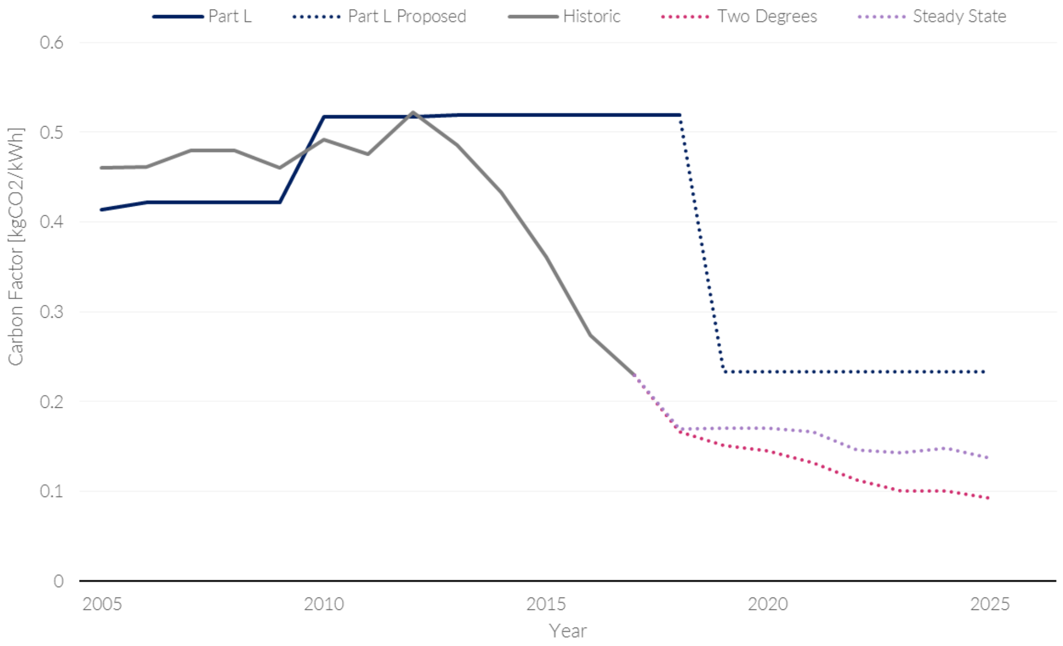


Figure 9 Changes in grid electricity carbon factors Distribution losses

Distribution losses in pipework from centralised energy centres can be substantial.

Estimated distribution loss factors have been calculated for the development (See Table 10). These present a significant increase compared to existing Part L guidelines (5%).

	Building-by-building distribution	Site-wide distribution
Distribution losses	1.25	1.50

Table 10: Estimated distribution loss factors based on the current design.

It is estimated that an additional ~45 tonnes CO_2/year could be lost if a centralised energy centre is implemented. Please refer to Figure 10. This would be equivalent to a carbon emission reduction 12% worse than the current estimate.

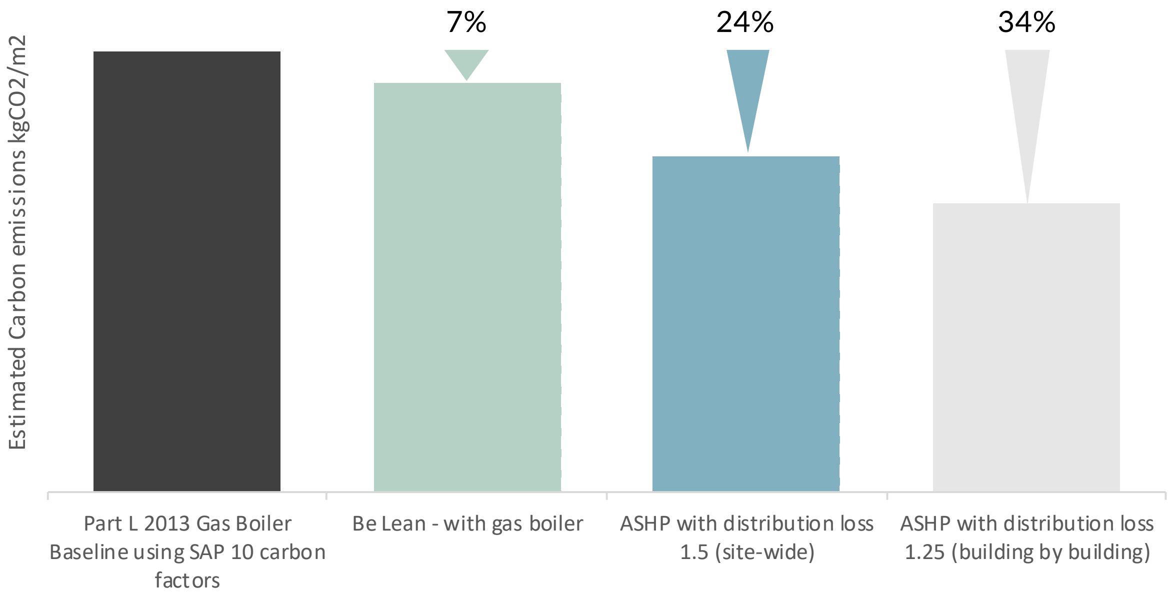


Figure 10 Expected reduction in carbon emissions for residential areas with various energy strategy inputs

Further, it has been assessed whether a centralised location for the ASHP systems could be allocated, and it is found that none of the roof spaces are large enough on their own to host the ASHP equipment in one place. Figure 11 shows the indicative layout of the proposed plant. Figure 12 shows what the space allocation would have to be, were the ASHP to be centralised in one location.

Space allowance has been made for heat interface units to the ground floor of each building, and a potential distribution route has been identified, should a district energy system become available in future which the Proposed Development could connect to. See Figure 13.

Please refer to appendices for further details, as follows:

- Appendix D: External Services Layout
- Appendix E: Concept LTHW/CHW Schematic

5.5 Summary of district energy assessment

It is clear from the above sections that building-by-building ASHP is be the most suitable solution from a carbon reduction perspective. Incorporating district energy pipework would not only add to the capital cost of the development but would also be expected to add increased operational cost due to increased distribution losses in district pipework, resulting in increased carbon emissions as well.

As there is no existing or planned district energy network in the vicinity of the site, and due to the site constraints (railways against two of the three boundaries) it is considered that the probability of a district energy network arriving at the one available site boundary is small. It is further expected that a connection would only be feasible if the potential future connection has a lower carbon content than the site systems. Given that the site systems are running on electricity, linked to a decreasing grid electricity carbon factor, this is also considered to have a low probability.

Nevertheless, the development has been future-proofed for connection to district energy by making a space allowance for a future potential heat exchanger at the ground floor of each block, so that a connection can be made in future, should a network become available, albeit this would require some ground work to extend the district connection from the site boundary to each block (please refer to Figure 13).

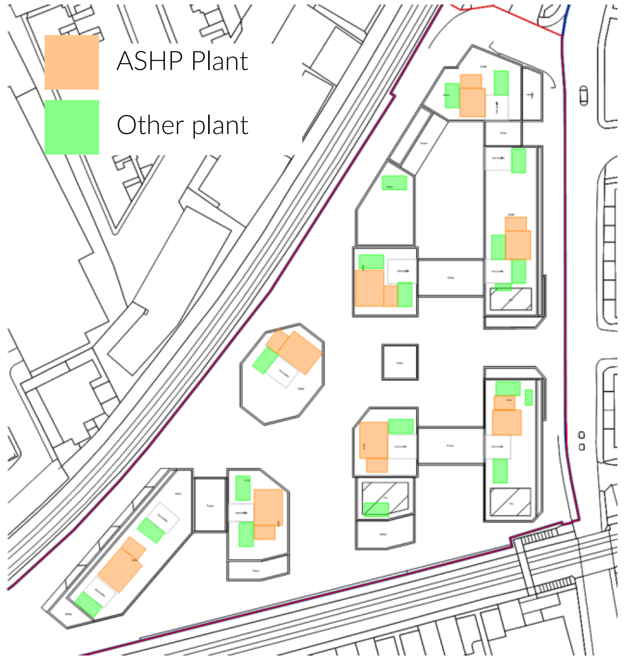


Figure 11: Proposed indicative plant layout

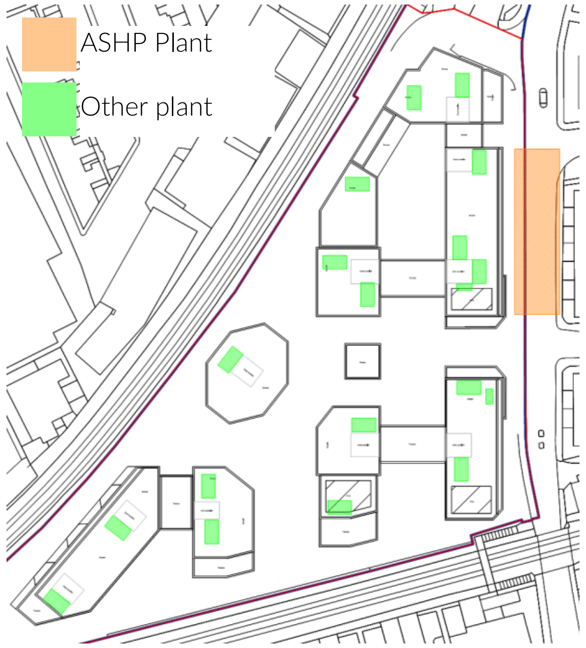


Figure 12: Centralised ASHP – indicative allocation required

Figure 13: Potential future connection route to district energy

5.6 Be Green

The following sections outline considerations of the renewable energy generation measures that have been considered, and those which will be implemented at the Proposed Development.

Renewable Technology Appraisal

Renewable technologies harness energy from the environment and convert this to a useful form. Many renewable technologies are available. However, not all these are commercially viable, suitable for conservation areas or appropriate for the Proposed Development.

Technologies considered for the Proposed Development include:

- Photovoltaics
- Solar thermal panels
- Biomass boilers
- Heat pumps (closed and open loop ground-source/ water source open loop/ air-source)
- Wind turbines

Where calculations are provided, these are representative of improvements over the new building dwellings only.

Photovoltaic (PVs) Panels

The potential areas suitable for PVs are limited given the location of the development in a conservation area.
However, an appraisal of roof space available for PV has been undertaken, taking into consideration the following:

- Overshading
- View from surrounding buildings
- Area required for access

Considering the roof space available, as shown in Figure 14, it is estimated that a 120m^2 PV panel area could be incorporated on roofs of the Proposed Development. Please refer to appendix G for a more detailed roof layout drawing.
Based on the solar irradiance data for London, an array of this size would generate approximately 14,000kWh of electricity per annum, reducing CO_2 emissions by 3.3 tonnes per annum. This is equivalent to a reduction in regulated CO_2 emissions of 0.8% beyond the GLA Gas boiler 'baseline'.
It is proposed to allocate PVs in the locations shown in the adjacent Figure 14.

Legend:

🟩 Residential amenity

🟫 Green / brown roof

⊞ Area allocated for PV panels

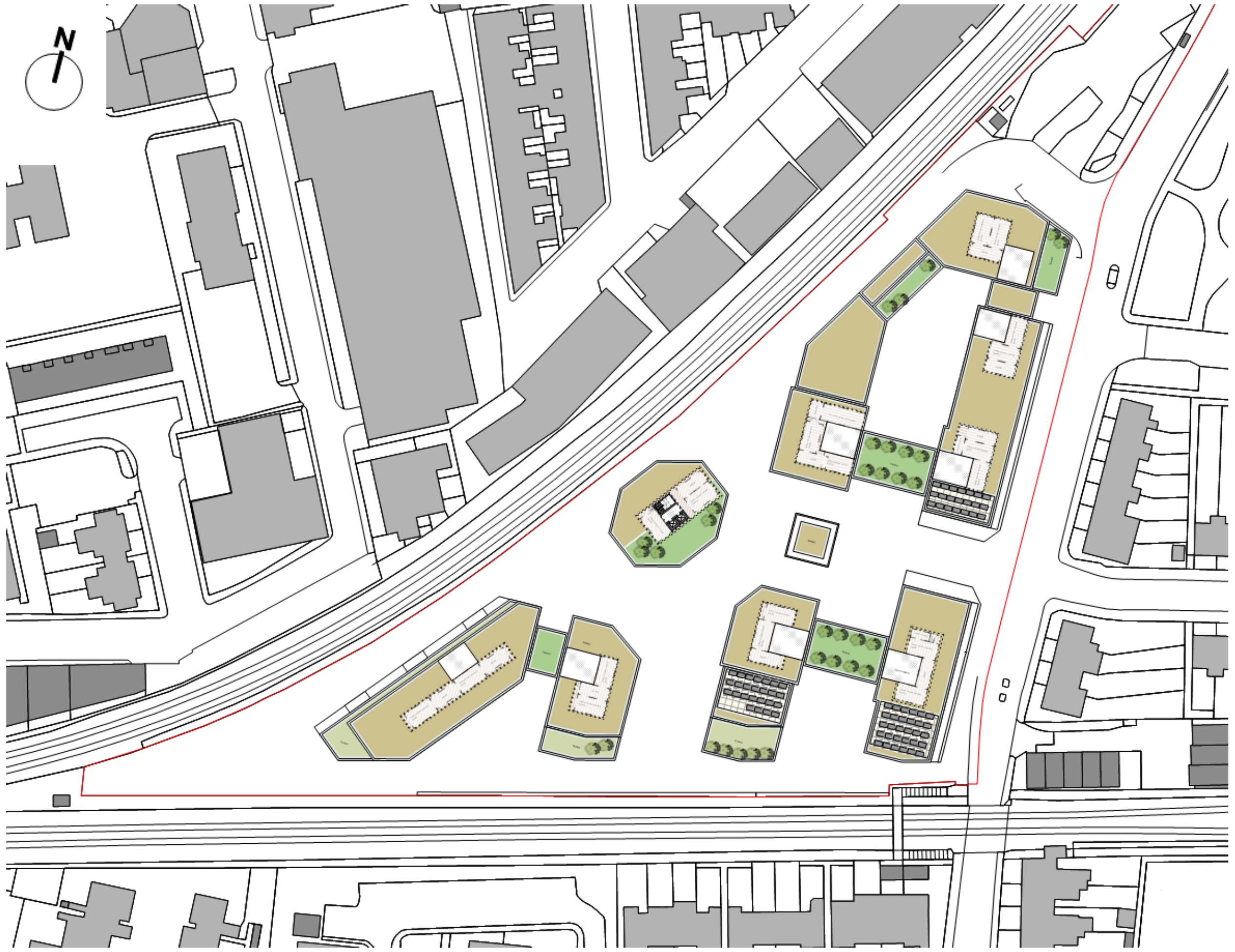


Figure 14: Roof plan demonstrating potential roof area for PV, plant, green/brown roofs and amenity space.

Solar Thermal Panels

Solar thermal panels operate by capturing solar energy and transferring this via a fluid (e.g. glycol) to a thermal store to generate hot water. These systems can operate at efficiencies up to ~75% thus a high yield of energy can be derived from small collector areas.

The appraisal of solar thermal panels has been undertaken with the same approach as for PV. Considering the available roof space, and allowing for access and maintenance requirements, a total solar thermal system size of 54kW could be installed at the Proposed Development.

Based on the solar irradiance data for London, an array of this size would generate approximately 49,000kWh of heat per annum. This level of thermal generation is equivalent to 4% of the annual hot water demand, reducing CO_2 emissions by 7.4tonnes per annum.
This is equivalent to a reduction in regulated CO_2 emissions of 1.9% beyond the Building Regulations Part L (2013) 'baseline'.

However, as roof area has already been allocated for PVs, and since the electrical output from PV panels will be more suitable for implementation with the energy strategy, a solar thermal system is not proposed for this development.

Biomass Boilers

Biomass boilers burn wood fuel or other bio-fuel sources to generate heat. These boilers can operate at high efficiencies, comparable to condensing gas boilers.

However, they require a large fuel store to maintain continuous operation during the winter months. Spatially this would be very difficult to accommodate at the Proposed Development. High numbers of fuel deliveries are required to keep the fuel store topped up during the peak heating season. The carbon associated with the delivery vehicles and their journeys reduces the net carbon saving gained from using a renewable fuel.

The reasons listed above alongside high maintenance implications and air quality implications mean that biomass boilers are not considered a suitable technology for the scheme.

Air / Water / Ground Source Heat Pumps

Ground Source systems work to extract heat or cooling energy from the ground. They are generally more efficient than air source systems, as the ground temperature is more stable over the course of the year relative to air temperature. There are four common varieties of ground source systems:

- Vertical, open loop, direct cooling (i.e. without heat pump)
- Vertical, open loop, with heat pump
- Horizontal, closed loop, with heat pump
- Vertical, closed loop, with heat pump

Regardless of the type of ground source heat loop used, all would require new below ground works to bury and install the system on site. This would incur substantial cost to the development. Further Ground Source Heat Pumps require a balanced heating and cooling load ion order to ensure heat and coolth is exchanges in balance to the aquifer. Due to the heating-led energy profile of this development, Ground Source Heat Pumps are not proposed for Manor Road.

Water source heat pumps use bodies of water, such as rivers, lakes or oceans to provide heating or cooling energy to a building. However, there are no such bodies of water local to site, therefore this technology could not be used.

Air source heat pumps use thermodynamic principles to convert heat from the air into useable heat within the building. Unlike some other sources of renewable energy, heat pumps do require energy (typically electricity or gas) to pump and compress refrigerant through the system. However, under the Renewable Energy Directive 2009/28/EC they are classified as renewable technologies provided that the final energy output significantly exceeds the primary energy input required to drive the heat pump.

Due to the changes in carbon factors for grid electricity, it is expected that carbon emission reductions from ASHP is greatly improved compared to previous iterations of SAP.
In order to serve a proportion of heating and hot water for the Proposed Development, an ASHP system size of could be installed at the Proposed Development to generate a proportion of heating and cooling for the scheme. Please refer to section 5.3 where this approach is described in further detail.

This system is expected to result in regulated CO_2 emission reductions of 27% beyond the Building Regulations Part L (2013) 'baseline' on a site-wide basis.

Air Source Heat Pumps are proposed for the development.

Micro Wind Turbines

For efficient operation and to yield high energy output, wind turbines require a smooth laminar flow of air. The Proposed Development is located a conservation area and therefore deemed unsuitable for micro wind turbines.

Moreover, mounting wind turbines on the roof of the building could result in unacceptable vibration and resonance being felt within occupied spaces. The turbines are also likely to generate noise which may be a nuisance to neighbouring residential properties. This scenario is likely to result in the turbines being switched off.

Therefore, given the complexities of installing this technology, the use of micro wind turbines is not proposed at the Proposed Development.

5.7 Summary

Preferred Strategy for Implementation
Table 11 provides a summary of the technologies assessed above.

	Pros	Cons	Suitability
Solar Photovoltaic Panels (PV)	Generates electricity from solar energy	Cost implications.	✓
Solar Thermal Panels	Generates hot water from solar energy	Roof space has been allocated for PV, which is better suited in interaction with the energy strategy as a whole.	✗
Wood Pellet Biomass Boiler	Uses a renewable fuel source to generate hot water	Large fuel stores required High number of fuel deliveries required High maintenance required Negative impacts on local air quality	✗
Ground Source Heat Pumps	Uses heat/coolth from the ground to provide usable heating or cooling to the building	Requires an auxiliary energy source to drive system Great cost implication to drill the required bore holes to feed system	✗
Air Source Heat Pumps	Uses heat/coolth from the air to provide usable heating or cooling to the building. Same technology can deliver the heating and cooling requirements of the building. Use of the refrigerant cycle delivers high energy efficiencies	Requires an energy source to drive system (can be fed in part by PVs). Roof space allocation required.	✓
Micro Wind Turbines	Generates electricity from wind energy	Potential noise and vibration impacts on the proposed development and neighbouring properties	✗

Table 11: Renewable Technologies Appraisal.

6. Operational Cost

Operational costs for end user are an important consideration when appraising energy strategy options. Focussing solely on carbon emissions can lead to unintended consequences in the form of higher than expected occupant energy bills if capital and operation expenditure of the energy systems and networks are passed on to end users.

This section provides an appraisal of potential end user costs for both boiler-led communal heating, and communal heat-pump strategies.

A summary of the appraisal is shown below in table 12. An overview of inputs and results is provided in Appendix J.

The applicability of Renewable Heat Incentive payments relies specifically on two inputs: The efficiency of the ASHP in heating mode, and whether or not the ASHP is designed to provide cooling.

For this assessment, it has been assumed that the minimum efficiency (2.9) in heating mode can be achieved.

System:	Estimated Cost per Unit of Heat (pence/kWh)	Notes / Basis of Assessment:
Communal gas boiler	4.0p / kWh	District heating network, no local thermal storage.
ASHP with Renewable Heat Incentive (RHI) included	2.5p / kWh	ASHP system + local storage with immersion. Renewable Heat Incentive (RHI) included.
ASHP with no Renewable Heat Incentive (RHI)	5.6p / kWh	ASHP system + local storage with immersion. Renewable Heat Incentive (RHI) not included.

Table 12: Operational Cost Appraisal Summary

As it is expected that some cooling will be provided for Manor Road, and therefore not all ASHP installations will be eligible for RHI payments, it is expected that the actual cost to consumers will fall between the two estimated costs calculated in Table 12 above.

Details of the cost assessment for each scenario, including assumptions, are shown below.

Global inputs		
Commercial gas	p/kWh	2.57
Commercial electricity	p/kWh	11.04
Commercial electricity exported	p/kWh	4.00
Dwelling gas	p/kWh	4.38
Dwelling electricity	p/kWh	16.48
ASHP RHI	p/kWh	2.69
Communal riser air temperature	C	20
Cold water temperature	C	10

Table 13: Cost Assessment Global Inputs

7. Summary of Results

The following tables demonstrate the relative carbon emission savings of the Proposed Development, compared to Part L 2013 baseline for the Be Lean, Be Clean and Be Green stages of the Mayor's energy hierarchy.

In line with GLA Energy Strategy guidelines, the results are presented separately for the residential and retail areas.

7.1 Dwellings

New Build Dwellings	Regulated Carbon Dioxide Emission Savings (tonnes CO_2/yr)	
	Regulated	Unregulated
Baseline: Part L 2013 Building Regulations with SAP 10 carbon factors	385	198
After energy demand reduction (Be Lean)	359	198
After heat network / CHP (Be Clean)	359	198
After renewable energy (Be Green)	251	198
	Regulated domestic carbon dioxide savings	
	(tonnes CO_2/yr)	(%)
Savings from energy demand reduction	25	7%
Savings from heat network / CHP	0	0%
Savings from renewable energy	109	28%
Cumulative on site savings	134	35%
Annual savings from offset payment	251	-
Dwellings offset Payment Rate (£/tCO_2)	£1,800	
Total Offset Payment	£451,800	

Table 14: Dwellings Summary of regulated carbon emissions saving and carbon offset payment.

7.2 Retail areas

New Build Retail	Regulated Carbon Dioxide Emission Savings (tonnes CO_2/yr)	
	Regulated	Unregulated
Baseline: Part L 2013 Building Regulations with SAP 10 carbon factors	10	6
After energy demand reduction (Be Lean)	8	6
After heat network / CHP (Be Clean)	8	6
After renewable energy (Be Green)	6	6
	Regulated non-domestic carbon dioxide savings	
	(tonnes CO_2/yr)	(%)
Savings from energy demand reduction	2	22%
Savings from heat network / CHP	0	0%
Savings from renewable energy	3	24%
Cumulative on site savings	5	46%
Total target savings	4	35%
Shortfall	N/A	-
Dwellings offset Payment Rate (£/tCO_2)	£1,800	
Total Offset Payment	£0	

Table 15: Retail Summary of regulated carbon emissions saving and carbon offset payment.

Figure 15: Comparison of regulated carbon emissions saving and carbon offset payment.

8. Overheating Risk (TM59)

In tandem with the energy and CO_2 emissions appraisal, an assessment has been undertaken to determine the risk of summertime overheating and consider measures for the minimisation of cooling demand.

8.1 Basis of the Assessment

The London Plan policy 5.9 (Overheating and Cooling) requests that Developments should reduce potential overheating risk and reliance on air conditioning systems. A 'cooling hierarchy' is provided and the Development has sought to follow this hierarchy.

The following cooling hierarchy has been followed to limit the effects of heat gains in summer:

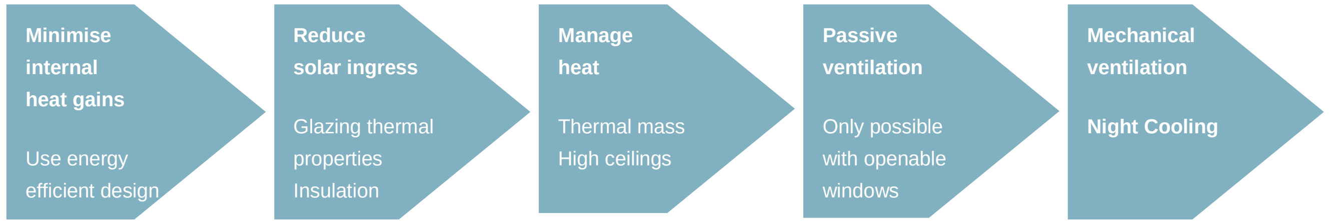


Figure 16: Mayor of London's cooling hierarchy

8.2 Mitigation Strategy

The following mitigation methods will be implemented at the Proposed Development.

Minimising internal heat generation through energy efficient design
The following mitigation methods will be implemented to minimise the internal heat generation through energy efficient design at the Proposed Development:

- Energy efficient lighting (such as LED or CFL) with low heat output
- Insulation to heating and hot water pipework and ductwork and minimisation of dead-legs to avoid standing heat loss (from pipework to dwellings)
- Energy efficient white goods with low heat output
- Low temperature hot water from air source heat pump to further reduce heat gain in communal pipework and risers

Reducing the amount of heat entering the building in summer
The following mitigation methods will be implemented at the Proposed Development to reduce the amount of heat entering the building in summer:

- Suitable glazing ratio responding to orientation and space use
- Low g-value glazing to limit solar heat gains (where appropriate)
- High levels of insulation and low fabric air permeability which will retain cool air during summer months

Thermal mass
Thermal mass is currently proposed to be introduced in ceilings to a proportion of apartment living rooms/kitchens in the form of a phase change material (PCM) plasterboard. Coupled with openable windows at night in these spaces, these ceilings can act as a storage for coolth, which will then be released into apartments during the day. This strategy will be assessed in further detail in the coming design stages, alongside the mechanical cooling provision, and the noise assessment for the site.

Passive ventilation
All dwellings will be fitted with fully openable windows, which allow passive solar heating and natural ventilation. Balconies will also provide shading.

Mechanical ventilation
All dwellings will also be provided with ventilation at rate in accordance with Part F through Mechanical Ventilation with Heat Recovery (MVHR).

MVHR units are an important addition to the building services to maintain good indoor air quality, by providing fresh air to living rooms and bedrooms and extracting vitiated air from bathrooms and kitchens. Providing fresh air minimises the risk of stale and stagnant air and limits the risk of condensation and mould growth. The heat recovery mechanism will be provided with a bypass to avoid returning hot air to the dwellings in summer.

It is anticipated that the MVHR units will be capable of delivering fresh air at a rate of 75 litres per second (l/s), which will aid the mitigation of high internal temperatures in summer months where required. Ductwork would be rigid type, circular wherever possible, with minimal flexible ductwork (for connections only).

8.3 Part L heat gain check

It is anticipated that the Proposed Development will achieve compliance with the Building Regulations Part L 2013 Criterion 3 and limit the effects of heat gains in summer months and reduce the need for comfort cooling/ air-conditioning. It is proposed that active cooling is provided to a proportion of dwellings, based on an assessment of site background noise, risk of overheating, and market expectations. It is anticipated that cooling will be provided as top-up cooling only to allow rooms to cool to 26 degrees, rather than full comfort cooling. In terms of commercial areas, it is likely that these will be actively cooled as part of the tenant fit-out.

Summary of SAP reports attached in Appendix H, and summary BRUKL reports attached in Appendix I.

8.4 CIBSE TM59 Overheating risk assessment

An overheating risk assessment was undertaken on a sample of dwellings across the site. The dwellings selected for assessment accounted for a range of orientations, layouts, and external acoustic environments.

The CIBSE TM59 guidance stipulates that modelling must be undertaken with the weather file most appropriate to the location for the project, for the 2020s, high emissions scenario 50th percentile. The most appropriate file for the location of Manor Road Development is London Heathrow.

The weather file used for this assessment is: London_LHR_DSY1_2020High50

With regards to external acoustic environment, the acoustic consultant has advised the site is exposed to moderate noise levels, with required sound reduction achieved through acoustic double glazing. Railway noise is the primary influencer on the acoustic environment and is most apparent on the south and west elevations. Exposure to noise levels reduce with height.

All dwellings will be provided with mechanical ventilation with heat recovery and openable windows, allowing the occupant to adapt their internal environment according to their own needs.

The building has been assessed against the predominantly naturally ventilated criteria. This is representative of 'free running' type buildings where people expect internal temperature to track external temperature, hence can adapt and tolerate in accordance with the adaptive comfort model. Phase-change material (PCM) ceiling boards in living rooms / kitchens have been included in the analysis in iteration 2. Please refer to Appendix C for further details.

	TM59 Criterion 1 - % pass Living rooms and bedrooms	TM59 Criterion 2 - % pass Bedrooms only	Communal Corridors – 28°C operative temperature
	Natural Ventilation		
1. Without PCM	80% of tested rooms	100% of tested rooms	Meets target
2. With PCM	100% of tested rooms	100% of tested rooms	

Table 16: Summary of CIBSE TM59 assessment results

9. Conclusion

This report has shown that the Proposed Development will result in a highly efficient, low-carbon scheme. New, high efficiency servicing equipment and efficient façades will minimise the energy usage of the building. Using the Mayor’s energy hierarchy, the strategy has been developed to ensure that the proposed development is efficient and economical.

The carbon emissions from regulated energy uses at the proposed development have been compared with the GLA London Plan emissions targets. It is expected that a carbon offset payment made to the local authority will be required. The current estimated offset payment is given in tables 15 and 16.

In line with LBR Local Plan (2018) Policy 22, proposals for new commercial areas will be required to meet BREEAM New Construction (NC) ‘Excellent’ standard (where feasible). It is the intention of the design team to meet the minimum standards for ‘Excellent’. Please refer to the Sustainability Statement, submitted in support of this planning application, for further information.

Appendix A: Regulatory & Policy Context

The following outlines the regulatory and planning policy requirements applicable to the Proposed Development.

National Policy

Current Policy Framework
The Proposed Development is not considered to be preferable to the Mayor of London. The policies considered when preparing this strategy are contained in the London Plan (GLA, 2016) and the Local Development Plan of LBR (2018). The Supplementary Planning Guidance (SPG) has also been reviewed and taken into consideration in the Energy Strategy.

Building Regulations Part L 2013

Approved Document Part L
Part L of the Building Regulations is the mechanism by which government is driving reductions in the regulated CO_2 emissions from new buildings.

Current Requirements: Part L 2013
Part L has five key criteria which must be satisfied as follows:

a. Criterion 1 - Achieving the Target Emission Rate (TER)
b. Criterion 2 - Limits on design flexibility
c. Criterion 3 - Limiting the effects of solar gains in summer
d. Criterion 4 - Building performance consistent with the Dwelling Emission Rate (DER)
e. Criterion 5 - Provision for energy efficient operation of the dwelling

Criteria one, two and three are addressed within this strategy.

Criterion one requires that the building as designed is not predicted to generate CO_2 emissions in excess of that set by the Target Emission Rate (TER) calculated in accordance with the approved Standard Assessment Procedure (SAP) 2012. Part L (2013) requires the following reductions:

a. A 6% aggregate reduction in CO_2 emissions beyond the requirements of Part L 2010 for dwellings; and
b. A 9% aggregate reduction in CO_2 emissions beyond the requirements of Part L 2010 for non-domestic buildings.

Criterion two places upper limits on the efficiency of controlled fittings and services for example, an upper limit to an external wall U-value of 0.30W/m^2.K (dwellings).

A Fabric Energy Efficiency Standard (FEES) has been introduced for new dwellings although no definitive targets have been set in this regard. Part L 2013 requires the following Fabric Energy Efficiency performance targets to be met:

a. Target Fabric Energy Efficiency (TFEE). The TFEE is calculated independently for each dwelling, based upon an elemental recipe of efficiency parameters, applied to the geometry of the dwelling in question. This would generate a notional value which would then be relaxed by 15% to generate the TFEE

Criterion three requires that dwellings are not at 'high' likelihood of high internal temperatures in summer months (June, July & August) and that zones in commercial buildings are not subject to excessive solar gains. This is demonstrated using the procedure given in SAP 2012 Appendix P for dwellings, and Simplified Building Energy Model (SBEM) or Dynamic Simulation Method (DSM) for non-residential buildings.

GLA Planning Policy

The London Plan (March 2016) Consolidated with Alterations Since 2011
The regional policies of the GLA are contained within the London Plan (2016), and the relevant SPGs.

The latest version of the consolidated London Plan (2016) was published and adopted in March 2016 and is current for any Stage 1 submissions to the GLA. This constitutes the London Plan 2011 consolidated with:

- Revised Early Minor Alterations to the London Plan (October 2013)
- Further Alterations to the London Plan (March 2015)
- Housing Standards Minor Alterations to the London Plan (March 2016)
- Parking Standards Minor Alterations to the London Plan (March 2016)

The target reduction in CO_2 emissions for Residential Buildings is to achieve 'zero carbon homes' for Stage 1 applications. The definition of this is clarified in the GLA's publication G*uidance on Preparing Energy Assessments*. The target for 'Non-Domestic Buildings' is to achieve 35% reduction in CO_2 emissions.

Energy Planning - Greater London Authority guidance on preparing energy assessments (March 2016)

This document was produced by the GLA to provide further detail on how to prepare an energy assessment to accompany strategic planning applications. Within this, the definition of 'zero carbon homes' is made as follows:

'Zero carbon' homes are homes forming part of major development applications where the residential element of the application achieves at least a 35 per cent reduction in regulated carbon dioxide emissions (beyond Part L 2013) on-site. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be off-set through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere (in line with policy 5.2E).

The cash in lieu payment is currently set at £1,800 per tonne of CO_2 (equivalent to £60 per tonne per year over 30 year period).

Use Type	CO_2 Reduction Target (beyond Part L 2013)	
	2013 – 2016	2016 – 2019 (1st October 2016)
Residential Buildings	35%	'Zero Carbon'
Non-Domestic Buildings	35%	35%

Table A1: Uplift in CO_2 emissions targets

London Plan Policy
Development within LBRuT is subject to the policy requirements of the London Plan 2016. The following policies of the London Plan (2016) have informed this strategy.

Policy 5.2: Minimising CO_2 Emissions

Policy 5.2 sets out the target CO_2 emission reductions as described above.

Policy 5.6: Decentralised Energy in Development Proposals

Policy 5.6 requires development proposals to evaluate the feasibility of Combined Heat & Power (CHP) systems and where a new CHP system is appropriate, examine opportunities to extend the system beyond the Site boundary. Developments should select energy systems on the following hierarchy:

a. connection to existing heating or cooling networks
b. site wide CHP network
c. communal heating and cooling

Where future network opportunities are identified, proposals should be designed to connect to these networks.

Policy 5.7: Renewable Energy

Policy 5.7 requires that developments should provide a reduction in expected CO_2 emissions through the use of on-site renewable energy generation, where feasible.

Policy 5.9: Overheating and Cooling

The GLA have produced a 'Domestic Overheating Checklist' (Appendix 5 of the 'Energy Planning' guidance) for use early in the design process to identify potential overheating risks and to trigger the incorporation of passive measures within the building envelope. The 'Energy Planning' guidance document also includes an update to the guidance on compliance with overheating policy that design teams should be aware of when undertaking risk analysis and thermal comfort modelling for dwellings.

It is the GLA's expectation that dynamic thermal modelling should be undertaken to determine overheating risk and demonstrate compliance with London Plan Policy 5.9. This should be in addition to the Building Regulations 'Criterion 3' assessment of heat gains in summer months.

The GLA has set out that dynamic modelling should be carried out in accordance with the guidance and data sets in CIBSE TM49 'Design Summer Years' for London (2014) using the three design weather years as follows:

- 1976: a year with a prolonged period of sustained warmth.
- 1989: a moderately warm summer (current design year for London).
- 2003: a year with a very intense single warm spell.

For developments in high density urban areas (e.g. Canary Wharf) and the 'Central Activity Zone' the 'London Weather Centre' data set should be used. In lower density urban and suburban areas the 'London Heathrow' dataset should be used. These data sets have been adjusted to account for future climate effects.

The modelling should also consider the additional guidance contained in CIBSE TM52 'The Limits of Thermal Comfort: Avoiding Overheating in European Buildings'.

The London Plan – Draft for consultation, December 2017, and Draft showing Minor Suggested Changes, August 2018

A draft of the proposed new London Plan has been published for consultation. The policies are yet to be adopted but the changes pertinent to an energy strategy for a non-residential development are set to shift substantially if adopted. The notable policy carbon emission targets are as follows:

- Non-residential developments are to target zero-carbon (annual regulated energy)
- 35% carbon saving must be from on-site reduction measures
- 15% carbon saving must be from energy efficiency measures
- Any carbon emissions shortfall will need to be offset by making a carbon offset payment to the Local Authority and the carbon offset price is under review and expected to be updated

The proposed policy targets have not been used to determine the energy efficiency and carbon offset payment calculations reported in this energy strategy.

GLA Sustainable Design and Construction SPG (April 2014)

This SPG provides more detailed guidance to aid implementation that cannot be covered in the London Plan. It updates the standards that were developed for the Mayor's SPG on Sustainable Design and Construction in 2006 and identifies these as priorities for the Mayor. The SPG provides guidance and practical advice for those designing schemes including architects, developers and engineers as well as those developing planning policy and neighbourhood plans.

To support the policies in the London Plan, the Sustainable Design and Construction SPG includes guidance on:

- energy efficient design
- meeting the carbon dioxide reduction targets
- decentralised energy
- how to offset carbon dioxide where the targets set out in the London Plan are not met
- retro-fitting measures
- support for monitoring energy use during occupation
- an introduction to resilience and demand side response
- air quality neutral
- resilience to flooding
- urban greening
- pollution control
- basements policy and developments
- local food growing

London Borough of Richmond upon Thames Local Plan

Local Plan (2018)

LBR's Local Plan was adopted in July 2018. The Local Plan replaces the previous Local Plan as well as the Local Development Management policies. Key policies relating to energy and sustainability are summarised below.

Policy LP 1 Local Character and Design Quality

The council will require all development to be of high architectural and urban design quality. The high quality character and heritage of the borough and its Villages will need to be maintained and enhanced where opportunities arise. Development proposals will have to demonstrate a thorough understanding of the site and how it relates to its existing context, including character and appearance, and take opportunities to improve the quality and character of buildings, spaces and the local area.

Policy LP 8 Amenity and Living Conditions

Design and layout of buildings enables good standards of daylight and sunlight to be achieved in new development and in existing properties affected by new development.

Policy LP 10 Local Environmental Impacts, Pollution and Land Contamination

Development proposals should not lead to detrimental effects on the health, safety and amenity of existing and new users or occupiers of the development site, or the surrounding land. These potential impacts can include, but are not limited to, air pollution, noise and vibration, light pollution, odours and fumes, solar glare, solar dazzle and land contamination.

Policy LP 17 Green Roofs and Walls

Green/brown roofs should be incorporated into new major developments with roof plate areas of 100sqm or more where technically feasible and subject to considerations of visual impact. If it is not feasible to incorporate a green/brown roof, then a green wall should be incorporated.

Policy LP 20 Climate Change Adaptation

Developments will be encouraged to be fully resilient to the future impacts of climate change in order to minimise vulnerability of people and property.

New developments should minimise the effects of overheating in accordance with the cooling hierarchy.

Policy LP 22 Sustainable Design and Construction

LP22A Sustainable Design and Construction

1. Developments of 1 dwelling or more, or 100sqm or more of non-residential floor space (including extensions) will be required to comply with the Sustainable Construction Checklist SPD.

2. Developments with new dwellings must achieve a water consumption of 110l per person per day for homes.

3. New non-residential buildings over 100sqm must achieve BREEAM "Excellent"

4. Change of use residential should meet BREEAM Domestic Refurbishment "Excellent", where feasible.

LP22B Reducing Carbon Dioxide Emissions

1. All new major residential developments should achieve zero carbon standards in line with London Plan policy.

2. All other new residential buildings should achieve 35% reduction

3. All major non-residential buildings should achieve a 35% reduction. From 2019 all major non-residential should achieve zero carbon standards in line with London Plan Policy.

LP22D Decentralised Energy Networks

1. All new development required to connect to existing DE network where feasible (including planned DE networks operational within 5 years of development completion).

2. Major developments will need to provide an assessment of the provision of on-site DE networks and CHP.

3. Where feasible, major developments will need to provide on-site DE and CHP. Provision for future connection should be incorporated where required.

Policy LP 23 Water Resources and Infrastructure

Water resources and supplies will be protected by resisting proposals that would pose an unacceptable threat. Proposals that seek to increase water availability or protect and improve water quality will be encouraged.

Policy LP 30 Health and Wellbeing

Developments that support the following will be encouraged:

- Sustainable modes of travel
- Access to green infrastructure
- Access to local community facilities, services and shops
- Access to local healthy food
- Access to toilet facilities open to all
- Inclusive public realm layout

Appendix B: GLA Overheating Checklist

Section 1 – Site Features affecting vulnerability to overheating		Please respond Yes or No
Site Location	Urban – within central London or high density conurbation	No
	Peri-urban – on the suburban fringes of London	Yes
Air Quality and/or Noise sensitivity – are any of the following in the vicinity of buildings?	Busy roads / A roads	Yes
	Railways / Overground / DLR	Yes
	Airport / Flight Path	Yes
	Industrial uses / waste facility	No
Proposed building use	Will any buildings be occupied by vulnerable people (e.g. elderly, disabled, young children)?	Yes, possibly elderly.
	Are residents likely to be at home during the day (e.g. students)?	Yes
Dwelling aspect	Are there any single aspect units?	Yes
Glazing ratio	Is the glazing ratio (glazing : internal floor area) greater than 25%?	No
	If yes, is this to allow acceptable levels of daylighting?	NA
Security – Are there any security issues that could limit opening of windows for ventilation?	Single storey ground floor units	No
	Vulnerable areas identified by the Police Architectural Liaison Officer	No
	Other	

Table 17: GLA Overheating checklist – Section 1

Section 2 – Design Features Implemented to Mitigate Overheating Risk		Please Respond
Landscaping	Will deciduous trees be provided for summer shading (to windows and pedestrian routes)?	Yes
	Will green roofs be provided?	Yes
	Will other green or blue infrastructure be provided around buildings for evaporative cooling?	Yes Roof terraces and soft landscaping around buildings
Materials	Have high albedo (light colour) materials been specified?	Yes White stone material specified on three building blocks

Section 2 – Design Features Implemented to Mitigate Overheating Risk		Please Respond
Dwelling Aspect	% of total units that are single aspect	44%
	% of single aspect with N/NE/NW orientation	10%
	% single aspect with E orientation	13%
	% single aspect with S/SE/SW orientation	7%
	% single aspect with W orientation	14%
Glazing Ratio – What is the glazing ratio (glazing: internal floor area) on each façade?	Block A	24%
	Block B	31%
	Block C	23%
	Block D	21%
Daylighting	What is the average daylight factor range	0.43 – 7.19% when considering the basement to the fourth floor. Higher floors will ultimately achieve higher values as there will be less local obstruction.
Window Opening	Are windows openable?	Yes
	What is the average percentage of openable area for the windows?	100% (all are openable doors)
Window Opening – what is the extent of the opening?	Fully openable	Yes (part)
	Limited (e.g. for security, safety, wind loading reasons)	Yes (part)
Security	Where there are security issues (e.g. ground floor flats) has an alternative night time natural ventilation method been provided (e.g. ventilation grates)?	NA
Shading	Is there any external shading?	No
	Is there any internal shading?	Yes Blinds
Glazing Specification	Is there any solar control glazing?	Yes – g-value of 0.4 throughout
Ventilation – what is the ventilation strategy?	Natural - background	No
	Natural – purge	Yes
	Mechanical – background (e.g. MVHR)	Yes
	Mechanical – purge	No

Section 2 – Design Features Implemented to Mitigate Overheating Risk		Please Respond
	What is the average design air change rate?	In line with part F requirements
Heating System	Is communal heating present?	Yes
	What is the flow/return temperature?	55/30
	Have horizontal pipe runs been minimized?	Yes
	Do the specifications include insulation levels in line with the London Heat Network Manual?	Yes

Table 18: GLA Overheating checklist – Section 2

Appendix C: CIBSE TM59 Results

Summary of Input Parameters

The following table provides an overview of the input parameters/ modelling assumptions.

Software	IESve 2018	Window Covering (SF = Shading Factor)	None
Weather Data	Design Summer Year (DSY1) London Heathrow 2020 High Emissions Scenario 50th Percentile	Window opening type	90° opening angle, side hung, with 65% openable area 10° opening angle, bottom hung at night
Assessment Criteria	CIBSE TM59	Occupancy	Bedrooms/Studio: 24/7 Living room/Kitchen: 9am-10pm
Wall U-Value	0.15 W/m^2.K	Max. Occupancy Density	1Bed – 2 People 2 Bed – 4 People 3 Bed – 6 People
Window Averaged U-value	1.4 W/m^2.K	Occupancy Heat Gains	75W / person (Sensible) 55W / person (Latent)
Window g-Value	0.4	Communal Corridor Internal Gains	12 W/m^2 (Initial estimation based upon improved pipework insulation)
Roof U-Value	0.16 W/m^2.K	Lighting Gains	2 W/m^2 (All areas)
Floor (ground) U-value	0.13 W/m^2.K	Max. Equipment Gains – Kitchen & Living	450 W (as per CIBSE TM59)
Floor (exposed) U-value	0.13 W/m^2.K	Max. Equipment Gains – Bedroom	80 W (as per CIBSE TM59)
Infiltration	0.25 ACH	Heat Interface Unit	20W – continuous output

Mechanical ventilation in dwellings	75 l/s
Temperature offset	-8°C from external air
Communal corridor ventilation	200 l/s

Table 19: Summary of input parameters used in the TM59 assessment

Results summary

Summary of TM59 results in the following tables. Both natural ventilation and mechanical ventilation scenarios have been included.

Most apartments pass the natural ventilation scenario, with only three living/kitchen zones failing Criterion 1. All bedrooms passed Criterion 2. A subsequent run was conducted with windows opening during the night at a reduced opening angle to purge hot air and charge the thermal mass in the ceilings with coolth from colder night air. This has improved the results leaving only two zones failing by a smaller margin.

It will be further assessed in the coming stages specifically which apartments will require a phase change material plasterboard ceiling to living rooms and kitchens.

Around half the rooms tested pass the mechanical ventilation/ sealed façade scenario. Additional cooling will be provided to mitigate the risk of high temperatures in apartments where there are acoustic constraints to opening windows.

	TM59 Criterion 1 - % pass Living rooms and bedrooms	TM59 Criterion 2 - % pass Bedrooms only	Corridors – 28°C operative temperature
Natural Ventilation			
Without PCM	80% of test rooms	100% of test rooms	Meets target
With PCM	100% of test rooms	100% of test rooms	

Table 20: Natural ventilation analysis results

	CIBSE Guide A - % pass Living rooms and bedrooms	Corridors – 28°C operative temperature
Mechanical Ventilation		
Without PCM	53% of test rooms	Meets target

Table 21: Mechanical ventilation/ sealed façade analysis results

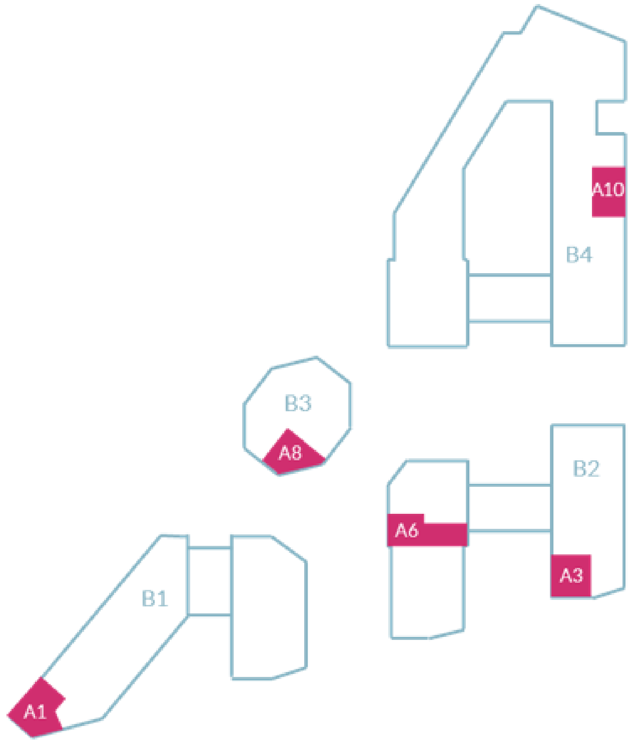
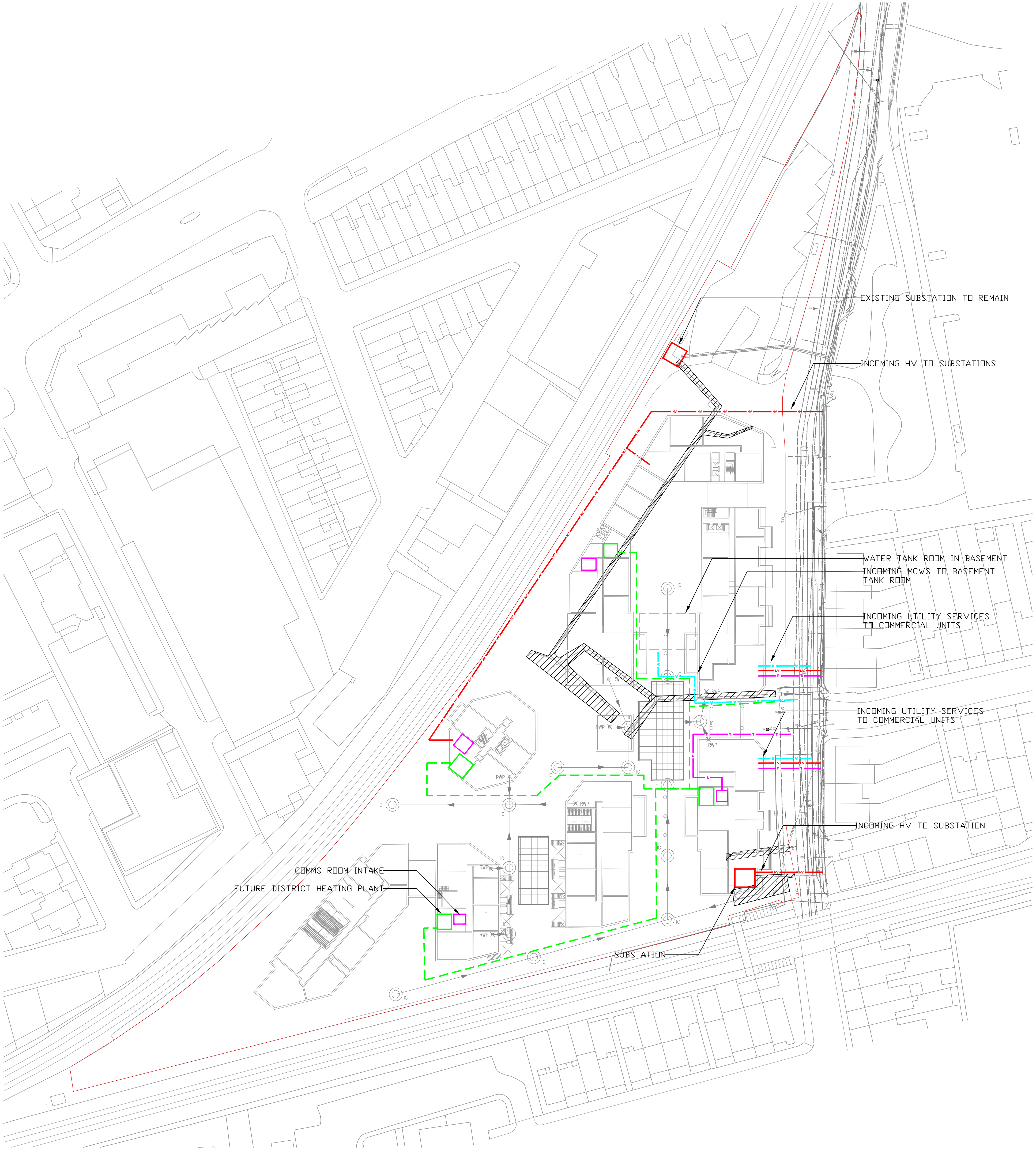


Figure 17: Sample of apartments tested. All tested apartments are located on the top-most floor of the respective building

Appendix D: External Services Layout

A1

This drawing shall not be scaled.
Work from the dimensions shown in the drawing or given in relevant specifications



CDM Regulations:

In addition to any information included in this drawing or the model from which it is derived, refer also to the project CDM Risk Register for information on residual risks.

General Notes:

- The drawing does not necessarily show all the information needed to interpret the design intent or the construction details.
- The drawing contains information from more than one source and must be read in conjunction with all relevant specifications.
- Any apparent drafting errors and differences between other drawings and specifications shall be brought to our attention.

Project Notes:

1. THIS DRAWING SHOWS INDICATIVE UTILITY ROUTES. FURTHER DETAILS TO BE DEVELOPED AS THE DESIGN PROGRESSES.
2. FOR FURTHER INFORMATION REGARDING EXISTING UTILITIES, REFER TO EXISTING UTILITY INFORMATION.

LEGEND

HV — HV	High Voltage Electricity
LV — LV	Low Voltage Electricity
SL — SL	Street Lighting Cable
W — W	Water Main
G — G	Gas Main
FW — FW	Foul Water
SW — SW	Surface Water
CS — CS	Combined Sewer
T — T	British Telecom
CT — CT	Cable Television
FO — FO	Fibre Optics
TS — TS	Traffic Signalling
LV Overhead LV — LV	Overhead Service (applies to any service)
— — —	Future District Heating
▨	Services to be made safe and removed
▦	Surface water attenuation tank
🟩	Future District Heating Plant
🟪	Incoming Comms Intake
🟥	Substation

Index	Description	Designed	Reviewed	Authorised	Date
P1	STAGE 2 ISSUE	GC	TC	MAH	01/19

REVISIONS:

HOARE LEA (H.)

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PROJECT TITLE:
MANOR ROAD
RICHMOND

DRAWING TITLE:
COMBINED SERVICES
EXTERNAL SERVICES LAYOUT

PRELIMINARY ISSUE

PERSON RESPONSIBLE FOR:

Design:	Review:	Authorising Issue:
GC	TC	MAH

Project No:	Date:	Scale @ A1:
0209506	JANUARY 2019	NTS

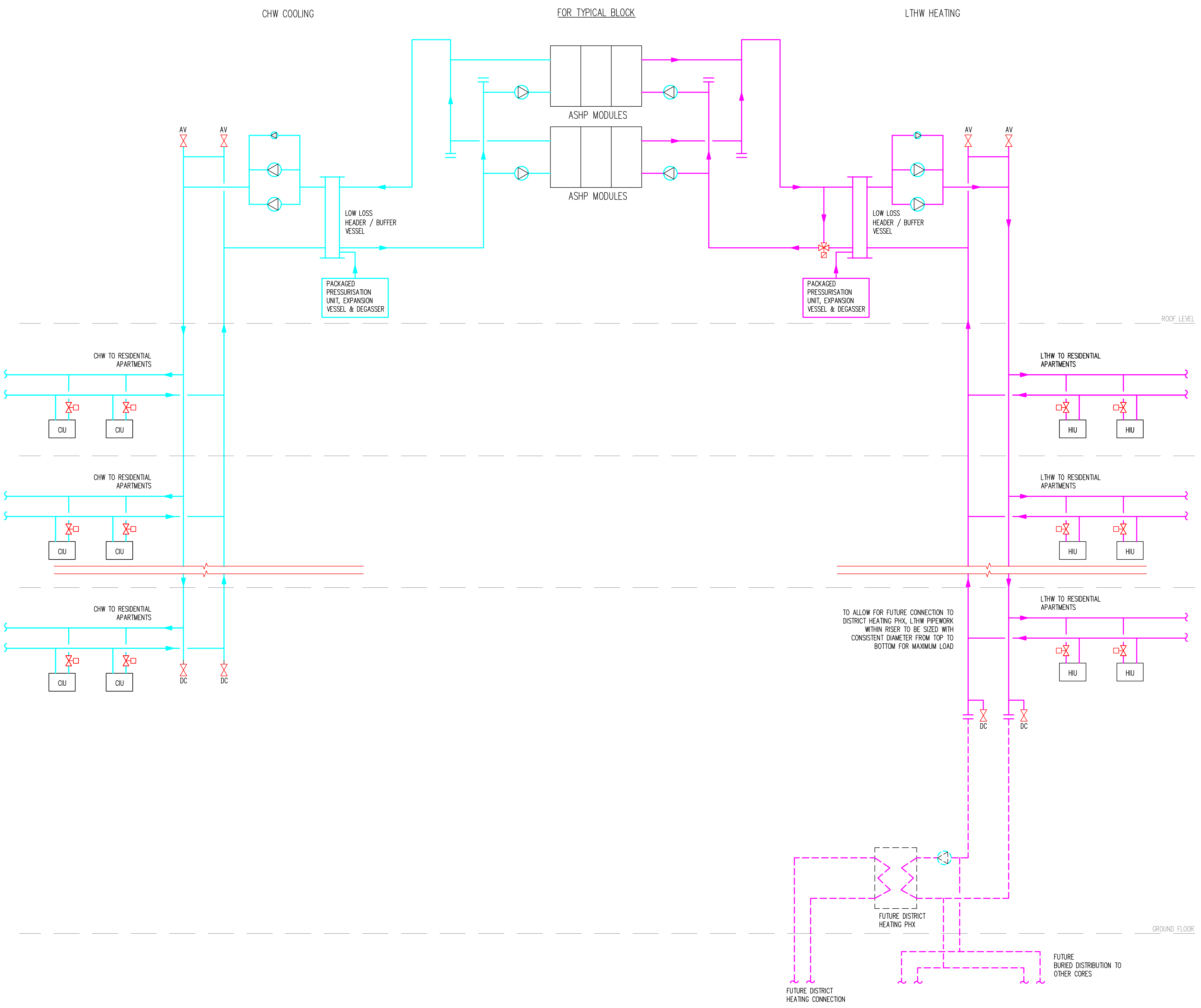
DRAWING NUMBER: 0209506-HL-XX-XX-GA-U-500-0001

Revision: P1

Appendix E: Concept LTHW/CHW Schematic

A1

This drawing shall not be scaled.
Work from the dimensions shown in the drawing or given in relevant specifications



CDM Regulations:

In addition to any information included in this drawing or the model from which it is derived, refer also to the project CDM Risk Register for information on residual risks.

General Notes:

- The drawing does not necessarily show all the information needed to interpret the design intent or the construction details.
- The drawing contains information from more than one source and must be read in conjunction with all relevant specifications.
- Any apparent drafting errors and differences between other drawings and specifications shall be brought to our attention.

Project Notes:

1. THIS DRAWING SHOWS THE TYPICAL ARRANGEMENT FOR A SINGLE BLOCK.
2. COOLING PROVISION TO APARTMENTS TO BE CONFIRMED.

LEGEND :

—	CHW F&R PIPEWORK
—	LTHW F&R PIPEWORK
▶	FLOW DIRECTION
▷	CIRCULATING PUMP
DC	DRAIN COCK
⋈	3-PORT MOTORISED VALVE
ASHP	AIR SOURCE HEAT PUMP
PHX	PLATE HEAT EXCHANGE
AV	AIR VENT
⋈□	CONTROL VALVE (PICV)

Index	Description	Designed	Reviewed	Authorised	Date
P1	STAGE 2 ISSUE	GC	TC	MAH	01/19

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PROJECT TITLE:
MANOR ROAD
RICHMOND

DRAWING TITLE:
MECHANICAL SERVICES
CONCEPT LTHW / CHW SCHEMATIC

PRELIMINARY ISSUE

PERSON RESPONSIBLE FOR:

Design:	Review:	Authorising Issue:
GC	TC	MAH

Project No:	Date:	Scale @ A1:
0209506	JANUARY 2019	NTS @ A1

DRAWING NUMBER: 0209506-HL-XX-XX-SM-M-590-0001

Revision: P1

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Appendix F: Grid Decarbonisation.

Historic progress

The carbon factor of the National Grid – the amount of carbon dioxide released per kilowatt hour of electricity produced and distributed – is recognised in current Building Regulations as being 0.519 $kgCO_2/kWh$. However, the national mix of electricity generation methods is progressing towards greener solutions with renewable sources accounting for 29.4% of the electricity generated in the UK in 2017; up from 24.5% in 2016 [3].

As a consequence, the Building Regulations Part L 2013 value of the National Grid carbon factor has been shown to be substantially higher than how the grid is performing in reality. This severely impacts the calculated emissions produced by all heat raising plant which use electricity directly or generate it to offset other emissions. The figure below shows how the mix of generation techniques serving the National Grid, as well as the associated carbon factor, has varied over the past six years – encouragingly, the carbon intensity of the grid has reduced to less than half its value in 2012 [HM Government, "Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal", 02 January 2018].

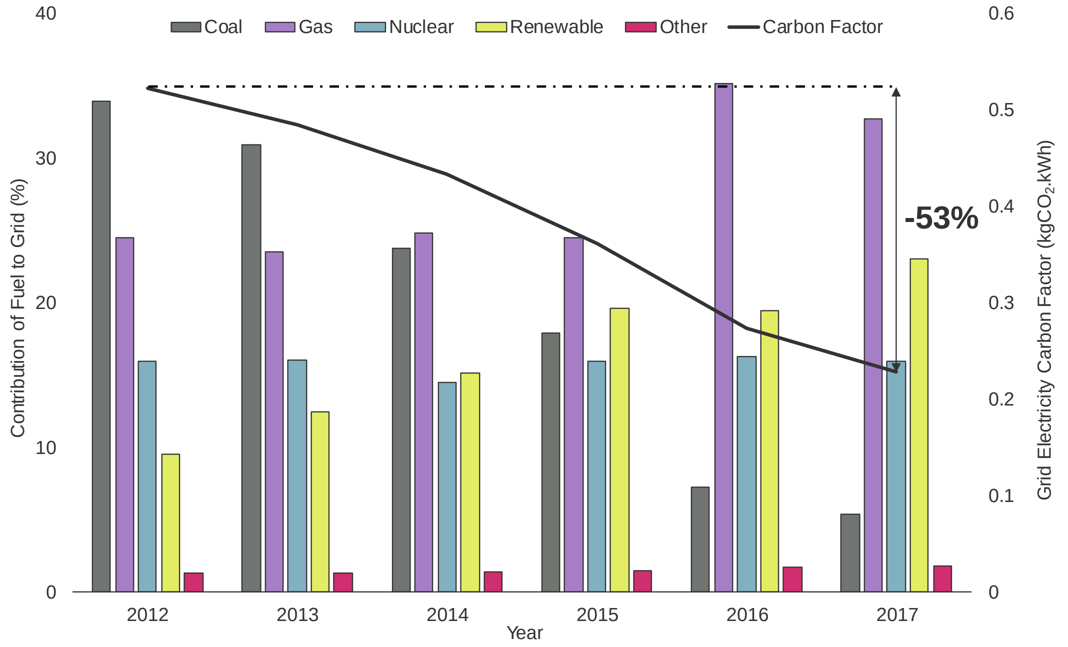


Figure 18: Historic mix of generation methods and associated carbon factor for the National Grid. 8% transmission and distribution losses are included. Sources: *electricityinfo.org* (generation mix); *BEIS Green Book* (historic carbon factors).

Future projections

The Future Energy Scenarios (FES) document, produced by the National Grid, discusses how the UK's energy landscape is changing. In this year's report, FES 2018, the carbon factor of the National Grid is projected to be less than 0.170 $kgCO_2/kWh$ by the end of this year, meaning the actual carbon emissions associated with electricity consumption are much lower than reported in Building Regulations. This means that, under the Part L 2013 methodology the CO_2 emissions associated with electrically-driven plant are being overestimated by over 200%. FES 2018 makes projections of how the mix of generation in the grid is likely to change between now and 2050 – the year by which the Climate Change Act 2008 set the target of reducing the UK's CO_2 emissions by 80% from 1990 levels.

FES discusses these projections in one of four scenarios with the best and worst-case scenarios (from an emissions perspective) being Two Degrees and Steady State respectively. Two Degrees describes a situation where a combination of drastic policy intervention and innovation pushes an ambitious agenda with a focus on long-term environmental goals – it is described as the 'cost optimal pathway to meet the UK's 2050 carbon emissions reduction target'. In contrast, Steady State is a 'business as usual' situation, where society is focussed on the short term and ensuring the security of the UK's energy supply.

The figure below combines these future trajectories with the actual carbon intensity of the National Grid over the past seven years. The reported emissions associated with electricity generation have fallen steeply since 2012 and in all cases, the FES 2018 scenarios see the carbon factor of electricity fall below 100gCO_2/kWh by 2035.

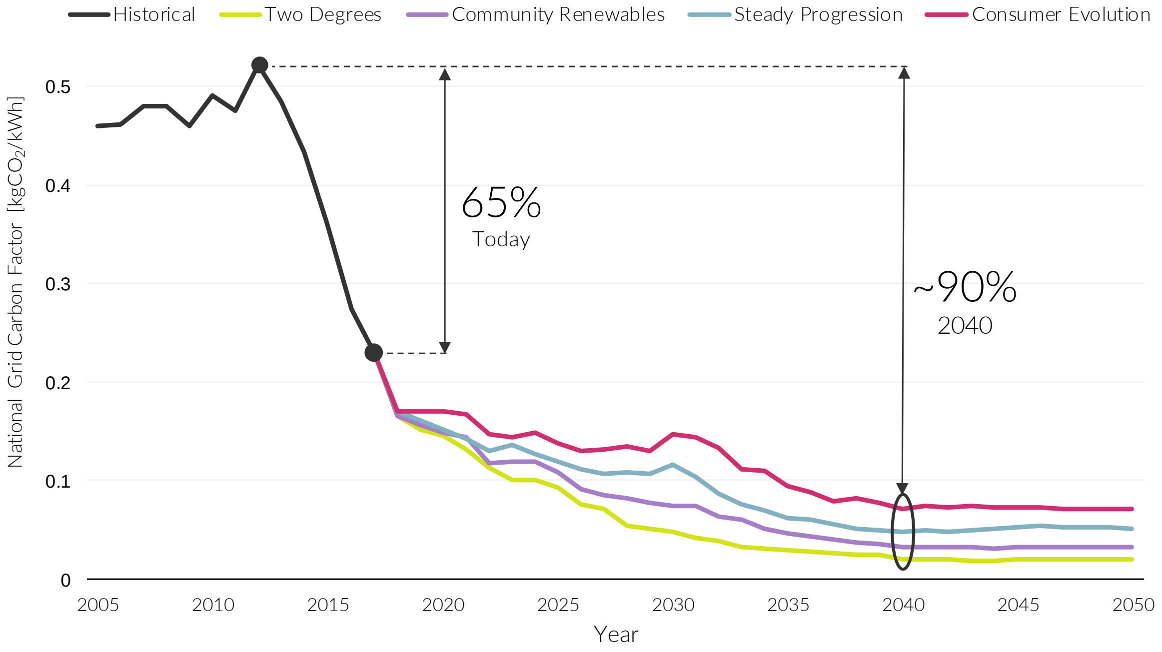


Figure 19: Historic and future projected carbon factor for the National Grid. 8% transmission and distribution losses are included. Sources: BEIS Green Book (historic carbon factors); National Grid Future Energy Scenarios (FES) 2018 (future projected carbon factors).

Shifting focus

As the carbon emissions associated with the generation of electricity continue to reduce, the proportion of the UK's overall greenhouse gas emissions for which the electricity sector is responsible will fall.

The carbon factor of natural gas is likely to remain relatively static. With 85% of homes in the UK relying on gas to supply their heating and hot water, as well as a significant proportion of commercial buildings, heating buildings and industry represents an ever-greater proportion of UK emissions – 32% in 2015 [HM Government, "Clean Growth Strategy," October 2017].

In order for the UK to maintain a trajectory sufficient to meet the 2050 Paris Agreement decarbonisation target of an 80% reduction in annual greenhouse gas emissions over 1990 levels, focus must necessarily shift to other contributors. The BEIS Clean Growth Strategy provides an indication of the direction the UK's energy policy is likely to take and "…sets out [the government's] proposals for decarbonising all sectors of the UK economy through the 2020s." This includes investing in infrastructure and mechanisms to facilitate a transition to low emission vehicles and strengthening the energy performance requirements of new and existing buildings.

As engineers and specialists in the built environment, staying abreast of this dynamism across all sectors is essential for Hoare Lea.

Updates to the Standard Assessment Procedure (SAP10)

In July 2018, the BRE released an update to the Standard Assessment Procedure (SAP) – used to assess dwellings' compliance with Building Regulations – for consultation. The following represents a brief summary of the changes to carbon factors over the current methodology, SAP2012.

Carbon factors

Many of the fuel types recognised in SAP have had their fuel types, carbon factors and primary energy factors amended following the decarbonisation of the grid and other national infrastructure changes. The table below shows the changes in carbon factor from SAP 2012 to SAP 10. It is worth noting the significant improvement for the electricity carbon factor (almost half of that used in 2012).

It is likely that that the next update to Building Regulations Part L will specify the SAP 10 carbon factors associated with natural gas and electricity.

Table 22: Current (SAP2012) and proposed (SAP10) carbon factors for natural gas and grid-supplied electricity.

Fuel	SAP 2012 Carbon Factor ($kgCO_2/kWh$)	SAP 10 Carbon Factor ($kgCO_2/kWh$)
Main Gas	0.216	0.210
Electricity	0.519	0.233

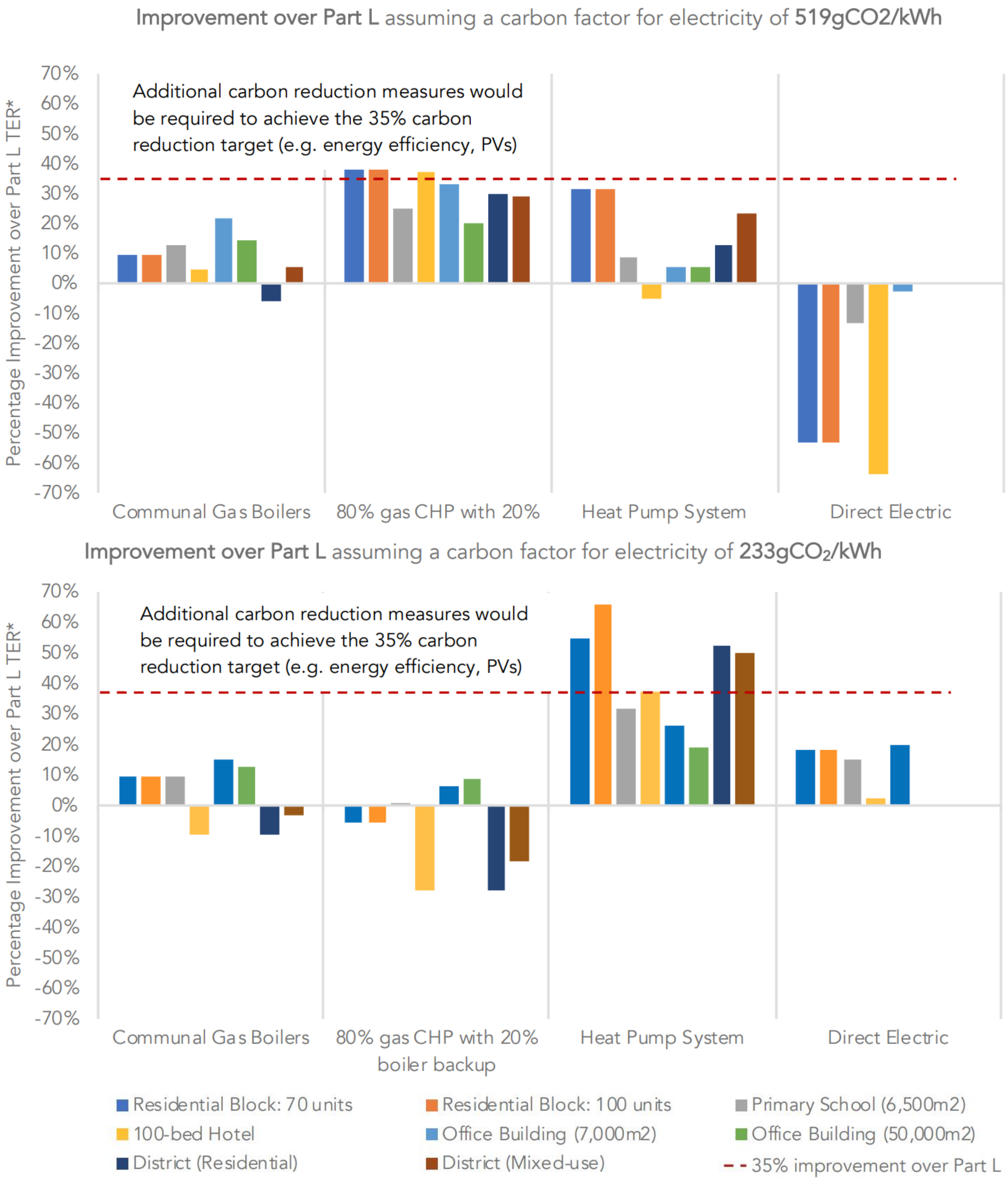
GLA Policy

This difference between national policy and reality means the emissions savings offered by all heat-raising plant are misrepresentative.

Figure 20 shows the percentage reduction in emissions over the GLA baseline for a variety of development types and servicing strategies using both the Part L 2013 and SAP10 carbon factors. Using the Part L 2013 carbon factor CHP offers substantial emissions savings in all scenarios (over 20%) whilst heat pumps offer a benefit in certain applications but a detriment in others. Direct electric is calculated to cause a net increase in emissions in all examples, over 60% in some circumstances.

However, using the SAP10 carbon factor, now specified within GLA energy assessment guidance (October 2018), the situation is markedly different. Heat pumps offer a significant benefit in all cases, with a minimum of a 20% reduction in regulated CO_2. CHP, on the other hand, now offer significantly less benefit, and actually cause over a 30% increase in net emissions in some applications where formerly they were strong. Direct electric is now better from an emissions perspective that the GLA gas boiler baseline in all scenarios.

However, whilst the updated SAP10 carbon factor is far closer to how the grid has been performing in recent years, the rate of progress is such that is may already be out of date. The Future Energy Scenarios 2018 report anticipated a carbon factor of $0.170kgCO_2/kWh$ by the end of 2018; a 28% reduction compared to the SAP10 carbon factor. Figure 21 shows how this difference affects the calculated emissions of a large-scale, mixed-use development for a variety of servicing strategies.



Improvement over Part L assuming a carbon factor for electricity of 519gCO2/kWh

Additional carbon reduction measures would be required to achieve the 35% carbon reduction target (e.g. energy efficiency, PVs)

Improvement over Part L assuming a carbon factor for electricity of $233gCO_2/kWh$

Additional carbon reduction measures would be required to achieve the 35% carbon reduction target (e.g. energy efficiency, PVs)

Figure 20: Percentage improvement over the baseline for a variety of development types and servicing strategies using both the current Part L 2013 carbon factor (top) and the updated SAP10 carbon factor (bottom) for electricity.

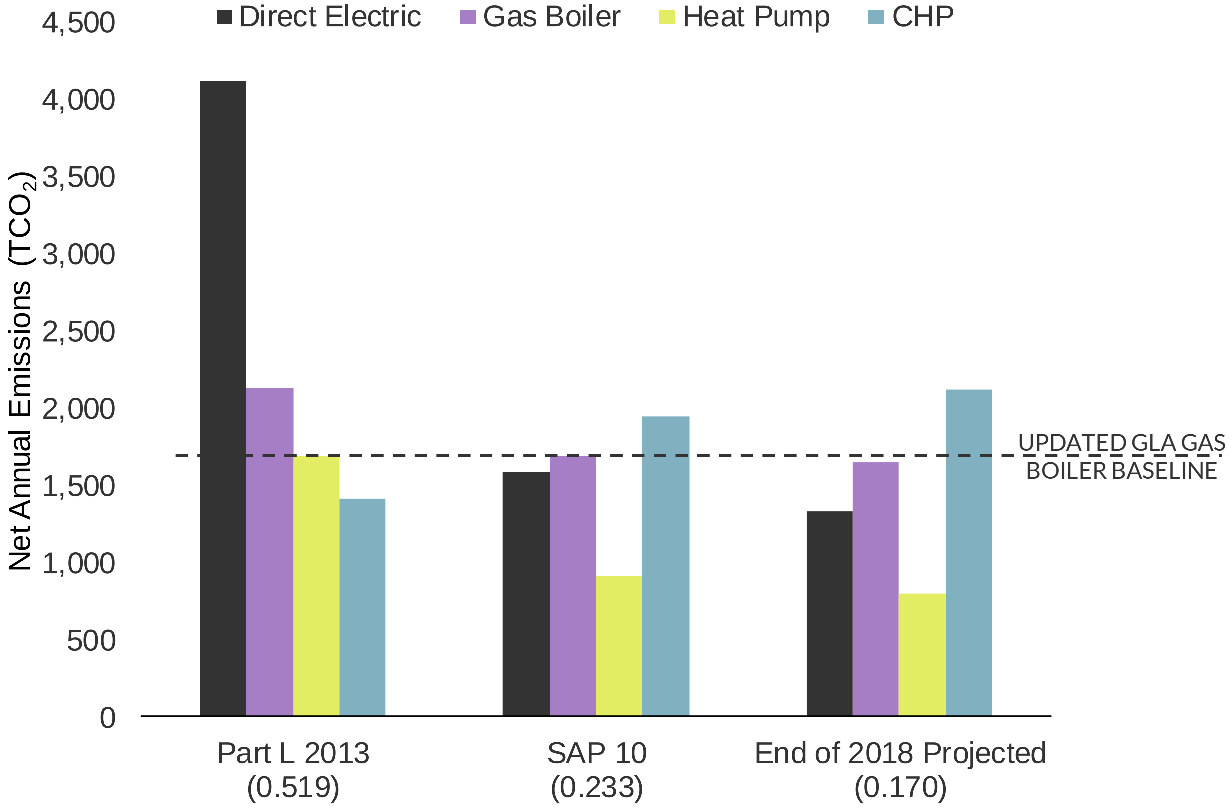


Figure 21: Net annual emissions for a large scale, mixed-use development for a variety of servicing strategies under Part L 2013, using the updated SAP10 carbon factor, and the projected carbon factor for the end of 2018 respectively.

Appendix G: Roof layout for PV.

21 panels = 33m² (gross)

25 panels = 40m² (gross)

30 panels = 48m² (gross)

Total PV Area = Approx. 120m²