MAX FORDHAM

Agar Grove Block B (Phase 2a)

Energy and Sustainability Update

Rev P02

27th May 2022

Camden

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ISSUE HISTORY

Issue	Date	Description
P01	25/05/22	Draft for comment
P02	27/05/22	Planning Issue

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1.0 EXECUTIVE SUMMARY

Planning permission was granted in August 2014 (and amended in 2020) for the comprehensive redevelopment of the Agar Grove Estate comprising mixed-tenure new homes along with retail, business and community spaces.

To date, Blocks A, F, G and H have been completed and construction works on Blocks I and JKL are underway.

This Report is submitted in support of an application to amend Block B of the approved scheme. The need for these changes arises due to the current housing needs of the returning Agar Grove estate residents; responding to current and emerging building regulations; and to take into account lessons learnt during the first phases of development, particularly in relation to Passivhaus.

Block B includes 2No. residential towers with 94No. dwellings, with a Community Centre and Flexible Workspace and Landlord's ancillary areas at Ground and first floor levels.

As described in the original planning application the Passivhaus standard will be used to deliver an enhanced GLA 'Be Lean' performance, denoting a low operational energy and high thermal comfort building. To maximise energy/carbon savings individual exhaust air heat pumps are now proposed for Block B dwellings and Air Source Heat Pump systems are proposed for the non- residential areas. This in line with the government's plan to phase out gas boilers. Photovoltaic panels will be located on the uppermost roofs of each building.

Block by block air source heat pump heating systems are still proposed for Block B in line with the draft new London plan and the government's plan to phase out gas boilers. However, Block B contains dwellings with very low thermal demands due to the Passivhaus approach, allowing decentralised exhaust air heat pumps (ExAHP) to provide heating. Photovoltaic panels will be located on the uppermost roofs of each building.

As a result of these measures a total carbon reduction of 69 % is achieved across the residential areas of the development and a 35% for the non-residential areas, resulting in a total site wide saving of 65% against Part L 2013.

A 25% saving will be made at the 'Be Lean' stage for residential areas and a 25% saving for the Non-residential areas.

1.1 Carbon Dioxide Reduction Targets

The carbon reduction target at the time of the original application was 40% reduction over 2010 Part L requirements. This 40% overall reduction was to include a 20% reduction in carbon dioxide emissions from on-site renewables.

As the carbon intensity of the grid continues to reduce new emission factors have been released and are proposed for use by the draft London Plan. To reflect this, the carbon reduction has been calculated using SAP 10 carbon emission factors in line with the draft new London Plan and to reflect the decarbonisation of the grid. According to the Greater London Authority document 'Energy Assessment Guidance' a 35% reduction against Part L 2013 is equivalent to a 40% reduction against Part L 2010

1.2 Emissions Factors

Unless otherwise stated SAP 10 current carbon emissions have been used throughout this report.

Carbon dioxide emissions factors for the original planning application based on SAP 2012 and current SAP 10 are provided in the table below.

	SAP 2012 (original planning)	SAP 10.0 (GLA use)
Natural Gas	0.216 kg CO2/kWh	0.210 kg CO2/kWh
Electricity	0.519 kg CO2/kWh	0.233 kg CO2/kWh

SAP 2012 and SAP 10 carbon factors

The SAP 10 carbon factors better reflect the decarbonisation of grid electricity. This results in electrically powered heat pumps being favoured for heating and means CHP engines are less beneficial in carbon terms. It also results in the perceived benefit of PVs being reduced

The SAP 10.2 adopted as part of the June 2022 changes to the building regulations in England and Wales set out a carbon factor for grid electricity at 0.136 kg CO2/kWh will mean an all-electric based development will reduce its carbon emissions by a further 41% compared to the SAP 10 (current) figures above.

1.3 Key Strategies

The key energy strategies are described below:

Be Lean- Demand Reduction

- High fabric performance- Passivhaus standards
- Mechanical Ventilation with Heat Recovery (MVHR) throughout

Be Clean- Efficient Energy Supply

- High efficiency MVHR

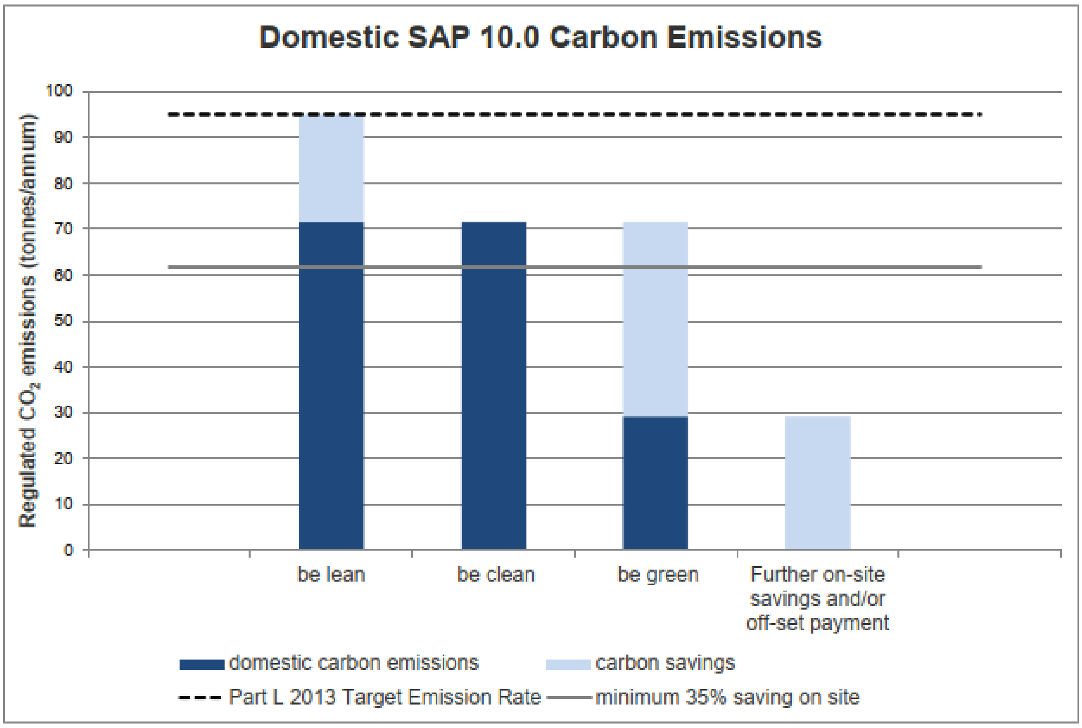
Be Green- Renewable Energy

- Air Source Heat Pumps used to provide heating and generate hot water
- PV array

1.4 Summary of Results

The proposed development has been remodelled in SAP incorporating the fabric and servicing strategy changes described above and in sections 3, 4 and 5.

<u>Domestic</u>



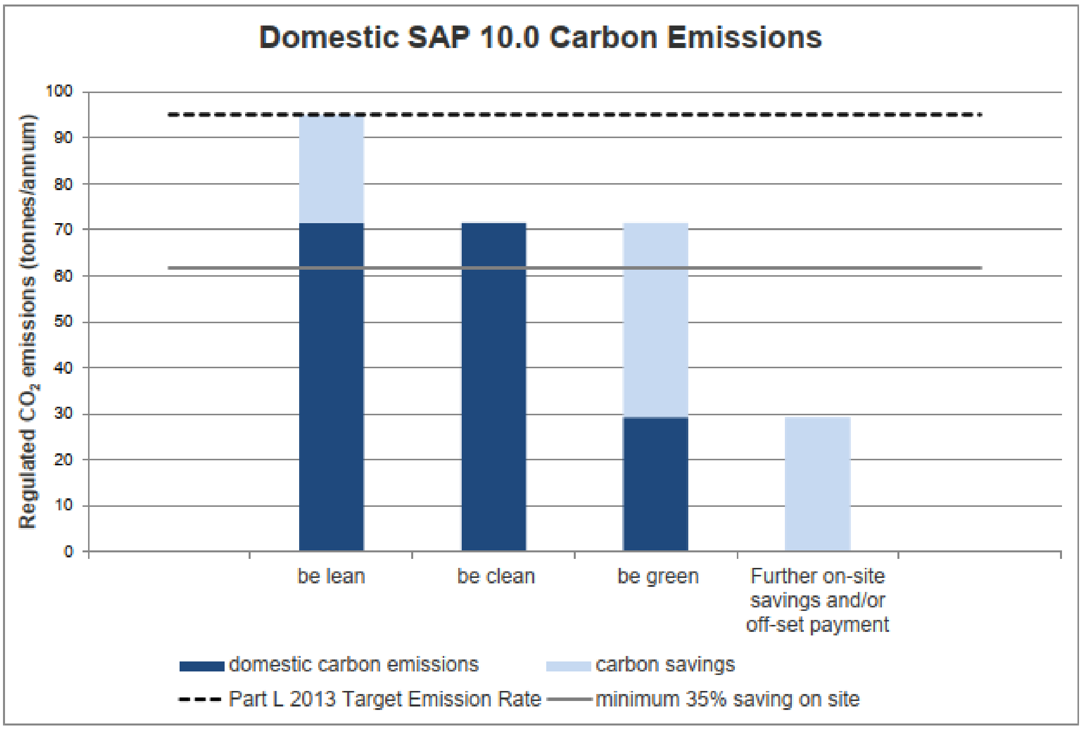


Figure 1 - Domestic SAP 10 Carbon Emissions Summary

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

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	95.1	121.4
After energy demand reduction (be lean)	71.5	121.4
After heat network connection (be clean)	71.5	121.4
After renewable energy (be green)	29.3	121.4

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

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: Savings from energy demand reduction	23.5	25%
Be clean: Savings from heat network	0.0	0%
Be green: Savings from renewable energy	42.3	44%
Cumulative on site savings	**65.8**	**69%**
Annual savings from off-set payment	29.3	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**878**	-
Cash in-lieu contribution (£)	**83,420**	

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

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

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	13.0	9.1
After energy demand reduction (be lean)	9.8	9.1
After heat network connection (be clean)	9.8	9.1
After renewable energy (be green)	8.5	9.1

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

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	3.3	25%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	1.3	10%
Total Cumulative Savings	**4.6**	**35%**
Annual savings from off-set payment	8.5	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**254**	-
Cash in-lieu contribution (£)*	**24,119**	

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

Non Domestic

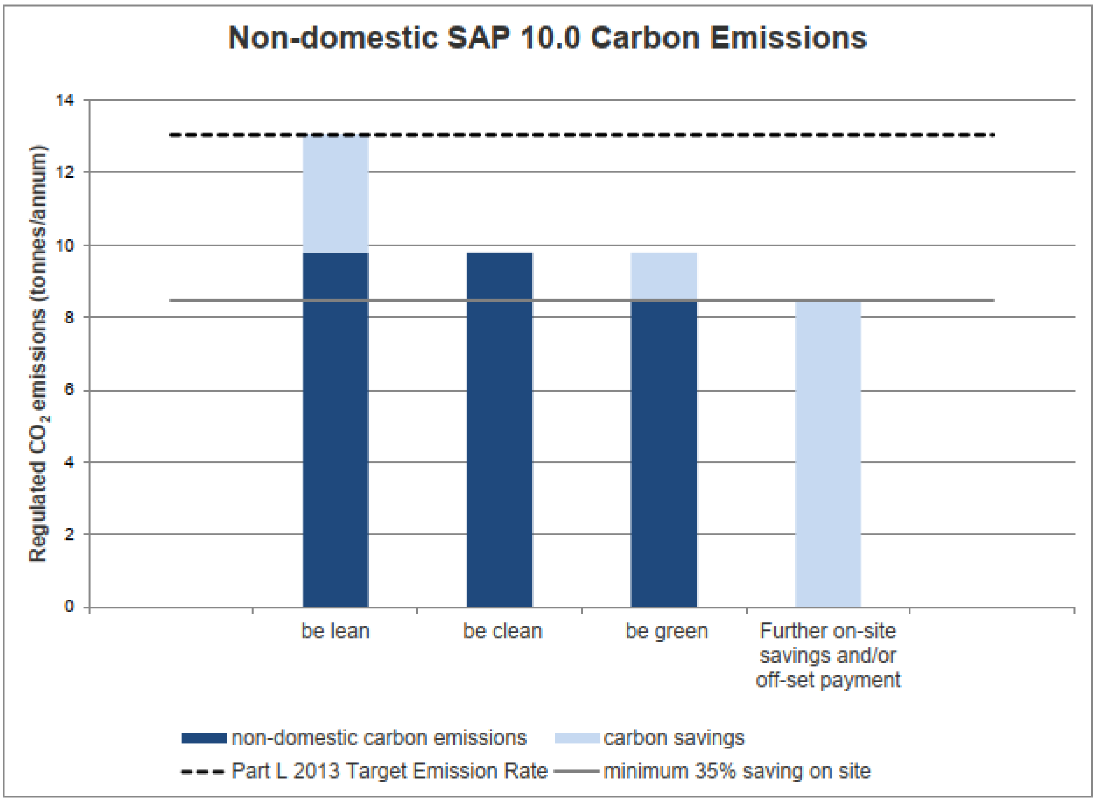


Figure 1 - Non-Domestic SAP 10 Carbon Emissions Summary

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

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	13.0	9.1
After energy demand reduction (be lean)	9.8	9.1
After heat network connection (be clean)	9.8	9.1
After renewable energy (be green)	8.5	9.1

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

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	3.3	25%
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Be green: savings from renewable energy	1.3	10%
Total Cumulative Savings	**4.6**	**35%**
Annual savings from off-set payment	8.5	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**254**	-
Cash in-lieu contribution (£)*	**24,119**	

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

Total site wide carbon savings

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	108.1		
Be lean	81.3	26.8	25%
Be clean	81.3	0.0	0%
Be green	37.7	43.6	40%
Total Savings	-	70.4	65%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**1,132.0**	-

Table 1 - SAP 10 Total site-wide carbon savings

2.0 CO_2 MODELLING METHODOLOGY

2.1 Dwellings

The carbon footprints as shown in the tables above have been calculated using the following methods:

Dwellings:
A Dwelling Emissions Rate (DER) has been calculated in line with the Building Regulations Part L 2013 methodology SAP 2012 using accredited software Stroma FSAP 2012. The results were then converted using the GLA SAP 10 conversion spreadsheet with the carbon factors listed in Section 1.2.

SAP calculations have been carried out for all of the 35No. unique SAP dwelling Energy types identified via different flat sizes, orientations, locations within each block i.e. bottom/middle/top floors. Full SAP flat type markups are provided in appendix 1, examples in the figure below. SAP work sheet and GLA SAP 10 spreadsheet can be found in appendix 2.

Figure 2 - SAP Energy Type Markup

2.2 Non-residential areas

The non-residential areas are located on the ground and first floor with a double height community hall situated on the west wall of the western block. The rest of the western block's ground floor area consists of a residential lobby, concierge office and space that has not yet been allocated. Meanwhile the ground floor of the eastern block contains plant space, bike storage and bin storage. 83m^2 of general flexible workspace is also situated on the ground floor and is connected to the first-floor flexible workspace that covers all the first floor, with no specific areas being marked out. Similarly, the western block's first floor consists entirely of community area and meeting rooms, demanding similar needs to the flexible workspace. In total, the commercial space covers 1850m^2 of floor space that has been assessed for Part L energy usage using IES modelling software (IES VE 2021.4.0.0). MEP systems in place to ensure user comfort is delivered efficiently are detailed below.

- VRF heat pump system
- Mechanical ventilation with heat recovery (MVHR)
- Efficient LED with daylighting control
- Local point of view hot water heating for restrooms and kitchens

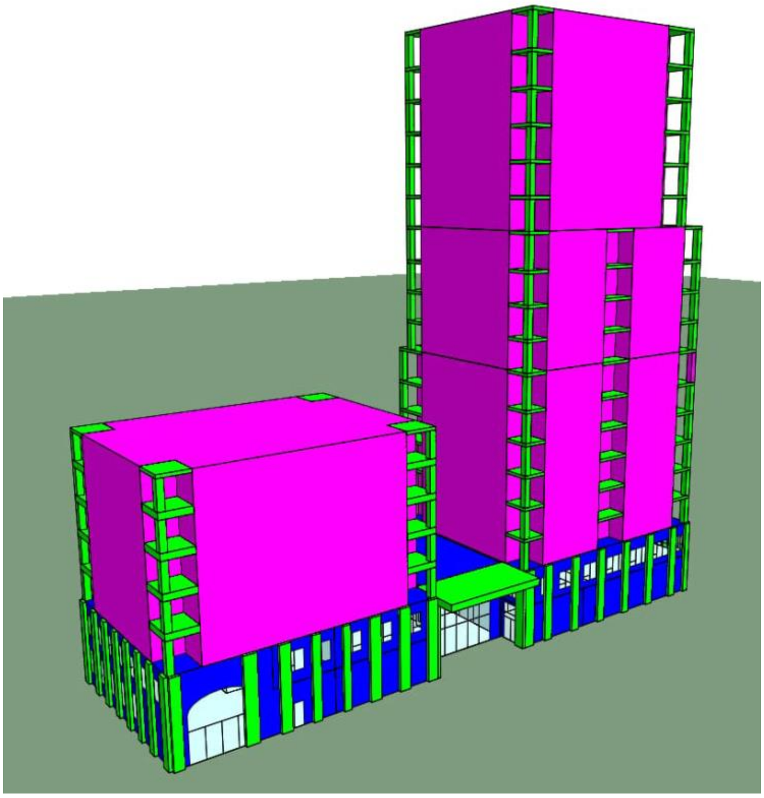


Figure 3 - No-Domestic Part L IES model

3.0 BUILDING FABRIC PERFORMANCE (BE LEAN)

3.1 Fabric Performance summary

As described in the previous planning report carbon emissions will be reduced primarily implementing ‘passive’ energy efficiency measures. Block B has been designed based on the Passivhaus approach.

It is recognised that Passivhaus is better at delivering lower energy in use than the SAP methodology. Achieving Passivhaus certification helps close the performance gap between what is designed and what is built. This is because Passivhaus follows a rigorous process, adopts stringent quality control measures during design and construction and uses tried and tested energy modelling tools (Passivhaus Planning Package or PPP)

Fabric performance targets are shown below.

Be Lean / Fabric Performance

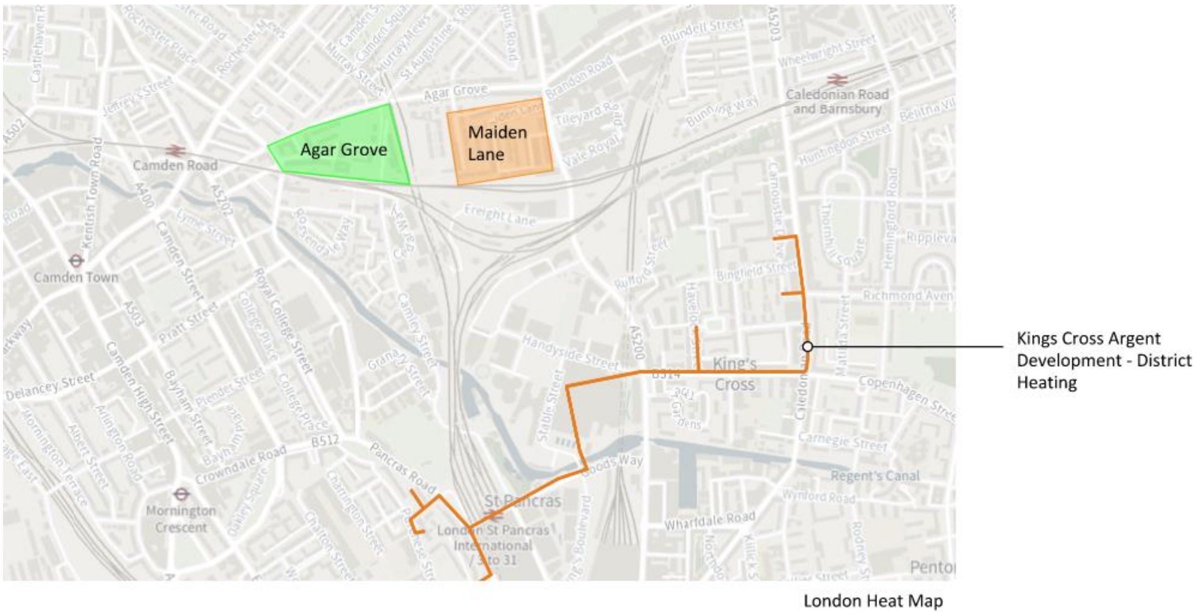
- Wall U-value – 0.18 W/m2K
- Window U-value – 0.85 W/m2K
- Roof U-Value – 0.15 W/m2K
- Glazing g-value – 0.4
- Whole building airtightness – 0.6 Air changes per hour@50Pa
- Thermal bridging calculated in line with SAP methodology
- Use of Passivhaus Certified High Efficiency Mechanical Ventilation with Heat Recovery units for both residential and non-residential areas (MVHR)

4.0 HEATING INFRASTRUCTURE (BE CLEAN)

At the original planning application stage, high efficiency gas condensing boilers were selected. As discussed in section1.2 the carbon factor for grid electricity is dropping over time and therefor electrification of heat has been investigated and energy strategy revised accordingly.

Connection to existing networks

As described in the original planning application connection to the existing King's Cross Argent network would not be feasible as the route would require crossing a major railway line and the existing boiler house has no



spare capacity.

Figure 4 - London heat map

No new heat networks have been developed in the area since the previous application.

Site wide district heating network

Latest GLA policy suggest that that CHP is no longer appropriate for a development such as Agar Grove Phase 2a CHP: A site wide heat network across the entire masterplan site, was earlier deemed inappropriate due to the phased delivery of the development and objections raised by residents during consultation.

An on-site heat network for Agar grove Phase 2a was investigated and compared against alternative strategies described in Section 0. On balance was found that decentralised systems would provide lower overall costs to residents than systems with an on-site heat network, reducing the risk of fuel poverty. Decentralised systems provide large carbon savings and allow a clear route to Passivhaus certification.

Benefits of decentralised system vs on-site heat network summarised below, see Section 0 for a more detailed description.

- No heat network distribution losses or pumping energy
- Lower annual servicing costs to residents
- Lower overall fuel costs
- No heat metering and billing/administration costs
- Lower plant replacement/sinking fund costs
- Lower overall annual costs to residents

Decarbonisation of the Grid

When looking at energy efficiency it is also useful to consider fuel sources and their carbon efficiency. Heating and hot water provided by natural gas boilers was previously proposed for the site. This is becoming a now becoming a comparatively carbon intense fuel source compared to mains electricity.

The current carbon intensity of the UK electricity grid is considerably lower than the factors written into the 2013 Part L of the Building Regulations. SAP 10.0 carbon emissions factors have been used in the calculations throughout this report - in line with GLA guidance on preparing energy assessment.

The latest proposed SAP 10.2 carbon factor for grid electricity at 0.136 kg CO_2/kWh will mean an all-electric based development (such Agar Grove Phase 2a) will reduce its carbon emissions by a further 41% compared to the SAP 10. This is more representative of the real-world situation.

As more renewable technologies are used to supply the electricity grid it is expected that this figure will continue to reduce. In terms of carbon reduction, efficient all electric systems are preferable. This is shown in the Department of Energy and Climate Change Energy and Emissions Predictions.

The solid blue line in the following graph shows how the carbon intensity of the UK grid is predicted to drop based on 2019 predictions, and the dashed blue line is the same measure based on 2018 predictions.

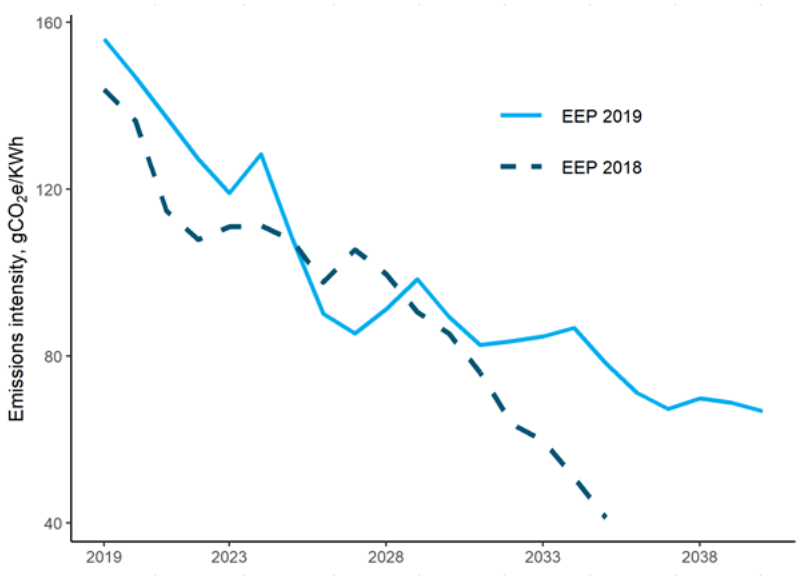


Figure 5 - Department of Energy and Climate Change (DECC) Energy and Emissions Predictions (EEP) 2018 and 2019.

Heat Source Selection

As previously described above SAP 10 carbon emission rates more accurately reflect the carbon intensity of the electricity grid. In line with latest GLA policy, electrification of heat has been prioritised, with heat pumps specified to maximise carbon savings.

5.0 RENEWABLE ENERGY (BE GREEN)

Heat pumps have been identified in the previous section as a more suitable heat source than gas boilers due to decarbonisation of the grid. This change in heat source will impact the selection of supplementary renewable technologies chosen. PV has also been maximised to all available/suitable roof area.

5.1 Air Source Heat Pumps

A heat pump is akin to a domestic fridge: it uses electricity to move heat from one material to another. An air source heat pump (ASHP) moves heat from the outside air to a fluid (water). It uses a refrigerant to achieve this, and generally uses electricity as a power source. Figure 6 illustrates in simple terms how a typical ASHP works.

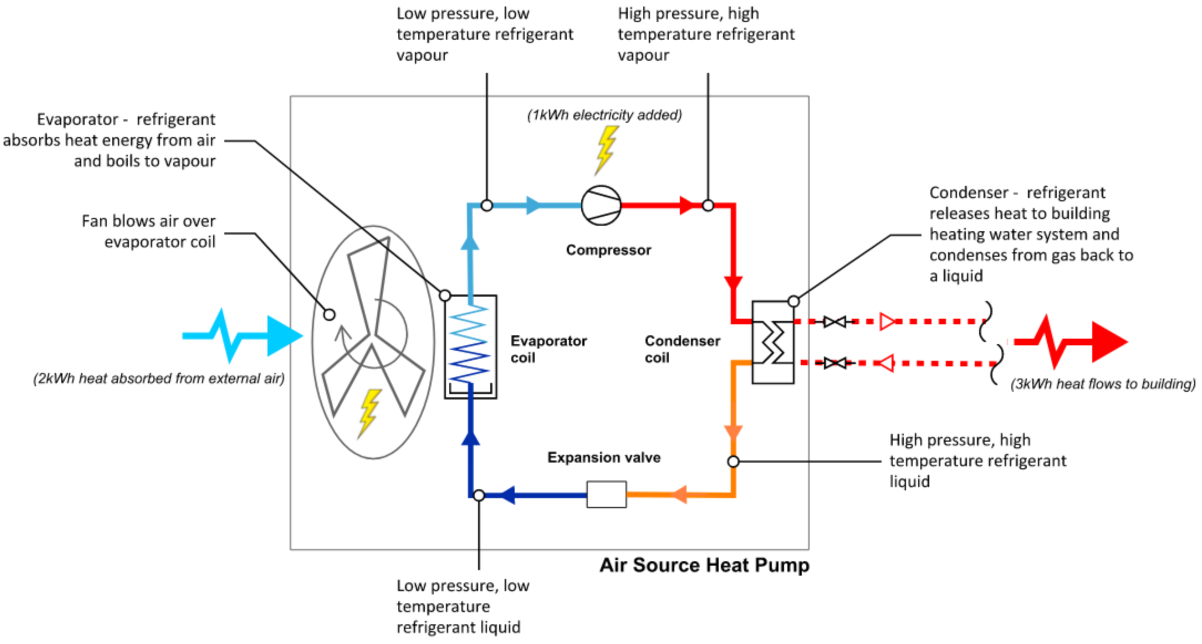


Figure 6 - How an air source heat pump works

As the ASHP is moving heat from one location to another, it is possible to transfer more heat than the energy put in. This is generally defined by the Coefficient of Performance (COP):

$$COP = \frac{Useful\ heat\ transferred}{Energy\ Input}$$

So a heat pump that moved 3kW of heat for 1kW of electrical power input would have a COP of 3. The COP is generally higher the closer the air and water temperatures are to each other.

5.2 Climate Change

Recent years have seen particularly warm summers, which are anticipated to continue with ongoing climate change. Carbon emissions contribute to climate change, so there is a responsibility to choose low-carbon solutions where possible.

The increasing temperatures also mean that summer comfort is increasingly becoming a concern. This means designs should allow for future climate change, and ideally ensure comfortable conditions can be achieved, including the provision of comfort cooling where passive measures will be inadequate.

5.3 Passivhaus Primary Energy Assessment

For the Passivhaus standard, the predicted total energy demand of the building is modelled. Passivhaus modelling results give a more reliable estimate of the in-use energy consumption, than those associated with Building Regulations compliance.

5.4 Proposed System and Rationale

Domestic
The proposed system uses individual compact Exhaust Air Heat Pumps (ExAHP) within each flat to locally generate heating and hot water. These units combine the functions of a traditional MVHR unit with a heat pump and hot water cylinder.

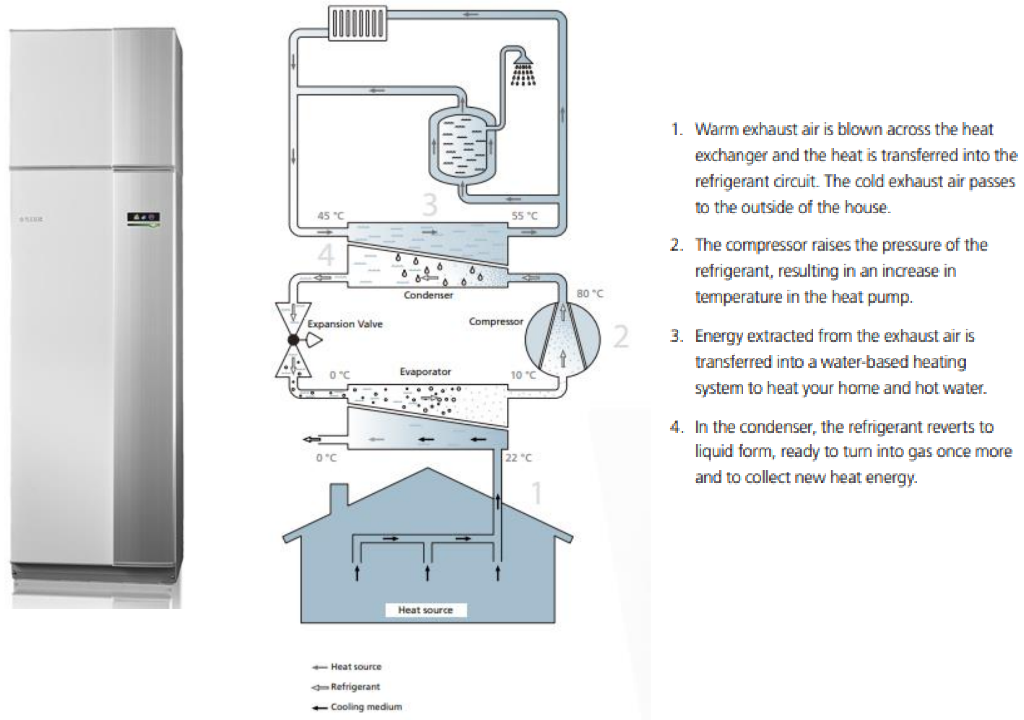


Figure 7 - Exhaust air heat pump system

Compact exhaust air heat pumps are only suitable dwellings with very low thermal demands. The rigorous Passivhaus approach used on Agar Grove Phase 2a will ensure the actual 'in use' heating demand is low enough to allow this technology to be used successfully.

ExAHP units recover energy from extracted air using a highly efficient counter flow heat exchanger in the same way as an MVHR unt. The remaining energy that is not utilised by the counter flow heat exchanger is used by the heat pump to charge a hot water, and to further heat the supply air.

The heat pump within an EXAHP unit is typically capable of running in reverse in summer to provide a small amount of cooling allowing the unit to temper the incoming supply air by up to around to 10 °C however it does not function as an air conditioning system. When 'cooling' mode is activated, the supply air is dehumidified; this helps provide a more pleasant indoor climate than is possible with standard MVHR system.

Heat energy extracted from the air is recovered where possible and used to produce hot water, offsetting associated energy demand.

The principal benefits of this system are:

- Efficiency: Generating heat locally with heat pumps, maximises efficiency avoiding heat losses and pumping energy associated with centralised systems.
- Fuel Poverty: Lowest overall costs to residents.
- Environmental impact: the use of electricity is consistent with a decarbonising electricity grid, and a design that is aligned with limiting environmental impact
- Compliance: the use of electricity is in line with the new London Plan
- Air quality: the use of electricity means there is no combustion on the site, and so no omission of particulates, or incomplete products of combustion (NO_x etc.)
- Futureproofing: the ExAHP units can provide both heating and small amount of cooling. Cooling also allows residents to shut their windows at night, and still be thermally comfortable, if there are external noise issues.
- Passivhaus : Compact units have low energy consumption and leaner pipework distribution that could help reduce heat losses, total energy demand and therefore achieve Passivhaus targets.

<u>Non-domestic</u>
It is proposed that the non-domestic areas, including community Centre and Flexible Workspace are serviced with VRF style heat pumps systems to provide heating and cooling supplies.

We note that the Flexible Workspace is likely to be handed over as shell and core space only, however for the purposes of the energy / carbon modelling carried out under this energy assessment, we have assumed VRF systems will be installed as this is a likely fit out strategy.

Supplementary renewable technologies
The original planning application identified solar thermal collectors and photovoltaic (PV) panels as the most appropriate renewable technologies for the site. As the heat source for Block B is being changed the suitability of these technologies has been reviewed.

Incorporating solar thermal collectors into the proposed system would be difficult, a separate system would be required to provide the hot water from the solar thermal collectors to dwellings.

It is instead proposed that PV panels only are installed on the highest roofs, these have been maximised to all available roof area.

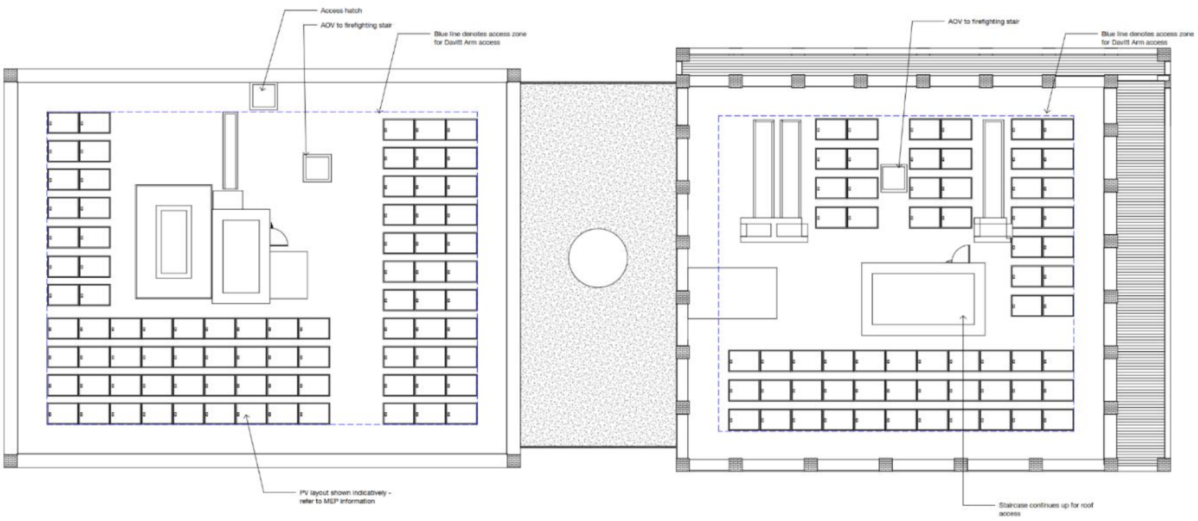


Figure 8 - Roof plant layout

The photovoltaic (PV) array is shown in figure 8. The PV array generates 23,803 kWh/year of electricity towards the energy compliance calculations.

6.0 WATER, OTHER RESOURCES AND SUSTAINABLE CONSTRUCTION

The sustainability approach beyond energy and carbon dioxide remains unchanged from the original planning application.

6.1 Water

Domestic water consumption is designed to achieve 105 litres/person/day.

The landscaping strategy also includes the provision of SUDS to the Mayor's preferred standard through green roofs, permeable paving and rain gardens.

6.2 Materials and Sustainable Construction

Wherever possible preference will be given to environmentally low impact materials: cement replacements will be specified in order to reduce the impact of concrete elements; the insulation used will not contain substances known to contribute to ozone depletion or have the potential to contribute to global warming

7.0 SUMMER COMFORT AND CLIMATE CHANGE ADAPTATION

7.1 Original planning application requirements versus latest guidance

The UK government and Camden council have both introduced legislation to ensure new developments address the emerging issues of the climate emergency and climate change:

1. Reduce carbon emissions to limit the severity of climate change- **minimise energy use**.
2. **Ensure developments are resilient** to increased overheating risks from future climate scenarios.

The Camden Local Plan 2017 calls for following the London Plan Cooling Hierarchy which aims to reduce overheating risk whilst also reducing reliance on air conditioning systems.

As described in the original application, the design team has been aware from an early stage of the need to mitigate the risk of overheating; and to create thermally comfortable spaces that will continue to operate successfully in future climates. It is a requirement for Passivhaus certification that the risk of overheating is mitigated. Passivhaus defines this risk as the percentage of time where the internal temperature exceeds 25°C. This should not exceed 10% for the year, however, considering future climate scenarios this should ideally be below 5%.

To reduce energy demand from cooling, the design follows the London Plan Cooling Hierarchy by adopting a passive design - opening windows for natural ventilation. However, there is a greater risk of overheating, both with the current and predicted future climate with a natural ventilation strategy. An overheating analysis was completed with the aims of showing compliance with legislation whilst also driving the design.

Methodology
The design standards for residential summer comfort have advanced since the original application. In line with the draft New London Plan, CIBSE's TM59 was used as the framework to assess overheating risk and to guide design to militate against this in the homes and TM52 was the approach used in the commercial spaces. TM59 has two criteria to pass – daytime comfort for all rooms, and night-time comfort for bedrooms. Various flats were reviewed including flats with higher solar gains due to being south facing and/or limited shading, single aspect glazing which doesn't allow cross flow and ground floor apartments where security issues mean limited opening of windows.

Conclusion
Following the London Plan Energy Hierarchy 'Be Lean, be clean, be green', the first option should 'be lean' adopting more passive design measures which will bring down energy demand. Measures that could be adopted now include adding blinds/shades/louvres to limit solar gains and the removal of fixed low-level glazing which adds to solar gains but does not aid natural ventilation. Retrofit options in the future include providing solar control film, fitting more external shading/louvres and adding ceiling fans.

Overheating modelling results can be found in Appendix 1, Overheating Risk Assesment.

The domestic apartments passed TM59 (except for one top floor living room which would require external shading to pass) with natural ventilation only.

Window opening areas have been optimised for overheating mitigation, however the non-domestic on ground floor and first floor do not pass TM52 with natural ventilation only. This is due to the solar irradiance and occupancy gains which are significant. These spaces will require active cooling during the warmest parts of the year. The aspiration is that natural ventilation will be used for as much of the year as possible and cooling only used as a last resort.

As also required by the Energy Assessment guidance, the overheating assessment has also tested the development against future weather scenario datasets. Results for these weather scenarios are also included in the report in Appendix 1.

7.2 London Plan cooling hierarchy

The most up to date London Plan cooling hierarchy is shown below in bold with the project response in blue.

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

Compared to the original planning application, the amount of glazing has been significantly reduced whilst balancing competing demmands for good internal daylight levels. Low G-value glass has beeen specified to reduce internal solar gain. Deep window reveals have been incorportated to help shade agains high angle summer sun. Where possible balconies have been are used to shade windows on the levels below.

2. Minimise internal heat generation through energy efficient design

Proposed decentralised energy strategy means that there is no heating network pipes running through communal areas, reducing the the risk of these areas overheating. Hot water pipework within flats to be as short as possible in line with Passivahus guidance.

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

Floor to floor heights in resi areas optimised to reduce embodied carbon emissions,

There is a double height space in community centre area which will mitigate against overheating.

4. Provide passive ventilation`

Dual aspect flats provided wherever possible. All dwellings capable of being cooled passively via opening windows in line with new Part O guidance p- see separate Overheating risk assessmen in the aappendices. Large openings also provided for non donestic areas to allow natural ventialtion, double height space in communit centre used for stack effect.

5. Provide mechanical ventilation

All dwellings and commercial areas to be provided with high efficiency Passivhaus certified MVHR units with controls capable of using 'free cooling' when the outside air temperature is below internal, they will also have a bypass for summer operation

5. Provide acticve cooling

As descibed in section 0, the EXAHP units is capable of running in reverse in summer to provide a small amount of cooling allowing the unit to temper the incoming supply air by up to around to 10 °C however it **does not function as an air conditioning system**. When 'cooling' mode is activated, the supply air is dehumidified; this helps provide a more pleasant indoor climate than is possible with standard MVHR system. Heat energy extracted from the air is recovered where possible and used to produce hot water, offsetting associated energy demand .

APPENDIX 1 – OVERHEATING RISK ASSESSMENT

1.0INTRODUCTION

This report describes the overheating assessment of the Planning Application for the Regeneration of the Agar Grove Estate.

Site Name	**Agar Grove Estate, Hazelbury Way, Camden, London**
Applicant	London Borough of Camden
Number of residential units	94

Description of Proposal

The construction of this development is phased to ensure existing residents only move once. The phasing has allowed the design for Phase 2a to be revisited.

This report is included as an overheating assessment as part of the planning amendment for Block B. Block B includes 2No. residential towers with 94No. dwellings, with a Community Centre and Flexible Workspace and Landlord's ancillary areas at Ground and first floor levels.

In recent years, with increased awareness of the warming climate and the 'urban heat island' effect, consideration of the overheating of buildings has justifiably drawn greater focus.

New overheating standards have consequently been introduced and adopted as planning requirements in many areas. In this report, we will first look at the planning requirements for the Agar Grove Estate; before describing the overheating risk, analysis carried out, presenting the results against the requisite standard and discussing the implications of this for building occupants.

The results of the overheating assessment shows that all spaces could fulfil the criteria for mitigation of overheating in accordance with CIBSE TM49 / TM59 criteria, using weather data DSY1 (Design Summer Year) for the 2020s, high emissions, 50% percentile scenario.

Overheating analysis for more extreme weather data sets are also included, as per the requirements of the current and London Plan guidance, see Section 1.1. There is no requirement, under the 2021 London Plan guidance, for the spaces to comply with the overheating criteria using these more extreme weather files, nonetheless the results have been provided within the report.

1.1 London Plan

In accordance with policy SI 4 of the London Plan, new developments must show that they follow the cooling hierarchy to reduce potential overheating and reduce reliance on air conditioning systems.

Policy SI 4 Managing heat risk

A Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

B Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
2) minimise internal heat generation through energy efficient design
3) manage the heat within the building through exposed internal thermal mass and high ceilings
4) provide passive ventilation
5) provide mechanical ventilation
6) provide active cooling systems.

The London Plan energy assessment guidance requires analyses of the risk of overheating to be undertaken, and compliance must be demonstrated with the following standards:

- Building Regulations Part L, Criterion 3 relating to solar gain. For all new buildings
- CIBSE TM59, using TM49 weather files, for new domestic buildings
- CIBSE TM52, using TM49 weather files, for new non-domestic buildings

1.2 CIBSE Technical Memorandum 52

CIBSE TM52 describes an 'adaptive' model of human comfort. Adaptive comfort models have been developed based on scientific research into human adaptation to temperature variation. Instead of fixed or absolute limits on temperature, the comfort parameters vary according to the prevailing weather conditions – so, for example, the maximum adaptive temperature will be higher during a period of hot weather.

The overheating risk criteria in TM52 are based on a 'maximum adaptive temperature', Tmax, a function of the running mean of the external air temperature. ΔT is then defined as the difference between the internal operative temperature, Top, and Tmax (ΔT=Top-Tmax). The operative temperature is simply a measure of internal temperature that considers radiant temperature as well as air temperature.

ΔT is calculated on an hourly basis and rounded to the nearest whole number. It is used to define three criteria, with a building failing to meet two out of three deemed at risk of overheating:

- **Criterion 1 - Hours of Exceedance:**
  The percentage of occupied hours for which ΔT > 1 must be less than 3%.

  I.e. the operative temperature can only exceed the maximum adaptive temperature by more than 1°C for a maximum of 3% of occupied hours.

- **Criterion 2 - Weighted Exceedance:**
  The sum of ΔT for each hour the building exceeds T_{max} must not exceed 6 in any one day.

So, for example, a building which exceeds T_{max} by 1°C for two hours and by 2°C for one hour in a day would meet the criterion (weighted exceedance = 4); while a building exceeding T_{max} by 1°C for three hours and by 2°C for two hours would not meet the criterion (weighted exceedance = 7).

- **Criterion 3 - Threshold/Upper Limit Temperature:**
  ΔT must never exceed 4°C.

  That is, the operative temperature can never exceed the maximum adaptive temperature by 4.5°C or more.

These criteria apply to all occupied rooms in a non-domestic building.

1.3 CIBSE Technical Memorandum 59

CIBSE TM59 builds on the work undertaken in TM52 and adapts it to specifically address the issue of overheating in dwellings.

CIBSE TM59 requires all dwellings to meet the following criteria:

- **Criterion 1 - for living rooms, kitchens and bedrooms:**
  The percentage of occupied hours for which ΔT > 1 must be less than 3%.

  I.e. the operative temperature can only exceed the maximum adaptive temperature by more than 1°C for a maximum of 3% of occupied hours.

  I.e. T_{op} - T_{max} < 1°C, for 97% of occupied hours.

- **Criterion 2 - for bedrooms only:**
  To guarantee comfort during the sleeping hours (from 10pm to 7am) the operative temperature in bedrooms shall not exceed 26°C for more than 1% of annual hours (corresponding to 32 hours).

  I.e. T_{op}<26°C for 99% of hours between 22:00 and 07:00

TM59 defines profiles for internal gains for different residential space types, allowing different buildings' performance to be compared fairly.

1.4 Weather Data

Alongside the development of improved overheating standards, weather data that are more representative of the current climate and the projected future climate have also been developed. CIBSE have now produced a huge range of weather data sets, covering a variety of weather and climate scenarios up to the year 2100.

Three new probabilistically generated 'Design Summer Years' (DSY) were released in 2016 specifically for the assessment of overheating:

- DSY1 – representing an above average, warm summer (approximate return period for London weather files: 7 years)
- DSY2 – containing a short but extreme period of heat (approximate return period for London weather files: 16 years)
- DSY3 – a longer period of intense, but less extreme, heat (approximate return period for London weather files: 24 years)

Each of these DSY have been projected forward using probabilistic climate models to give future weather data sets covering the periods 2011-2040 (DSY#2020s); 2041-2070 (DSY#2050s); and 2071-2100 (DSY#2080s). Each of these is then available for a ‘high’, ‘medium’ and ‘low’ emissions scenario; and each of these as a 10th, 50th and 90th percentile - i.e. respectively that with a 90%, 50% or 10% chance of being exceeded.

DSY following this methodology have been produced for 14 locations across the UK. To capture the effects of the Urban Heat Island, DSY are available for three separate sites in London, each applicable to developments in a different zone of the city:

- London Weather Centre - used for development in the high-density urban areas of the ‘central activity zone’
- London Heathrow – used in the lower density urban and suburban areas
- London Gatwick – for the low-density peri-urban and rural areas around the city

The Agar Grove Estate site sits within the lower density urban area of London, and as such, in line with the GLA guidance on preparation of energy statements, the weather data for London Heathrow will be used.

As can be seen from the expected return periods of the Design Summer Years, they all represent unusual weather occurrences. However, DSY1 represents what might be called a more frequently experienced ‘hot’ summer, while DSY2 and DSY3 do represent much less frequent ‘extreme’ weather events.

This is acknowledged in the London Plan 2021, which requires only compliance against the 2020s DSY1 weather file, in the high emissions scenario at the 50th percentile: i.e. DSY1_2020_High_50. While accepting that it is extremely difficult to achieve a pass, the London Plan also asks that buildings be tested against the more extreme 2020s weather years – DSY2 and DSY3 – and the DSY1 projected forward to the 2050s and 2080s. However, it should be noted that there is no requirement to meet the TM52 or TM59 criteria for these weather years, but the results will be reported, and potential future mitigation measures discussed where necessary.

2.0 METHODOLOGY

2.1 Dynamic Thermal Simulation

The IES 2021 software package has been used to model the building. This software dynamically simulates the performance of a building over time, using hourly weather data to calculate internal conditions based on the user inputs: the 3D geometry and the thermal parameters of each building element.

2.2 TM52: Community Hall, Community Rooms and Flexible Storage

Figures 1-3 shows the IES model from all elevations. The geometry and fenestration have been based on the Architectural information issued on the 11th May 2022. All spaces have been modelled in detail with associated gains and thermal properties – refer to section **Error! Reference source not found.** for further details.

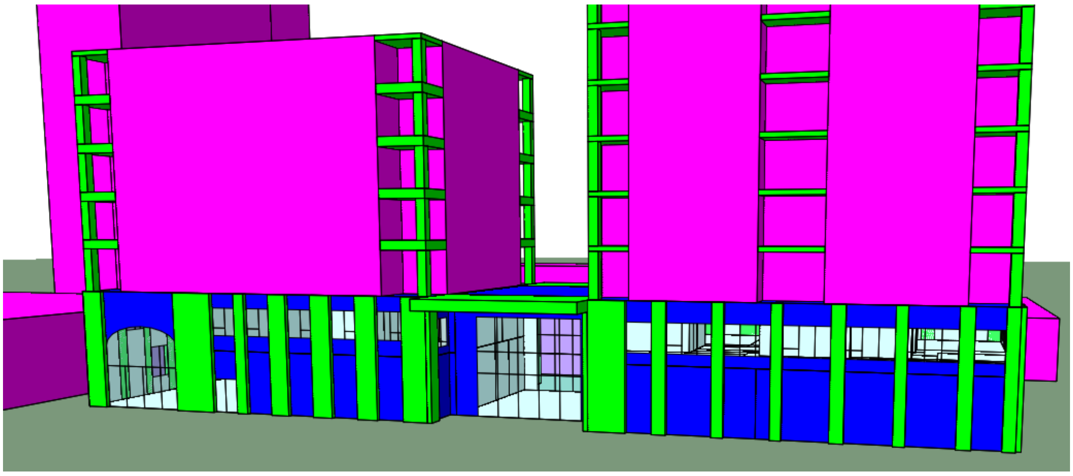


Figure 1: IES Model showing the south elevation of the non-domestic spaces

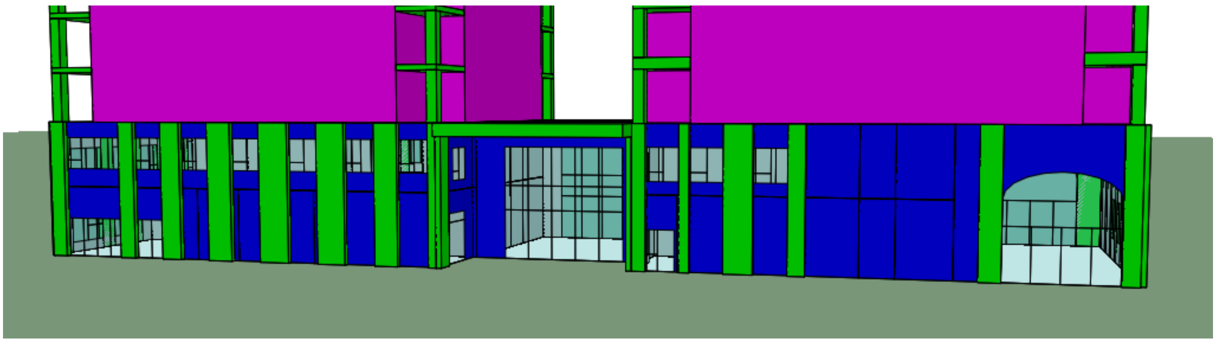


Figure 2: IES Model showing the north elevation of the non-domestic spaces

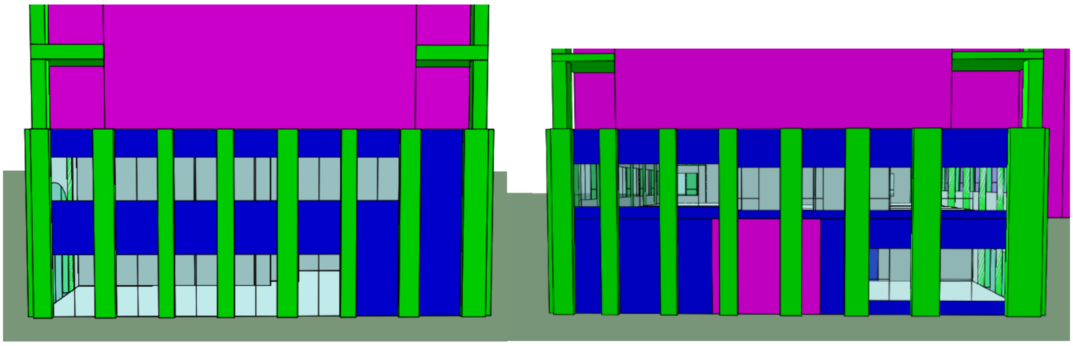


Figure 3: IES Model showing the west elevation (left) and the east elevation (right) of the non-domestic spaces

However, the overheating risk assessed by TM52 only applies to permanently occupied spaces – i.e. those with continuous occupation during the operational day. The rooms considered here are highlighted in the architectural plan extract below and labelled with the reference used in this document.

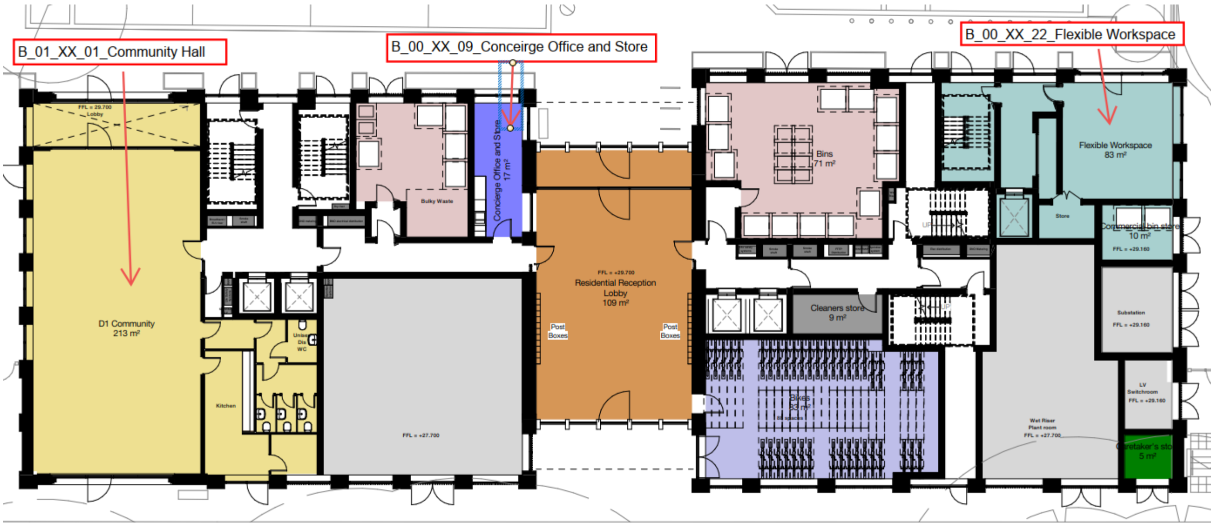


Figure 4: Internal layout of the ground floor of Block B

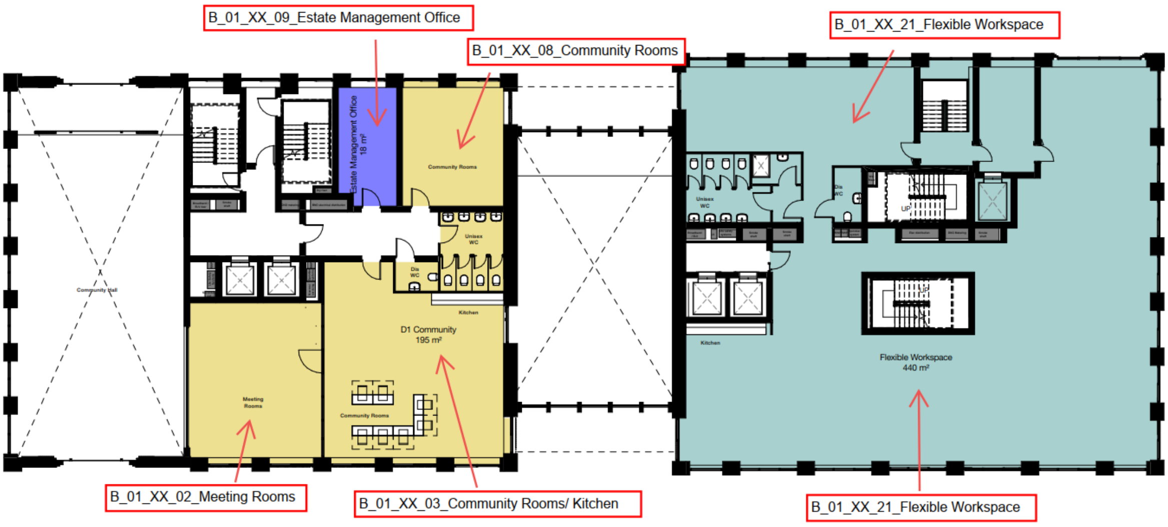


Figure 5: Internal layout of the first floor of Block B

2.3 TM59: Dwellings Model

For residential developments containing multiple dwellings TM59 requires that a sample of the ‘worst case’ dwellings are analysed. In this case a selection of 16No. dwellings has been made, representing a sample of the dwelling types in the building most at risk of overheating. These are generally located on the upper floors – where shading from balconies and adjacent buildings is at a minimum – and includes those dwellings with glazed facades orientated to the west or south where the highest solar gains will occur. The flats selected and the reason for their selection is summarised in the following table.

Reference	Type	Selection Rationale
B1_06_F1	2B4P	South facing façade Dual aspect – top floor
B1_06_F2	2B4P	South facing façade Dual aspect – top floor
B1_06_F3	3B5P	Dual aspect – top floor
B1_06_F4	3B5P	Dual aspect – top floor
B2_06_F5	2B3P	South facing façade Dual aspect – mid floor
B2_06_F6	1B2P	South facing façade Single aspect – mid floor
B2_06_F7	2B3P	South facing façade Dual aspect – mid floor
B2_06_F8	2B4P	Dual aspect – mid floor
B2_06_F9	2B4P	Dual aspect – mid floor
B2_08_F1	1B2P	South facing façade Dual aspect – mid floor
B2_08_F2	1B2P	South facing façade Single aspect – mid floor
B2_08_F3	2B3P	South facing façade Dual aspect – mid floor
B2_08_F4	2B3P	Dual aspect – mid floor
B2_08_F5	2B3P	Dual aspect – mid floor
B2_17_F1	2B3P	South facing façade

		Dual aspect – top floor
B2_17_F2	1B2P	South facing façade Dual aspect – top floor
B2_17_F3	1B2P	Dual aspect – top floor
B2_17_F4	2B3P	Dual aspect – top floor

Figures 4-5 below shows the 16 selected flats in the context of the overall building. The internal layouts of these flats can be seen in Figures 6-8.

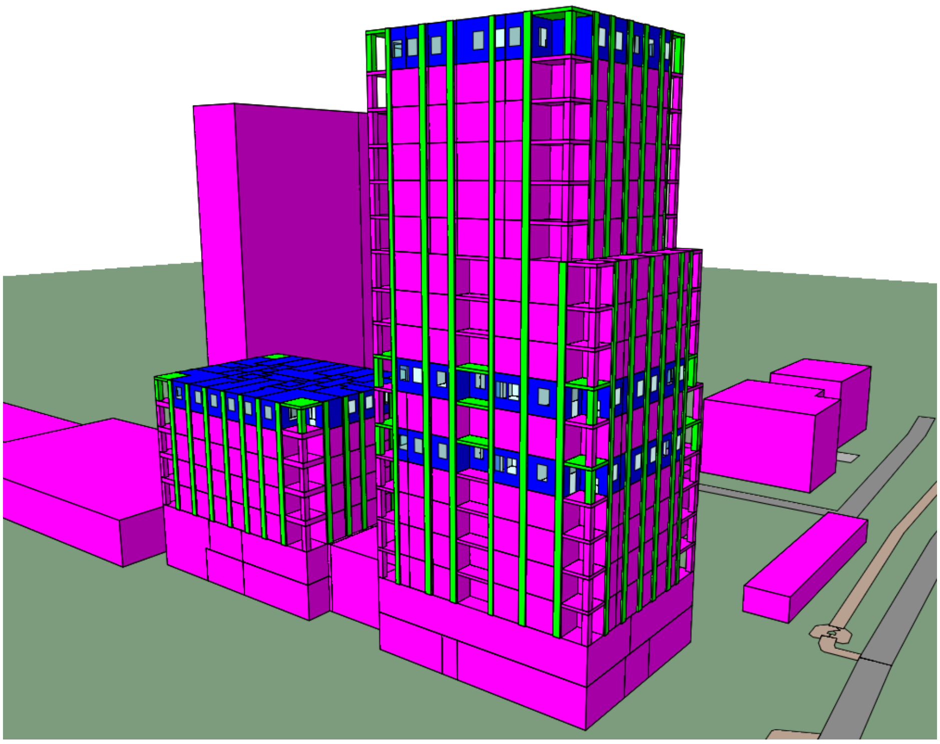


Figure 4: South Elevation of IES Model of Block B with modelled flats shown in blue

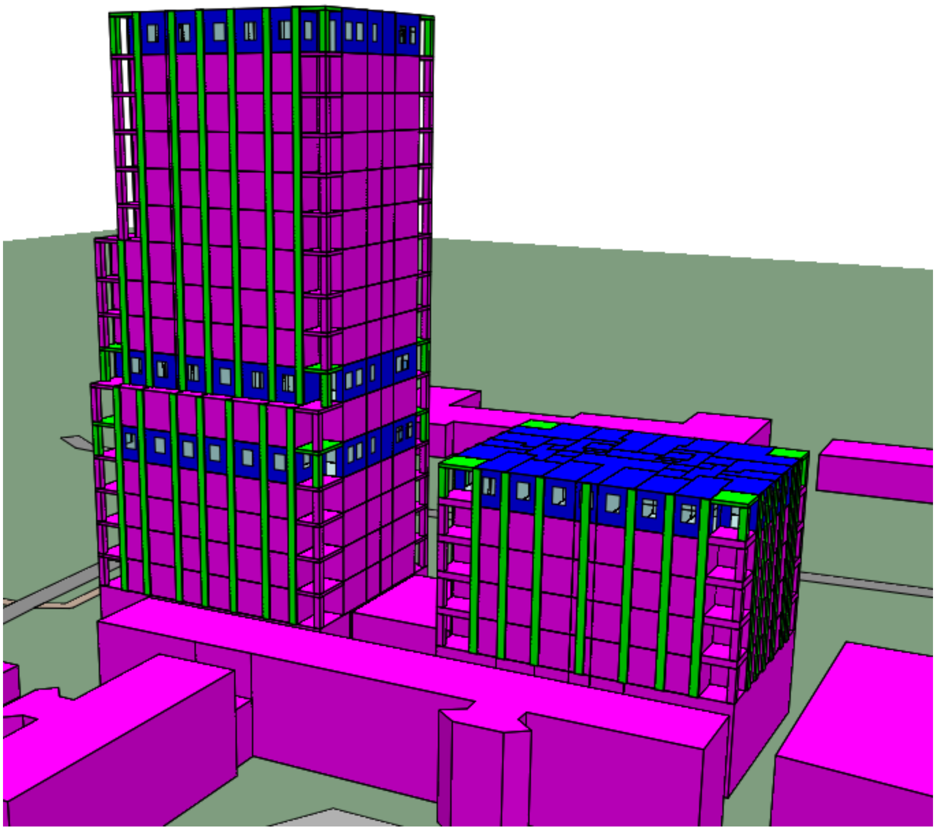


Figure 5: North Elevation of IES Model of Block B with modelled flats shown in blue

Figure 6: Internal layouts of Floor G Block B flats

Figure 7: Internal layouts of Floor 8 Block B2 Flats

Figure 8: Internal Layouts of Upper Floor Block B2 Flats

Communal Corridors

TM59 recommends that where heating pipework is present in communal corridors and there is a risk of overheating, these should be modelled. There is window openings and no hot water pipework in the corridors, so it is not considered that the corridors are at particular risk of overheating.

2.4 Cooling/Ventilation Strategy

Window recesses (200mm) have been implemented across all the glazing to shade the windows from high angle summer sun providing a passive design solution to limit solar gain.

Window opening profiles, detailed in the approved Part O document, shown below have been incorporated into the TM59 model.

2.6 All of the following limits on CIBSE's TM59, section 3.3, apply.

a. When a room is occupied during the day (8am to 11pm), openings should be modelled to do all of the following.
   i. Start to open when the internal temperature exceeds 22°C.
   ii. Be fully open when the internal temperature exceeds 26°C.
   iii. Start to close when the internal temperature falls below 26°C.
   iv. Be fully closed when the internal temperature falls below 22°C.

b. At night (11pm to 8am), openings should be modelled as fully open if both of the following apply.
   i. The opening is on the first floor or above and not easily accessible.
   ii. The internal temperature exceeds 23°C at 11pm.

c. When a ground floor or easily accessible room is unoccupied, both of the following apply.
   i. In the day, windows, patio doors and balcony doors should be modelled as open, if this can be done securely, following the guidance in paragraph 3.7 below.
   ii. At night, windows, patio doors and balcony doors should be modelled as closed.

It is assumed that as all the dwellings are on the 2nd to the 17th floor the windows can be modelled as fully open at night from 11pm to 8am when the internal temperature exceeds 23°C. The use of unrestricted windows through the night is key to the mitigation of overheating risk and it must be ensured that this is possible from the perspective of safety and security of occupants.

All flats are to be provided with MVHR units to optimise the energy efficiency of winter ventilation. These will operate in summer-bypass mode when conditions are appropriate. The effect of increased mechanical ventilation rates are also considered.

All flats are assessed without the need for mechanical cooling in line with the London Plan Cooling Hierarchy.

2.5 Input Parameters

<table>
<tr><th>Parameter</th><th>Model Inputs</th></tr>
<tr><td>Geometry</td><td>Building geometry, shading and fenestration based on Architect’s Design Freeze layouts, issued 11th May 2022.</td></tr>
<tr><td>Constructions</td><td>U-values:

• Internal Doors: 2.20 W/m²K
• External Doors: 0.80 W/m²K
• External Wall: 0.18 W/m²K
• Roof: 0.15 W/m²K
• Exposed/ Ground Floor: 0.18 W/m²K
• Windows: 0.82 W/m²K

Windows g value: 0.4

No exposed thermal mass is assumed in the building</td></tr>
<tr><td>Internal Gains</td><td>Residential:
Profiles as defined in TM59.

Non-residential: TM52 Profiles
<table>
<tr><th>Room Type</th><th>People & Occupied Hours</th><th>Occupant Density (m²/person)</th><th>Lighting (W/m²)</th><th>Equipment (W/m²)</th></tr>
<tr><td>Concierge Office and Store</td><td>2
9am-6pm</td><td>8.8</td><td>6</td><td>10</td></tr>
<tr><td>Flexible Workspace</td><td>42
9am-6pm</td><td>10.0</td><td>6</td><td>10</td></tr>
<tr><td>Meeting Rooms</td><td>20
9am-6pm</td><td>9.0</td><td>6</td><td>5</td></tr>
<tr><td>Estate Management Office</td><td>2
9am-6pm</td><td>11.5</td><td>6</td><td>10</td></tr>
<tr><td>Community Rooms</td><td>30
9am-8pm</td><td>9.0</td><td>6</td><td>5</td></tr>
<tr><td>Community Hall</td><td>65
9am-10pm</td><td>3.2</td><td>6</td><td>5</td></tr>
</table>
Please refer to the table at the end of Appendix 3 for full details of the internal gain’s assumption.</td></tr>
<tr><td>Windows and Natural Ventilation Opening</td><td>All windows and openings are modelled as per Architectural Elevations issued 11th May 2022.

Openings have been modelled as side hung windows with a maximum opening angle of 90° to provide a 90% free area.</td></tr>
</table>

	Residential When a room is occupied during the day (8am to 11pm), openings are modelled to do all of the following. i. Start to open when the internal temperature exceeds 22°C. ii. Be fully open when the internal temperature exceeds 26°C. iii. Start to close when the internal temperature falls below 26°C. iv. Be fully closed when the internal temperature falls below 22°C. **Option 1: Unrestricted night-time opening** At night (11pm to 8am), openings should be modelled as fully open if both of the following apply. i. The opening is on the first floor or above and not easily accessible. ii. The internal temperature exceeds 23°C at 11pm. **Option 2: Restricted night-time opening** When a ground floor or easily accessible room is unoccupied, both of the following apply. i. In the day, windows and balcony doors should be modelled as open, if this can be done securely ii. At night, windows and balcony doors should be modelled as closed Wind pressure coefficients: 'semi exposed'. Internal doors have a maximum openable area of 90% and are open whilst occupants are awake (07:00 - 22:00 sleeping hours as defined by TM59 Criteria B). **Non-residential** Openings have been modelled as side hung windows with a maximum opening angle of 90° to provide a 90% free area. When a room is occupied during the day, openings are modelled to do all of the following. i. Start to open when the internal temperature exceeds 22°C. ii. Be fully open when the internal temperature exceeds 26°C. iii. Start to close when the internal temperature falls below 26°C. iv. Be fully closed when the internal temperature falls below 22°C. At night, windows are modelled as open to a 100mm restriction when the external temperature exceeds 18°C and when the internal temperature is greater than the external temperature.
Systems	MVHR in summer bypass mode has been allowed for. Since we are not interested in energy, the model does not include heat recovery mode for other seasons.

	The flow rate for the dwellings has been defined as 8.34 l/s/person for the 2B3P, 2B4P and 3B5P flats and 9 l/s in the bedrooms and 10 l/s in the living rooms for the 1B2P flats. The flow rate for the non-residential units has been defined as 10 l/s/p during occupied hours. Infiltration to all rooms at 0.1 ACH.

3.0 RESULTS

The report confirms that the residential apartments and the non-residential elements could comply with the London Plan Policy SI 4, for the required weather year - DSY1 (Design Summer Year) for the 2020s, high emissions, 50% percentile scenario).

As also required by the Energy Assessment guidance, the overheating assessment has also tested the development against future weather scenario datasets. Results for these weather scenarios are also included in the report.

3.1 DSY1 2020s High 50

TM52: Non-domestic

The results of the TM52 overheating risk assessment using the GLA mandatory weather file, DSY1 2020s High 50, for the non-domestic spaces are shown in the table below. The numbers below each criterion indicate the value corresponding to that criterion – so criterion 1 indicates the percentage of hours where ΔT exceeds 1K (max. 3%); criterion 2 the peak weighted exceedance (max. 6), and criterion 3 the peak value of ΔT (max. 4K). Any criteria being failed are then indicated, and the overall pass/fail result (if two or more criteria are failed).

The model was initially run with the windows being allowed to open during the day as per the conditions described in Section 2.5 and during the night the windows were modelled as fully closed. The g value implemented in the model was 0.4. The results of these conditions are shown in the table below:

Room Name	Criterion 1 (% Hours Delta T >= 1K)	Criterion 2 (Max Daily Weight)	Criterion 3 (Max Delta T)	TM52 (Pass/Fail)
B_00_XX_09_Conceirge Office and Store	3.6	19	5	Fail
B_00_XX_22_Flexible Workspace	15.0	31	5	Fail
B_01_XX_01_Community Hall	13.1	52.5	6	Fail
B_01_XX_02_Meeting Rooms	8.8	26.5	5	Fail
B_01_XX_03_Community Rooms/ Kitchen	5.5	22.5	5	Fail
B_01_XX_08_Community Rooms	4.1	21	5	Fail
B_01_XX_09_Estate Management Office	3.9	16.5	4	Fail
B_01_XX_21_Flexible Workspace	6.4	27.5	5	Fail
B_01_XX_21_Flexible Workspace	5.2	24.5	5	Fail

As shown from the results, all spaces fail the TM52 overheating analysis. This is due to several factors including the significant amount of solar gain due to the high proportion of glazing. Another reason is the high occupancy, and resulting high internal gains, in some of the spaces including the flexible workspaces, meeting rooms and community halls.

The window opening strategy is shown in Figures 9-11 below. A red box with the letter F indicates a fixed pane of glazing, a blue box with the letter O indicates an openable window which is closed at night for security reasons and an orange box with the letters SD indicates a security door which is closed all the time.

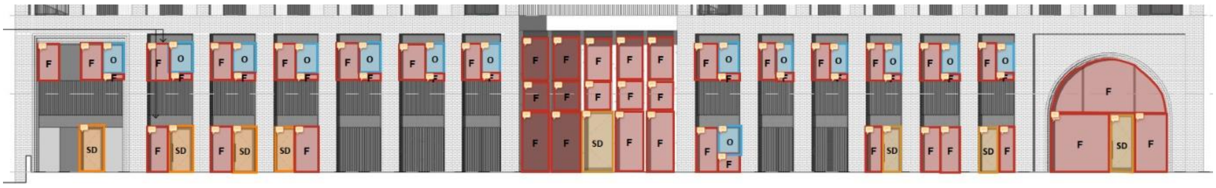


Figure 9: North elevation and window opening strategy indicated by the coloured boxes

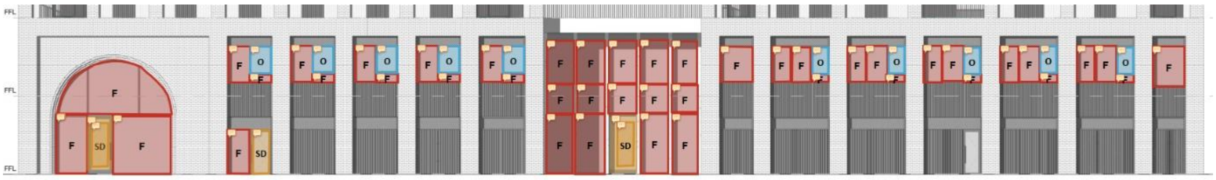


Figure 10: South elevation and window opening strategy indicated by the coloured boxes

Figure 11: East elevation (left) and west elevation (right) and window opening strategy indicated by the coloured boxes

The high proportion of fixed glazing shown in the figures above has a significant effect on the overheating.

To improve the performance of these spaces it is recommended that the solar gain be reduced and night ventilation introduced. Solar gain could be reduced via increased shading, reduced glazing area or reduced glazing g value – here we have looked only at glazing g value, however it may be possible to achieve the same performance using an alternative method. Night ventilation allows a building to purge heat built up during the day when there is typically cooler outside air available. It can be extremely effective at reducing daytime temperatures; however, it is dependent on the provision of secure openings and management /control of these to ensure they are opened at appropriate times.

To determine whether the spaces will pass with night-time natural ventilation the windows were allowed to open with a 100mm restriction at night. At night the windows were modelled to open when the external temperature exceeds 18°C and when the internal temperature is greater than the external temperature. Furthermore, half of the area of the ground floor windows were also allowed to open with a 100mm restriction at night and the g-value for all glazing was reduced to 0.3. The results of this are shown in the table below.

Room Name	Criterion 1 (% Hours Delta T >= 1K)	Criterion 2 (Max Daily Weight)	Criterion 3 (Max Delta T)	TM52 (Pass/Fail)
B_00_XX_09_Conceirge Office and Store	2.4	15	4	Pass
B_00_XX_22_Flexible Workspace	9.7	22.5	4	Fail
B_01_XX_01_Community Hall	6.3	40.5	5	Fail
B_01_XX_02_Meeting Rooms	4.5	18	4	Fail
B_01_XX_03_Community Rooms/ Kitchen	3.4	17	4	Fail
B_01_XX_08_Community Rooms	2.9	15.5	4	Pass

B_01_XX_09_Estate Management Office	1.9	10.5	3	Pass
B_01_XX_21_Flexible Workspace	4.3	21.5	5	Fail
B_01_XX_21_Flexible Workspace	3.9	20	5	Fail

Despite these measures, the results show that most spaces still fail and therefore it is evident that the high occupancy in combination with the current facade design will impose an overheating risk. Therefore, it is likely that the commercial spaces will require some element of mechanical cooling to achieve comfortable internal summertime conditions. The input data provided above should be reviewed to ensure this is a realistic representation of how the spaces will be used. Even if a mechanically cooled solution is pursued, effort should still be concentrated on passive design measures and optimisation of the façade to minimise the cooling energy required.

TM59: Residential

The report presents cases where the residential apartments comply with the London Plan Policy SI 4, for the required weather year - DSY1 (Design Summer Year) for the 2020s, high emissions, 50% percentile scenario).

Option 1:

For Option 1, the windows are unrestricted during the day and at night as per the conditions highlighted in 'Windows and Natural Ventilation Opening' in Input Parameters above. As we can see from the results below, all of the rooms, except one living room pass the TM59 overheating analysis.

Room Name	Criterion A (% Hours Delta T >= 1K)	Criterion B (% Hours Operative T > 26 Deg. C)	Criterion B (Hours Operative T > 26 Deg. C)	TM59 (Pass/Fail)
B_06_XX_B1_F4_3B5P_Bedroom	0.83	0.68	22.5	Pass
B_06_XX_B1_F4_3B5P_Living Room	3.42			Fail
B_06_XX_B1_F4_3B5P_Kitchen	2.31			Pass
B_06_XX_B1_F4_3B5P_Bedroom1P	1.67	0.75	24.5	Pass
B_06_XX_B1_F4_3B5P_Bedroom	1.35	0.81	26.5	Pass
B_06_XX_B1_F1_2B4P_LivingRoom/kitchen	2.64			Pass
B_06_XX_B1_F1_2B4P_Bedroom	1.21	0.82	27	Pass
B_06_XX_B1_F2_2B4P_Bedroom	0.93	0.87	28.5	Pass
B_06_XX_B1_F1_2B4P_Bedroom	1.01	0.87	28.5	Pass
B_06_XX_B1_F2_2B4P_Bedroom	1.23	0.82	27	Pass
B_06_XX_B1_F3_3B5P_Bedroom	0.86	0.64	21	Pass
B_06_XX_B1_F3_3B5P_Kitchen	2.24			Pass
B_06_XX_B1_F3_3B5P_Living Room	2.56			Pass
B_06_XX_B1_F2_2B4P_Living Room/kitchen	2.31			Pass
B_06_XX_B1_F3_3B5P_Bedroom1P	1.24	0.68	22.5	Pass
B_06_XX_B1_F3_3B5P_Bedroom2P	1.06	0.78	25.5	Pass
B_06_XX_B2_F9_2B4P_Bedroom	0.84	0.82	27	Pass
B_06_XX_B2_F8_2B4P_Bedroom	0.67	0.81	26.5	Pass
B_06_XX_B2_F9_2B4P_Bedroom	1.06	0.79	26	Pass
B_06_XX_B2_F8_2B4P_Bedroom	0.75	0.82	27	Pass
B_06_XX_B2_F8_2B4P_Living Room/Kitchen	2.39			Pass
B_06_XX_B2_F7_2B3P_Bedroom1P	1.44	0.76	25	Pass
B_06_XX_B2_F7_2B3P_Bedroom	1.27	0.79	26	Pass
B_06_XX_B2_F5_2B3P_Living Room/kitchen	2.87			Pass
B_06_XX_B2_F5_2B3P_Bedroom	1.09	0.88	29	Pass
B_06_XX_B2_F6_1B2P_Living room/kitchen	2.41			Pass
B_06_XX_B2_F7_2B3P_Living room/kitchen	2.54			Pass
B_08_XX_B2_F1_1B2P_Bedroom	1.38	0.53	17.5	Pass
B_08_XX_B2_F2_1B2P_Bedroom	0.99	0.81	26.5	Pass
B_08_XX_B2_F2_1B2P_Living room/ kitchen	2.44			Pass

B_08_XX_B2_F3_2B3P_Kitchen/ Living room	2.61			Pass
B_08_XX_B2_F3_2B3P_Bedroom	1.27	0.79	26	Pass
B_08_XX_B2_F5_2B3P_Bedroom1P	1.35	0.73	24	Pass
B_08_XX_B2_F5_2B3P_Bedroom	1.03	0.79	26	Pass
B_08_XX_B2_F4_2B3P_Bedroom	0.79	0.82	27	Pass
B_08_XX_B2_F4_1B2P_Bedroom1P	1.06	0.75	24.5	Pass
B_08_XX_B2_F1_1B2P_Living room/ kitchen	2.41			Pass
B_08_XX_B2_F5_2B3P_Living room/ kitchen	2.29			Pass
B_08_XX_B2_F4_2B3P_Living room/ kitchen	2.56			Pass
B_08_XX_B2_F3_2B3P_Bedroom1P	1.44	0.76	25	Pass
B_06_XX_B2_F6_1B2P_Bedroom	0.98	0.82	27	Pass
B_06_XX_B2_F5_2B3P_Bedroom1P	1.38	0.79	26	Pass
B_06_XX_B2_F9_2B4P_Living room/ Kitchen	2.19			Pass
B_17_XX_B2_F4_2B3P_Bedroom1P	1.38	0.75	24.5	Pass
B_17_XX_B2_F2_1B2P_Living room/ kitchen	2.49			Pass
B_17_XX_B2_F2_1B2P_Bedroom	0.75	0.65	21.5	Pass
B_17_XX_B2_F1_2B3P_Bedroom	1.08	0.82	27	Pass
B_17_XX_B2_F4_2B3P_Living room/ kitchen	2.64			Pass
B_17_XX_B2_F3_1B2P_Living room/ kitchen	2.11			Pass
B_17_XX_B2_F3_1B2P_Bedroom	1.01	0.81	26.5	Pass
B_17_XX_B2_F4_2B3P_Bedroom	1.08	0.78	25.5	Pass
B_17_XX_B2_F1_2B3P_Bedroom1P	1.54	0.76	25	Pass
B_17_XX_B2_F1_2B3P_Living room/ kitchen	2.89			Pass

As shown above, there is one space failing: B_06_XX_B1_F4_3B5P_Living Room. This is likely due to its north-west position which gets high solar gains in the afternoon. A solution to this would be to introduce some external shading to reduce the effect of the solar gain.

Option 2:

For Option 2, the windows are unrestricted during the day, however, during the night they are now modelled as closed. As shown below, having no night-time ventilation has a significant effect on the results and the analysed rooms are now failing the TM59 overheating analysis. This highlights the importance of having night-time ventilation to pass TM59, so it is critical to ensure that openings are designed to facilitate this safely and securely.

Room Name	Criterion A (% Hours Delta T >= 1K)	Criterion B (% Hours Operative T > 26 Deg. C)	Criterion B (Hours Operative T > 26 Deg. C)	TM59 (Pass/Fail)
B_06_XX_B1_F4_3B5P_Bedroom	1.43	2.53	83	Fail
B_06_XX_B1_F4_3B5P_Living Room	3.9			Fail
B_06_XX_B1_F4_3B5P_Kitchen	3.17			Fail

B_06_XX_B1_F4_3B5P_Bedroom1P	2.15	2.63	86.5	Fail
B_06_XX_B1_F4_3B5P_Bedroom	1.84	2.82	92.5	Fail
B_06_XX_B1_F1_2B4P_LivingRoom/kitchen	3.44			Fail
B_06_XX_B1_F1_2B4P_Bedroom	1.89	3.06	100.5	Fail
B_06_XX_B1_F2_2B4P_Bedroom	1.53	3.39	111.5	Fail
B_06_XX_B1_F1_2B4P_Bedroom	1.67	3.24	106.5	Fail
B_06_XX_B1_F2_2B4P_Bedroom	1.85	2.88	94.5	Fail
B_06_XX_B1_F3_3B5P_Bedroom	1.42	2.39	78.5	Fail
B_06_XX_B1_F3_3B5P_Kitchen	3.04			Fail
B_06_XX_B1_F3_3B5P_Living Room	3.17			Fail
B_06_XX_B1_F2_2B4P_Living Room/ kitchen	3.14			Fail
B_06_XX_B1_F3_3B5P_Bedroom1P	1.77	2.45	80.5	Fail
B_06_XX_B1_F3_3B5P_Bedroom2P	1.51	2.6	85.5	Fail
B_06_XX_B2_F9_2B4P_Bedroom	1.35	2.82	92.5	Fail
B_06_XX_B2_F8_2B4P_Bedroom	1.35	2.98	98	Fail
B_06_XX_B2_F9_2B4P_Bedroom	1.51	2.69	88.5	Fail
B_06_XX_B2_F8_2B4P_Bedroom	1.5	3.07	101	Fail
B_06_XX_B2_F8_2B4P_Living Room/Kitchen	3.32			Fail
B_06_XX_B2_F7_2B3P_Bedroom1P	2.08	2.97	97.5	Fail
B_06_XX_B2_F7_2B3P_Bedroom	1.92	2.89	95	Fail
B_06_XX_B2_F5_2B3P_Living Room/ kitchen	3.85			Fail
B_06_XX_B2_F5_2B3P_Bedroom	1.65	3.01	99	Fail
B_06_XX_B2_F6_1B2P_Living room/kitchen	3.42			Fail
B_06_XX_B2_F7_2B3P_Living room/kitchen	3.44			Fail
B_08_XX_B2_F1_1B2P_Bedroom	2.04	3.09	101.5	Fail
B_08_XX_B2_F2_1B2P_Bedroom	1.58	3.5	115	Fail
B_08_XX_B2_F2_1B2P_Living room/ kitchen	3.44			Fail
B_08_XX_B2_F3_2B3P_Kitchen/ Living room	3.44			Fail
B_08_XX_B2_F3_2B3P_Bedroom	1.92	2.85	93.5	Fail
B_08_XX_B2_F5_2B3P_Bedroom1P	1.95	2.86	94	Fail
B_08_XX_B2_F5_2B3P_Bedroom	1.51	2.95	97	Fail
B_08_XX_B2_F4_2B3P_Bedroom	1.48	3.17	104	Fail
B_08_XX_B2_F4_1B2P_Bedroom1P	1.91	3.04	100	Fail
B_08_XX_B2_F1_1B2P_Living room/ kitchen	3.24			Fail
B_08_XX_B2_F5_2B3P_Living room/ kitchen	3.37			Fail
B_08_XX_B2_F4_2B3P_Living room/ kitchen	3.42			Fail
B_08_XX_B2_F3_2B3P_Bedroom1P	2.07	2.94	96.5	Fail
B_06_XX_B2_F6_1B2P_Bedroom	1.53	3.36	110.5	Fail
B_06_XX_B2_F5_2B3P_Bedroom1P	1.96	2.94	96.5	Fail
B_06_XX_B2_F9_2B4P_Living room/ Kitchen	3.22			Fail
B_17_XX_B2_F4_2B3P_Bedroom1P	1.91	2.77	91	Fail
B_17_XX_B2_F2_1B2P_Living room/ kitchen	3.47			Fail
B_17_XX_B2_F2_1B2P_Bedroom	1.38	3.35	110	Fail
B_17_XX_B2_F1_2B3P_Bedroom	1.59	2.85	93.5	Fail
B_17_XX_B2_F4_2B3P_Living room/ kitchen	3.52			Fail
B_17_XX_B2_F3_1B2P_Living room/ kitchen	3.09			Fail
B_17_XX_B2_F3_1B2P_Bedroom	1.54	3.15	103.5	Fail

B_17_XX_B2_F4_2B3P_Bedroom	1.55	2.79	91.5	Fail
B_17_XX_B2_F1_2B3P_Bedroom1P	2.07	2.83	93	Fail
B_17_XX_B2_F1_2B3P_Living room/ kitchen	3.67			Fail

3.2 Extreme and Future Weather Files

This section presents results from the overheating assessments for the extreme weather years tested – DSY2 and DSY3 for the 2020s high emission scenario at the 50th percentile. These years represent weather events with a return period of 16 and 24 years respectively. DSY2 contains a short but extremely intense period of heat, while DSY3 contains a slightly less intense, but much longer hot spell.

London Plan Policy SI 4 does not require the designs to comply with these extreme weather datasets.

Commercial Spaces

DSY2 2020s High 50

Room Name	Criterion 1 (% Hours Delta T >= 1K)	Criterion 2 (Max Daily Weight)	Criterion 3 (Max Delta T)	TM52 (Pass/Fail)
B_01_XX_03_Community Rooms/ Kitchen	4.54	34.5	7	Fail
B_00_XX_09_Conceirge Office and Store	3.3	31	6	Fail
B_00_XX_22_Flexible Workspace	8.24	41	7	Fail
B_01_XX_02_Meeting Rooms	5.27	36.5	7	Fail
B_01_XX_09_Estate Management Office	3.34	24.5	5	Fail
B_01_XX_08_Community Rooms	3.74	33.5	7	Fail
B_01_XX_01_Community Hall	6.61	62	8	Fail
B_01_XX_21_Flexible Workspace	5.08	41	8	Fail
B_01_XX_21_Flexible Workspace	4.5	37	7	Fail

DSY3 2020s High 50

Room Name	Criterion 1 (% Hours Delta T >= 1K)	Criterion 2 (Max Daily Weight)	Criterion 3 (Max Delta T)	TM52 (Pass/Fail)
B_01_XX_03_Community Rooms/ Kitchen	7.01	21.5	4	Fail
B_00_XX_09_Conceirge Office and Store	6.03	18.5	4	Fail
B_00_XX_22_Flexible Workspace	12.02	32	5	Fail
B_01_XX_02_Meeting Rooms	7.95	25.5	5	Fail
B_01_XX_09_Estate Management Office	5.77	15.5	4	Fail
B_01_XX_08_Community Rooms	6.35	21.5	5	Fail
B_01_XX_01_Community Hall	10.13	54.5	6	Fail
B_01_XX_21_Flexible Workspace	8.1	28.5	5	Fail
B_01_XX_21_Flexible Workspace	7.48	26.5	5	Fail

DSY1 2050s High 50

Room Name	Criterion 1 (% Hours Delta T >= 1K)	Criterion 2 (Max Daily Weight)	Criterion 3 (Max Delta T)	TM52 (Pass/Fail)
B_01_XX_03_Community Rooms/ Kitchen	6.94	24.5	5	Fail
B_00_XX_09_Conceirge Office and Store	5.01	22	5	Fail

B_00_XX_22_Flexible Workspace	18.23	33.5	6	Fail
B_01_XX_02_Meeting Rooms	8.79	26	5	Fail
B_01_XX_09_Estate Management Office	4.87	18	4	Fail
B_01_XX_08_Community Rooms	5.88	24.5	6	Fail
B_01_XX_01_Community Hall	11.81	54.5	7	Fail
B_01_XX_21_Flexible Workspace	8.75	31	6	Fail
B_01_XX_21_Flexible Workspace	7.77	29	6	Fail

DSY1 2080s High 50

Room Name	Criterion 1 (% Hours Delta T >= 1K)	Criterion 2 (Max Daily Weight)	Criterion 3 (Max Delta T)	TM52 (Pass/Fail)
B_01_XX_03_Community Rooms/ Kitchen	16.88	36.5	7	Fail
B_00_XX_09_Conceirge Office and Store	11.18	33.5	7	Fail
B_00_XX_22_Flexible Workspace	32.61	47.5	7	Fail
B_01_XX_02_Meeting Rooms	18.3	38	7	Fail
B_01_XX_09_Estate Management Office	12.93	29	6	Fail
B_01_XX_08_Community Rooms	12.85	36	7	Fail
B_01_XX_01_Community Hall	20.24	73.5	8	Fail
B_01_XX_21_Flexible Workspace	17.72	43.5	7	Fail
B_01_XX_21_Flexible Workspace	16.05	41.5	7	Fail

The commercial spaces fail to meet the TM52 criteria for both the DSY2 and DSY3 weather years. DSY2 comprises a short, very intense spell of heat – meaning the maximum adaptive temperature stays relatively low through it, which is manifested in the severe failures seen in the upper limit temperature criterion 3. DSY3 contains a slightly less intense, but much longer period of hot weather – again a feature manifested in the buildings failing to meet the hours of exceedance criterion 1.

Thus, different approaches may be required to ameliorate performance in each of these scenarios. For DSY2, it is thought that additional shading – either internal or external – and more active window control – for example closing them during very hot weather – could be effective mitigation measures. For DSY3 increased thermal mass would be beneficial, allowing the building to more effectively cool through the night during an extended hot spell and thus reduce the daily temperature peaks.

For the future weather scenarios, the commercial spaces again fail to meet the TM52 criteria – though for the 2050s scenario this is less severe (covering 2041-2070). The 2080s (covering 2071 – 2100), demonstrates a more dramatic failure for the teaching spaces. The performance in both these scenarios would be improved by the measures mentioned above – the addition of exposed thermal mass along with more shading and active window control – but also more flexible measures will have a positive effect – such as the use of local or ceiling mounted fans to produce a perceived cooling effect.

Residential

Option 1 – Future and Extreme Files

DSY2 2020s High 50s

Room Name	Criterion A (% Hours Delta T >= 1K)	Criterion B (% Hours Operative T > 26 Deg. C)	Criterion B (Hours Operative T > 26 Deg. C)	TM59 (Pass/Fail)
B_06_XX_B1_F4_3B5P_Bedroom	1.6	1.1	37.0	Fail
B_06_XX_B1_F4_3B5P_Living Room	4.3			Fail
B_06_XX_B1_F4_3B5P_Kitchen	3.5			Fail
B_06_XX_B1_F4_3B5P_Bedroom1P	2.3	1.0	33.5	Fail
B_06_XX_B1_F4_3B5P_Bedroom	2.0	1.3	42.0	Fail
B_06_XX_B1_F1_2B4P_LivingRoom/ kitchen	3.8			Fail
B_06_XX_B1_F1_2B4P_Bedroom	2.0	1.4	45.0	Fail
B_06_XX_B1_F2_2B4P_Bedroom	1.9	1.5	49.0	Fail
B_06_XX_B1_F1_2B4P_Bedroom	1.8	1.5	48.5	Fail
B_06_XX_B1_F2_2B4P_Bedroom	2.0	1.4	45.0	Fail
B_06_XX_B1_F3_3B5P_Bedroom	1.7	1.1	34.5	Fail
B_06_XX_B1_F3_3B5P_Kitchen	3.6			Fail
B_06_XX_B1_F3_3B5P_Living Room	3.8			Fail
B_06_XX_B1_F2_2B4P_Living Room/ kitchen	3.7			Fail
B_06_XX_B1_F3_3B5P_Bedroom1P	2.0	1.0	33.0	Fail
B_06_XX_B1_F3_3B5P_Bedroom2P	1.9	1.2	40.5	Fail
B_06_XX_B2_F9_2B4P_Bedroom	1.6	1.3	43.5	Fail
B_06_XX_B2_F8_2B4P_Bedroom	1.6	1.3	43.0	Fail
B_06_XX_B2_F9_2B4P_Bedroom	1.7	1.2	40.5	Fail
B_06_XX_B2_F8_2B4P_Bedroom	1.6	1.3	43.0	Fail
B_06_XX_B2_F8_2B4P_Living Room/Kitchen	3.8			Fail
B_06_XX_B2_F7_2B3P_Bedroom1P	2.1	1.2	38.5	Fail
B_06_XX_B2_F7_2B3P_Bedroom	2.0	1.3	43.5	Fail
B_06_XX_B2_F5_2B3P_Living Room/ kitchen	3.9			Fail
B_06_XX_B2_F5_2B3P_Bedroom	1.9	1.6	51.0	Fail
B_06_XX_B2_F6_1B2P_Living room/kitchen	3.8			Fail
B_06_XX_B2_F7_2B3P_Living room/kitchen	3.9			Fail
B_08_XX_B2_F1_1B2P_Bedroom	2.0	0.8	25.0	Pass
B_08_XX_B2_F2_1B2P_Bedroom	1.9	1.3	43.5	Fail
B_08_XX_B2_F2_1B2P_Living room/ kitchen	3.9			Fail
B_08_XX_B2_F3_2B3P_Kitchen/ Living room	3.9			Fail
B_08_XX_B2_F3_2B3P_Bedroom	2.0	1.3	42.0	Fail
B_08_XX_B2_F5_2B3P_Bedroom1P	1.9	1.1	36.5	Fail
B_08_XX_B2_F5_2B3P_Bedroom	1.7	1.3	42.0	Fail
B_08_XX_B2_F4_2B3P_Bedroom	1.7	1.3	43.5	Fail
B_08_XX_B2_F4_1B2P_Bedroom1P	1.8	1.2	38.0	Fail

B_08_XX_B2_F1_1B2P_Living room/ kitchen	3.7			Fail
B_08_XX_B2_F5_2B3P_Living room/ kitchen	3.7			Fail
B_08_XX_B2_F4_2B3P_Living room/ kitchen	3.9			Fail
B_08_XX_B2_F3_2B3P_Bedroom1P	2.1	1.1	37.5	Fail
B_06_XX_B2_F6_1B2P_Bedroom	1.8	1.4	46.0	Fail
B_06_XX_B2_F5_2B3P_Bedroom1P	2.1	1.3	41.5	Fail
B_06_XX_B2_F9_2B4P_Living room/ Kitchen	3.5			Fail
B_17_XX_B2_F4_2B3P_Bedroom1P	2.0	1.0	34.0	Fail
B_17_XX_B2_F2_1B2P_Living room/ kitchen	4.0			Fail
B_17_XX_B2_F2_1B2P_Bedroom	1.6	1.0	33.0	Fail
B_17_XX_B2_F1_2B3P_Bedroom	1.9	1.4	44.5	Fail
B_17_XX_B2_F4_2B3P_Living room/ kitchen	3.8			Fail
B_17_XX_B2_F3_1B2P_Living room/ kitchen	3.7			Fail
B_17_XX_B2_F3_1B2P_Bedroom	1.8	1.3	42.5	Fail
B_17_XX_B2_F4_2B3P_Bedroom	1.8	1.2	40.0	Fail
B_17_XX_B2_F1_2B3P_Bedroom1P	2.2	1.1	35.5	Fail
B_17_XX_B2_F1_2B3P_Living room/ kitchen	4.1			Fail

DSY3 2020s High 50s

Room Name	Criterion A (% Hours Delta T >= 1K)	Criterion B (% Hours Operative T > 26 Deg. C)	Criterion B (Hours Operative T > 26 Deg. C)	TM59 (Pass/Fail)
B_06_XX_B1_F4_3B5P_Bedroom	2.59	1.8	59	Fail
B_06_XX_B1_F4_3B5P_Living Room	6.51			Fail
B_06_XX_B1_F4_3B5P_Kitchen	5.4			Fail
B_06_XX_B1_F4_3B5P_Bedroom1P	3.58	1.66	54.5	Fail
B_06_XX_B1_F4_3B5P_Bedroom	3.28	1.95	64	Fail
B_06_XX_B1_F1_2B4P_LivingRoom/kitchen	5.71			Fail
B_06_XX_B1_F1_2B4P_Bedroom	3.09	2.05	67.5	Fail
B_06_XX_B1_F2_2B4P_Bedroom	2.82	2.19	72	Fail
B_06_XX_B1_F1_2B4P_Bedroom	2.75	2.19	72	Fail
B_06_XX_B1_F2_2B4P_Bedroom	3.01	2.02	66.5	Fail
B_06_XX_B1_F3_3B5P_Bedroom	2.56	1.64	54	Fail
B_06_XX_B1_F3_3B5P_Kitchen	5.2			Fail
B_06_XX_B1_F3_3B5P_Living Room	5.61			Fail
B_06_XX_B1_F2_2B4P_Living Room/ kitchen	5.48			Fail
B_06_XX_B1_F3_3B5P_Bedroom1P	3.05	1.52	50	Fail
B_06_XX_B1_F3_3B5P_Bedroom2P	2.79	1.84	60.5	Fail
B_06_XX_B2_F9_2B4P_Bedroom	2.61	1.96	64.5	Fail
B_06_XX_B2_F8_2B4P_Bedroom	2.48	1.93	63.5	Fail
B_06_XX_B2_F9_2B4P_Bedroom	2.79	1.99	65.5	Fail
B_06_XX_B2_F8_2B4P_Bedroom	2.53	1.96	64.5	Fail
B_06_XX_B2_F8_2B4P_Living Room/Kitchen	5.43			Fail

B_06_XX_B2_F7_2B3P_Bedroom1P	3.34	1.86	61	Fail
B_06_XX_B2_F7_2B3P_Bedroom	3.1	1.98	65	Fail
B_06_XX_B2_F5_2B3P_Living Room/ kitchen	6.03			Fail
B_06_XX_B2_F5_2B3P_Bedroom	2.87	2.22	73	Fail
B_06_XX_B2_F6_1B2P_Living room/kitchen	5.35			Fail
B_06_XX_B2_F7_2B3P_Living room/kitchen	5.66			Fail
B_08_XX_B2_F1_1B2P_Bedroom	3.17	1.19	39	Fail
B_08_XX_B2_F2_1B2P_Bedroom	2.85	1.99	65.5	Fail
B_08_XX_B2_F2_1B2P_Living room/ kitchen	5.4			Fail
B_08_XX_B2_F3_2B3P_Kitchen/ Living room	5.71			Fail
B_08_XX_B2_F3_2B3P_Bedroom	3.12	1.98	65	Fail
B_08_XX_B2_F5_2B3P_Bedroom1P	3.09	1.8	59	Fail
B_08_XX_B2_F5_2B3P_Bedroom	2.78	2.01	66	Fail
B_08_XX_B2_F4_2B3P_Bedroom	2.59	1.99	65.5	Fail
B_08_XX_B2_F4_1B2P_Bedroom1P	2.86	1.77	58	Fail
B_08_XX_B2_F1_1B2P_Living room/ kitchen	5.38			Fail
B_08_XX_B2_F5_2B3P_Living room/ kitchen	5.68			Fail
B_08_XX_B2_F4_2B3P_Living room/ kitchen	5.68			Fail
B_08_XX_B2_F3_2B3P_Bedroom1P	3.32	1.86	61	Fail
B_06_XX_B2_F6_1B2P_Bedroom	2.79	2.07	68	Fail
B_06_XX_B2_F5_2B3P_Bedroom1P	3.21	1.9	62.5	Fail
B_06_XX_B2_F9_2B4P_Living room/ Kitchen	5.4			Fail
B_17_XX_B2_F4_2B3P_Bedroom1P	3.09	1.74	57	Fail
B_17_XX_B2_F2_1B2P_Living room/ kitchen	5.71			Fail
B_17_XX_B2_F2_1B2P_Bedroom	2.46	1.6	52.5	Fail
B_17_XX_B2_F1_2B3P_Bedroom	2.83	1.99	65.5	Fail
B_17_XX_B2_F4_2B3P_Living room/ kitchen	6.03			Fail
B_17_XX_B2_F3_1B2P_Living room/ kitchen	5.28			Fail
B_17_XX_B2_F3_1B2P_Bedroom	2.78	1.98	65	Fail
B_17_XX_B2_F4_2B3P_Bedroom	2.86	1.95	64	Fail
B_17_XX_B2_F1_2B3P_Bedroom1P	3.36	1.7	56	Fail
B_17_XX_B2_F1_2B3P_Living room/ kitchen	6.18			Fail

DSY1 2050s High 50s

Room Name	Criterion A (% Hours Delta T >= 1K)	Criterion B (% Hours Operative T > 26 Deg. C)	Criterion B (Hours Operative T > 26 Deg. C)	TM59 (Pass/Fail)
B_06_XX_B1_F4_3B5P_Bedroom	2.3	1.77	58	Fail
B_06_XX_B1_F4_3B5P_Living Room	6.31			Fail
B_06_XX_B1_F4_3B5P_Kitchen	5.18			Fail
B_06_XX_B1_F4_3B5P_Bedroom1P	3.31	1.74	57	Fail
B_06_XX_B1_F4_3B5P_Bedroom	2.91	2.13	70	Fail
B_06_XX_B1_F1_2B4P_LivingRoom/ kitchen	5.48			Fail

B_06_XX_B1_F1_2B4P_Bedroom	2.78	2.33	76.5	Fail
B_06_XX_B1_F2_2B4P_Bedroom	2.41	2.48	81.5	Fail
B_06_XX_B1_F1_2B4P_Bedroom	2.45	2.56	84	Fail
B_06_XX_B1_F2_2B4P_Bedroom	2.7	2.27	74.5	Fail
B_06_XX_B1_F3_3B5P_Bedroom	2.27	1.7	56	Fail
B_06_XX_B1_F3_3B5P_Kitchen	4.9			Fail
B_06_XX_B1_F3_3B5P_Living Room	5.38			Fail
B_06_XX_B1_F2_2B4P_Living Room/ kitchen	4.9			Fail
B_06_XX_B1_F3_3B5P_Bedroom1P	2.79	1.72	56.5	Fail
B_06_XX_B1_F3_3B5P_Bedroom2P	2.41	2.05	67.5	Fail
B_06_XX_B2_F9_2B4P_Bedroom	2.3	2.25	74	Fail
B_06_XX_B2_F8_2B4P_Bedroom	2.07	2.22	73	Fail
B_06_XX_B2_F9_2B4P_Bedroom	2.59	2.18	71.5	Fail
B_06_XX_B2_F8_2B4P_Bedroom	2.12	2.24	73.5	Fail
B_06_XX_B2_F8_2B4P_Living Room/Kitchen	5.13			Fail
B_06_XX_B2_F7_2B3P_Bedroom1P	3.02	2.07	68	Fail
B_06_XX_B2_F7_2B3P_Bedroom	2.74	2.28	75	Fail
B_06_XX_B2_F5_2B3P_Living Room/ kitchen	5.53			Fail
B_06_XX_B2_F5_2B3P_Bedroom	2.56	2.54	83.5	Fail
B_06_XX_B2_F6_1B2P_Living room/kitchen	5.25			Fail
B_06_XX_B2_F7_2B3P_Living room/kitchen	5.18			Fail
B_08_XX_B2_F1_1B2P_Bedroom	2.86	1.13	37	Fail
B_08_XX_B2_F2_1B2P_Bedroom	2.46	2.28	75	Fail
B_08_XX_B2_F2_1B2P_Living room/ kitchen	5.3			Fail
B_08_XX_B2_F3_2B3P_Kitchen/ Living room	5.2			Fail
B_08_XX_B2_F3_2B3P_Bedroom	2.75	2.27	74.5	Fail
B_08_XX_B2_F5_2B3P_Bedroom1P	3.09	1.86	61	Fail
B_08_XX_B2_F5_2B3P_Bedroom	2.53	2.25	74	Fail
B_08_XX_B2_F4_2B3P_Bedroom	2.23	2.27	74.5	Fail
B_08_XX_B2_F4_1B2P_Bedroom1P	2.63	1.98	65	Fail
B_08_XX_B2_F1_1B2P_Living room/ kitchen	5.13			Fail
B_08_XX_B2_F5_2B3P_Living room/ kitchen	5.2			Fail
B_08_XX_B2_F4_2B3P_Living room/ kitchen	5.4			Fail
B_08_XX_B2_F3_2B3P_Bedroom1P	3.04	2.01	66	Fail
B_06_XX_B2_F6_1B2P_Bedroom	2.41	2.39	78.5	Fail
B_06_XX_B2_F5_2B3P_Bedroom1P	2.86	2.12	69.5	Fail
B_06_XX_B2_F9_2B4P_Living room/ Kitchen	5.08			Fail
B_17_XX_B2_F4_2B3P_Bedroom1P	3.15	1.83	60	Fail
B_17_XX_B2_F2_1B2P_Living room/ kitchen	5.3			Fail
B_17_XX_B2_F2_1B2P_Bedroom	2.17	1.75	57.5	Fail
B_17_XX_B2_F1_2B3P_Bedroom	2.59	2.28	75	Fail
B_17_XX_B2_F4_2B3P_Living room/ kitchen	5.46			Fail
B_17_XX_B2_F3_1B2P_Living room/ kitchen	4.95			Fail
B_17_XX_B2_F3_1B2P_Bedroom	2.53	2.24	73.5	Fail
B_17_XX_B2_F4_2B3P_Bedroom	2.72	2.13	70	Fail
B_17_XX_B2_F1_2B3P_Bedroom1P	3.09	1.77	58	Fail
B_17_XX_B2_F1_2B3P_Living room/ kitchen	5.58			Fail

DSY1 2080s High 50

Room Name	Criterion A (% Hours Delta T >= 1K)	Criterion B (% Hours Operative T > 26 Deg. C)	Criterion B (Hours Operative T > 26 Deg. C)	TM59 (Pass/Fail)
B_06_XX_B1_F4_3B5P_Bedroom	4.41	4.72	155	Fail
B_06_XX_B1_F4_3B5P_Living Room	11.99			Fail
B_06_XX_B1_F4_3B5P_Kitchen	9.9			Fail
B_06_XX_B1_F4_3B5P_Bedroom1P	6.67	4.57	150	Fail
B_06_XX_B1_F4_3B5P_Bedroom	5.96	5.42	178	Fail
B_06_XX_B1_F1_2B4P_LivingRoom/ kitchen	10.31			Fail
B_06_XX_B1_F1_2B4P_Bedroom	5.43	5.62	184.5	Fail
B_06_XX_B1_F2_2B4P_Bedroom	4.89	6.06	199	Fail
B_06_XX_B1_F1_2B4P_Bedroom	4.86	6.06	199	Fail
B_06_XX_B1_F2_2B4P_Bedroom	5.41	5.51	181	Fail
B_06_XX_B1_F3_3B5P_Bedroom	4.25	4.47	147	Fail
B_06_XX_B1_F3_3B5P_Kitchen	9			Fail
B_06_XX_B1_F3_3B5P_Living Room	9.6			Fail
B_06_XX_B1_F2_2B4P_Living Room/ kitchen	9.5			Fail
B_06_XX_B1_F3_3B5P_Bedroom1P	5.31	4.44	146	Fail
B_06_XX_B1_F3_3B5P_Bedroom2P	4.87	5.22	171.5	Fail
B_06_XX_B2_F9_2B4P_Bedroom	4.66	5.49	180.5	Fail
B_06_XX_B2_F8_2B4P_Bedroom	4.23	5.51	181	Fail
B_06_XX_B2_F9_2B4P_Bedroom	4.96	5.39	177	Fail
B_06_XX_B2_F8_2B4P_Bedroom	4.34	5.48	180	Fail
B_06_XX_B2_F8_2B4P_Living Room/Kitchen	9.55			Fail
B_06_XX_B2_F7_2B3P_Bedroom1P	5.68	4.96	163	Fail
B_06_XX_B2_F7_2B3P_Bedroom	5.32	5.45	179	Fail
B_06_XX_B2_F5_2B3P_Living Room/ kitchen	10.71			Fail
B_06_XX_B2_F5_2B3P_Bedroom	5.07	6.13	201.5	Fail
B_06_XX_B2_F6_1B2P_Living room/kitchen	10.03			Fail
B_06_XX_B2_F7_2B3P_Living room/kitchen	10.08			Fail
B_08_XX_B2_F1_1B2P_Bedroom	5.73	3.38	111	Fail
B_08_XX_B2_F2_1B2P_Bedroom	4.93	5.6	184	Fail
B_08_XX_B2_F2_1B2P_Living room/ kitchen	10.08			Fail
B_08_XX_B2_F3_2B3P_Kitchen/ Living room	10.18			Fail
B_08_XX_B2_F3_2B3P_Bedroom	5.38	5.43	178.5	Fail
B_08_XX_B2_F5_2B3P_Bedroom1P	5.47	4.79	157.5	Fail
B_08_XX_B2_F5_2B3P_Bedroom	4.93	5.48	180	Fail
B_08_XX_B2_F4_2B3P_Bedroom	4.47	5.57	183	Fail
B_08_XX_B2_F4_1B2P_Bedroom1P	4.98	4.89	160.5	Fail
B_08_XX_B2_F1_1B2P_Living room/ kitchen	9.65			Fail
B_08_XX_B2_F5_2B3P_Living room/ kitchen	10.06			Fail
B_08_XX_B2_F4_2B3P_Living room/ kitchen	10.01			Fail
B_08_XX_B2_F3_2B3P_Bedroom1P	5.66	4.98	163.5	Fail

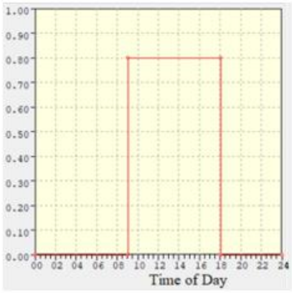
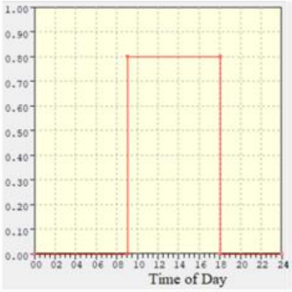
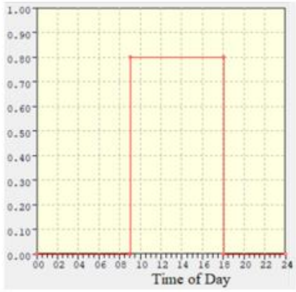
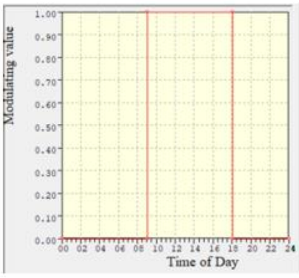
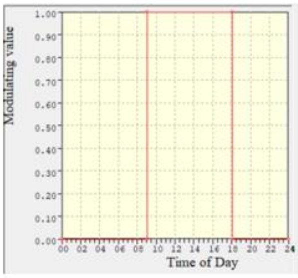
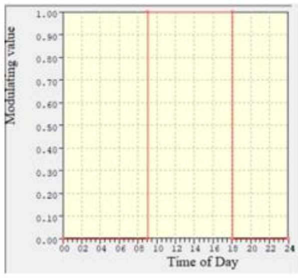
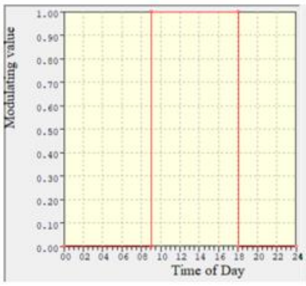
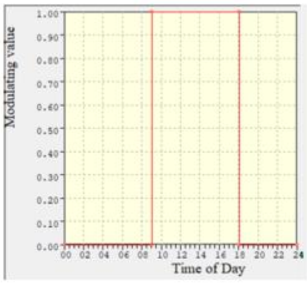
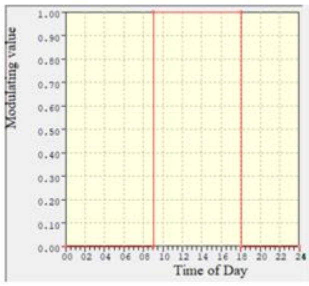
B_06_XX_B2_F6_1B2P_Bedroom	4.9	5.81	191	Fail
B_06_XX_B2_F5_2B3P_Bedroom1P	5.58	5.27	173	Fail
B_06_XX_B2_F9_2B4P_Living room/ Kitchen	9.6			Fail
B_17_XX_B2_F4_2B3P_Bedroom1P	5.76	4.64	152.5	Fail
B_17_XX_B2_F2_1B2P_Living room/ kitchen	10.16			Fail
B_17_XX_B2_F2_1B2P_Bedroom	4.22	4.54	149	Fail
B_17_XX_B2_F1_2B3P_Bedroom	5.04	5.6	184	Fail
B_17_XX_B2_F4_2B3P_Living room/ kitchen	10.66			Fail
B_17_XX_B2_F3_1B2P_Living room/ kitchen	9.1			Fail
B_17_XX_B2_F3_1B2P_Bedroom	4.66	5.48	180	Fail
B_17_XX_B2_F4_2B3P_Bedroom	5.12	5.39	177	Fail
B_17_XX_B2_F1_2B3P_Bedroom1P	5.92	4.72	155	Fail
B_17_XX_B2_F1_2B3P_Living room/ kitchen	10.99			Fail

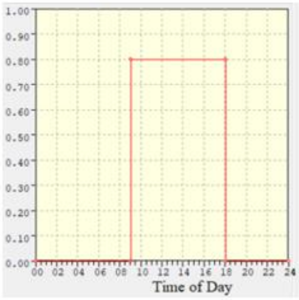
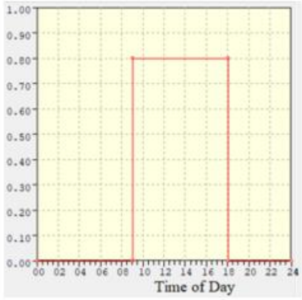
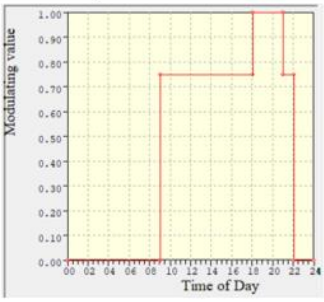
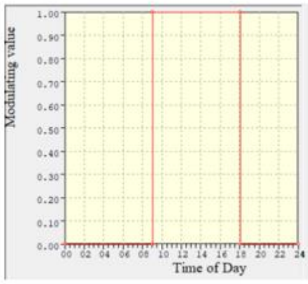
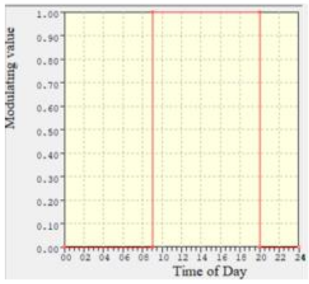
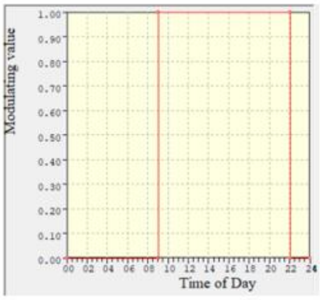
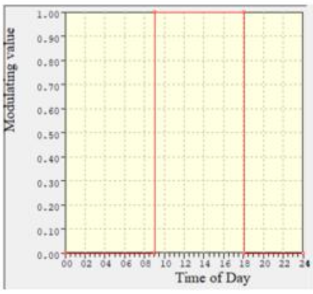
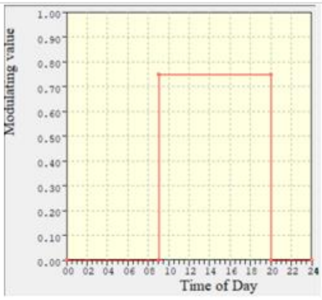
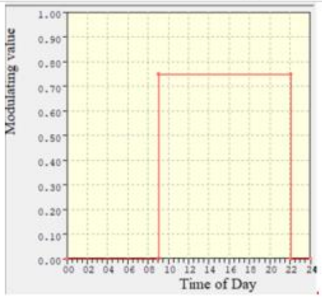
As can be seen, the dwellings also perform less well during extreme weather events – the bedrooms fail to meet the night-time temperature limit of criterion 2. However, it should be noted that this is a non-adaptive criterion – instead it is an absolute temperature limit that will inevitably become more difficult to achieve as the weather becomes hotter. The kitchen and living areas fail the overheating analysis.

Many of the failures in DSY2 are quite marginal. This suggests that relatively straightforward measures could improve conditions for these relatively infrequent very hot days – for example the use of desk or ceiling fans, which can provide a perceived cooling effect of 2-3°C; or other shading devices across the building could be implemented.

Further Information

TM52 Commercial Spaces Internal Gains:

	Conceirge Office	Flexible Workspace	Meeting Rooms
People			
Lighting			
Equipment			

	Estate management office	Community Rooms	Community hall
People			
Lighting			
Equipment			

APPENDIX 2 – SAP MODELLING OUTPUT GLA CONVERSION SPREADSHEET

SAP 2012 Performance	SAP 10.0 Performance

Domestic

SAP 2012 Performance

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

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	108.2	267.5
After energy demand reduction (be lean)	87.9	267.5
After heat network connection (be clean)	87.9	267.5
After renewable energy (be green)	65.2	267.5

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

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	20.3	19%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	22.7	21%
Cumulative on site savings	**43.0**	**40%**
Annual savings from off-set payment	65.2	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**1,956**	-
Cash in-lieu contribution (£)	**185,815**	

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

SAP 10.0 Performance

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

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	95.1	121.4
After energy demand reduction (be lean)	71.5	121.4
After heat network connection (be clean)	71.5	121.4
After renewable energy (be green)	29.3	121.4

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

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: Savings from energy demand reduction	23.5	25%
Be clean: Savings from heat network	0.0	0%
Be green: Savings from renewable energy	42.3	44%
Cumulative on site savings	**65.8**	**69%**
Annual savings from off-set payment	29.3	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**878**	-
Cash in-lieu contribution (£)	**83,420**	

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

Non-domestic

SAP 2012 Performance

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

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	24.7	20.3
After energy demand reduction (be lean)	18.9	20.3
After heat network connection (be clean)	18.9	20.3
After renewable energy (be green)	18.9	20.3

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

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	5.8	24%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	0.0	0%
Total Cumulative Savings	**5.9**	**24%**
Annual savings from off-set payment	18.9	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**566**	-
Cash in-lieu contribution (£)	**53,724**	

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

SAP 10.0 Performance

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

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	13.0	9.1
After energy demand reduction (be lean)	9.8	9.1
After heat network connection (be clean)	9.8	9.1
After renewable energy (be green)	8.5	9.1

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

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	3.3	25%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	1.3	10%
Total Cumulative Savings	**4.6**	**35%**
Annual savings from off-set payment	8.5	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**254**	-
Cash in-lieu contribution (£)*	**24,119**	

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

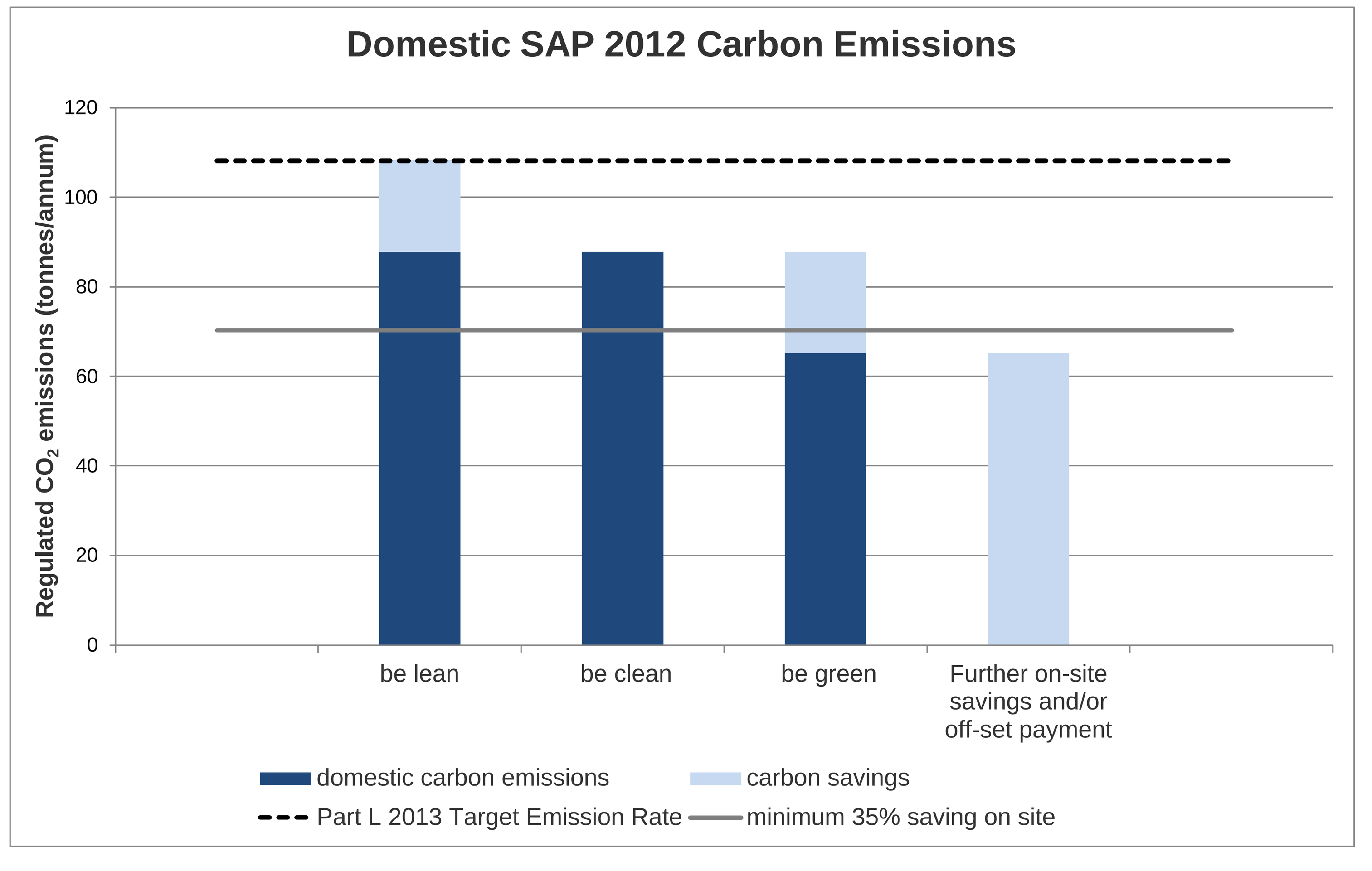
SITE-WIDE

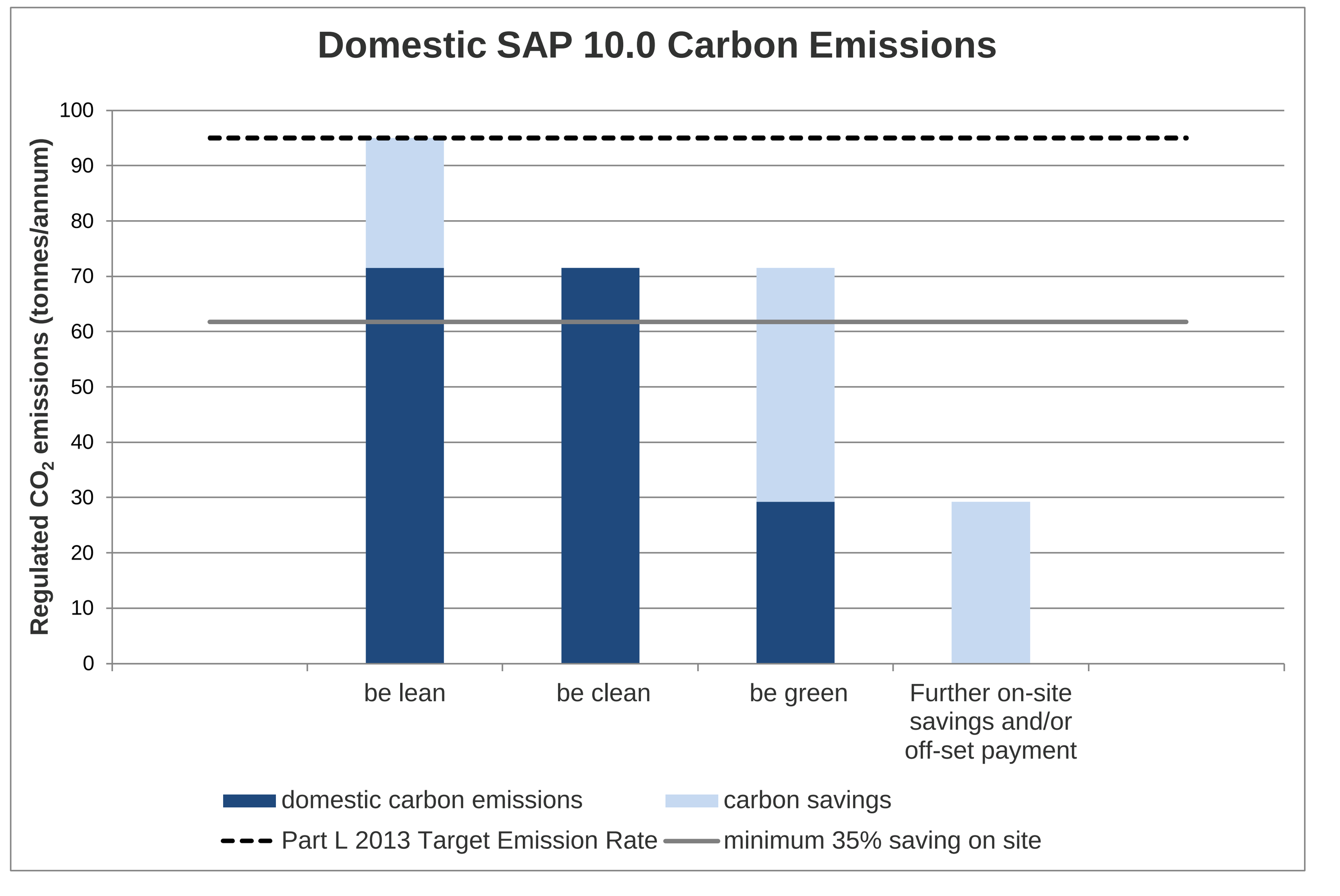
	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	132.9		
Be lean	106.8	26.1	20%
Be clean	106.8	0.0	0%
Be green	84.0	22.7	17%
Total Savings	-	48.9	37%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**2,521.5**	-

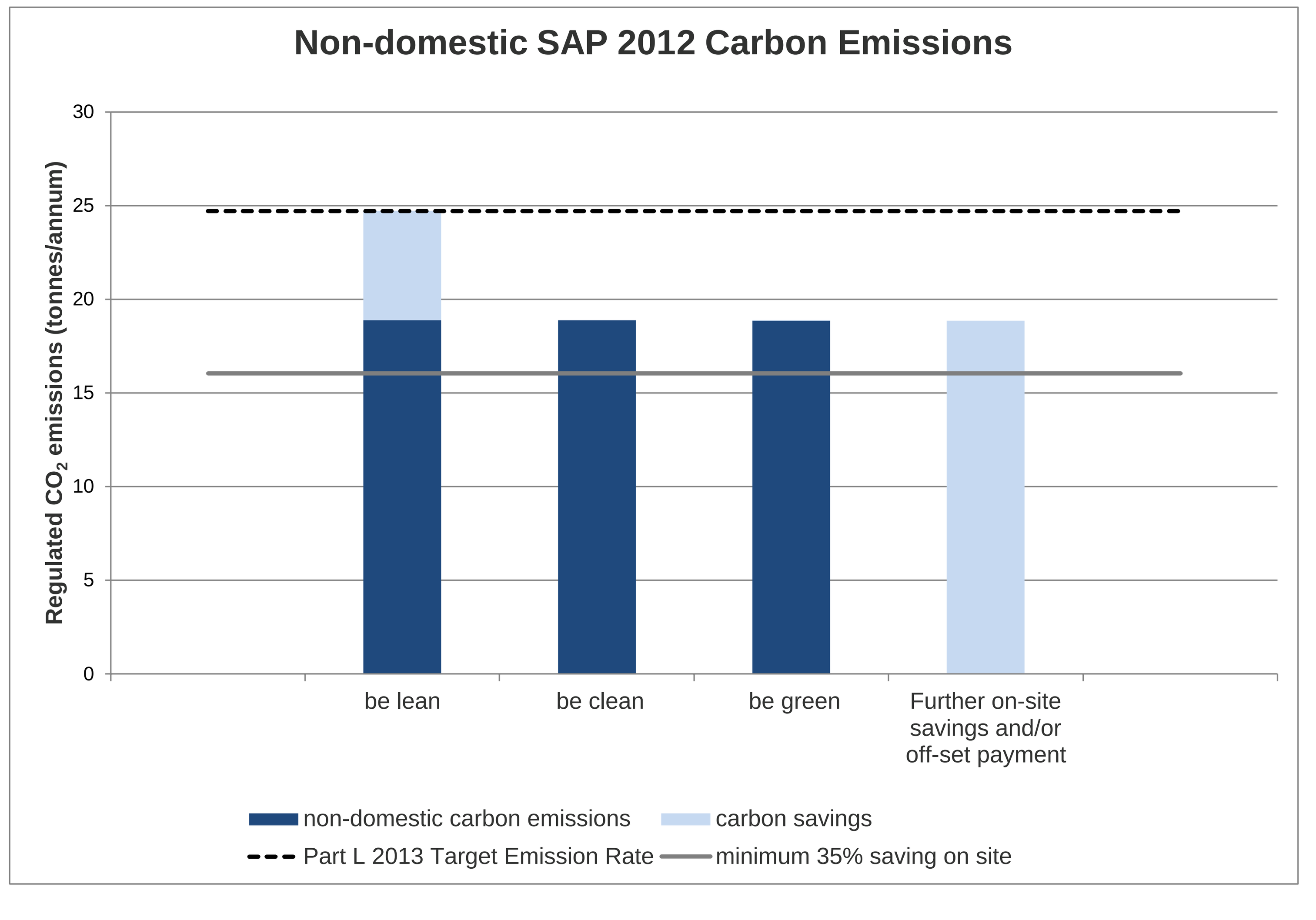
	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2013 baseline	108.1		
Be lean	81.3	26.8	25%
Be clean	81.3	0.0	0%
Be green	37.7	43.6	40%
Total Savings	-	70.4	65%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**1,132.0**	-

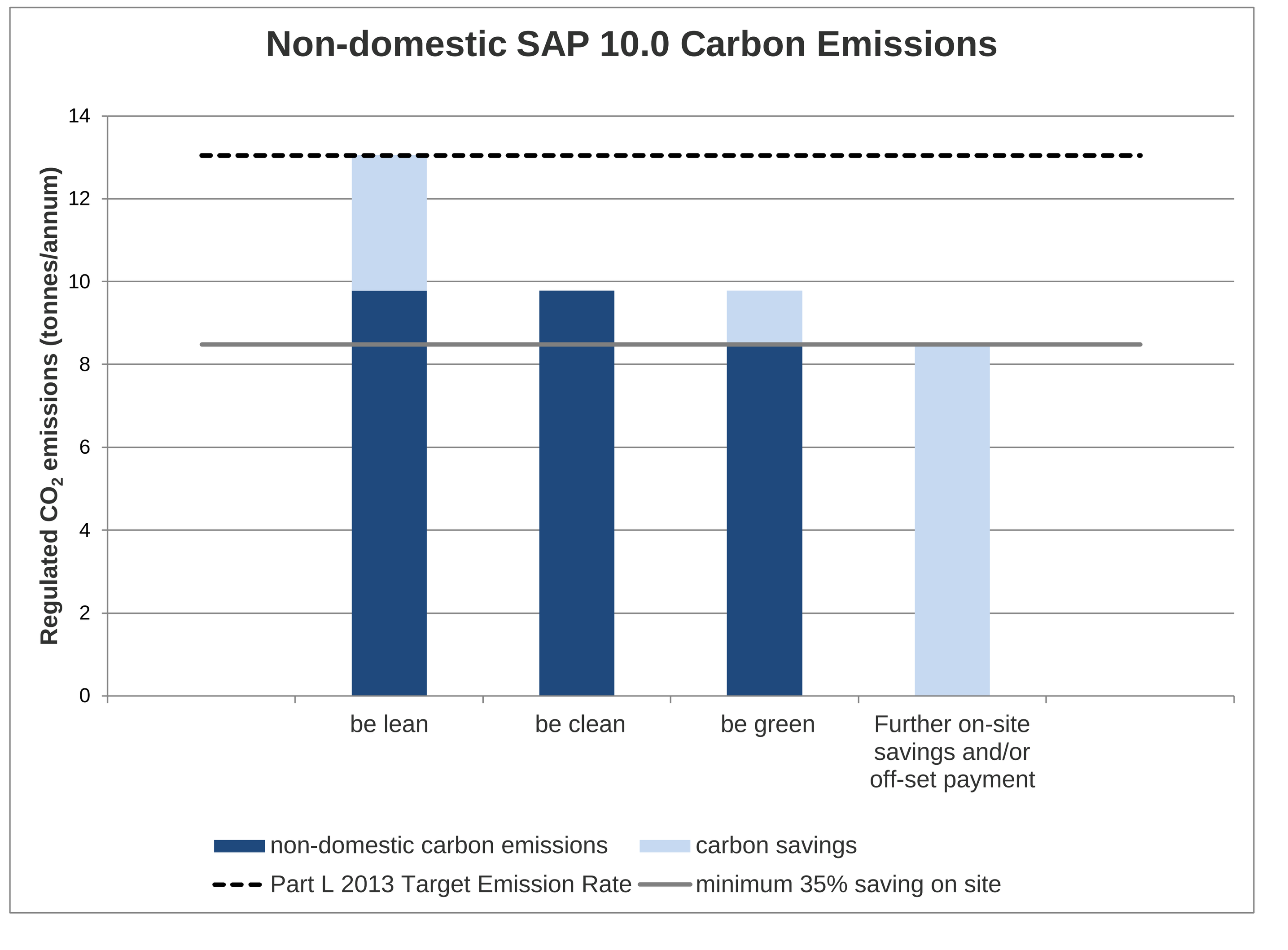
	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	42.23	29.19	31%

	Area weighted non-domestic cooling demand (MJ/m²)	Total area weighted non-domestic cooling demand (MJ/year)
Actual		
Notional		









The applicant should complete all the light blue cells including information on the modelled units, the area per unit, the number of units, the baseline energy consumption figures, the TER and the TFEE.

SAP 2012 CO_2 PERFORMANCE | SAP 10.0 CO_2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated TER 2012 ($kgCO_2 / m^2$)	VALIDATION CHECK: TER Worksheet TER 2012 ($kgCO_2 / m^2$)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - TER WORKSHEET: Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling
TER Worksheet (Row 4)					TER Worksheet (Row 273)	TER Worksheet (Row 211)		TER Worksheet (Row 219)		TER Worksheet (Row 232)	TER Worksheet (Row 231)	N / A
AB61_Top	60.55	1	60.55	22.4	22.4	3269.53	Natural Gas	2167.79	Natural Gas	274.47	75	
AB61a	60.55	9	544.95	17.9	17.9	1963.21	Natural Gas	2191.36	Natural Gas	287.71	75	
AB61b L11 Offset	60.55	1	60.55	18.4	18.4	2125.32	Natural Gas	2187.82	Natural Gas	281.67	75	
AB61b	60.55	3	181.65	16.7	16.7	1632.73	Natural Gas	2201.46	Natural Gas	281.67	75	
AB76WCA_Top	75.61	1	75.61	18.7	18.7	3185.36	Natural Gas	2338.94	Natural Gas	351.67	75	
AB76WCA	75.61	5	378.05	16.5	16.5	2407.5	Natural Gas	2354.23	Natural Gas	351.67	75	
AB67_Top	66.93	1	66.93	19.5	19.5	2848.61	Natural Gas	2251.57	Natural Gas	312.18	75	
AB67	66.93	10	669.3	15.8	15.8	1665.88	Natural Gas	2279.71	Natural Gas	318.73	75	
AB67 Bottom	66.93	1	66.93	18.0	18.0	2389.31	Natural Gas	2260.47	Natural Gas	315.2	75	
AB67WCA	67	4	268	16.0	16.0	1741.2	Natural Gas	2278.16	Natural Gas	319.08	75	
AB55_Top	54.58	1	54.58	23.1	23.1	2958.29	Natural Gas	2093.47	Natural Gas	256.11	75	
AB55	54.58	5	272.9	20.2	20.2	2190.88	Natural Gas	2107.74	Natural Gas	256.11	75	
AB64 L11 Offset	63.55	1	63.55	18.0	18.0	2151.46	Natural Gas	2224.92	Natural Gas	306.59	75	
AB64	63.55	8	508.4	15.9	15.9	1515.71	Natural Gas	2243.4	Natural Gas	306.59	75	
AB64 Bottom	63.55	1	63.55	16.0	16.0	1556.52	Natural Gas	2242.01	Natural Gas	306.59	75	
AB50	50	9	450	17.8	17.8	1223.73	Natural Gas	2071.7	Natural Gas	267.68	75	
AB50 Bottom	50	1	50	19.2	19.2	1573.5	Natural Gas	2060.01	Natural Gas	262.02	75	
AB73a L07 Offset	73	1	73	17.9	17.9	2717.63	Natural Gas	2320.2	Natural Gas	345.02	75	
AB73b L07 Offset	73	1	73	16.0	16.0	2049.77	Natural Gas	2335.63	Natural Gas	345.02	75	
AB73a	73	4	292	16.8	16.8	2352.62	Natural Gas	2328.01	Natural Gas	345.02	75	
AB73b	73	4	292	15.7	15.7	1966.41	Natural Gas	2337.93	Natural Gas	345.02	75	
AB73a Bottom	73	1	73	19.1	19.1	3146.44	Natural Gas	2312.55	Natural Gas	345.02	75	
AB73b Bottom	73	1	73	18.0	18.0	2768.75	Natural Gas	2319.21	Natural Gas	345.02	75	
AA73a Top	73	1	73	17.3	17.4	2461.11	Natural Gas	2324.38	Natural Gas	373.57	75	
AA73b Top	73	1	73	17.8	17.8	2622.17	Natural Gas	2321.01	Natural Gas	373.57	75	
AA86a Top	86	1	86	19.0	19.0	4013.53	Natural Gas	2414.05	Natural Gas	393.05	75	
AA86b Top	86	1	86	19.0	19.0	4013.53	Natural Gas	2414.05	Natural Gas	393.05	75	
AA73a	73	3	219	17.9	17.9	2635.78	Natural Gas	2320.74	Natural Gas	373.57	75	
AA73b	73	3	219	17.9	17.9	2635.78	Natural Gas	2320.74	Natural Gas	373.57	75	
AA86a	86	3	258	15.1	15.1	2458.11	Natural Gas	2441.17	Natural Gas	393.05	75	
AA86b	86	3	258	15.1	15.1	2458.11	Natural Gas	2441.17	Natural Gas	393.05	75	
AA73a Bottom	73	1	73	19.6	19.6	3219.9	Natural Gas	2310.52	Natural Gas	373.57	75	
AA73b Bottom	73	1	73	19.6	19.6	3219.9	Natural Gas	2310.52	Natural Gas	373.57	75	
AA86a Bottom	86	1	86	16.9	16.9	3162.78	Natural Gas	2426.72	Natural Gas	393.05	75	
AA86b Bottom	86	1	86	16.9	16.9	3162.78	Natural Gas	2426.72	Natural Gas	393.05	75	
Sum	6,302	94	6,302	17.2	-	198,777	N/A	212,436	N/A	30,272	7,050	0

Unit identifier	SAP 2012 – REGULATED CO_2 EMISSIONS PER UNIT ($kgCO_2$ p.a.): Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO_2 emissions ($kgCO_2$ p.a.)	SAP 10.0 – REGULATED CO_2 EMISSIONS PER UNIT: Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated TER SAP 10.0 ($kgCO_2 / m^2$)
AB61_Top	706	468	142	39		1,356	687	455	64	17		1,223	20.2
AB61a	424	473	149	39		1,086	412	460	67	17		957	15.8
AB61b L11 Offset	459	473	146	39		1,117	446	459	66	17		989	16.3
AB61b	353	476	146	39		1,013	343	462	66	17		888	14.7
AB76WCA_Top	688	505	183	39		1,415	669	491	82	17		1,260	16.7
AB76WCA	520	509	183	39		1,250	506	494	82	17		1,099	14.5
AB67_Top	615	486	162	39		1,303	598	473	73	17		1,161	17.4
AB67	360	492	165	39		1,057	350	479	74	17		920	13.8
AB67 Bottom	516	488	164	39		1,207	502	475	73	17		1,067	15.9
AB67WCA	376	492	166	39		1,073	366	478	74	17		936	14.0
AB55_Top	639	452	133	39		1,263	621	440	60	17		1,138	20.9
AB55	473	455	133	39		1,100	460	443	60	17		980	18.0
AB64 L11 Offset	465	481	159	39		1,143	452	467	71	17		1,008	15.9
AB64	327	485	159	39		1,010	318	471	71	17		878	13.8
AB64 Bottom	336	484	159	39		1,019	327	471	71	17		887	14.0
AB50	264	447	139	39		890	257	435	62	17		772	15.4
AB50 Bottom	340	445	136	39		960	330	433	61	17		842	16.8
AB73a L07 Offset	587	501	179	39		1,306	571	487	80	17		1,156	15.8
AB73b L07 Offset	443	504	179	39		1,165	430	490	80	17		1,019	14.0
AB73a	508	503	179	39		1,229	494	489	80	17		1,081	14.8
AB73b	425	505	179	39		1,148	413	491	80	17		1,002	13.7
AB73a Bottom	680	500	179	39		1,397	661	486	80	17		1,244	17.0
AB73b Bottom	598	501	179	39		1,317	581	487	80	17		1,166	16.0
AA73a Top	532	502	194	39		1,266	517	488	87	17		1,109	15.2
AA73b Top	566	501	194	39		1,301	551	487	87	17		1,143	15.7
AA86a Top	867	521	204	39		1,631	843	507	92	17		1,459	17.0
AA86b Top	867	521	204	39		1,631	843	507	92	17		1,459	17.0
AA73a	569	501	194	39		1,303	554	487	87	17		1,145	15.7
AA73b	569	501	194	39		1,303	554	487	87	17		1,145	15.7
AA86a	531	527	204	39		1,301	516	513	92	17		1,138	13.2
AA86b	531	527	204	39		1,301	516	513	92	17		1,138	13.2
AA73a Bottom	695	499	194	39		1,427	676	485	87	17		1,266	17.3
AA73b Bottom	695	499	194	39		1,427	676	485	87	17		1,266	17.3
AA86a Bottom	683	524	204	39		1,450	664	510	92	17		1,283	14.9
AA86b Bottom	683	524	204	39		1,450	664	510	92	17		1,283	14.9
Sum	42,936	45,886	15,711	3,659	0	108,192	41,743	44,612	7,053	1,643	0	95,051	15.1

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Building Use	Model Area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated TER 2012 ($kgCO_2 / m^2$)	VALIDATION CHECK: BRUKL TER 2012 ($kgCO_2 / m^2$)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) TER - SOURCE: BRUKL OUTPUT: Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) TER - SOURCE: BRUKL.INP or *SIM.CSV FILE: Natural Gas (0.216 $kgCO_2$/kWh)	Grid Electricity (0.519 $kgCO_2$/kWh)	Equipment (0.519 $kgCO_2$/kWh)			2012 CO_2 emissions ($kgCO_2$ p.a.)	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) - TER BRUKL: Natural Gas (0.210 $kgCO_2$/kWh)	Grid Electricity (0.233 $kgCO_2$/kWh)	Unregulated Grid Electricity (0.233 $kgCO_2$/kWh)			REGULATED CO_2 EMISSIONS: SAP10.0 CO_2 emissions ($kgCO_2$ p.a.)	BRUKL TER SAP10.0 ($kgCO_2 / m^2$)
Agar Grove 2A nor	1611.4	1	1611.4	15.3	15.3	8.8	Natural Gas	1.92	Natural Gas	17.57	1.19	6.97	11	25	58			24,712	11	25	58			13,047	8.1
Sum	1,611	1	1,611	15.3	-	14,180	N/A	3,094	N/A	28,312	1,918	11,231	17,274	40,425	94,251	N/A	N/A	24,712	17,274	40,425	94,251	N/A	N/A	13,047	8.1

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Total Area (m²)	Calculated TER 2012 ($kgCO_2 / m^2$)	-	REGULATED ENERGY CONSUMPTION: Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)		REGULATED CO_2 EMISSIONS: 2012 CO_2 emissions ($kgCO_2$ p.a.)		REGULATED CO_2 EMISSIONS PER UNIT: SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated TER SAP 10.0 ($kgCO_2 / m^2$)
Sum	7,913	16.8	-	212,958		215,530		58,584	8,968	11,231		132,904		108,097	13.7

DEMAND
Fabric Energy Efficiency (FEE)
Target Fabric Energy Efficiency (TFEE) (kWh/m²)
68.2
43.8
46.9
38.1
53.5
42.1
54.5
35
46.9
36.2
68.4
52.9
45.1
34.2
34.9
35.6
43.4
48
38.1
42.6
36.8
54.5
48.8
43.9
46.3
57.8
57.8
46.5
46.5
38
38
55.4
55.4
46.9
46.9
42.23

The applicant should complete all the light blue cells including information on the 'be lean' energy consumption figures, the 'be lean' DER, the DFEE and the regulated energy demand of the 'be lean' scenario.

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated DER 2012 ($kgCO_2$ / m^2)	VALIDATION CHECK: DER Worksheet DER 2012 ($kgCO_2$ / m^2)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE LEAN' SAP DER WORKSHEET: Space Heating	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Secondary Heating system	Fuel type Space Heating	Lighting	Auxiliary	Cooling		SAP 2012 CO_2 PERFORMANCE – REGULATED CO_2 EMISSIONS PER UNIT ($kgCO_2$ p.a.): Space Heating CO_2 emissions ($kgCO_2$ p.a.)	Domestic Hot Water CO_2 emissions ($kgCO_2$ p.a.)	Lighting CO_2 emissions ($kgCO_2$ p.a.)	Auxiliary CO_2 emissions ($kgCO_2$ p.a.)	Cooling CO_2 emissions ($kgCO_2$ p.a.)	2012 CO_2 emissions ($kgCO_2$ p.a.)	SAP 10.0 CO_2 PERFOR – REGULATED CO_2 EMISSIO: Space Heating CO_2 emissions ($kgCO_2$ p.a.)	Domestic Hot Water CO_2 emissions ($kgCO_2$ p.a.)	Lighting CO_2 emissions ($kgCO_2$ p.a.)	Auxiliary CO_2 emissions ($kgCO_2$ p.a.)
					DER Sheet (Row 384)	DER Sheet [(Row 307a) ÷ (Row 367a x 0.01)]	Select fuel type	DER Sheet [Row 310b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 309]	Select fuel type	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315											
AB61_Top	60.55	1	60.55	18.6	18.6	1678.256983	Natural Gas	2349.687151	Natural Gas	0	Grid Electricity	274.47	219.06	0		363	508	142	114	0	1,126	352	493	64	51
AB61a	60.55	9	544.95	14.6	14.6	571.2513966	Natural Gas	2349.687151	Natural Gas	0	Grid Electricity	287.71	201.99	0		123	508	149	105	0	885	120	493	67	47
AB61b L11 Offse	60.55	1	60.55	14.6	14.6	586.4581006	Natural Gas	2349.687151	Natural Gas	0	Grid Electricity	281.67	202.12	0		127	508	146	105	0	885	123	493	66	47
AB61b	60.55	3	181.65	13.4	13.4	255.3296089	Natural Gas	2349.687151	Natural Gas	0	Grid Electricity	281.67	198.99	0		55	508	146	103	0	812	54	493	66	46
AB76WCA_Top	75.61	1	75.61	14.2	14.2	997.0391061	Natural Gas	2523.731844	Natural Gas	0	Grid Electricity	351.67	250.85	0		215	545	183	130	0	1,073	209	530	82	58
AB76WCA	75.61	5	378.05	12.5	12.5	406.0670391	Natural Gas	2523.731844	Natural Gas	0	Grid Electricity	351.67	245.41	0		88	545	183	127	0	943	85	530	82	57
AB67_Top	66.93	1	66.93	16.0	16.0	1223.988827	Natural Gas	2429.162011	Natural Gas	0	Grid Electricity	312.18	233.59	0		264	525	162	121	0	1,072	257	510	73	54
AB67	66.93	10	669.3	12.9	12.9	291.3743017	Natural Gas	2429.162011	Natural Gas	0	Grid Electricity	318.73	218.42	0		63	525	165	113	0	866	61	510	74	51
AB67 Bottom	66.93	1	66.93	15.4	15.4	1029.787709	Natural Gas	2429.162011	Natural Gas	0	Grid Electricity	315.2	225.27	0		222	525	164	117	0	1,028	216	510	73	52
AB67WCA	67	4	268	13.1	13.1	333.877095	Natural Gas	2429.988827	Natural Gas	0	Grid Electricity	319.08	219.03	0		72	525	166	114	0	876	70	510	74	51
AB55_Top	54.58	1	54.58	19.9	19.9	1666.290503	Natural Gas	2270.268156	Natural Gas	0	Grid Electricity	256.11	194.12	0		360	490	133	101	0	1,084	350	477	60	45
AB55	54.58	5	272.9	17.0	17.0	961.4301676	Natural Gas	2270.268156	Natural Gas	0	Grid Electricity	256.11	187.67	0		208	490	133	97	0	928	202	477	60	44
AB64 L11 Offset	63.55	1	63.55	14.4	14.4	592.3687151	Natural Gas	2387.932961	Natural Gas	0	Grid Electricity	306.59	211.14	0		128	516	159	110	0	912	124	501	71	49
AB64	63.55	8	508.4	13.0	13.0	197.6201117	Natural Gas	2387.932961	Natural Gas	0	Grid Electricity	306.59	207.42	0		43	516	159	108	0	825	42	501	71	48
AB64 Bottom	63.55	1	63.55	13.6	13.6	360.9385475	Natural Gas	2387.932961	Natural Gas	0	Grid Electricity	306.59	208.97	0		78	516	159	108	0	861	76	501	71	49
AB50	50	9	450	14.9	14.9	200.5698324	Natural Gas	2208	Natural Gas	0	Grid Electricity	267.68	166.75	0		43	477	139	87	0	746	42	464	62	39
AB50 Bottom	50	1	50	16.4	16.4	547.1284916	Natural Gas	2208	Natural Gas	0	Grid Electricity	262.02	170.05	0		118	477	136	88	0	819	115	464	61	40
AB73a L07 Offse	73	1	73	14.1	14.1	872.0111732	Natural Gas	2497.150838	Natural Gas	0	Grid Electricity	345.02	242.04	0		188	539	179	126	0	1,032	183	524	80	56
AB73b L07 Offse	73	1	73	12.5	12.5	328.7709497	Natural Gas	2497.150838	Natural Gas	0	Grid Electricity	345.02	236.98	0		71	539	179	123	0	912	69	524	80	55
AB73a	73	4	292	13.3	13.3	603.0167598	Natural Gas	2497.150838	Natural Gas	0	Grid Electricity	345.02	239.55	0		130	539	179	124	0	973	127	524	80	56
AB73b	73	4	292	12.3	12.3	263.452514	Natural Gas	2497.150838	Natural Gas	0	Grid Electricity	345.02	236.36	0		57	539	179	123	0	898	55	524	80	55
AB73a Bottom	73	1	73	16.2	16.2	1568.167598	Natural Gas	2497.150838	Natural Gas	0	Grid Electricity	345.02	248.42	0		339	539	179	129	0	1,186	329	524	80	58
AB73b Bottom	73	1	73	14.9	14.9	1123.519553	Natural Gas	2497.150838	Natural Gas	0	Grid Electricity	345.02	244.35	0		243	539	179	127	0	1,088	236	524	80	57
AA73a Top	73	1	73	13.8	13.8	692.5921788	Natural Gas	2497.150838	Natural Gas	0	Grid Electricity	373.57	240.34	0		150	539	194	125	0	1,008	145	524	87	56
AA73b Top	73	1	73	14.3	14.3	871.3072626	Natural Gas	2497.150838	Natural Gas	0	Grid Electricity	373.57	241.99	0		188	539	194	126	0	1,047	183	524	87	56
AA86a Top	86	1	86	15.8	15.7	2015.519553	Natural Gas	2612.625698	Natural Gas	0	Grid Electricity	393.05	290.97	0		435	564	204	151	0	1,355	423	549	92	68
AA86b Top	86	1	86	15.8	15.7	2015.519553	Natural Gas	2612.625698	Natural Gas	0	Grid Electricity	393.05	290.97	0		435	564	204	151	0	1,355	423	549	92	68
AA73a	73	3	219	14.2	14.2	825.7988827	Natural Gas	2497.150838	Natural Gas	0	Grid Electricity	373.57	241.57	0		178	539	194	125	0	1,037	173	524	87	56
AA73b	73	3	219	14.2	14.2	825.7988827	Natural Gas	2497.150838	Natural Gas	0	Grid Electricity	373.57	241.57	0		178	539	194	125	0	1,037	173	524	87	56
AA86a	86	3	258	12.1	12.1	483.6089385	Natural Gas	2612.625698	Natural Gas	0	Grid Electricity	393.05	316.33	0		104	564	204	164	0	1,037	102	549	92	74
AA86b	86	3	258	12.1	12.1	483.6089385	Natural Gas	2612.625698	Natural Gas	0	Grid Electricity	393.05	316.33	0		104	564	204	164	0	1,037	102	549	92	74
AA73a Bottom	73	1	73	16.8	16.8	1689.642458	Natural Gas	2497.150838	Natural Gas	0	Grid Electricity	373.57	249.5	0		365	539	194	129	0	1,228	355	524	87	58
AA73b Bottom	73	1	73	16.8	16.8	1689.642458	Natural Gas	2497.150838	Natural Gas	0	Grid Electricity	373.57	249.5	0		365	539	194	129	0	1,228	355	524	87	58
AA86a Bottom	86	1	86	14.2	14.2	1414.413408	Natural Gas	2612.625698	Natural Gas	0	Grid Electricity	393.05	285.51	0		306	564	204	148	0	1,222	297	549	92	67
AA86b Bottom	86	1	86	14.2	14.2	1414.413408	Natural Gas	2612.625698	Natural Gas	0	Grid Electricity	393.05	285.51	0		306	564	204	148	0	1,222	297	549	92	67
Sum	6,302	94	6,302	14.0	-	56,080	N/A	227,552	N/A	0	N/A	30,272	21,073	0	N/A	12,113	49,151	15,711	10,937	0	87,913	11,777	47,786	7,053	4,910

NON-DOMESTIC ENERGY CONSUMPTION AND CO2 ANALYSIS

Building Use	Model Area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated BER 2012 ($kgCO_2$ / m^2)	VALIDATION CHECK: BRUKL BER 2012 ($kgCO_2$ / m^2)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL OUTPUT: Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water			Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE: Natural Gas	Grid Electricity	Equipment				2012 CO_2 emissions ($kgCO_2$ p.a.)	REGULATED CO_2 EMISSIO: Natural Gas	Grid Electricity	Equipment	
															0.216 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh					0.210 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	
Agar Grove 2A r	1611.4	1	1611.4	11.7	11.7	5.35	Natural Gas	1.84	Natural Gas			8.16	3.35	8.07	7	20	58				18,878	7	20	58	
Sum	1,611	1	1,611	11.7	-	8,621	N/A	2,965	N/A	N/A	N/A	13,149	5,398	13,004	11,586	31,551	94,251	N/A	N/A	N/A	18,878	11,586	31,551	94,251	

SITE-WIDE ENERGY CONSUMPTION AND CO2 ANALYSIS

	Calculated	REGULATED ENERGY CONSUMPTION		REGULATED CO_2 EMISSIONS	

Use	Total Area (m²)	BER 2012 (kgCO$_2$ / m^2)	-	Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Secondary Heating System (kWh p.a.)	N/A	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)		2012 CO$_2$ emissions (kgCO$_2$ p.a.)	
Sum	7,913	13.5	-	64,701		230,517		0		43,421	26,471	13,004		*106,790*	

RMANCE				FEES
NS PER UNIT				Fabric Energy Efficiency (FEE)
Cooling CO_2 emissions ($kgCO_2$ p.a.)	Unregulated ($kgCO_2$ p.a.)	SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated DER SAP 10.0 ($kgCO_2$ / m^2)	Dwelling Fabric Energy Efficiency (DFEE) (kWh/m^2)
0	503	961	15.9	48.1
0	503	727	12.0	30.8
0	503	729	12.0	31
0	503	659	10.9	24.8
0	600	880	11.6	33.1
0	600	754	10.0	24.7
0	546	894	13.4	38.6
0	546	696	10.4	23.6
0	546	852	12.7	35.5
0	546	706	10.5	24.5
0	462	932	17.1	50.6
0	462	782	14.3	39.2
0	523	746	11.7	30
0	523	663	10.4	22.5
0	523	697	11.0	25.9
0	429	607	12.1	25.1
0	429	679	13.6	33.1
0	584	844	11.6	33.1
0	584	729	10.0	25.2
0	584	787	10.8	29.5
0	584	715	9.8	24.1
0	584	992	13.6	41.7
0	584	898	12.3	36.3
0	584	813	11.1	30.2
0	584	851	11.7	32.6
0	659	1,131	13.2	42.5
0	659	1,131	13.2	42.5
0	584	841	11.5	32
0	584	841	11.5	32
0	659	815	9.5	25.7
0	659	815	9.5	25.7
0	584	1,024	14.0	42.8
0	584	1,024	14.0	42.8
0	659	1,004	11.7	36.4
0	659	1,004	11.7	36.4
0	51,119	*71,526*	11.4	29.19

NS PER UNIT			
	SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	BRUKL BER SAP 10.0 ($kgCO_2$ / m^2)	N/A
	9,784	6.1	
	9,784	6.1	

REGULATED CO_2 EMISSIONS

	SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated BER SAP 10.0 ($kgCO_2$ / m^2)	N/A
	81,311	10.3	

The applicant should complete all the light blue cells including information on the 'be clean' energy consumption figures and the 'be clean' DER.

SAP 2012 CO_2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated DER 2012 ($kgCO_2 / m^2$)	VALIDATION CHECK: DER Worksheet DER 2012 ($kgCO_2 / m^2$)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE CLEAN' SAP DER WORKSHEET: Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP	Fuel type CHP	Total Electricity generated by CHP (-)	Secondary Heating system	Fuel type Secondary Heating	Lighting	Auxiliary	Cooling
										if applicable	if applicable	if applicable					
					DER Sheet (Row 384)	DER Sheet [Row 307b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 310b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) ÷ (Row 362 x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) × (Row 361 ÷ 362)]	DER Sheet [Row 309]	Select fuel type	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
AB61_Top	60.55	1	60.55	18.6	18.6	1678.256983	Natural Gas	2349.687151	Natural Gas	0		0	0		274.47	219.06	0
AB61a	60.55	9	544.95	14.6	14.6	571.2513966	Natural Gas	2349.687151	Natural Gas	0		0	0		287.71	201.99	0
AB61b L11 Offse	60.55	1	60.55	14.6	14.6	586.4581006	Natural Gas	2349.687151	Natural Gas	0		0	0		281.67	202.12	0
AB61b	60.55	3	181.65	13.4	13.4	255.3296089	Natural Gas	2349.687151	Natural Gas	0		0	0		281.67	198.99	0
AB76WCA_Top	75.61	1	75.61	14.2	14.2	997.0391061	Natural Gas	2523.731844	Natural Gas	0		0	0		351.67	250.85	0
AB76WCA	75.61	5	378.05	12.5	12.5	406.0670391	Natural Gas	2523.731844	Natural Gas	0		0	0		351.67	245.41	0
AB67_Top	66.93	1	66.93	16.0	16.0	1223.988827	Natural Gas	2429.162011	Natural Gas	0		0	0		312.18	233.59	0
AB67	66.93	10	669.3	12.9	12.9	291.3743017	Natural Gas	2429.162011	Natural Gas	0		0	0		318.73	218.42	0
AB67 Bottom	66.93	1	66.93	15.4	15.4	1029.787709	Natural Gas	2429.162011	Natural Gas	0		0	0		315.2	225.27	0
AB67WCA	67	4	268	13.1	13.1	333.877095	Natural Gas	2429.988827	Natural Gas	0		0	0		319.08	219.03	0
AB55_Top	54.58	1	54.58	19.9	19.9	1666.290503	Natural Gas	2270.268156	Natural Gas	0		0	0		256.11	194.12	0
AB55	54.58	5	272.9	17.0	17.0	961.4301676	Natural Gas	2270.268156	Natural Gas	0		0	0		256.11	187.67	0
AB64 L11 Offset	63.55	1	63.55	14.4	14.4	592.3687151	Natural Gas	2387.932961	Natural Gas	0		0	0		306.59	211.14	0
AB64	63.55	8	508.4	13.0	13.0	197.6201117	Natural Gas	2387.932961	Natural Gas	0		0	0		306.59	207.42	0
AB64 Bottom	63.55	1	63.55	13.6	13.6	360.9385475	Natural Gas	2387.932961	Natural Gas	0		0	0		306.59	208.97	0
AB50	50	9	450	14.9	14.9	200.5698324	Natural Gas	2208	Natural Gas	0		0	0		267.68	166.75	0
AB50 Bottom	50	1	50	16.4	16.4	547.1284916	Natural Gas	2208	Natural Gas	0		0	0		262.02	170.05	0
AB73a L07 Offse	73	1	73	14.1	14.1	872.0111732	Natural Gas	2497.150838	Natural Gas	0		0	0		345.02	242.04	0
AB73b L07 Offse	73	1	73	12.5	12.5	328.7709497	Natural Gas	2497.150838	Natural Gas	0		0	0		345.02	236.98	0
AB73a	73	4	292	13.3	13.3	603.0167598	Natural Gas	2497.150838	Natural Gas	0		0	0		345.02	239.55	0
AB73b	73	4	292	12.3	12.3	263.452514	Natural Gas	2497.150838	Natural Gas	0		0	0		345.02	236.36	0
AB73a Bottom	73	1	73	16.2	16.2	1568.167598	Natural Gas	2497.150838	Natural Gas	0		0	0		345.02	248.42	0
AB73b Bottom	73	1	73	14.9	14.9	1123.519553	Natural Gas	2497.150838	Natural Gas	0		0	0		345.02	244.35	0
AA73a Top	73	1	73	13.8	13.8	692.5921788	Natural Gas	2497.150838	Natural Gas	0		0	0		373.57	240.34	0
AA73b Top	73	1	73	14.3	14.3	871.3072626	Natural Gas	2497.150838	Natural Gas	0		0	0		373.57	241.99	0
AA86a Top	86	1	86	15.8	15.7	2015.519553	Natural Gas	2612.625698	Natural Gas	0		0	0		393.05	290.97	0
AA86b Top	86	1	86	15.8	15.7	2015.519553	Natural Gas	2612.625698	Natural Gas	0		0	0		393.05	290.97	0
AA73a	73	3	219	14.2	14.2	825.7988827	Natural Gas	2497.150838	Natural Gas	0		0	0		373.57	241.57	0
AA73b	73	3	219	14.2	14.2	825.7988827	Natural Gas	2497.150838	Natural Gas	0		0	0		373.57	241.57	0
AA86a	86	3	258	12.1	12.1	483.6089385	Natural Gas	2612.625698	Natural Gas	0		0	0		393.05	316.33	0
AA86b	86	3	258	12.1	12.1	483.6089385	Natural Gas	2612.625698	Natural Gas	0		0	0		393.05	316.33	0
AA73a Bottom	73	1	73	16.8	16.8	1689.642458	Natural Gas	2497.150838	Natural Gas	0		0	0		373.57	249.5	0
AA73b Bottom	73	1	73	16.8	16.8	1689.642458	Natural Gas	2497.150838	Natural Gas	0		0	0		373.57	249.5	0
AA86a Bottom	86	1	86	14.2	14.2	1414.413408	Natural Gas	2612.625698	Natural Gas	0		0	0		393.05	285.51	0
AA86b Bottom	86	1	86	14.2	14.2	1414.413408	Natural Gas	2612.625698	Natural Gas	0		0	0		393.05	285.51	0
Sum	6,302	94	6,302	14.0	-	56,080	N/A	227,552	N/A	0	N/A	0	0	N/A	30,272	21,073	0

Unit identifier	REGULATED CO_2 EMISSIONS PER UNIT ($kgCO_2$ p.a.): Space Heating	Domestic Hot Water	Space Heating and DHW from CHP	Electricity generated by CHP	Lighting	Auxiliary	Cooling
			if applicable	if applicable			
AB61_Top	363	508		0	142	114	0
AB61a	123	508		0	149	105	0
AB61b L11 Offse	127	508		0	146	105	0
AB61b	55	508		0	146	103	0
AB76WCA_Top	215	545		0	183	130	0
AB76WCA	88	545		0	183	127	0
AB67_Top	264	525		0	162	121	0
AB67	63	525		0	165	113	0
AB67 Bottom	222	525		0	164	117	0
AB67WCA	72	525		0	166	114	0
AB55_Top	360	490		0	133	101	0
AB55	208	490		0	133	97	0
AB64 L11 Offset	128	516		0	159	110	0
AB64	43	516		0	159	108	0
AB64 Bottom	78	516		0	159	108	0
AB50	43	477		0	139	87	0
AB50 Bottom	118	477		0	136	88	0
AB73a L07 Offse	188	539		0	179	126	0
AB73b L07 Offse	71	539		0	179	123	0
AB73a	130	539		0	179	124	0
AB73b	57	539		0	179	123	0
AB73a Bottom	339	539		0	179	129	0
AB73b Bottom	243	539		0	179	127	0
AA73a Top	150	539		0	194	125	0
AA73b Top	188	539		0	194	126	0
AA86a Top	435	564		0	204	151	0
AA86b Top	435	564		0	204	151	0
AA73a	178	539		0	194	125	0
AA73b	178	539		0	194	125	0
AA86a	104	564		0	204	164	0
AA86b	104	564		0	204	164	0
AA73a Bottom	365	539		0	194	129	0
AA73b Bottom	365	539		0	194	129	0
AA86a Bottom	306	564		0	204	148	0
AA86b Bottom	306	564		0	204	148	0
Sum	12,113	49,151	0	0	15,711	10,937	0

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Building Use	Model Area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated BER 2012 ($kgCO_2 / m^2$)	VALIDATION CHECK: BRUKL BER 2012 ($kgCO_2 / m^2$)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE CLEAN' BER - SOURCE: BRUKL OUTPUT: Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water			Electricity generated by CHP (-)			Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)
												if applicable					
Agar Grove 2A n	1611.4	1	1611.4	11.7	11.7	5.35	Natural Gas	1.84	Natural Gas	N/A	N/A	0	N/A	N/A	8.16	3.35	8.07
Sum	1,611	1	1,611	11.7	-	8,621	N/A	2,965	N/A			0			13,149	5,398	13,004

Building Use	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE CLEAN' BER - SOURCE: BRUKL.INP or *SIM.CSV F: Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-)	Equipment		
				if applicable			
	0.216 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh		
Agar Grove 2A n	7	20	0	0	58	N/A	N/A
Sum	11,586	31,551	0	0	94,251		

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Total Area (m²)	Calculated BER 2012 ($kgCO_2 / m^2$)	-	REGULATED ENERGY CONSUMPTION: Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Space and Domestic Hot Water from CHP (kWh p.a.)	N/A	Electricity generated by CHP (kWh p.a.) if applicable	Secondary Heating System (kWh p.a.)	N/A	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)

Sum	7,913	13.5	-	64,701		230,517		0		0	0		43,421	26,471	13,004	

SAP 10.0 CO_2 PERFORMANCE

2012 CO_2 emissions ($kgCO_2$ p.a.)	Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Lighting	Auxiliary	Cooling	SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated DER SAP 10.0 ($kgCO_2$ / m^2)
	REGULATED CO_2 EMISSIONS PER UNIT ($kgCO_2$ p.a.)								
1,126	352	493		0	64	51	0	961	15.9
885	120	493		0	67	47	0	727	12.0
885	123	493		0	66	47	0	729	12.0
812	54	493		0	66	46	0	659	10.9
1,073	209	530		0	82	58	0	880	11.6
943	85	530		0	82	57	0	754	10.0
1,072	257	510		0	73	54	0	894	13.4
866	61	510		0	74	51	0	696	10.4
1,028	216	510		0	73	52	0	852	12.7
876	70	510		0	74	51	0	706	10.5
1,084	350	477		0	60	45	0	932	17.1
928	202	477		0	60	44	0	782	14.3
912	124	501		0	71	49	0	746	11.7
825	42	501		0	71	48	0	663	10.4
861	76	501		0	71	49	0	697	11.0
746	42	464		0	62	39	0	607	12.1
819	115	464		0	61	40	0	679	13.6
1,032	183	524		0	80	56	0	844	11.6
912	69	524		0	80	55	0	729	10.0
973	127	524		0	80	56	0	787	10.8
898	55	524		0	80	55	0	715	9.8
1,186	329	524		0	80	58	0	992	13.6
1,088	236	524		0	80	57	0	898	12.3
1,008	145	524		0	87	56	0	813	11.1
1,047	183	524		0	87	56	0	851	11.7
1,355	423	549		0	92	68	0	1,131	13.2
1,355	423	549		0	92	68	0	1,131	13.2
1,037	173	524		0	87	56	0	841	11.5
1,037	173	524		0	87	56	0	841	11.5
1,037	102	549		0	92	74	0	815	9.5
1,037	102	549		0	92	74	0	815	9.5
1,228	355	524		0	87	58	0	1,024	14.0
1,228	355	524		0	87	58	0	1,024	14.0
1,222	297	549		0	92	67	0	1,004	11.7
1,222	297	549		0	92	67	0	1,004	11.7
87,913	11,777	47,786	0	0	7,053	4,910	0	*71,526*	11.4

FILE

2012 CO_2 emissions ($kgCO_2$ p.a.)	Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	Equipment		SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	BRUKL BER SAP10.0 ($kgCO_2$ / m^2)
	REGULATED CO_2 EMISSIONS PER UNIT							
	0.210 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh			
18,878	7	20			58		9,784	6.1
18,878	11,586	31,551	0	0	94,251		*9,784*	6.1

REGULATED CO_2 EMISSIONS		REGULATED CO_2 EMISSIONS PER UNIT	
2012 CO_2 emissions ($kgCO_2$ p.a.)		SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated BER SAP 10.0 ($kgCO_2$ / m^2)

106,790		*81,311*	10.3

The applicant should complete all the light blue cells including information on the 'be green' energy consumption figures and the 'be green' DER.

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated DER 2012 ($kgCO_2 / m^2$)	VALIDATION CHECK: DER Worksheet DER 2012 ($kgCO_2 / m^2$)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE GREEN' SAP DER WORKSHEET: Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Space Heating (Heat source 2)	Fuel type Space Heating	Domestic Hot Water (Heat source 2)	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP	Fuel type CHP	Total Electricity generated by CHP (-)	Secondary Heating system	Fuel type Secondary Heating	Electricity generated by renewable (-)	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water
					DER Sheet (Row 384)	DER Sheet [Row 307b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 310b ÷ (Row 367b x 0.01)]	Select fuel type	if applicable DER Sheet [Row 307c ÷ (Row 367c x 0.01)]	Select fuel type	if applicable DER Sheet [Row 310c ÷ (Row 367c x 0.01)]	Select fuel type	if applicable DER Sheet [(Row 307a + 310a) ÷ (Row 362 x 0.01)]	if applicable Select fuel type	if applicable DER Sheet [(Row 307a + 310a) × (Row 361 ÷ 362)]	DER Sheet Row 309	Select fuel type	if applicable DER Sheet Row 333	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315		
AB61_Top	60.55	1	60.55	12.5	12.5	357.32	Grid Electricity	781.52	Grid Electricity										-228.15	274.47	276.92	0	185	406
AB61a	60.55	9	544.95	10.7	10.7	142.12	Grid Electricity	781.52	Grid Electricity										-228.15	287.71	266.27	0	74	406
AB61b L11 Offse	60.55	1	60.55	10.7	10.7	144.11	Grid Electricity	781.52	Grid Electricity										-228.15	281.67	266.27	0	75	406
AB61b	60.55	3	181.65	10.1	10.1	73.5	Grid Electricity	781.52	Grid Electricity										-228.15	281.67	266.27	0	38	406
AB76WCA_Top	75.61	1	75.61	11.0	11.0	355.06	Grid Electricity	857.92	Grid Electricity										-288.99	351.67	332.49	0	184	445
AB76WCA	75.61	5	378.05	9.7	9.7	159.95	Grid Electricity	857.92	Grid Electricity										-288.99	351.67	332.49	0	83	445
AB67_Top	66.93	1	66.93	11.2	11.2	263.62	Grid Electricity	816.4	Grid Electricity										-250.96	312.18	306.1	0	137	424
AB67	66.93	10	669.3	9.7	9.7	76.03	Grid Electricity	816.4	Grid Electricity										-250.96	318.73	294.32	0	39	424
AB67 Bottom	66.93	1	66.93	10.9	10.9	226.61	Grid Electricity	816.4	Grid Electricity										-250.96	315.2	294.32	0	118	424
AB67WCA	67	4	268	9.8	9.8	85.15	Grid Electricity	816.77	Grid Electricity										-250.96	319.08	294.63	0	44	424
AB55_Top	54.58	1	54.58	13.3	13.3	361.77	Grid Electricity	746.66	Grid Electricity										-205.33	256.11	240.02	0	188	388
AB55	54.58	5	272.9	12.0	12.0	221.84	Grid Electricity	746.66	Grid Electricity										-205.33	256.11	240.02	0	115	388
AB64 L11 Offset	63.55	1	63.55	10.5	10.5	141.91	Grid Electricity	798.31	Grid Electricity										-243.36	306.59	279.46	0	74	414
AB64	63.55	8	508.4	9.8	9.8	57.36	Grid Electricity	798.31	Grid Electricity										-243.36	306.59	279.46	0	30	414
AB64 Bottom	63.55	1	63.55	10.1	10.1	93.54	Grid Electricity	798.31	Grid Electricity										-243.36	306.59	279.46	0	49	414
AB50	50	9	450	11.2	11.2	63.1	Grid Electricity	719.32	Grid Electricity										-190.12	267.68	219.88	0	33	373
AB50 Bottom	50	1	50	11.9	12.0	140.13	Grid Electricity	719.32	Grid Electricity										-190.12	262.02	219.88	0	73	373
AB73a L07 Offse	73	1	73	10.2	10.2	198.45	Grid Electricity	846.25	Grid Electricity										-273.78	345.02	321.02	0	103	439
AB73b L07 Offse	73	1	73	9.4	9.4	87.71	Grid Electricity	846.25	Grid Electricity										-273.78	345.02	321.02	0	46	439
AB73a	73	4	292	9.8	9.8	144.72	Grid Electricity	846.25	Grid Electricity										-273.78	345.02	321.02	0	75	439
AB73b	73	4	292	9.3	9.3	73.46	Grid Electricity	846.25	Grid Electricity										-273.78	345.02	321.02	0	38	439
AB73a Bottom	73	1	73	11.2	11.2	334.04	Grid Electricity	846.25	Grid Electricity										-273.78	345.02	321.02	0	173	439
AB73b Bottom	73	1	73	10.6	10.6	247.75	Grid Electricity	846.25	Grid Electricity										-273.78	345.02	321.02	0	129	439
AA73a Top	73	1	73	10.2	10.2	160.6	Grid Electricity	846.25	Grid Electricity										-273.78	373.57	321.02	0	83	439
AA73b Top	73	1	73	10.4	10.4	196.43	Grid Electricity	846.25	Grid Electricity										-273.78	373.57	321.02	0	102	439
AA86a Top	86	1	86	11.9	11.9	633.22	Grid Electricity	896.94	Grid Electricity										-327.01	393.05	378.18	0	329	466
AA86b Top	86	1	86	11.9	11.9	633.22	Grid Electricity	896.94	Grid Electricity										-327.01	393.05	378.18	0	329	466
AA73a	73	3	219	10.3	10.3	187.36	Grid Electricity	846.25	Grid Electricity										-273.78	373.57	321.02	0	97	439
AA73b	73	3	219	10.3	10.3	187.36	Grid Electricity	846.25	Grid Electricity										-273.78	373.57	321.02	0	97	439
AA86a	86	3	258	9.4	9.4	176.28	Grid Electricity	896.94	Grid Electricity										-327.01	393.05	417.53	0	91	466
AA86b	86	3	258	9.4	9.4	176.28	Grid Electricity	896.94	Grid Electricity										-327.01	393.05	417.53	0	91	466
AA73a Bottom	73	1	73	11.5	11.6	357.09	Grid Electricity	846.25	Grid Electricity										-273.78	373.57	321.02	0	185	439
AA73b Bottom	73	1	73	11.5	11.6	357.09	Grid Electricity	846.25	Grid Electricity										-273.78	373.57	321.02	0	185	439
AA86a Bottom	86	1	86	10.8	10.8	454.6	Grid Electricity	896.94	Grid Electricity										-327.01	393.05	378.18	0	236	466
AA86b Bottom	86	1	86	10.8	10.8	454.6	Grid Electricity	896.94	Grid Electricity										-327.01	393.05	378.18	0	236	466
Sum	6,302	94	6,302	10.3	-	14,790	N/A	76,396	N/A	0	N/A	0	N/A	0	N/A	0	0	N/A	-23,803	30,272	27,969	0	7,676	39,649

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated BER 2012 ($kgCO_2 / m^2$)	VALIDATION CHECK: BRUKL BER 2012 ($kgCO_2 / m^2$)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE GREEN' BER - SOURCE: BRUKL OUTPUT: Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water							Electricity generated by CHP (-)			Electricity generated by renewable technology (-)	Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)	Natural Gas	Grid Electricity
																if applicable			if applicable				$0.216\ kgCO_2/kWh$	$0.519\ kgCO_2/kWh$
Agar Grove 2A n	1611.4	1	1611.4	11.7	11.7	1.22	Grid Electricity	1.74	Grid Electricity	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	0	8.16	3.35	8.07	0	23
Sum	1,611	1	1,611	11.7	-	1,966	N/A	2,804	N/A							0			0	13,149	5,398	13,004	0	36,321

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

REGULATED ENERGY CONSUMPTION

Use	Total Area (m²)	Calculated BER 2012 ($kgCO_2 / m^2$)	-	Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Space Heating (Heat source 2) (kWh p.a.)	N/A	Domestic Hot Water (Heat source 2) (kWh p.a.)	N/A	Space and Domestic Hot Water from CHP (kWh p.a.)	N/A	Electricity generated by CHP (kWh p.a.) *if applicable*	Secondary Heating system (kWh p.a.)	N/A	Electricity generated by renewable (kWh p.a.) *if applicable*	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)	
Sum	7,913	10.6	-	16,756		79,200		0		0		0		0	0		-23,803	43,421	33,368	13,004	

SAP 2012 CO_2 PERFORMANCE | SAP 10.0 CO_2 PERFORMANCE

REGULATED CO_2 EMISSIONS PER UNIT ($kgCO_2$ p.a.) | REGULATED CO_2 EMISSIONS PER UNIT

SAP 2012: Space Heating and DHW from CHP	SAP 2012: Electricity generated by CHP	SAP 2012: Electricity generated by renewable	SAP 2012: Lighting	SAP 2012: Auxiliary	SAP 2012: Cooling		2012 CO_2 emissions ($kgCO_2$ p.a.)	SAP 10.0: Space Heating	SAP 10.0: Domestic Hot Water	SAP 10.0: Space Heating and DHW from CHP	SAP 10.0: Electricity generated by CHP	SAP 10.0: Electricity generated by renewable	SAP 10.0: Lighting	SAP 10.0: Auxiliary	SAP 10.0: Cooling		SAP 10.0 CO_2 emissions ($kgCO_2$ p.a.)	Calculated DER SAP 10.0 ($kgCO_2$ / m^2)
if applicable	if applicable	if applicable								if applicable	if applicable	if applicable						
		-118	142	144	0		759	83	182			-53	64	65	0		341	5.6
		-118	149	138	0		648	33	182			-53	67	62	0		291	4.8
		-118	146	138	0		646	34	182			-53	66	62	0		290	4.8
		-118	146	138	0		610	17	182			-53	66	62	0		274	4.5
		-150	183	173	0		835	83	200			-67	82	77	0		375	5.0
		-150	183	173	0		733	37	200			-67	82	77	0		329	4.4
		-130	162	159	0		751	61	190			-58	73	71	0		337	5.0
		-130	165	153	0		651	18	190			-58	74	69	0		292	4.4
		-130	164	153	0		727	53	190			-58	73	69	0		327	4.9
		-130	166	153	0		656	20	190			-58	74	69	0		295	4.4
		-107	133	125	0		726	84	174			-48	60	56	0		326	6.0
		-107	133	125	0		654	52	174			-48	60	56	0		293	5.4
		-126	159	145	0		666	33	186			-57	71	65	0		299	4.7
		-126	159	145	0		622	13	186			-57	71	65	0		279	4.4
		-126	159	145	0		641	22	186			-57	71	65	0		288	4.5
		-99	139	114	0		560	15	168			-44	62	51	0		252	5.0
		-99	136	114	0		597	33	168			-44	61	51	0		268	5.4
		-142	179	167	0		746	46	197			-64	80	75	0		335	4.6
		-142	179	167	0		688	20	197			-64	80	75	0		309	4.2
		-142	179	167	0		718	34	197			-64	80	75	0		322	4.4
		-142	179	167	0		681	17	197			-64	80	75	0		306	4.2
		-142	179	167	0		816	78	197			-64	80	75	0		366	5.0
		-142	179	167	0		771	58	197			-64	80	75	0		346	4.7
		-142	194	167	0		741	37	197			-64	87	75	0		333	4.6
		-142	194	167	0		760	46	197			-64	87	75	0		341	4.7
		-170	204	196	0		1,025	148	209			-76	92	88	0		460	5.3
		-170	204	196	0		1,025	148	209			-76	92	88	0		460	5.3
		-142	194	167	0		755	44	197			-64	87	75	0		339	4.6
		-142	194	167	0		755	44	197			-64	87	75	0		339	4.6
		-170	204	217	0		808	41	209			-76	92	97	0		363	4.2
		-170	204	217	0		808	41	209			-76	92	97	0		363	4.2
		-142	194	167	0		843	83	197			-64	87	75	0		378	5.2
		-142	194	167	0		843	83	197			-64	87	75	0		378	5.2
		-170	204	196	0		932	106	209			-76	92	88	0		418	4.9
		-170	204	196	0		932	106	209			-76	92	88	0		418	4.9
0	0	-12,354	15,711	14,516	0	NA	*65,198*	3,446	17,800	0	0	-5,546	7,053	6,517	0	NA	*29,270*	4.6

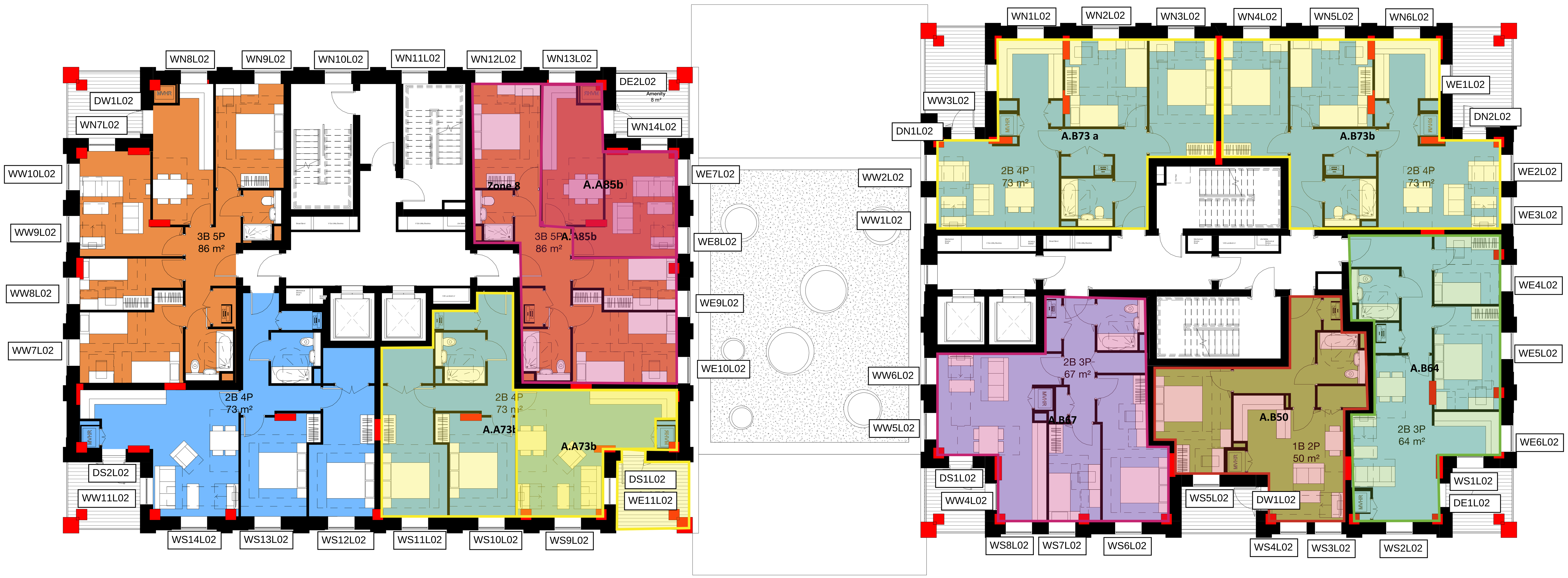
REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE GREEN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE | REGULATED CO_2 EMISSIONS PER UNIT

SAP 2012: Bespoke DH Factor	SAP 2012: Electricity generated by CHP (-)	SAP 2012: Electricity generated by renewable technology (-)	SAP 2012: Enter Carbon Factor 1	SAP 2012: Enter Carbon Factor 2	SAP 2012: Enter Carbon Factor 3	SAP 2012: Equipment	2012 CO_2 emissions ($kgCO_2$ p.a.)	SAP 10.0: Natural Gas	SAP 10.0: Grid Electricity	SAP 10.0: Bespoke DH Factor	SAP 10.0: Electricity generated by CHP (-)	SAP 10.0: Electricity generated by renewable technology (-)	SAP 10.0: Enter Carbon Factor 1	SAP 10.0: Enter Carbon Factor 2	SAP 10.0: Enter Carbon Factor 3	SAP 10.0: Equipment	SAP 10.0 CO_2 emissions	BRUKL BER SAP 10.0 ($kgCO_2$ / m^2)
	if applicable	if applicable									if applicable	if applicable						
0.000 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.519 $kgCO_2$/kWh		0.210 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh	0.136 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.000 $kgCO_2$/kWh	0.233 $kgCO_2$/kWh		
0	*0*	0	0	0	0	*24*	18,851		23							24	8,463	5.3
0	0	0	0	0	0	39,173	*18,851*	0	36,321	0	0	0	0	0	0	39,173	*8,463*	5.3

REGULATED CO_2 EMISSIONS | REGULATED CO_2 EMISSIONS

	2012 CO_2 emissions		N/A	SAP 10.0 CO_2 emissions	Calculated BER SAP 10.0 ($kgCO_2$ / m^2)
	84,049			*37,733*	4.8

APPENDIX 3 – SAP ENERGY TYPE MARKUPS



Rev	Description	Date
P1	GA Draft Freeze Issue	08/04/2022

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Project
Agar Grove Phase 2A

Drawing
Level 02 General Arrangement Plan

Scale @ A1	Date
1 : 100	03/09/22

Drawn By	Checked By
RB	JC

Job Number	Status	Purpose of Issue
1423D	S2	For Information

Drawing No.	Rev
AGV-HBA-B-02-DR-A-20-0102	P1

Rev	Description	Date
P1	GA Draft Freeze Issue	08/04/2022

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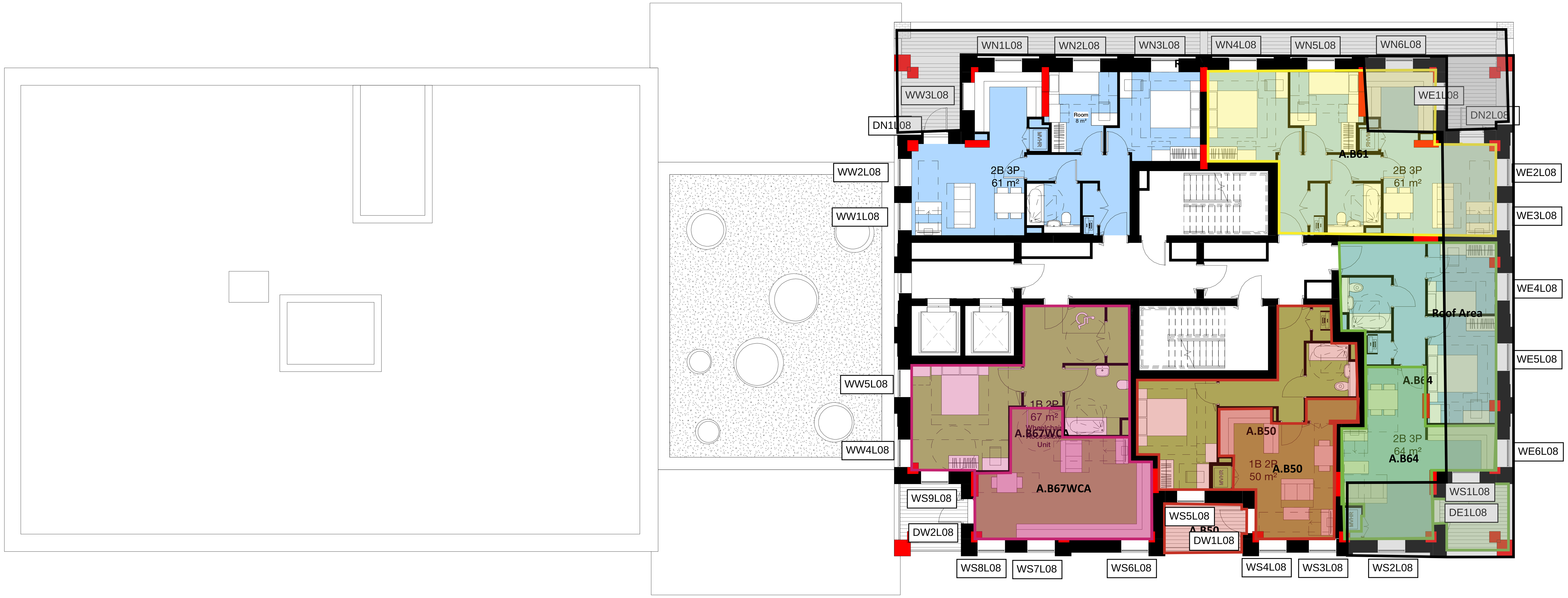
Project
Agar Grove Phase 2A

Drawing
Level 07 General Arrangement Plan

Scale @ A1	Date
1 : 100	04/07/22
Drawn By	**Checked By**
RB	JC

Job Number	Status	Purpose of Issue
1423D	S2	For Information

Drawing No.	Rev
AGV-HBA-B-07-DR-A-20-0107	P1



Rev	Description	Date
P1	GA Draft Freeze Issue	08/04/2022

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Project
Agar Grove Phase 2A

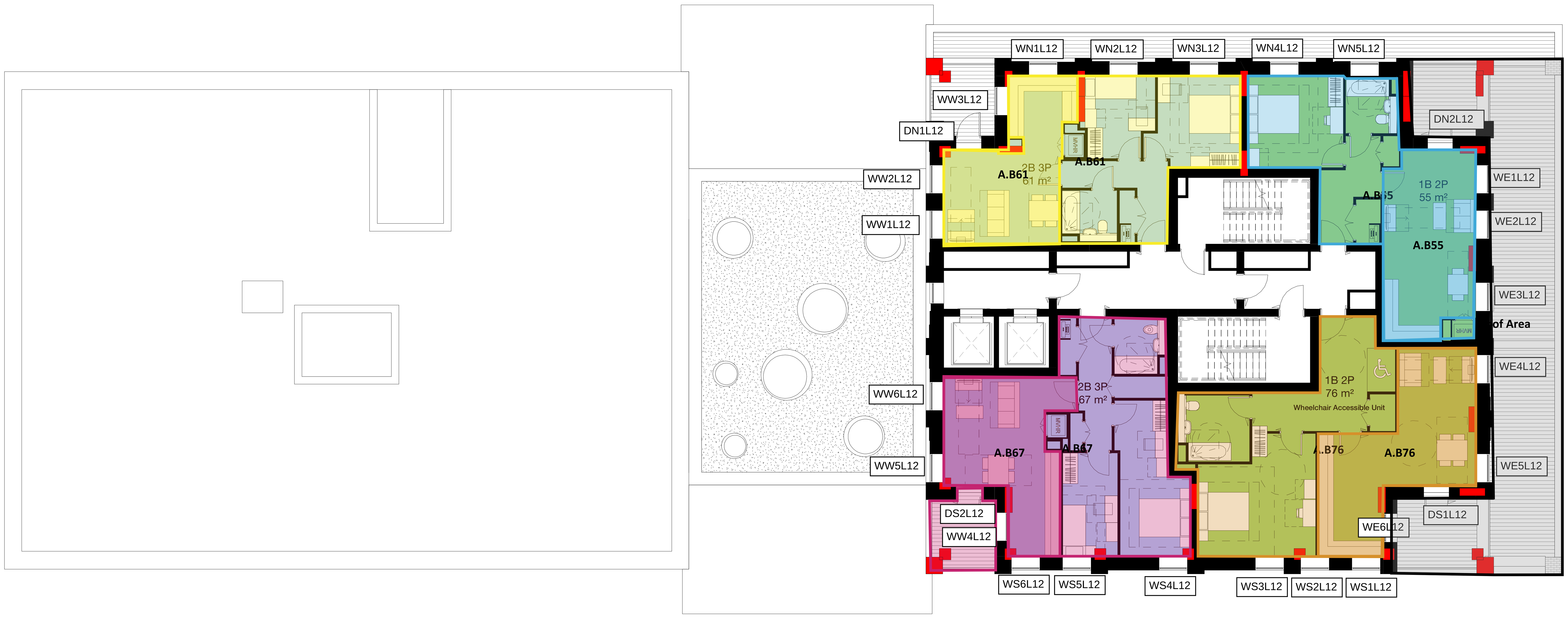
Drawing
Level 08 General Arrangement Plan

Scale @ A1	Date
1 : 100	03/09/22

Drawn By	Checked By
RB	JC

Job Number	Status	Purpose of Issue
1423D	S2	For Information

Drawing No.	Rev
AGV-HBA-B-08-DR-A-20-0108	P1



Rev	Description	Date
P1	GA Draft Freeze Issue	08/04/2022

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Project
Agar Grove Phase 2A

Drawing
Level 12 General Arrangement Plan

Scale @ A1	Date
1 : 100	08/14/14

Drawn By	Checked By
RB	JC

Job Number	Status	Purpose of Issue
1423D	S2	For Information

Drawing No.	Rev
AGV-HBA-B-12-DR-A-20-0112	P1