Energy & Sustainability Statement

for

Healey Development Solutions (Hayes) Ltd

9 Nestles Avenue
London Borough of Hillingdon
Hayes, London UB3 4SA

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ISSUE

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EXECUTIVE SUMMARY

Mecserve have been appointed by Healey Development Solutions (Hayes) Ltd to prepare an Energy and Sustainability Statement to support the planning application for proposed development site at 9 Nestle Avenue in London Borough of Hillingdon.

This Energy and Sustainability Statement, prepared in line with the Energy Assessment Guidance of Greater London Authority (October 2018), outlines the key features and strategies adopted by the development team to enhance the environmental performance of the proposed 9 Nestle Avenue Scheme. The scheme complies with all relevant policies with regards to Energy and Sustainability set by London Plan and London Borough of Hillingdon Local Plan. Sections 2 and 3 review these policies and demonstrate how the design meets planning targets and the requirements in terms of energy and sustainability.

The strategy for reducing energy use and associated carbon emissions through the design of the scheme follows the London Plan energy hierarchy, namely:

- Be Lean – Reduce energy demand through passive design strategies and best practice design of building services, lighting and controls;
- Be Clean – Reduce energy consumption further by connecting to an existing district heating system (no existing district heating is currently available at the site location); and,
- Be Green – Generate power on site through Renewable Energy Technologies.

The following passive and active energy efficiency features have been considered in the proposed strategy for the proposed scheme:

- High performance building fabric in terms of U-values and thermal bridging to reduce heating demand;
- Excellent air tightness to reduce heat losses through infiltration;
- Highly efficient building services systems for heating, cooling and ventilation that exceed minimum Part L standards in terms of performance; and,
- Low energy light fittings with occupancy and daylight sensors.

The following Low/Zero Carbon Technologies proposed will provide heat or generate energy on site:

- Air source heat pumps, coupled with back-up gas-fired boilers, will provide space heating and hot water throughout the scheme; and,
- Photovoltaic panels installed on the roof will generate renewable energy thus providing electricity to be consumed on site.

Following the proposed energy strategy, the building achieves significant carbon savings that exceed both the Building Regulations' Target Emission Rate and the London Plan Target Reduction in terms of CO_2 emissions. Please note the new carbon emission factors (SAP 10.0) are used in this report.

The following tables demonstrate the overall reduction in the regulated and unregulated carbon emission of the development after each stage of the London Plan Energy Hierarchy.

Table 1 Regulated 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	102	57
After energy demand reduction (be lean)	90	51
After heat network connection (be clean)	90	51
After renewable energy (be green)	50	51

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	13	13%
Be clean: Savings from heat network	0	0%
Be green: Savings from renewable energy	39	38%
Cumulative on site savings	52	51%
Annual savings from off-set payment	50	
	(Tonnes CO_2 per annum)	
Cumulative savings for off-set payment	1,514	
Cash-in-lieu contribution	£90,849	

Results above demonstrate the total regulated CO_2 savings from each stage of the Energy Hierarchy for proposed development. A reduction of 51% over the London Plan Baseline Emission Rate can be achieved after applying the proposed strategy.

The figures below show the total carbon savings achieved for the domestic and non-domestic elements of the 9 Nestle Avenue scheme over the London Plan's Baseline Emission Rate at each stage of the proposed London Plan Energy Hierarchy as a result of the energy strategy proposed for the scheme.

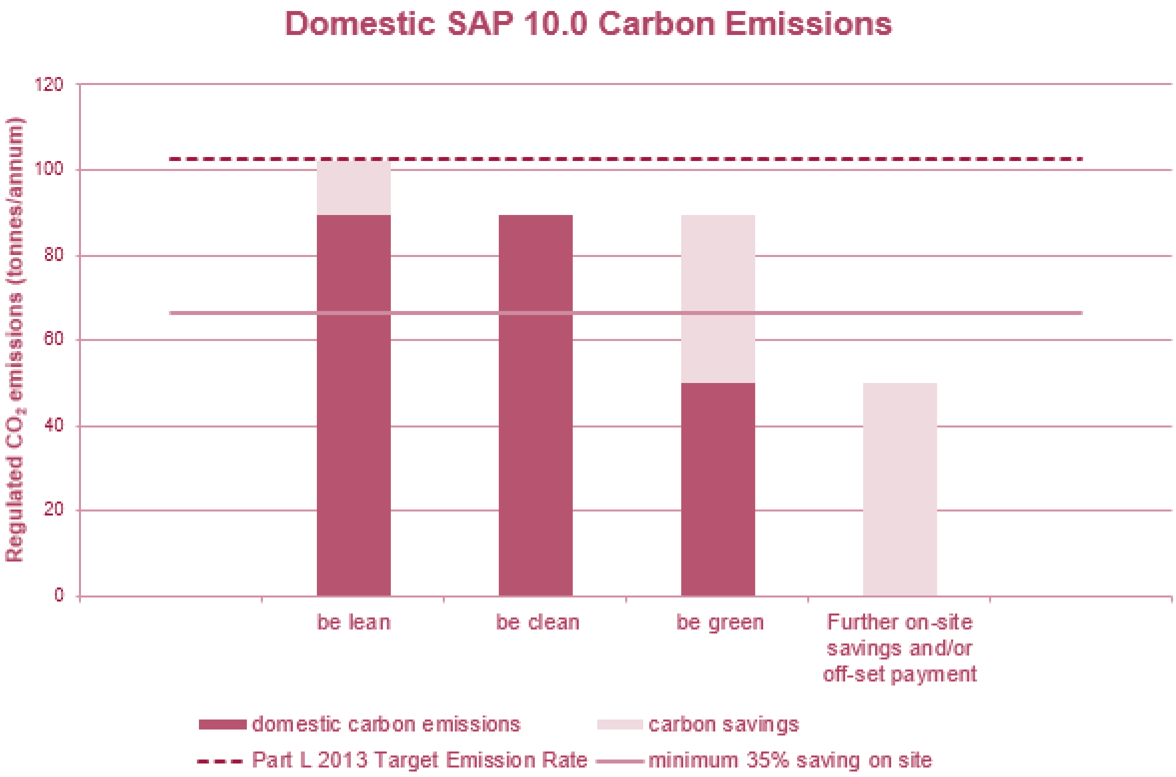

Figure 1 Domestic carbon savings at each stage of the London Plan Hierarchy

1. INTRODUCTION

Over recent years, global public opinion has been increasingly concerned with the state of the environment and the impact of climate change. Buildings are responsible for a significant proportion of the world's energy consumption. In the United Kingdom, domestic, commercial buildings and industry contribute 43%[1] of the total CO_2 emissions. These figures highlight the need for building owners, developers and designers to design environmentally sustainable buildings.

This report provides a review of the sustainability and efficiency benchmarks for the scheme and sets out targets for the development in terms of both sustainability and energy. An overview of different sustainability and energy-efficiency technologies that are likely to be appropriate for the development are also included in this statement.

As the design progresses, the strategies outlined in this report will be further developed and subjected to detailed financial feasibility studies. The environmental strategies and options outlined in this report are based on the current information available and are likely to evolve during the detailed design stage. The energy calculations presented in this report will need to be continually updated through the detailed design stages to reflect any changes. The energy analysis presented here should be treated as preliminary information based on the currently available concept design data.

1.1 PROPOSED DEVELOPMENT

Existing site:

The 0.22 hectares site is currently occupied by a single-storey industrial building dating from the late 1940's, with a two-storey administration block to the Nestles Avenue frontage.

The elevation has Art Deco influenced styling and is set 15 meters back from Nestles Avenue with a largely hard landscaped forecourt. It was until recently, used as a printing works until the company went into administration early in 2018.

To the west is a similar industrial building with planning consent for educational use. To the immediate east is a 9 storey building, part of the former Nestles Factory site. The entire Nestles Factory site forms the Nestles Conservation Area (Botwell).

To the north is the Squirrels Trading Estate comprising of seven late 20th century light industrial units, which are in use as furniture manufacturers and car repair workshops. To the south are two storey semi-detached 1930's houses with forecourt parking.

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[1] Department for Environment, Food and Rural Affairs, http://www.defra.gov.uk/, 2008

Proposed site: The development proposal planning application seeks the demolition of the existing building and redevelopment to provide a building up to 11 storeys, comprising 103 residential units, with associated landscaping, access, car parking and cycle parking. The site forms part of the wider masterplan for mixed use residential led redevelopment.

More information can be found on the Design & Access Statement prepared by TateHindle Limited Architects.

Figure 2 Existing site

Figure 3 Proposed scheme

2. OVERVIEW OF ENVIRONMENTAL STANDARDS, TARGETS AND POLICIES

2.1 NATIONAL POLICIES

ENERGY WHITE PAPER

The Energy White Paper: Our Energy Future – Creating a Low Carbon Economy[2] is an energy policy in response to the increasing challenges faced by the UK, including climate change, decreasing domestic supplies of fossil fuel and escalating energy prices. The Energy White Paper sets four priorities:

- Cutting the UK's carbon dioxide emissions - the main contributor to global warming - by some 60% by about 2050, with real progress by 2020;
- Security of supply;
- A competitive market for the benefit of businesses, industries and households;
- Affordable energy for the poor.

CLIMATE CHANGE ACT 2008

Published in 2008 by the UK Government, Climate Change Act[3] is the world's first long-term legally binding framework to mitigate against climate change. The Act sets legally binding targets to increase greenhouse gas emission reductions through action in the UK and abroad from the 60% target to 80% by 2050.

In addition to the standards, targets and policies discussed above, the relevant British Standards and CIBSE Guidelines were used to assist in determining the most appropriate Ecologically Sustainable Design (ESD) initiatives for the development.

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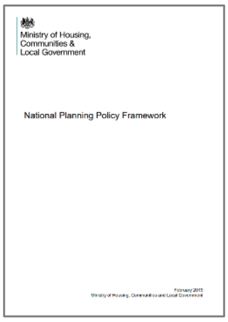
[2] Dti, (2003); Energy White Paper Our Energy Future - Creating a Low Carbon Economy. TSO.

[3] OPSI, (2008); Climate Change Act. HMSO.

NATIONAL PLANNING POLICY FRAMEWORK (NPPF) (FEBRUARY 2019)



Ministry of Housing,
Communities &
Local Government

National Planning Policy Framework

The Government has developed the National Planning Policy Framework (NPPF) which plays a key role in delivering the Government's objectives on sustainable development. The framework encourages ownership at the local level and provides guidance to promote effective environmental protection, economic growth and ensuring a better quality of life for all, both now and in future generations.

a) an economic objective – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;

b) a social objective – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and

c) an environmental objective – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

2.2 REGIONAL POLICIES

THE LONDON PLAN (MARCH 2016 AND NEW LONDON PLAN)

The London Plan – Intend to Publish version December 2019

MAYOR OF LONDON

The London Plan

Intend to Publish (clean version)

Spatial Development Strategy
for Greater London

December 2019

MAYOR OF LONDON

THE
LONDON
PLAN

THE SPATIAL DEVELOPMENT
STRATEGY FOR GREATER LONDON
DRAFT FOR PUBLIC CONSULTATION

DECEMBER 2017

The London Plan, prepared by the Mayor of London's office, deals with matters that are of strategic importance to Greater London. The London Plan is the overall strategic plan setting out an integrated social, economic and environmental framework for the future development of London, looking forward until 2036.

Chapter 5 of the London Plan deals with matters related to climate change.

Supplementary Planning Guidance, Sustainable Design and Construction (April 2014) provides framework for implementing the London policies.

The current 2016 Plan (The London Plan consolidated with alterations since 2011) is still the adopted Development Plan, but the New London Plan (Intend to publish) is a material consideration in planning decisions. The significance given to it is a matter for the decision maker, but it gains more weight as it moves through the process to adoption.

This Energy Statement has been prepared in line with the GLA Energy Assessment Guidance (October 2018) and is therefore in line with the New London Plan (Intend to Publish) policies regarding energy efficiency and carbon reduction. The following table shows how the proposed development design responds to the New London Plan policies.

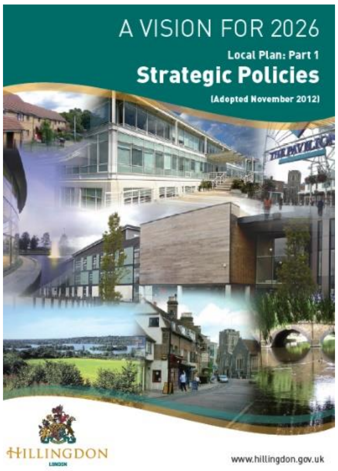
Table 3 New London Plan policies

Policy G1 Green infrastructure **Policy G5** Urban greening **Policy G6** Biodiversity and access to nature	An ecological assessment has been completed, covering Urban Greening Factor.
Policy SI 1 Improving air quality	An Air Quality Assessment has been carried out for the scheme.
Policy SI 2 Minimising greenhouse gas emissions	Section 4 presents the outcomes of the energy assessment carried out for the scheme in line with the GLA Energy Assessment Guidance. Results show that the proposed development following the London Plan Energy Hierarchy achieves the zero-carbon target set by GLA, with significant savings at the Be Lean stage due to energy efficiency measures incorporated in the proposed energy strategy for both regulated and unregulated energy uses.
Policy SI 3 Energy infrastructure	Section 4 of this report provides details on the proposed energy centre to supply heat throughout the development featuring Air Source Heat Pumps.
Policy SI 4 Managing heat risk	An overheating assessment has been carried out in line with the London Plan Cooling Hierarchy.
Policy SI 5 Water infrastructure	Low water use fittings will be specified throughout the development to improve the water consumption over the baseline.
Policy SI 7 Reducing waste and supporting the circular economy	A waste management plan will be prepared for the site at construction stage, targeting a reduction in waste generated on site. Further, more than 90% of all waste generated on site will be recycled. Many principles of Circular Economy have been followed during the design, including some principles of designing for flexibility,

	designing out waste and designing for climate change scenarios.
Policy SI 12 Flood risk assessment **Policy SI 13** Sustainable drainage	A Flood Risk assessment and Drainage Strategy and Water Quality Management report, describing the proposed SUDs strategy, have been prepared for the scheme.

2.3 LOCAL POLICIES

HILLINGDON'S LOCAL PLAN (2012)



Hillingdon's Local Plan (Part 1) 2012

The Local Plan Part 1 - Strategic policies sets out the overall level and broad locations of growth up to 2026 and is part of Hillingdon Council's development plan. It comprises a spatial vision, strategic objectives, a spatial strategy, core policies and a monitoring and implementation framework with clear objectives for achieving delivery.

The UDP was Hillingdon's long term development strategy. Since it's adoption, in 1998, the strategic policies have been replaced by the Local Plan Part 1 - strategic policies 2012.The remaining UDP policies have been saved and are being replaced by the emerging Local Plan Part 2 documents.

Hillingdon's Local Plan (Part 2) Development Management Policies 2020

The Local Plan Part 2 Development Management Policies and Site Allocations and Designations were adopted as part of the borough's development plan at Full Council on 16 January 2020.

This comprises Development Management Policies, Site Allocations and Designations and Polices Map. It delivers the detail of the strategic policies set out in the Local Plan Part 1: Strategic Polices (2012). Together they form a comprehensive development strategy for the borough up to 2026.

3. CLIMATE CHANGE MITIGATION AND ADAPTATION STRATEGY

Climate Change is the rise in average global temperature due to increasing levels of greenhouse gases in the earth's atmosphere (primarily CO_2) that prevent the radiation of heat into space.

Buildings and spaces built today should respond to climate change issues and adapt to mitigation and adaptation measures. The London Plan through its policies addresses these issues and will require London Boroughs to consider how their developments will function in the future in the context of changing climate.

Hillingdon's Local plan aims to make provision to meet needs for housing, business, community services and infrastructure, in a sustainable way, protecting and improving both the built and the natural environments while mitigating climate change.

The climate change risks for the borough are summarised below

- Hotter, drier summers;
- Milder, wetter winters;
- More frequent extreme high temperatures;
- More frequent heavy downpours of rain;
- Significant decreases in soil moisture content in summer;
- Sea level rise and increases in storm surge height;
- Possible higher wind speeds.

3.1 CLIMATE CHANGE MITIGATION

As per the definition of United Nations Environment Programme (UNEP), Climate Change Mitigation refers to efforts to reduce or prevent emission of greenhouse gases. Mitigation can mean using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behaviour.

The following policies from the London Plan and Hillingdon's Local Plan relate to Climate Change Mitigation, in the context of this proposed development.

LONDON PLAN 2016

- Policy 5.2 Minimising carbon dioxide emissions;
- Policy 5.3 Sustainable design and construction;
- Policy 5.6 Decentralised energy in development proposals;
- Policy 5.7 Renewable energy;

HILLINGDON'S LOCAL PLAN

Hillingdon's Local Plan (Part 1) 2012

- Policy EM1: Climate Change Adaptation and Mitigation

Hillingdon's Local Plan (Part 2) Development Management Policies 2020

- Policy DMEI 2: Reducing Carbon Emissions
- Policy DMEI 3: Decentralised Energy

The policies above are explained and reviewed in detail below providing a response on measures implemented for this proposed development.

3.2 CLIMATE CHANGE MITIGATION- POLICY REVIEW AND MEASURES IMPLEMENTED

LONDON PLAN 2016 POLICIES

Policy 5.2 Minimising Carbon Dioxide Emissions

A. Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

- Be lean: use less energy;
- Be clean: supply energy efficiently;
- Be green: use renewable energy.

B. The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Non-domestic buildings:

Year	Improvement on 2010 Building Regulations
2013 – 2016	40 per cent (equivalent to 35% over Part L 2013 TER)
2016 – 2019	As per building regulations requirements
2019 – 2031	Zero carbon

C. Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.

D. As a minimum, energy assessments should include the following details:

- calculation of the energy demand and carbon dioxide emissions covered by Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (see paragraph 5.22) at each stage of the energy hierarchy;
- proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services;
- proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP);
- proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.

E. The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

Measures being considered in the project to meet the above policy requirements

In order to design an energy efficient, low carbon development, the design team has followed the London Plan Energy Hierarchy i.e.

- The development is designed to have a highly efficient envelope and passive strategies have been incorporated in the design where possible. Efficient building services and lighting are proposed to reduce energy consumption;
- The design team has carried out a feasibility study to assess the potential of connecting the scheme to a district heating network. Please refer to the relevant section;
- Renewable energy technologies are explored, and the most feasible options are proposed for the development.

Section 4 of the report presents the energy assessment and outlines the energy strategy developed for the proposed scheme. This is prepared in line with the GLA Energy Assessment Guidance. The assessment also covers carbon emissions due to non-regulated energy use in the development and lists a number of measures to reduce these.

According to the energy results, a reduction of 51% over the London Plan Baseline Emission Rate can be achieved after applying the proposed strategy.

Policy 5.3 Sustainable Design and Construction

A. The highest standards of sustainable design and construction should be achieved in London to improve the environmental performance of new developments and to adapt to the effects of climate change over their lifetime.

B. Development proposals should demonstrate that sustainable design standards are integral to the proposal, including its construction and operation, and ensure that they are considered at the beginning of the design process.

C. Major development proposals should meet the minimum standards outlined in the Mayor's supplementary planning guidance and this should be clearly demonstrated within a design and access statement. The standards include measures to achieve other policies in this Plan and the following sustainable design principles:

a. minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems);
b. avoiding internal overheating and contributing to the urban heat island effect;
c. efficient use of natural resources (including water), including making the most of natural systems both within and around buildings;
d. minimising pollution (including noise, air and urban runoff);

> e. minimising the generation of waste and maximising reuse or recycling;
> f. avoiding impacts from natural hazards (including flooding);
> g. ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions;
> h. securing sustainable procurement of materials, using local supplies where feasible; and,
> i. promoting and protecting biodiversity and green infrastructure.

Measures being considered in the project to meet the above policy requirements

The GLA and the local sustainability guidance is used to ensure the design complies with the sustainability requirements set in the Hillingdon Local Plan.

As a major development, the scheme achieves a carbon reduction greater than 35% over the Baseline Emission Rate set by GLA, in accordance with London Plan’s Policy 5.2.

The scheme will meet the principles of sustainable design and construction standards, including efficient use of natural resources such as water and daylight and passive design measures to enhance the energy performance of the building. Even though the Code for Sustainable Homes (Policy 5.2 asks for a Code level 5 rating) has been withdrawn, the design aspires to demonstrate that sustainable design standards are integral to the proposal, including its construction and operation.

The energy section of this report provides details on how significant carbon savings can be achieved across the site and which measures will be considered to tackle overheating. Passive design measures such as enhanced details to ensure continuous insulation and reduce thermal bridging as well as low air permeability, coupled with Mechanical Ventilation with Heat Recovery (MVHR) will help reduce heating demand first and then energy consumption.

Low water use fittings will be installed to minimise water consumption on site targeting a daily consumption less than 105 litres/person/day for residential units.

The residential units will rely mainly on natural cross ventilation through openable windows to remove excessive solar gains and eliminate the risk of overheating. When needed, extra supply air can be provided through the MVHR units, bypassing heat recovery when not needed.

Materials of low environmental impact, which will be responsibly resourced, will be also specified for the scheme.

Policy 5.6 Decentralised Energy in Development Proposals

A. Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

B. Major development proposals should select energy systems in accordance with the following hierarchy:

- Connection to existing heating or cooling networks;
- Site wide CHP network;
- Communal heating and cooling.

C. Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

Measures being considered in the project to meet the above policy requirements

The design team has explored opportunities for installation of decentralised energy system including CHP system. This report includes a summary of the findings.

According to the London Heat Map, the Hillingdon District Heating system is over 500m away from the site. However, given the location of this District Heating System, it is not feasible to connect the system to the building as the District Heating Network is on the other side of the railway and passing through the railway is not technically feasible or viable.

However, the energy centre of the building is designed such that once a district heating network becomes available closer to the building location, the building could connect to the network easily, subject to viability of connection and subject to all financial agreements.

The site to the southeast of the proposal, has recently achieved planning permission for a major mixed used development with a substantial residential part. This site has a central energy centre, fed by gas CHP and Boilers. We are currently in discussions with Barratt London, to investigate the potential of connection to this site. The scheme will use carbon heating utilising ASHPs to meet both hot water and heating demand.

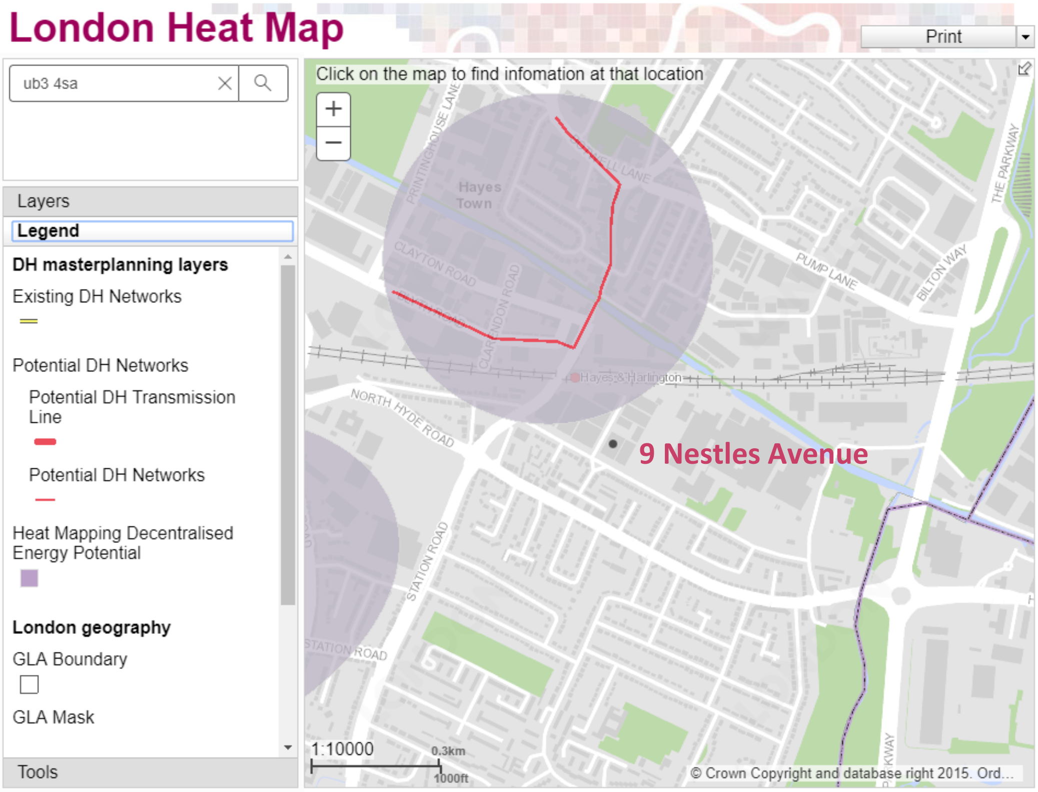


Figure 4 London Heat Map

Policy 5.7 Renewable Energy

A. The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London.

B. Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

D. All renewable energy systems should be located and designed to minimise any potential adverse impacts on biodiversity, the natural environment and historical assets, and to avoid any adverse impacts on air quality.

Measures being considered in the project to meet the above policy requirements

The design team has carried out a feasibility study, presented in the following section, to identify those renewable energy technologies that are appropriate for the proposed development.

The scheme will make use of the available roof space for installation of photovoltaic panels. The PV array will be carefully designed to avoid overshadowing of the panels from surrounding features such as plant screen, the roof parapet etc.

Further, Air Source Heat Pumps are being proposed to meet the total heating and hot water demand of the site. The energy assessment results show that the scheme achieves a carbon reduction of 38% as a result of the integration of renewable energy technologies on site.

Hillingdon's Local Plan (Part 1) 2012 Policies

Policy EM1: Climate Change Adaptation and Mitigation

The Council will ensure that climate change mitigation is addressed at every stage of the development process by:

1. Prioritising higher density development in urban and town centres that are well served by sustainable forms of transport.
2. Promoting a modal shift away from private car use and requiring new development to include innovative initiatives to reduce car dependency.
3. Ensuring development meets the highest possible design standards whilst still retaining competitiveness within the market.
4. Working with developers of major schemes to identify the opportunities to help provide efficiency initiatives that can benefit the existing building stock.
5. Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.
6. Targeting areas with high carbon emissions for additional reductions through low carbon strategies. These strategies will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.
7. Encouraging sustainable techniques to land remediation to reduce the need to transport waste to landfill. In particular, developers should consider bioremediation as part of their proposals.
8. Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan. Identify opportunities for new sources of electricity generation including anaerobic digestion, hydroelectricity and a greater use of waste as a resource.
9. Promoting new development to contribute to the upgrading of existing housing stock where appropriate.

The Borough will ensure that climate change adaptation is addressed at every stage of the development process by:

1. Locating and designing development to minimise the probability and impacts of flooding.
2. Requiring major development proposals to consider the whole water cycle impact which includes flood risk management, foul and surface water drainage and water
3. consumption.
4. Giving preference to development of previously developed land to avoid the loss of further green areas
5. Promoting the use of living walls and roofs, alongside sustainable forms of drainage to manage surface water run-off and increase the amount of carbon sinks.

Promoting the inclusion of passive design measures to reduce the impacts of urban heat effects.

Measures being considered in the project to meet the above policy requirements

Refer to the response to London Plan policy above on reducing carbon emissions, connection to district heating networks and provision of LZC energy.

The measures also satisfy the requirements of the development management policies Policy DME1 2 : Reducing Carbon Emissions and Policy DMEI 3: Decentralised Energy.

More details are provided in Section 4 of the report.

3.3 CLIMATE CHANGE ADAPTATION

For a long time, the main focus of climate change has been on mitigation, making sure we minimise our impact on the environment. Adaptation strategies are those that take into account climate change and ensure that the building is capable of dealing with future change in climate. Given the time lag associated with climate change, even if we change the way we live, there is likely to be noticeable change in the climate during the life of the building.

To ensure that buildings maintain their relevance, it is essential that adaptation strategies are addressed during the design phase. Adoption of these strategies will mean that, even as we undergo climate change, the buildings can still function as required.

The following policies from the London Plan relate to Climate Change Adaptation, in the context of this proposed development.

LONDON PLAN 2016 ADAPTATION POLICIES

- Policy 5.9 Overheating and cooling;
- Policy 5.10 Urban greening;
- Policy 5.11 Green roofs and development site environs;
- Policy 5.12 Flood risk management;
- Policy 5.13 Sustainable drainage;
- Policy 5.15 Water use and supplies.
- Policy 5.16 Waste Net self-sufficiency
- Policy 7.14 Improving air quality
- Policy 6.3 Assessing effects of development on transport capacity

HILLINGDON'S LOCAL PLAN

Hillingdon's Local Plan (Part 1) 2012

- Policy EM1: Climate Change Adaptation and Mitigation
- Policy EM6: Flood Risk Management
- Policy EM7: Biodiversity and Geological Conservation
- Policy EM8: Land, Water, Air and Noise
- Policy EM11: Sustainable Waste Management

Hillingdon's Local Plan (Part 2) Development Management Policies 2020

- Policy DMEI 1 Living Walls and Roofs and Onsite Vegetation
- Policy DMEI 7 Biodiversity Protection and Enhancement
- Policy DMEI 9 Management of Flood Risk
- Policy DMEI 10 Water Management, Efficiency and Quality
- Policy DMEI 14 Air Quality
- Policy DMT 1 Managing Transport Impacts
- Policy DMT 5 Pedestrians and Cyclists

The policies above are explained and reviewed in detail in the next section providing a response on measures implemented for this proposed development.

3.4 CLIMATE CHANGE ADAPTATION- POLICY REVIEW AND MEASURES IMPLEMENTED

London Plan Polices (2016)

Policy 5.9 Overheating and Cooling

A. The Mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of places and spaces to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

B. Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

- minimise internal heat generation through energy efficient design;
- reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls;
- manage the heat within the building through exposed internal thermal mass and high ceilings;
- passive ventilation;
- mechanical ventilation;
- active cooling systems (ensuring they are the lowest carbon options).

C. Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible. Further details and guidance regarding overheating and cooling are outlined in the London Climate Change Adaptation Strategy.

D. Within LDFs boroughs should develop more detailed policies and proposals to support the avoidance of overheating and to support the cooling hierarchy.

Measures being considered in the project to meet the above policy requirements:

The design of the proposed development has followed the overheating and cooling hierarchy as required by London Plan Policy 5.9 Overheating and Cooling. The cooling hierarchy has been addressed to reduce potential overheating risk and reduce demand for active cooling. Dynamic thermal modelling has been carried out to assess the performance of the development and ensure the risk of overheating is mitigated.

A detailed description of the overheating strategy can be found in Section 4. Appendix B presents the overheating study carried out for the scheme in line with the methodology provided in GLA's Energy Assessment Guidance.

Policy 5.10 Urban Greening

A. The Mayor will promote and support urban greening, such as new planting in the public realm (including streets, squares and plazas) and multifunctional green infrastructure, to contribute to the adaptation to, and reduction of, the effects of climate change.

B. The Mayor seeks to increase the amount of surface area greened in the Central Activities Zone by at least five per cent by 2030, and a further five per cent by 2050,

C. Development proposals should integrate green infrastructure from the beginning of the design process to contribute to urban greening, including the public realm. Elements that can contribute to this include tree planting, green roofs and walls, and soft landscaping. Major development proposals within the Central Activities Zone should demonstrate how green infrastructure has been incorporated.

Policy 5.11 Green Roofs and Development Site Environs

A. Major development proposals should be designed to include roof, wall and site planting, especially green roofs and walls where feasible, to deliver as many of the following objectives as possible:

a) adaptation to climate change
b) sustainable urban drainage;
c) mitigation of climate change
d) enhancement of biodiversity;
e) accessible roof space;
f) improvements to appearance and resilience of the building;
g) growing food.

Policy DM16 Biodiversity

a) When considering development proposals the council will seek the retention and enhancement, or the creation of biodiversity.
b) Where development will affect a Site of Importance for Nature Conservation and/or species of importance the council will expect the proposal to meet the requirements of London Plan Policy 7.19E.
c) Development adjacent to or within areas identified as part of the Green Grid Framework will be required to make a contribution to the enhancement of the Green Grid.

Measures being considered in the project to meet the above policy requirements:

The existing site is of low ecological value. The site ecology will be enhanced by the provision of green roof and ground floor planting which will contribute to biodiversity and help tackle climate change.

Figure 5 Roof layout – Proposed landscape design (TateHindle Architects)

Policy 5.12 Flood Risk Management

B. Development proposals must comply with the flood risk assessment and management requirements set out in the NPPF and the associated technical Guidance on flood risk over the lifetime of the development and have regard to measures proposed in Thames Estuary 2100 (TE2100 – see paragraph 5.55) and Catchment Flood Management Plans.

C. Developments which are required to pass the Exceptions Test set out in the NPPF and the Technical Guidance will need to address flood resilient design and emergency planning by demonstrating that:

- the development will remain safe and operational under flood conditions;
- strategy of either safe evacuation and/or safely remaining in the building is followed under flood conditions;
- key services including electricity, water etc. will continue to be provided under flood conditions;
- buildings are designed for quick recovery following a flood.

D. Development adjacent to flood defences will be required to protect the integrity of existing flood defences and wherever possible should aim to be set back from the banks of watercourses and those defences to allow their management, maintenance and upgrading to be undertaken in a sustainable and cost effective way.

Policy 5.13 Sustainable Drainage

A. Development should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

1. store rainwater for later use;
2. use infiltration techniques, such as porous surfaces in non-clay areas;
3. attenuate rainwater in ponds or open water features for gradual release;
4. attenuate rainwater;
5. discharge rainwater direct to a watercourse;
6. discharge rainwater to a surface water sewer/drain;
7. discharge rainwater to the combined sewer.

Drainage should be designed and implemented in ways that deliver other policy objectives of this Plan, including water use efficiency and quality, biodiversity, amenity and recreation.

B. Within LDFs boroughs should, in line with the Flood and Water Management Act 2010, utilise Surface Water Management Plans to identify areas where there are particular surface water management issues and develop actions and policy approaches aimed at reducing these risks.

Measures being considered in the project to meet the above policy requirements:

According to the Environment Agency’s (EA) indicative flood map for planning and surface water flood map the proposed development site is located within a low risk Flood Zone 1 . A detailed Flood Risk Assessment and Drainage Strategy Report has been prepared in support of the planning application by HTS Structural engineers.

Below is a summary of the findings from the report:

- Risk of flooding from surface water, sewers, reservoirs or groundwater is low;
- The SUDs strategy follows the abovementioned hierarchy and include any item that is technically feasible. Rainwater Harvesting has been considered for the scheme; however, its technical feasibility and viability will be further assessed at the detailed design strategy;
- Geo cellular attenuation tank, permeable paving and blue roof are proposed as the SUDS strategy to achieve a total discharge of 3.8 litres per second for all storm durations up to and including 1 in 100-years + 40% Climate Change event, which equates to a betterment of up to 96% over the existing scenario;
- The development will provide green roofs which will contribute to biodiversity and help tackle climate change.

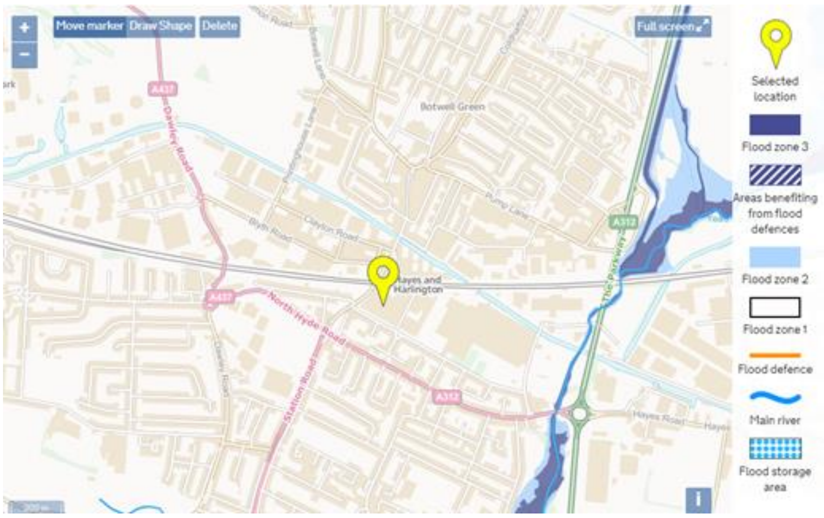


Figure 6 Environmental Agency flood map showing site located in Flood Zone 1

Policy 5.15 Water Use and Supplies

B. Development should minimise the use of mains water by:
  a. Incorporating water saving measures and equipment
  b. designing residential development so that mains water consumption would meet a target of 105 litres or less per head per day

C. New development for sustainable water supply infrastructure, which has been selected within water companies' Water resource management plans, will be supported.

Measures being considered in the project to meet the above policy requirements:

Low water use fittings will be installed throughout the scheme to help reduce water consumption on site. This will reduce the water consumption per apartment to 105 l/p/day or less.

Policy 5.16 Waste net self-sufficiency

Strategic

A. The Mayor will work with London boroughs and waste authorities, the London Waste and Recycling Board (LWaRB), the Environment Agency, the private sector, voluntary and community sector groups, and neighbouring regions and authorities to:

- manage as much of London's waste within London as practicable, working towards managing the equivalent of 100% of London's waste within London by 2026
- create positive environmental and economic impacts from waste processing
- work towards zero biodegradable or recyclable waste to landfill by 2026.

B. This will be achieved by:

- minimising waste
- encouraging the reuse of and reduction in the use of materials
- exceeding recycling/composting levels in local authority collected waste (LACW) of 45 per cent by 2015, 50 per cent by 2020 and aspiring to achieve 60 per cent by 2031
- exceeding recycling/composting levels in commercial and industrial waste of 70 per cent by 2020
- exceeding recycling and reuse levels in construction, excavation and demolition (CE&D) waste of 95 per cent by 2020
- improving London's net self-sufficiency through reducing the proportion of waste exported from the capital over time
- working with neighbouring regional and district authorities to coordinate strategic waste management across the greater south east of England.

Measures being considered in the project to meet the above policy requirements:

Construction waste will be reduced by encouraging measures to optimise material efficiency in the design process in order to minimise environmental impact of material use and waste. The contractor will be required to have a construction resource management plan and also reduce construction waste on site and off site and divert non-hazardous construction (on-site and dedicated off-site manufacture/fabrication), demolition and excavation waste (where applicable) generated by the project from landfill.

Dedicated space will be provided for the segregation and storage of operational recyclable waste volumes generated by the building and will include the segregation of recyclable waste and general waste.

Policy 7.14 Improving air quality

Strategic

A The Mayor recognises the importance of tackling air pollution and improving air quality to London’s development and the health and wellbeing of its people. He will work with strategic partners to ensure that the spatial, climate change, transport and design policies of this plan support implementation of his Air Quality and Transport strategies to achieve reductions in pollutant emissions and minimize public exposure to pollution.

Planning decisions

B Development proposals should:

a. minimise increased exposure to existing poor air quality and make provision to address local problems of air quality (particularly within Air Quality Management Areas (AQMAs) and where development is likely to be used by large numbers of those particularly vulnerable to poor air quality, such as children or older people) such as by design solutions, buffer zones or steps to promote greater use of sustainable transport modes through travel plans (see Policy 6.3)

b. promote sustainable design and construction to reduce emissions from the demolition and construction of buildings following the best practice guidance in the GLA and London Councils’ ‘The control of dust and emissions from construction and demolition’

c. be at least ‘air quality neutral’ and not lead to further deterioration of existing poor air quality (such as areas designated as Air Quality Management Areas (AQMAs)).

d. ensure that where provision needs to be made to reduce emissions from a development, this is usually made on-site. Where it can be demonstrated that on-site provision is impractical or inappropriate, and that it is possible to put in place measures having clearly demonstrated equivalent air quality benefits, planning obligations or planning conditions should be used as appropriate to ensure

Measures being considered in the project to meet the above policy requirements:

The energy centre will feature ASHPs as the primary heating source, coupled with low NOx gas-fired boilers to supplement the heating in conditions that the ASHP cannot perform as efficiently or heat during periods of high demand. The following table shows the total fuel consumption per energy source.

Table 4 Reporting template for air quality impacts

Energy source	Total fuel consumption (residential)
ASHP – grid electricity	101 MWh/year
Communal gas-fired boilers	76 MWh/year

A detailed Air quality assessment has been completed by Mayer Brown Limited in support of the planning application covering assessment of the implications of Construction Dust, Construction Traffic and Plant, Operational traffic/Development traffic and building emissions. Mitigation measures have been proposed for construction dust management and Construction Traffic. As there is no implication on air quality from operational traffic and building emissions and hence mitigation measures will not be required. For more information on please refer to the air quality assessment report.

Policy 6.3 Assessing effects of development on transport capacity

Planning decisions

A Development proposals should ensure that impacts on transport capacity and the transport network, at both a corridor and local level, are fully assessed. Development should not adversely affect safety on the transport network.

B Where existing transport capacity is insufficient to allow for the travel generated by proposed developments, and no firm plans exist for an increase in capacity to cater for this, boroughs should ensure that development proposals are phased until it is known these requirements can be met, otherwise they may be refused. The cumulative impacts of development on transport requirements must be taken into account.

C Transport assessments will be required in accordance with TfL’s Transport Assessment Best Practice Guidance for major planning applications. Workplace and/or residential travel plans should be provided for planning applications exceeding the thresholds in, and produced in accordance with, the relevant TfL guidance. Construction logistics plans and delivery and servicing plans should be secured in line with the London Freight Plan1 and should be co-ordinated with travel plans.

LDF preparation

D Boroughs should take the lead in exploiting opportunities for development in areas where appropriate transport accessibility and capacity exist or is being introduced. Boroughs should facilitate opportunities to integrate major transport proposals with development in a way that supports London Plan priorities.

E LDFs should include policies requiring transport assessments, travel plans, construction logistics and delivery/servicing plans as set out in C above.

Measures being considered in the project to meet the above policy requirements:

A detailed transport assessment and framework travel plan has been completed by i-Transport in support of the planning application.

The site is located in a PTAL 4 (rising to PTAL 5 with introduction of the Elizabeth Line) area with good access to public transport, including rail and a number of local bus services (with the closest bus stop under 400m from the site). The new PTAL 5 classification will bring the area in line with the zone within which development should be 'car-free' according to both the adopted London Plan and emerging London Plan.

In addition, and in support of car-free development, there is very good accessibility to local facilities and services, with the vast majority of key destinations within a distance most people will walk to (1,600m) and the remaining still within a realistic distance where some people will walk (3,200m), indicating that future occupiers of the site will have significant opportunities to utilise sustainable travel modes.

Below is a summary of the sustainable transport measures:

- Cycle parking for the development will be provided in the form of double stacked cycle racks which will be capable of accommodating 144 bicycles, including 136 cycle parking spaces for the residential units and eight cycle parking spaces for the commercial unit. In addition, there will be seven external short-stay/visitor cycle parking spaces (two for employment and five for residential).
- The development is car free development aside from provision of four disabled parking spaces. All four spaces will be equipped with electric vehicle charging points.
- Zipcar will be secured as the car club membership provider for the proposed development.
- The Travel Plan will be adopted and is anticipated to influence behaviour change of the residents towards sustainable modes of travel and active travel.

The above travel measures also satisfy the development management polices (to be adopted) of Hillingdon's for sustainable transport measures Policy DMT 1 Managing Transport Impacts and Policy DMT 5 Pedestrians and Cyclists.

Hillingdon's Local Plan (Part 1) 2012 Policies

Policy EM1: Climate Change Adaptation and Mitigation

The Council will ensure that climate change mitigation is addressed at every stage of the development process by:

1. Prioritising higher density development in urban and town centres that are well served by sustainable forms of transport.
2. Promoting a modal shift away from private car use and requiring new development to include innovative initiatives to reduce car dependency.
3. Ensuring development meets the highest possible design standards whilst still retaining competitiveness within the market.
4. Working with developers of major schemes to identify the opportunities to help provide efficiency initiatives that can benefit the existing building stock.
5. Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.
6. Targeting areas with high carbon emissions for additional reductions through low carbon strategies. These strategies will also have an objective to minimise other pollutants that impact on local air quality. Targeting areas of poor air quality for additional emissions reductions.
7. Encouraging sustainable techniques to land remediation to reduce the need to transport waste to landfill. In particular, developers should consider bioremediation as part of their proposals.
8. Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan. Identify opportunities for new sources of electricity generation including anaerobic digestion, hydroelectricity and a greater use of waste as a resource.
9. Promoting new development to contribute to the upgrading of existing housing stock where appropriate.

The Borough will ensure that climate change adaptation is addressed at every stage of the development process by:

10. Locating and designing development to minimise the probability and impacts of flooding.
11. Requiring major development proposals to consider the whole water cycle impact which includes flood risk management, foul and surface water drainage and water
12. consumption.
13. Giving preference to development of previously developed land to avoid the loss of further green areas
14. Promoting the use of living walls and roofs, alongside sustainable forms of drainage to manage surface water run-off and increase the amount of carbon sinks.

Promoting the inclusion of passive design measures to reduce the impacts of urban heat effects.

Measures being considered in the project to meet the above policy requirements:

The development will be designed in line with London Plan Policy 5.3 Sustainable design and construction which address all the above issues listed in Policy EM1 such as reducing carbon emissions through passive and active design measures, energy efficiency, specification of LZC and renewable technology, flood risk and surface water runoff management, sustainable waste management, protection and enhancing site biodiversity, pollution prevention, material resource efficiency, water efficiency etc as described in the London polices above.

Policy EM6: Flood Risk Management

The Council will require new development to be directed away from Flood Zones 2 and 3 in accordance with the principles of the National Planning Policy Framework (NPPF).
The subsequent Hillingdon Local Plan: Part 2 -Site Specific Allocations LDD will be subjected to the Sequential Test in accordance with the NPPF. Sites will only be allocated within Flood Zones 2 or 3 where there are overriding issues that outweigh flood risk. In these instances, policy criteria will be set requiring future applicants of these sites to demonstrate that flood risk can be suitably mitigated.

The Council will require all development across the borough to use sustainable urban drainage systems (SUDS) unless demonstrated that it is not viable. The Council will encourage SUDS to be linked to water efficiency methods. The Council may require developer contributions to guarantee the long term maintenance and performance of SUDS is to an appropriate standard.

Measures being considered in the project to meet the above policy requirements:

Refer to response to London Plan Policy 5.12 Flood Risk Management and Policy 5.13 sustainable Drainage above. The measures also comply with the requirements of Hillingdon's development management policies, Policy DMEI 9 Management of Flood Risk.

Policy EM7: Biodiversity and Geological Conservation

The Council will review all the Borough grade Sites of Importance for Nature Conservation (SINCs). Deletions, amendments and new designations will be made where appropriate within the Hillingdon Local Plan: Part 2- Site Specific Allocations Local Development Document. These designations will be based on previous recommendations made in discussions with the Greater London Authority.

Hillingdon's biodiversity and geological conservation will be preserved and enhanced with particular attention given to:
1. The conservation and enhancement of the natural state of:

- Harefield Gravel Pits
- Colne Valley Regional Park
- Fray's Farm Meadows
- Harefield Pit

2. The protection and enhancement of all Sites of Importance for Nature Conservation. Sites with Metropolitan and Borough Grade 1 importance will be protected from any adverse impacts and loss. Borough Grade 2 and Sites of Local Importance will be protected from loss with harmful impacts mitigated through appropriate compensation.
3. The protection and enhancement of populations of protected species as well as priority species and habitats identified within the UK, London and the Hillingdon Biodiversity Action Plans.
4. Appropriate contributions from developers to help enhance Sites of Importance for Nature Conservation in close proximity to development and to deliver/ assist in the delivery of actions within the Biodiversity Action Plan.
5. The provision of biodiversity improvements from all development, where feasible.
6. The provision of green roofs and living walls which contribute to biodiversity and help tackle climate change.
7. The use of sustainable drainage systems that promote ecological connectivity and natural habitats.

Measures being considered in the project to meet the above policy requirements:

Refer to response to London Plan Policy 5.10 Urban Greening and Policy 5.11 Green Roofs and Development Site environs above. The measures also comply with the requirements of Hillingdon's development management policies Policy DMEI 1 Living Walls and Roofs and Onsite Vegetation and Policy DMEI 7 Biodiversity Protection and Enhancement.

Policy EM8: Land, Water, Air and Noise

Water Quality

The Council will seek to safeguard and improve all water quality, both ground and surface. Principal Aquifers, and Source Protection Zones will be given priority along with the:

- River Colne
- Grand Union Canal
- River Pinn
- Yeading Brook
- Porter Land Brook
- River Crane
- Ruislip Lido

Air Quality

All development should not cause deterioration in the local air quality levels and should

ensure the protection of both existing and new sensitive receptors.
All major development within the Air Quality Management Area (AQMA) should demonstrate air quality neutrality (no worsening of impacts) where appropriate; actively contribute to the promotion of sustainable transport measures such as vehicle charging points and the increased provision for vehicles with cleaner transport fuels; deliver increased planting through soft landscaping and living walls and roofs; and provide a management plan for ensuring air quality impacts can be kept to a minimum.

The Council seeks to reduce the levels of pollutants referred to in the Government's National Air Quality Strategy and will have regard to the Mayor's Air Quality Strategy.

London Boroughs should also take account of the findings of the Air Quality Review and Assessments and Actions plans, in particular where Air Quality Management Areas have been designated.
The Council has a network of Air Quality Monitoring stations but recognises that this can be widened to improve understanding of air quality impacts. The Council may therefore require new major development in an AQMA to fund additional air quality monitoring stations to assist in managing air quality improvements.

Noise
The Council will investigate Hillingdon's target areas identified in the Defra Noise Action Plans, promote the maximum possible reduction in noise levels and will minimise the number of people potentially affected.

The Council will seek to identify and protect Quiet Areas in accordance with Government Policy on sustainable development and other Local Plan policies.

The Council will seek to ensure that noise sensitive development and noise generating development are only permitted if noise impacts can be adequately controlled and mitigated.

Land Contamination

The Council will expect proposals for development on contaminated land to provide mitigation strategies that reduce the impacts on surrounding land uses. Major development proposals will be expected to demonstrate a sustainable approach to remediation that includes techniques to reduce the need to landfill.

Water Resources
The Council will require that all new development demonstrates the incorporation of water efficiency measures within new development to reduce the rising demand on potable water. All new development must incorporate water recycling and collection facilities unless it can be demonstrated it is not appropriate. For residential developments, the Council will require

applicants to demonstrate that water consumption will not surpass 105 litres per person per day.

Measures being considered in the project to meet the above policy requirements:

Refer to response above on London Plan Policy 7.14 Improving Air Quality on measures to reduce air pollution.

Refer to response above on London Plan Policy 5.15 Water Use Supplies for measures on water efficiency.

The above measures also satisfy the requirements of the development management polices (to be adopted) Policy DMEI 10 Water Management, Efficiency and Quality and Policy DMEI 14 Air Quality.

Policy EM11: Sustainable Waste Management

The Council will aim to reduce the amount of waste produced in the Borough and work in conjunction with its partners in West London, to identify and allocate suitable new sites for waste management facilities within the West London Waste Plan to provide sufficient capacity to meet the apportionment requirements of the London Plan which is 382 thousand tonnes per annum for Hillingdon by 2026.

The Council will require all new development to address waste management at all stages of a development's life from design and construction through to the end use and activity on site, ensuring that all waste is managed towards the upper end of the waste hierarchy.

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

The Council will seek to maximise the use of existing waste management sites through intensification or co-location of facilities.

Measures being considered in the project to meet the above policy requirements:

Refer to response above on London Plan Policy 5.16 Waste net self sufficiency

4. ENERGY ASSESSMENT

The energy assessment of the proposed scheme has been assessed following the Standard Assessment Procedure (SAP) . This section, prepared in line with GLA Guidance on preparing energy assessments (October 2018), outlines the energy strategy developed for the scheme and shows how significant carbon savings can be achieved by integrating energy efficiency measures and using renewable energy technologies on site.

4.1 BUILDING REGULATION COMPLIANCE

Part L (Conservation of Fuel and Power) of the Building Regulations applies to all components of the development. This was updated in 2013 and came into effect in April 2014.

All components of the development will be designed to exceed the requirements of the Building Regulations Part L. Compliance with Part L 2013 will be demonstrated by completing carbon emission calculations in line with the SAP 2012 methodology. The energy assessment details a number of energy efficiency improvements and includes a renewable energy analysis which leads to a reduced carbon emission rate for the development.

Meeting the requirements of Part L will be achieved through:

- Efficient Thermal Elements and Controlled fittings: the building fabric will be designed to improve on minimum Part L 2013 requirements;
- Building Services and Lighting: The new building services will be designed and specified to perform better than the minimum standards detailed in the Domestic Building Services Compliance Guide (2013 edition).

4.2 ENERGY MODELLING

The Standard Assessment Procedure (SAP 2012) was used to model the residential elements of the building. The energy assessment has been completed by Mecserve's energy modelling team who are accredited On Construction Domestic Energy Assessors[5].

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[5] Panos Dalapas; On-Construction Domestic Energy Assessor to work on new-built dwellings (Accreditation No. STRO030082)

4.3 BASELINE CARBON EMISSION RATE

According to GLA's Energy Assessment Guidance (October 2018), the Building Regulations Part L1A Target Emission Rate (TER) should be used to determine the baseline CO_2 emissions for the scheme. Table 5 below presents the baseline CO_2 emissions for the scheme.

Table 5 Baseline Carbon Dioxide emissions

Regulated Carbon dioxide emissions (Tonnes CO_2 per annum)	Dwellings
GLA Baseline: Part L 2013 of the Building Regulations Compliant Development	102

From 6 April 2014, Approved Document L1A has introduced a fabric energy efficiency target (FEE). This is the maximum space heating and cooling energy demand for a new home. It is measured as the amount of energy which would normally be needed to maintain comfortable internal temperatures in a home and is measured in kWh per m^2 per annum. The table below presents the Target Fabric Energy Efficiency (TFEE) calculated by FSAP 2012 software.

Table 6 Dwellings Fabric Energy Efficiency

Fabric Energy Efficiency (kWh/sqm per annum)	Dwellings
Part L1A Target Fabric Energy Efficiency (TFEE) Rate	44.94

4.4 LONDON PLAN ENERGY HIERARCHY

To meet the requirements of Policy 5.2 Minimising Carbon Dioxide Emissions development proposals should minimise carbon dioxide emissions in accordance with the following energy hierarchy:

- Be lean: use less energy;
- Be clean: supply energy efficiently;
- Be green: use renewable energy.

The hierarchy provides the mechanism through which the carbon dioxide (CO_2) emission reduction targets in Policy 5.2 of the London Plan are achieved. It also contributes to the implementation of strategic energy policies relating to decentralised networks and ensures opportunities for building occupants to receive efficient, secure and affordable energy.

GLA Energy Assessment Guidance (October 2018) states that the energy assessment must clearly identify the carbon footprint of the development after each stage of the energy hierarchy. Regulated emissions must be provided and, separately, those emissions associated with uses not covered by Building Regulations i.e. unregulated energy uses.

The following sections demonstrates the performance of the development in relation to the London Plan carbon reduction targets for major developments. The target is zero carbon i.e. minimum 35% savings achieved on-site with a cash-in-lieu contribution for the remaining carbon to 100% for the domestic elements.

4.5 BE LEAN – DEMAND REDUCTION

Be Lean measures is the first stage of the Energy Hierarchy where energy demand of the building is reduced through architectural and building fabric measures (passive design) and energy efficient services (active design). Be Lean measures should demonstrate the extent to which the energy demand meets or exceeds Building Regulations.

The following sections demonstrates how the proposed development will achieve energy and CO_2 emissions reduction over the baseline emissions.

PASSIVE DESIGN

Passive design measures, including optimising orientation and site layout, natural ventilation and lighting, thermal mass and solar shading have been integrated in the design.

Energy demand reduction will be achieved through:

- **Building Orientation Optimisation:** The building's orientation is largely dictated by the shape of the site. The majority of the units have a SE/NW orientation.
- **Passive Solar Design and Daylight:** All rooms have good access to daylight and sunlight, thus enhancing visual comfort and providing passive heating during winter. Windows will feature high performance glass of low g-value to reduce solar energy been transmitted through the pane in summer thus reducing the risk of overheating.
- **Thermal performance of the fabric:** the proposed building fabric exceeds the requirements set in Part L of Building Regulations;
- **Thermal bridging:** Accredited Construction Details will be used to minimise the impact of thermal bridging thus reducing heat losses through the building fabric;
- **Air-tightness:** Using enhanced construction skills and rigorous detailing to reduce the air permeability of the building and therefore eliminate heat losses through infiltration.

Table 7 below shows initial assumptions on building fabric specifications including air permeability. These will be thoroughly reviewed by the design team at detailed design stage.

Table 7 Proposed building fabric specifications

Building Fabric	**U-value [W/m^{2}K]**	**Wall**	0.16 – Domestic elements
		Floor	0.15 – Ground floor
		Roof	0.15
		Windows	1.20 – g-value: 0.4
		Solid Doors	1.00
	Air permeability		3 m^3/m^{2}hr @50Pa
	Thermal Bridging		The Architects have confirmed that the guidance provided in the Accredited Construction Details will be followed to ensure insulation continuity and reduce thermal bridging (Approved psi-values from Table K1-SAP 2012 have been used in line with the methodology provided in SAP) Lintels of high thermal performance (psi ≤ 0.05W/mK) will be also installed to reduce heat losses further

Achieving the above values will reduce the energy demand of the development in advance of adding any active energy efficiency measures or renewable energy systems to the development.

ACTIVE DESIGN

After reducing the energy demand of the development, the next stage would be to use energy efficient building services, lighting and controls throughout the scheme to reduce fuel consumption. Our proposed energy strategy includes the following:

- **Space Heating and Hot Water:** A communal heating system will provide heating and hot water throughout the scheme using Air Source Heat Pumps coupled with back-up gas-fired boilers to meet peak demand.
- **Ventilation:** Fresh air will be provided to the dwellings via Mechanical Ventilation with Heat Recovery. All windows can be fully openable and the MVHR unit can be set on summer bypass mode during the warmer months;
- **Building services insulation:** The hot water tanks, pipes and ducts will be insulated to a high standard;
- **Lighting:** Low energy light fittings of LED types will be used throughout the scheme. PIR sensors will be provided in ancillary areas such as communal stores and circulation areas.

Table 8 Proposed building services systems

<table>
<tr><td rowspan="2">Space Heating</td><td>Communal Heating system</td><td colspan="3">LTHW system utilising gas-fired condensing boilers of 95% efficiency with underfloor heating have been assumed at the Be Lean stage to calculate the carbon emission rate at this stage[6]</td></tr>
<tr><td>Controls</td><td colspan="3">Charging system linked to use of community heating, programmer and TRVs</td></tr>
<tr><td rowspan="3">Domestic Hot Water</td><td>System</td><td colspan="3">Heat Interface Units (HIUs) installed in each flat will be fed by the communal heating system</td></tr>
<tr><td>Consumption</td><td colspan="3">Dwellings designed to achieve a water use target less than 105 litres/person/day</td></tr>
<tr><td>Distribution loss factor</td><td colspan="3">The SAP default factor of 1.05 has been used at the Be Lean stage in line with the GLA Energy Assessment Statement.
A distribution loss factor of 1.08, calculated on the basis of the total pipework length and insulation loss, has been used at the Be Green stage in line with the GLA Energy Assessment Statement.</td></tr>
<tr><td rowspan="5">Ventilation</td><td rowspan="5">Dwellings</td><td colspan="3">Whole house balanced mechanical ventilation with heat recovery (Approved installation scheme) with summer bypass</td></tr>
<tr><td>No. of wet fans (excl. kitchen)</td><td>SFP (W/l/s)</td><td>Efficiency (%)</td></tr>
<tr><td>2</td><td>0.61</td><td>93%</td></tr>
<tr><td>3</td><td>0.66</td><td>93%</td></tr>
<tr><td>4</td><td>0.83</td><td>92%</td></tr>
<tr><td>Lighting</td><td>Luminaire efficacy</td><td colspan="3">All light fittings will be dedicated low energy types i.e. LED fittings</td></tr>
</table>

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[6] According to the GLA Energy Assessment Guidance (2018) paragraph 8.8, "If the final heating proposal is to be low carbon or renewable energy, gas boilers must still be assumed for the purposes of the 'be lean' element of the hierarchy. Higher efficiencies should only be used if gas boilers will be part of the final strategy (i.e. after the 'be clean' and 'be green' tiers of the hierarchy have also been addressed), in which case the gross efficiency of the gas boiler model to be specified can be used".

CARBON SAVINGS FROM 'BE LEAN' MEASURES

After implementing all the passive and active energy efficiency measures listed above, the carbon dioxide emissions of the proposed scheme are reduced by $13tnCO_2$. Therefore, the reduction in carbon emissions at this stage is 13% i.e. in excess of 10% required by the GLA Energy Assessment Guidance.

Table 9 Carbon Dioxide emissions reduction – Lean Stage

Regulated Carbon dioxide emissions (Tonnes CO_2 per annum)	Dwellings
GLA Baseline Emissions	102
Be Lean: After energy demand reduction	90
Carbon Savings over Baseline	13
Carbon Reduction over Baseline	13%

Subsequently, the reduction in Fabric Energy Efficiency of the domestic elements is 4%, as the following table demonstrates.

Table 10 Dwellings Fabric Energy Efficiency

Fabric Energy Efficiency (kWh/sqm per annum)	Dwellings
Part L1A Target Fabric Energy Efficiency (TFEE) Rate	44.94
Area-weighted average Dwelling Fabric Energy Efficiency (DFEE) Rate	43.03
Reduction over Part L1A 2013 TFEE	4%

4.6 OVERHEATING AND COOLING POLICY

The project design has followed the overheating and cooling hierarchy as required by the London Plan Policy 5.9 Overheating and Cooling. The cooling hierarchy has been addressed to reduce potential overheating risk and reduce demand for active cooling.

The orientation of the dwellings varies throughout the scheme, the majority though have been given a SE/NW orientation. All dwellings will feature a Mechanical Ventilation unit with Heat recovery to provide background ventilation throughout the year. This will run in a summer bypass mode during the warmer months. Windows can be fully openable to allow for single-sided or cross ventilation in single-aspect and dual-aspect units respectively. A natural ventilation strategy will allow for additional flow rates to remove excessive heat gains when required. Windows can be also left open during the night in hot summer periods to allow for night-time cooling for cooling down the structure by taking advantage of the lower external temperatures.

Building fabric of high performance and excellent airtightness is specified to prevent heat transfer from the ambient environment in the living areas. Windows will be of low g-value to reduce solar energy being transmitted through the openings. Low energy LED light fittings and energy efficiency appliances will be used throughout the scheme to reduce internal heat production. Light fittings of LED energy efficient types will be installed throughout the scheme and tenants will be advised to use energy efficiency appliances so that to reduce internal heat gains thus avoiding heat building up on warm summer days. Highly insulated pipework will be also specified to reduce heat losses from the LTHW circuit.

Finally, landscape design includes planting in the courtyard, which will reduce the urban island heat effect and contribute to passive cooling.

An Overheating study has been completed for the proposed scheme in line with the GLA guidance. Dynamic thermal modelling has been carried out for the development in line with the CIBSE TM59 methodology; results are presented in Appendix B.

4.7 NON-REGULATED ENERGY USE

London Plan (2016) requires that the energy demand and carbon dioxide emissions of the non-regulated end uses should also be calculated and reported in the energy assessments.

The total carbon emissions of the non-regulated end uses for the scheme have been calculated using the Standard Assessment Procedure (SAP).

The following strategies are proposed to reduce the non-regulated energy demand of the development:

- The dwellings will be fitted out with highly efficient A-rated appliances. A Building User Guide issued to future residents will provide more information on energy efficiency use of appliances;
- Energy meters with display monitors will be provided within each flat. This will encourage the occupants to become more interested and involved in how energy is being used in their house;
- Information will be provided to occupants which will explain the operations of the installed systems and PV panels and how energy efficient behaviour can reduce the cost/carbon emissions of the development.

It is estimated that the proposed measures described above may reduce the non-regulated carbon emissions by at least 10%. However, at this stage, this can only be an assumption as small power consumption depends mainly on occupant's behaviour.

Table 11 Unregulated energy use and associated carbon emissions

Unregulated Carbon dioxide emissions (Tonnes CO_2 per annum)	Dwellings
GLA Baseline Emissions (based on SAP)	57
Be Lean: Assuming above measures will be considered	51
Carbon Savings over Baseline	6
Carbon Reduction over Baseline	10%

4.8 BE CLEAN – HEATING INFRASTRUCTURE

In accordance with the Decentralised Energy Hierarchy of London Plan 2016, connection to existing district heat networks, and incorporation of communal heating system in the buildings have been considered for the scheme.

DISTRICT ENERGY NETWORK

According to the London Heat Map, the Hillingdon District Heating system is over 500m away from the site. However, given the location of this District Heating System, it is not feasible to connect the system to the building as the District Heating Network is on the other side of the railway and passing through the railway is not technically feasible or viable.

The energy centre of the building is designed such that once a district heating network becomes available close to the building location, the building could connect to the network easily, subject to viability of connection and subject to all financial agreements. Please refer to the schematic in Appendix F, showing provision for a future connection of the energy centre to a district heating network, shall one become available in close proximity.

The site on the west side of the proposed, has recently achieved planning permission for a major mixed used development with a substantial residential part, being developed by Barratt London. This site has an energy centre, served by gas CHP and boilers. We are currently in discussions with Barratt London team, to investigate the possibility of connection to their energy centre.

If due to different development programmes and completion date or for other reasons, connection was not initially feasible, the building will be future proofed to allow connection into a future district heating network when the opportunity arises. The design team has considered the following options to allow for a potential future connection to a district heating network:

- Provision of a single plant-boiler room to provide space heating;
- Identify and allow space for heat exchangers; and,
- Identify and safeguard external pipework routes.

COMBINED HEAT AND POWER

Installation of a Combined Heat and Power unit for the building has been also considered. According to the GLA guidance in relation to CHPs, due to the decarbonisation of the grid the carbon savings achieved from gas-engine CHP has diminished.

Accounting also for the potential impact of the technology on air quality, the option of utilising a CHP unit has been disregarded and ASHPs are proposed instead to provide the base heating load throughout the year.

4.9 BE GREEN – RENEWABLE ENERGY TECHNOLOGIES

In order to further reduce emissions from the development in accordance with Local Authority Policies and London Plan Energy Hierarchy, it is necessary to consider the introduction of renewable energy systems on site.

A high-level assessment of the following renewable technologies was carried out as part of the feasibility study:

- Photovoltaic panels;
- Biomass Heating;
- Heat pumps (Ground/Water/Air);
- Wind turbines;
- Solar Hot Water System.

Air Source Heat Pumps (ASHPs) and Photovoltaic (PV) panels were identified as the most appropriate technology for this site. Appendix A of this report provides brief commentary on the technologies not considered appropriate for the scheme.

AIR SOURCE HEAT PUMPS

Air-source or aerothermal heat-pumps extract heat from the ambient air and transfer it through refrigerants acting as a medium to the hot water storage. Given the reduction in the central grid electricity carbon factor in the recent years, installation of air source heat pump which uses electricity can reduce the carbon emission of the site significantly.

The entire heating and hot water demand of the scheme will be provided by the site wide energy centre, utilising all-electric energy efficient air source heat pumps coupled with back-up gas-fired boilers.

A noise assessment has been carried out to establish the level of noise at the location from traffic and other sources. At the detailed design stage, the external plant will be designed such that the noise level from the plant will be in accordance with the relevant standards. This will reduce or eliminate any noise pollution.

Table 12 Proposed Renewable Energy Technology (ASHP)

RENEWABLE ENERGY TECHNOLOGIES			
AIR SOURCE HEAT PUMPS (ASHPs)	Heating fuel	Electricity	
	Domestic ASHPs	Make/Model	Mitsubishi Ecodan CAHV
		Sze/Output	15 No. units of 42kW each
		Heating SCOP	2.85, calculated on the basis of COP at various conditions (part loads/external T) and DSM results (Appendix I).

The entire site will be served by the Air Source Heat Pumps located on level 11 where the site wide energy centre is located. Please refer to the drawings in Appendix E. The schematic in Appendix G shows how the scheme is serviced by the energy centre. It also demonstrates the flow and return temperatures.

The seasonal efficiency SCOP of both Mitsubishi ASHP units is calculated for the whole year and incorporates variation in source temperature and sink temperature. The system complies with the minimum performance requirement set out in Enhanced Capital Allowance.

The end user will be provided with detailed information on how to control and operate the system at point of occupancy.

PHOTOVOLTAIC PANELS

Installation of Photovoltaic panels on the roof areas of the development has been also considered. An array of SW facing Photovoltaic panels is proposed on the 10th floor roof. The lower roof spaces have been designated for communal terrace and play space use and therefore it is not feasibly to include PVs in those location. The quantum of panels at 10th floor can be optimised as the space allows. The roof layout in Appendix H shows the indicative position of the PV panels at Level 11.

The proposed configuration of the PV array should allow enough space between the panels to avoid overshadowing during winter when the sun is at its lowest altitude (minimum 1520mm). A distance of at least 1m should be kept from the roof edge and the plant screen to provide access and address safety issues during installation and maintenance. This is also to avoid the higher wind loads occurring closer to the roof edge and reduce the impact of wind uplift. As shown in Figure 5, the lower floor terraces i.e. at levels 4, 6 and 9 are used as amenity spaces, therefore, it is not possible to install PV panels there.

The details of the proposed PV panels will be confirmed at the detailed design stage by a Microgeneration Certification Scheme (MCS)[7] accredited body responsible for design and installation of the PV array. The current layout is based on the specifications described in Table 13.

Table 13 Proposed Renewable Energy Technology (PV panels)

Photovoltaic (PV) Panels	**No. of panels**	14
	Power output	5.6kWp (assuming 400Wp each)
	Module Efficiency	22.6%
	Area of each panel	1.77 sqm (1690 mm x 1046mm)
	Orientation	Facing due SE/SW
	Inclination	15 degrees

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[7] MCS is an eligibility requirement for the Government's financial incentives, which include the Feed-in Tariff and the Renewable Heat Incentive.

The energy output of the PV panels, circa 4.4MWh, will be used to meet the demand of the development. PV panels will offer carbon savings of circa 1.03tnCO_2 per year.

The following table presents the carbon savings achieved after proposing renewable energy technologies on site.

Table 14 Carbon Dioxide emissions reduction for the development

Regulated Carbon dioxide emissions (Tonnes CO_2 per annum)	Dwellings
GLA Baseline Emissions	102
Be Lean: After energy demand reduction	90
Be Clean: After heat network / CHP	90
Be Green: After renewable energy technologies	50
Carbon Savings over Clean stage	39
Carbon Reduction over Clean stage	38%

4.10 BE SEEN – ENERGY MONITORING

Various passive design measures have been integrated in the design of the scheme to reduce heating demand and energy consumption. A carbon reduction of 13%, exceeding the 10% reduction target set by GLA, has been achieved at the Be Lean stage. Both the energy demand and the associated energy costs have therefore been minimised through the proposed energy efficient design as described in the previous sections.

The proposed communal heating system will be designed and delivered in line with the guidance and following the quality standards provided in the CIBSE Heat Networks Code of Practice for the UK to reduce maintenance and operating costs.

The development of the proposed scheme will be designed to comply with the requirements of the 'Be Seen' policy with regards to monitoring and reporting energy use at post construction.

5. CONCLUSIONS

This Energy Statement outlines the key features and strategies adopted by the development team to reduce energy use and carbon emissions for the scheme and demonstrate compliance with the London Plan and Hillingdon Council's Climate Change Mitigation and Adaptation Policies.

The strategy for reducing energy use and associated carbon emissions through the design of the scheme follows a three-step approach in line with the London Plan energy hierarchy.

- Reducing the energy demand through passive design strategies and provision of high-quality building envelope;
- Reducing the energy consumption through best practice design of building services, lighting and control; and,
- Installation of on-site renewable energy technologies.

Passive and active energy efficiency features include:

- Building fabric of high thermal performance in terms of U-values and air tightness;
- Building services systems of high efficiency; and,
- Low energy LED Light fitting installed throughout the scheme.

The following Low/Zero Carbon Technologies proposed will provide heat or generate energy on site:

- Air source heat pumps, coupled with back-up gas-fired boilers, will provide space heating and hot water throughout the scheme;
- Photovoltaic panels installed on the roof will generate renewable energy thus providing electricity to be consumed on site.

Non-regulated energy demand will be reduced by using energy efficiency appliances that consume less energy than standard equipment. Small power will also be metered separately to track down energy consumption patterns throughout the day. Finally, a building user guide will be distributed to future tenants to advise on how to reduce energy consumption.

Following the proposed energy strategy, the building achieves significant carbon savings that exceed both the Building Regulations' Target Emission Rate and the London Plan Target Reduction in terms of CO_2 emissions. Please note the new carbon emission factors (SAP 10.0) are used in this report.

The following tables demonstrate the overall reduction in the regulated and unregulated carbon emission of the development after each stage of the London Plan Energy Hierarchy.

Table 15 Regulated 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	102	57
After energy demand reduction (be lean)	90	51
After heat network connection (be clean)	90	51
After renewable energy (be green)	50	51

Table 16 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	13	13%
Be clean: Savings from heat network	0	0%
Be green: Savings from renewable energy	39	38%
Cumulative on site savings	52	51%
Annual savings from off-set payment	50	-
	(Tonnes CO_2 per annum)	
Cumulative savings for off-set payment	1,514	
Cash-in-lieu contribution	£90,849	

Results above demonstrate the total regulated CO_2 savings from each stage of the Energy Hierarchy for proposed development. A reduction of 51% over the London Plan Baseline Emission Rate can be achieved after applying the proposed strategy.

The figures below show the total carbon savings achieved for the domestic and non-domestic elements of the 9 Nestle Avenue scheme over the London Plan's Baseline Emission Rate at each stage of the proposed London Plan Energy Hierarchy as a result of the energy strategy proposed for the scheme.

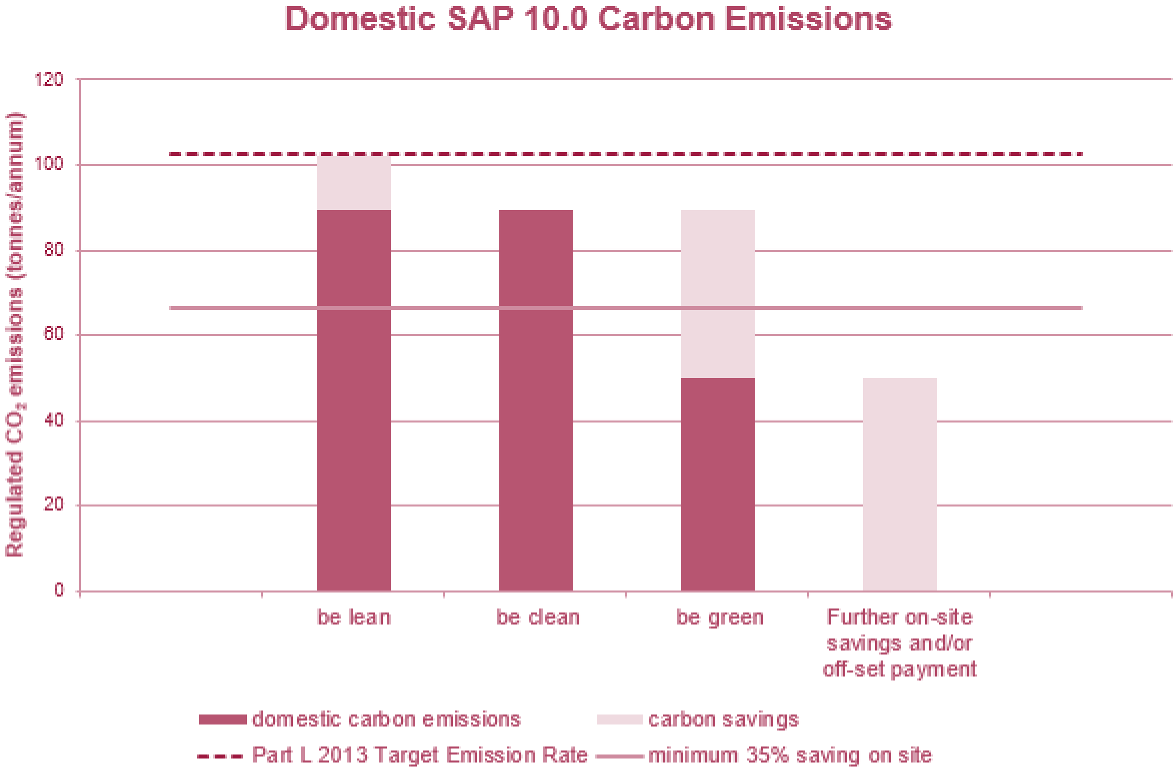

Figure 7 Domestic carbon savings at each stage of the London Plan Hierarchy

APPENDIX A RENEWABLE ENERGY SYSTEMS NOT FEASIBLE FOR THE SITE

A.1 BIOMASS HEATING

Mainly due to the high hot water demand of the proposed scheme throughout the year and the fact that this is located in a London borough, there are concerns regarding the supply chain and the reliability of supply throughout the life of project. The impact of frequent fuel deliveries on local traffic and noise should also be considered. There are also concerns within the local authority over air-quality issues associated with biomass boilers. The issues outlined above, together with the fact that biomass boilers need very large fuel storages to reduce the frequency of deliveries, especially for this scale of development, means that we would not consider this option either appropriate or practical for the development.

A.2 GROUND SOURCE HEAT PUMPS

The possibility of utilising a ground source heat pump has been considered for the scheme. With a closed loop borehole system, it would be possible to drop loops beneath the basement of the building and extract heat from the ground, which has a constant temperature throughout the year. However, a ground source system is considered to be more complex, technically risky and costly when compared to the proposed ASHP system.

A.3 WIND TURBINES

The urban setting of the development means that the wind speed may not be consistent and reliable to generate the expected energy. Previous studies on wind turbine performance in urban climate have shown that air turbulence in the urban area will usually result in lower energy production than expected. Additionally, installation of wind turbines might not be acceptable in a dense residential urban environment due to noise issues and aesthetic impacts. We would therefore consider wind turbines inappropriate for the site.

A.4 SOLAR HOT WATER SYSTEM

Solar thermal hot water systems can work well on residential developments. However, it is decided that the limited space available on the roof will be used for installation of PV panels that can generate electricity on site and supply this to the proposed ASHP centre.

APPENDIX B OVERHEATING ASSESSMENT

MECSERVE

Overheating Assessment

for

Healey Development Solutions (Hayes) Ltd

9 Nestles Avenue
London Borough of Hillingdon
Hayes UB3 4SA

Issue No:	02
Issue Date:	July 2020
Reference:	P20-086

ISSUE

Issue No.	Date of issue	Purpose of issue	Prepared by	Checked by	Changes
01	28.07.2020	First draft	P Dalapas	N Dabidian	
02	31.07.2020	Final issue	P Dalapas	N Dabidian	Minor amendments

CONTENTS

EXECUTIVE SUMMARY

Mecserve have been appointed by Healey Development Solutions (Hayes) Ltd to carry out an overheating assessment of the proposed residential scheme at 9 Nestles Avenue in the London Borough of Hillingdon.

The assessment has identified those dwellings that are at higher risk of overheating and a sample of units representing these dwellings have been assessed against the overheating criteria. These include units with a larger glazing area, units with S/SW-facing windows, top-floor units that receive higher solar gains, single aspect units where cross ventilation is not possible and ground floor units where not all openings can be left open at night for safety reasons.

The sample of dwellings has been assessed against the CIBSE TM59 overheating criteria for homes on the basis of the methodology provided in the guide and assumptions regarding the building fabric and the occupants' behaviour, summarised in the following sections.

TM59 requires all units to comply with the relevant criteria when assessed against the 2020s Design Summer Year DSY1 weather data file, describing a moderately warm summer. The analysis results show that all units comply with both TM59 overheating criteria against the DSY1 weather data i.e. during moderately warm summer conditions the risk of overheating is low. Therefore, the proposed development complies with Policy 5.9 'Overheating and cooling' of GLA's London Plan (March 2016) with regards to mitigating the risk of overheating.

As required by both TM59 and GLA Energy Assessment Guidance (April 2020), the more extreme DSY2 and DSY3 weather data files for 2020s, describing a short intense warm spell and a less intense but longer warm spell respectively, have been also used in this study. Even though compliance with DSY2 and DSY3 is not mandatory, the performance of the dwellings has been assessed against these summer conditions and results are presented in Appendix A.

Finally, guidelines on how to operate the building in the most efficient way to avoid overheating during the warmer months are provided in Section 8. These should be included in the Home User Guide provided to the future occupants.

1. INTRODUCTION

This report presents the Overheating Assessment carried out for a sample of dwellings in the proposed 9 Nestles Avenue scheme in the London Borough of Hillingdon. The study aims to assess the risk of overheating in the main occupied areas of the assessed units i.e. open plan kitchen/living rooms and bedrooms against the CIBSE TM59 overheating criteria and in line with the methodology described in the GLA Energy Assessment Guidance (April 2020).

Section 3 reviews all the relevant planning policies with regards to Overheating and Cooling and sets out the strategy for the new scheme to address the cooling hierarchy set by London Plan's Policy 5.9 'Overheating and cooling'.

1.1 PROPOSED DEVELOPMENT

The development proposal planning application seeks the demolition of the existing building and redevelopment to provide a building up to 11 storeys, comprising 103 residential units, with associated landscaping, access, car parking and cycle parking (Figure 1). The site forms part of the wider masterplan for mixed use residential led redevelopment.

More information can be found on the Design and Access Statement prepared by TateHindle Limited Architects.

Figure 1 Proposed 9 Nestles Avenue scheme – SE elevation (TateHindle Limited Architects)

2. THERMAL MODELLING

Thermal modelling has been carried out using IES Virtual Environment (Version 2019.2.0.0). IES software is approved by CIBSE AM11 ‘Building Energy and Environmental Modelling’ (2015) to provide full dynamic thermal analysis.

The model geometry was based on the planning layouts and elevations drawings (Information Issue: 17 July 2020) received by TateHindle Limited Architects (Figure 2).

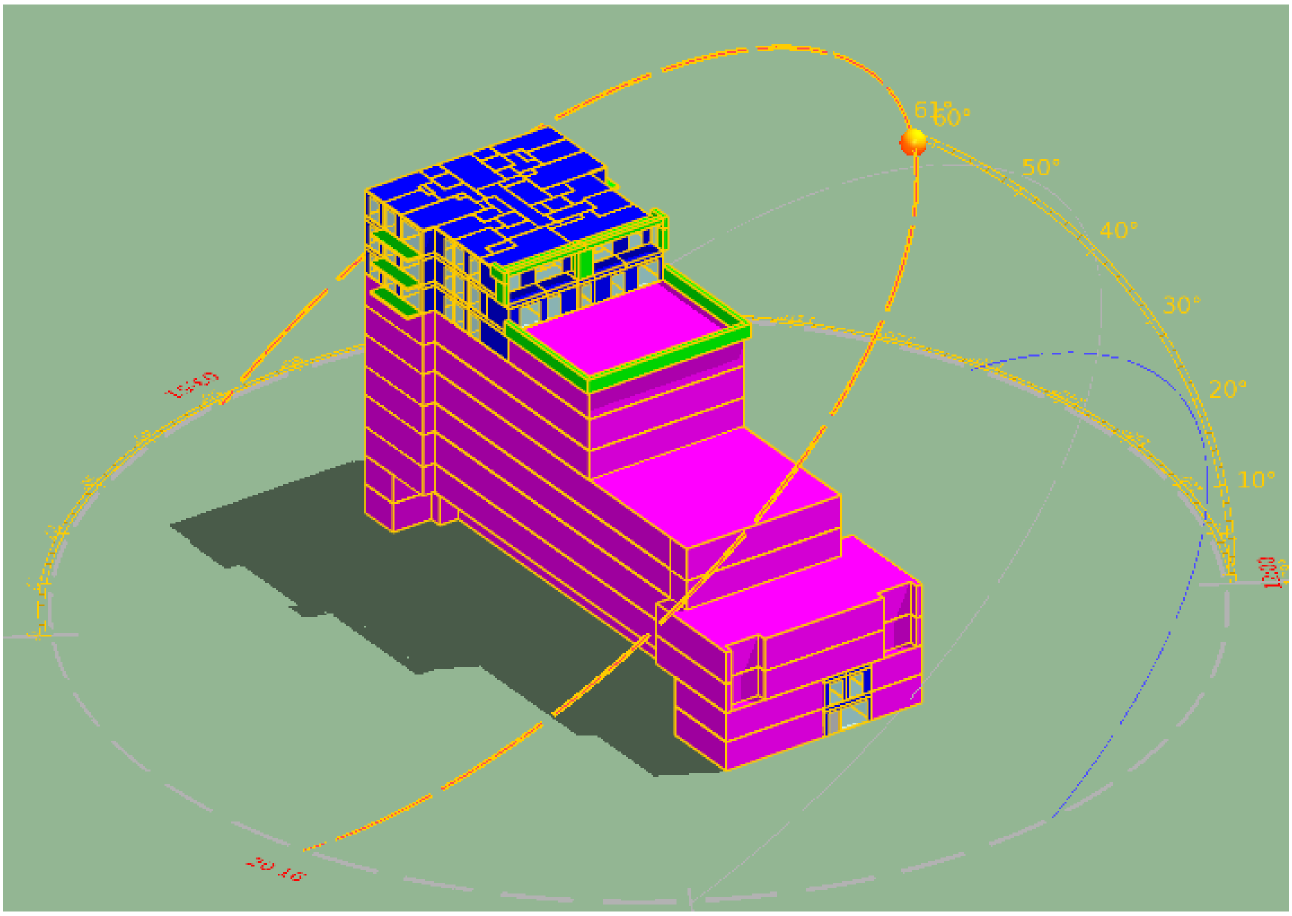

Figure 2 Proposed 9 Nestles Avenue scheme – IES thermal model

3. LONDON PLAN POLICY 5.9

Given the higher temperatures London is likely to experience in the near future, as a result of the climate change that would intensify the urban heat island effect in many areas within Greater London, London Plan, through the cooling hierarchy in Policy 5.9 'Overheating and cooling', seeks to reduce any potential of overheating and need of active cooling.

London Plan – Policy 5.9 'Overheating and cooling'

B. Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

1. minimise internal heat generation through energy efficient design
2. reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
3. manage the heat within the building through exposed internal thermal mass and high ceilings
4. passive ventilation
5. mechanical ventilation
6. active cooling systems (ensuring they are the lowest carbon options).

C. Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible. Further details and guidance regarding overheating and cooling are outlined in the London Climate Change Adaptation Strategy.

Measures being considered in the project to meet the above policy requirements:

Measures to eliminate the risk of overheating have been considered and integrated in the design of the new dwellings. The following will be applied to ensure thermal comfort during summer within the main living areas of each unit:

- The effective openable area of the windows will be maximised to allow for natural ventilation thus providing adequate air flow rates to remove excessive heat gains;
- Windows are fully openable to allow for natural ventilation thus providing sufficient air flow rates to remove excessive heat gains;
- Glazing of low g-value, i.e. 0.40 for all windows and glazed doors will be specified to avoid heat transmittance during summer but allow for passive heating in the winter;
- The use of internal shading devices e.g. curtains or blinds of low shading coefficient will be recommended to the future tenants for controlling solar gains. The impact of internal shading devices is not included in our assessment;

- External shading in the form of balconies and brise soleil is provided throughout the scheme for additional solar control;
- Mechanical ventilation units with heat recovery and summer by-pass mode will be installed in the dwellings to supply additional flow rates while making use of 'free cooling';
- Occupants will be advised to use A-rated appliances of low energy consumption to reduce internal heat gains and avoid prolonged use of any appliances during hot summer days;
- Energy efficiency light fittings that emit less heat than standard types will be also specified to reduce overheating potential;
- Communal hot water pipework will be highly insulated to avoid excessive heat losses in the communal corridors;
- Green roof areas will be integrated in the landscape design to enhance both ecology and microclimate.

3.1 GLA GUIDANCE ON OVERHEATING

Section 8 of the GLA Energy Assessment Guidance (April 2020) provides the methodology for assessing the risk of overheating in major developments includes a section on Overheating modelling.

This report follows the GLA guidance closely. It uses the CIBSE TM59 guidance to assess the risk of overheating in the dwellings. CIBSE TM59 (2017) uses the adaptive method described in CIBSE TM52 (2013), however, sets specific criteria for assessing the risk of overheating in residential buildings.

The more extreme weather data files DSY2 and DSY3, as described in TM49, for 2020s have been also used in this study. TM59 does not require a pass for these two additional weather files, it recommends, however, reporting against these. The analysis results against the DSY2 and DSY3 weather data are presented in Appendix A.

4. OVERHEATING CRITERIA

4.1 CIBSE TM59 OVERHEATING CRITERIA FOR DWELLINGS

CIBSE has published TM59 'Design methodology for the assessment of overheating risk in homes' in May 2017. TM59 provides designers with a standardised approach to predicting overheating risk for residential building designs using dynamic thermal analysis.

The methodology provides a baseline for all domestic overheating risk assessments. Studies for buildings of multi-residential character, including student accommodation, care homes etc., can also employ this methodology as a starting point, provided that any deviation is clearly stated and justified. Compliance is based on passing both of the following two criteria.

Table 1 CIBSE TM59 Overheating criteria

Hours of exceedance (H_e) criteria for homes predominantly naturally ventilated	
Criterion 1	For living rooms, bedrooms and kitchens: the number of hours (H_e) during which ΔT, the difference between the actual operative temperature in the room at any time (T_{op}) and T_{max} the limiting maximum acceptable temperature, is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours.
Criterion 2	For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26 °C will be recorded as a fail).

- Criterion 1 provides an understanding of how often a room is likely to exceed its comfort range during the summer months.
- Criterion 2 applies only to bedrooms and assess thermal comfort during night time.

5. PASSIVE DESIGN MEASURES

According to London Plan's Policy 5.9, measures at the highest priority level of the GLA's Cooling Hierarchy should include passive design solutions to reduce excessive heat gains and therefore eliminate the risk of overheating. The following passive design measures have been incorporated in the design of the proposed residential development at 9 Nestles Avenue:

Table 2 Passive Design Measures

Passive Design Solutions	Description
Orientation	The dwellings' orientation varies throughout the proposed development, the majority though have southeast/northwest facing windows. The assessed sample includes units with windows facing at all directions.
High performance building fabric & Fenestration	Building fabric of high performance in terms of U-values and airtightness will be specified to reduce heat transfer from the ambient environment on warm days. In addition, any party walls/floors between the dwellings and plant areas as well as risers will be well insulated to prevent any heat transfer. Windows of high performance will be provided to all the units. These will have a low U-value to reduce heat losses during winter and prevent heat transfer from outside during summer. Solar control glass of a low g-value (0.40) will be specified to reduce solar gains being transmitted through the windows. Thermal mass is a property that enables building materials to absorb, store, and later release significant amounts of heat. Therefore, the dwellings can benefit from the proposed external walls' inherent thermal mass that when combined with a night-time cooling strategy can store excess heat during the day and remove it during the night.
Shading	The apartments' balconies act as canopies thus providing overshadowing to the rooms below. The top floor flats with windows facing towards south will feature a brise-soleil system to reduce solar gains. The dwellings located on the lower floors also take advantage of the overshadowing from the neighboring buildings. The use of internal shading devices has not been considered in the assessment as per GLA's guidance. However, occupants will be advised to install curtains or blinds of low shading coefficient to allow for manual

	control of solar gains during summer, thus reducing the risk of overheating further.
Natural Ventilation	A natural ventilation strategy with fully openable windows has been developed for the scheme. Where possible, the openable area of the windows has been maximised to increase the fresh air supply. Windows can be left open throughout the day to enhance the natural ventilation strategy. In ground floor units, windows can be left open btm-hung by a minimum of 10 degrees at night to benefit from free cooling without compromising tenants' safety.
Mechanical Ventilation	In addition to the natural ventilation strategy proposed using fully openable windows, Mechanical Ventilation units with Heat Recovery (MVHR) will be installed in the dwellings. During summer, this will operate using a summer bypass to provide additional air flow in the living areas when needed.
Energy efficient lighting & appliances	Internal heat generation will be minimised by installing energy efficient light fittings of LED types. Future tenants will be also advised to use A-rated appliances that emit lower heat gains to reduce the risk of overheating. Also, occupancy PIR sensors will be provided in all communal circulation areas to reduce internal heat gains from lighting further.
Heat distribution infrastructure	Well insulated pipework will be specified to reduce heat losses from the hot water pipes running across the communal corridors and inside the dwellings. In line with the GLA Guidance, the length of the heat distribution pipework will be minimised as much as possible and this will be highly insulated. Insulation continuity will be also ensured to minimise heat losses. With the proposed energy strategy i.e. utilising mainly ASHPs to provide heating, the distribution temperatures are significantly lower thus reducing heat losses in the communal corridors. With conventional community heating systems, the distribution temperatures are normally around 80°C / 60°C, however, with an ASHP system these will be circa 60°C / 40°C. Therefore, with the lower flow and return temperatures, heat losses will be reduced significantly.

Green areas	Provision of green roof areas and planting at ground floor level will contribute to improving the site's microclimate and reducing the impact of the heat island effect. Trees provided at ground floor level will also provide an additional level of shading to the lower floor units. The impact of these has not been included in our analysis.

6. MODELLING INPUT DATA

Building category	Category II: Normal expectation (for new buildings and renovations)

Sample size	The below units have been included in the analysis and assessed against TM59 criteria. • 9th floor: All units • 10th floor: All units Appendix B of the report shows the assessed units on the floor layout drawings. The assessed dwellings have been selected in line with the guidance provided in Section 3.1 of TM59. These include units with a larger glazing area, units with S/SW-facing windows, top-floor units that receive higher solar gains, single aspect units where cross ventilation is not possible and ground floor units where not all openings can be left open at night for safety reasons.

Weather file	As required by TM59, the study has been carried out using the latest CIBSE Design Summer Year (DSY1, representing a moderately warm summer) weather file for 2020s, high emissions, 50% percentile scenario. The London Heathrow airport data, representing lower density urban and suburban areas, was used. In line with the GLA methodology, the following more extreme weather files have been also used and results are presented separately in Appendix A of the report: • DSY2 (2020s): featuring short intense warm spell • DSY3 (2020s): featuring long, less intense warm spell

Ventilation strategy	All dwellings will feature Mechanical Ventilation with Heat recovery to provide background ventilation throughout the year. This will run in a summer by-pass mode during the warmer months. Windows can be fully openable to allow for single-sided or cross ventilation in single-aspect and dual-aspect units respectively. A natural ventilation strategy will allow for additional flow rates to remove excessive heat gains when required.

	Windows can be also left open during the night in hot summer periods to allow for night-time cooling for cooling down the structure by taking advantage of the lower external temperatures. In ground floor units, windows can be left open btm-hung by a minimum of 10 degrees at night to benefit from free cooling without compromising tenants' safety. All ground floor doors are assumed to be kept closed at night.

Windows and door openings	Windows in each room have been modelled to open when the internal dry bulb temperature is greater than both 22°C and the external dry bulb Temperature. In all the dwellings, internal doors in living/kitchens and bedrooms have been assumed to be left open when needed to take advantage of cross ventilation to increase air movement inside the house.
Shading devices	The impact of using internal shading devices on reducing the risk of overheating has not been assessed in line with GLA's guidance. Tenants will be advised to install curtains or blinds of low shading coefficient to allow for manual control of solar gains during summer, thus reducing the risk of overheating further.

Air speed	The modelled air speed inside the rooms have been set at 0.1 m/s in line with the TM59 methodology
Exposure type	Depending on the location of each window, various exposure types have been applied in the thermal model.
Air infiltration	0.15 ACH

TM59 assumptions on internal heat gains from occupants, equipment and lighting, presented in the below tables, have been used in the assessment.

TM59 Internal gains: **Occupancy**	**No. of people**	Living room/Kitchen	Same as No. of bedrooms
		Double Bedrooms	2
		Single Bedrooms	1
	Peak load	Sensible	75 W/person
		Latent	55 W/person

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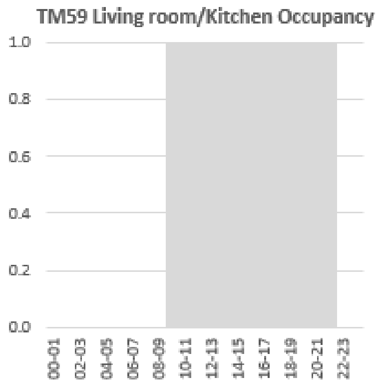
<td>
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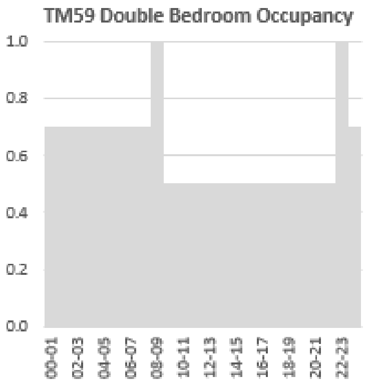
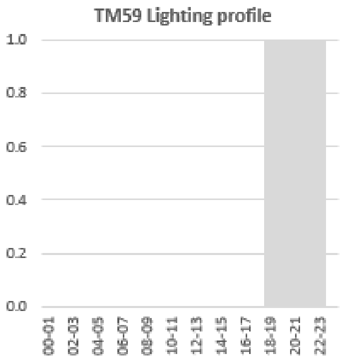
<td>
</td>
</tr>
</table>

<table>
<tr>
<td>TM59 Internal gains:
Lighting</td>
<td>Low energy light fittings (LED) will be installed throughout the dwellings.
A power density of 2W/sqm has been assumed in line with TM59.</td>
<td>
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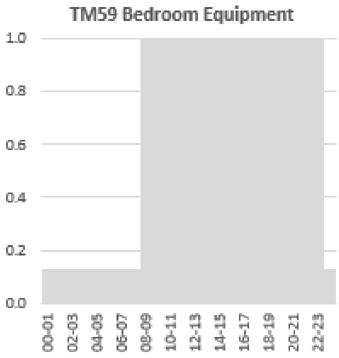
</tr>
</table>

<table>
<tr>
<td rowspan="2">TM59 Internal gains:
Equipment</td>
<td>Double/ Single Bedroom</td>
<td>Peak load: 80W
Total load: 1293.6W</td>
<td>Living/Kitchen</td>
<td>Peak load: 450W
Total load: 3253.5W</td>
</tr>
<tr>
<td colspan="2">
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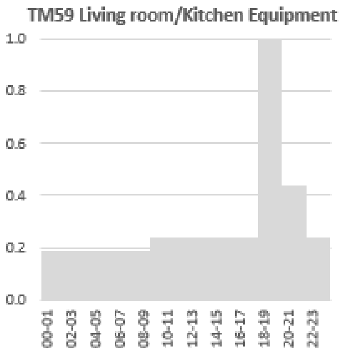
<td colspan="2">
</td>
</tr>
</table>

7. ANALYSIS RESULTS

Dynamic thermal modelling has been carried out on the basis of the assumptions presented in the previous section. The risk of overheating in all the main areas have been assessed against the CIBSE DSY1 weather file. The table below provides a summary of the No. of assessed rooms complying with Criteria 1 and 2 of the CIBSE TM59 Guide.

Table 3 No. of rooms passing TM59 Overheating criteria (CIBSE DSY1 2020s weather file)

Room	Total No.	Without internal shading devices	
		Criterion 1 ≤ 3%	Criterion 2 ≤ 32hrs
Open plan Living room/Kitchen	9	9	N/A
Double/Single Bedrooms	20	20	20
CIBSE TM59 Compliance	**29**	**29**	
		100%	

Results show that all the assessed rooms comply with the TM59 overheating criteria as a result of the passive design features described in the previous sections been integrated in the proposed design. Detailed results, in terms of percentage of occupied hours when the internal dry resultant temperature is within the comfort range given by both TM59 criteria, are presented in Appendix A.

All rooms have also been assessed against the more extreme weather conditions, described by weather files DSY2 and DSY3. Results are presented in Appendix A for the 2020s data files.

7.1 COMMUNAL CORRIDORS – VENTILATION STRATEGY

The following strategy has been proposed to tackle the risk of overheating in the corridors and reduce heat transfer to the adjacent dwellings.

The smoke control system will be used to provide ventilation in the corridors when internal Temperature rises during warm days. Excess heat will be extracted through the smoke shafts via balancing dampers and the Automatic Opening Vents (AOVs) provided at the top of the shafts. Inlet air will be supplied from the stairs using the weathered smoke vent installed on the roof. This will allow for a cross ventilation strategy, through fire rated smoke dampers, between the stair and the corridor.

The design of this system needs further development during detailed design stage to establish the exact position and size of shafts, dampers, AOVs and controls to ensure adequate ventilation rate will be provided to all levels. If this ventilation strategy is to be modelled accurately, the detailed design information is needed to ensure the model is a good representative of how the building works. However, this level of details is not yet developed at planning stage.

Also, as explained in our report and in line with the GLA Guidance, the length of the heat distribution pipework will be minimised as much as possible and this will be highly insulated. Insulation continuity will be also ensured to minimise heat losses. Also, occupancy PIR sensors will be provided in all communal circulation areas to reduce internal heat gains from lighting further.

Finally, the proposed change in the energy strategy i.e. utilising ASHPs to provide heating. the distribution temperatures are significantly lower thus reducing heat losses in the communal corridors. With conventional community heating systems, the distribution temperatures are normally 82^{o}C / 62^{o}C, however, with an ASHP system, currently proposed, these will be circa 60^{o}C / 40^{o}C. Therefore, with the lower flow and return temperatures the heat gains to the space will be reduced significantly.

High-level thermal modelling has been carried out at this stage on the communal corridors of the 9th and 10th floors. This is on the basis of natural ventilation only.

Our preliminary assessment results show that the operative temperature in the assessed corridors served by the smoke shafts complies with the CIBSE TM59 overheating criterion for corridors. The following table provides results in terms of annual percentage of hours when operative temperature exceeds 28^{o}C. Once the proposed ventilation strategy has been developed in detail, internal conditions in the communal areas will be assessed further.

Table 4 Overheating risk in communal corridors (CIBSE DSY1 2020s weather file)

Room	% annual hours when operative temperature > 28^{o}C
Communal corridor – 9th floor	0.3%
Communal corridor – 10th floor	0.4%

8. GUIDELINES ON MANAGING THE RISK OF OVERHEATING

The following mitigation measures should be considered during the event of a heatwave to minimise the risk of overheating in the new dwellings and ensure thermal comfort for the future occupants. These should be included in the Home User Guide distributed to the occupants.

- Comprehensive instructions on how to operate the windows should be given to the future occupants to control thermal comfort in their rooms.

- Occupants should be advised to leave the windows open whenever the internal room temperature rises over 22^{o}C. However, when the external temperature is higher than the internal temperature (in hot summer days) windows need to remain closed for that period. As long as the external temperature cools down, these should be left open again to provide fresh air in the dwellings.

- Occupants should be advised to leave their windows open during the night on warm summer days to take advantage of the low external temperatures during the night for cooling down their rooms and remove the excessive heat that builds up throughout the day.

- Occupants should be advised to install internal shading devices e.g. curtains or blinds of low solar transmittance (shading coefficient < 0.35) to control solar gains.

- Use of internal shading devices is recommended on sunny and warm days to prevent direct solar gains been transmitted into the rooms. These should be left closed when the rooms are not occupied.

- Occupants should be advised that, when using the curtains/blinds, they should make sure that these do not cover the openable area of the windows completely so that the air movement is not blocked. Curtains should be installed such that the main openable area of the window is not fully covered but allow for as much air flow as possible. Depending on the position of the sun they should raise/open the shading devices to those windows that do not receive direct sunlight thus allowing more fresh air.

- All fixed building elements such as ceiling lights and fridges will be very energy efficient. It is essential that the occupants also use energy efficient equipment, for example, energy efficient light fittings of LED types and A+ rated electrical appliances such as TVs that consume less energy should be specified and promoted to reduce internal heat gains.

- Occupants should be also advised against prolonged use of any appliances during hot summer days.

9. CONCLUSIONS

Mecserve have been appointed by Healey Development Solutions (Hayes) Ltd to carry out an overheating assessment of the proposed residential scheme at 9 Nestles Avenue in the London Borough of Hillingdon.

The assessment has identified a sample of dwellings that have a higher risk of overheating. These include units with a larger glazing area, units with S/SW-facing windows, top-floor units that receive higher solar gains, units where cross ventilation is not possible and ground floor units where not all openings can be left open at night for safety reasons.

These dwellings have been assessed against the CIBSE TM59 overheating criteria for homes on the basis of the methodology provided in the guide and assumptions regarding the building fabric and the occupants' behaviour, summarised in Section 6 of this report.

TM59 requires the development to comply with the relevant criteria using the DSY1 weather data file (describing a moderately warm summer) for the 2020s. The analysis results show that all assessed units comply with the TM59 overheating criteria against the DSY1 weather data i.e. during a moderately warm summer (as described by DSY1) these are expected to cope with moderately warm weather conditions.

As required by both TM59 and GLA Energy Assessment Guidance, the more extreme DSY2 and DSY3 weather data files for 2020s, featuring a short intense warm spell and a long, less intense warm spell respectively, have been also used. Even though compliance with DSY2 and DSY3 is not mandatory, these have been used in our study and results are presented in Appendix A.

To ensure minimum disruption during the event of a hot spell, it is important that occupants are aware of how to operate the building following the guidelines provided in Section 8. Opening the windows to allow for natural ventilation and closing the internal shading devices to control solar gains without blocking the windows' openable area is essential to tackle the risk of overheating and ensure thermal comfort. These should be included in the Home User Guide distributed to the occupants.

This report and the supporting thermal modelling are based on guidance provided by CIBSE TM59. It is also using predicted weather conditions as described in TM59 and assumes future occupants will follow the recommendations of this report. The output of our simulation corelates to this input data and is only correct when the input data is valid. All results provided by an overheating analysis are indication of risk of overheating rather than an accurate prediction of absolute internal temperatures under operational conditions. Occupant perception of thermal comfort is a complex area and the most recent CIBCE guides TM59 have tried to consider this to some extent, however they do not claim to predict risk of discomfort for every occupant.

APPENDIX A TM59 RESULTS

The following table presents results in detail for each of the assessed room. Compliance for bedrooms is based on passing both of the following two criteria.

In line with the CIBSE TM59 methodology, the proposed development is required to be assessed against and pass the criteria using the CIBSE 2020s DSY1 weather file. In addition, GLA guidance recommends that the following two more extreme TM49 design weather years for 2020s,

- 1976: a year with a prolonged period of sustained warmth (DSY3);
- 2003: a year with a very intense single warm spell (DSY2).

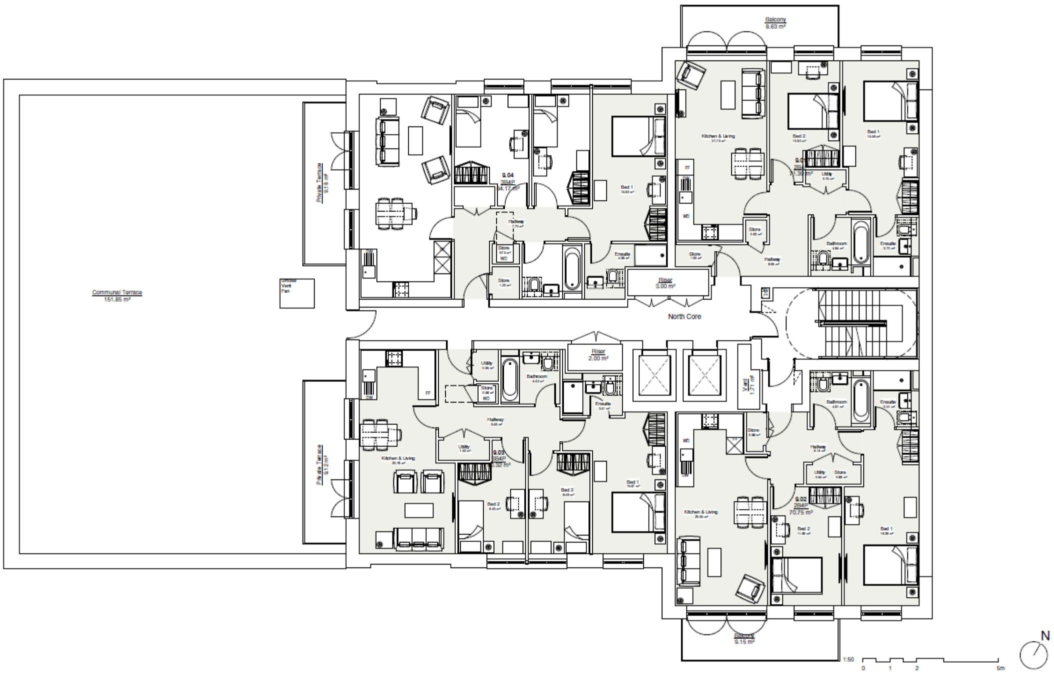
should be also used to further test the design, even though, a pass against these is not mandatory.

	DSY1			DSY2			DSY3		
	Crit. 1	Crit. 2		Crit. 1	Crit. 2		Crit. 1	Crit. 2	
Room	**≤ 3%**	**≤ 32hrs**	TM59	**≤ 3%**	**≤ 32hrs**	TM59	**≤ 3%**	**≤ 32hrs**	TM59
G.03-2B4P L/K	2.4	N/A	Pass	3.3	N/A	Fail	4.8	N/A	Fail
G.03-DB1	1.9	22	Pass	2.2	35	Fail	3.2	50	Fail
G.03-DB2	2.3	22	Pass	2.7	33	Fail	4	49	Fail
9.01-2B4P L/K	1.6	N/A	Pass	2.4	N/A	Pass	3.5	N/A	Fail
9.01-DB1	0	15	Pass	0	22	Pass	0.3	43	Fail
9.01-DB2	0.5	19	Pass	0.8	25	Pass	1.4	40	Fail
9.02-2B4P L/K	1.4	N/A	Pass	2.9	N/A	Pass	3.2	N/A	Fail
9.02-DB1	0	16	Pass	0.2	27	Pass	0.2	39	Fail
9.02-DB2	0.4	18	Pass	1.2	23	Pass	1.3	41	Fail
9.03-3B4P L/K	2.9	N/A	Pass	4	N/A	Fail	5.6	N/A	Fail
9.03-DB	0.5	18	Pass	1.5	22	Pass	1.4	36	Fail
9.03-SB2	1	21	Pass	2.1	27	Pass	2.9	39	Fail
9.03-SB3	2.5	22	Pass	3.1	27	Fail	4.3	38	Fail
9.04-3B4P L/K	2.3	N/A	Pass	3.3	N/A	Fail	5	N/A	Fail
9.04-DB	0.4	21	Pass	0.8	27	Pass	1.4	51	Fail
9.04-SB2	0.9	14	Pass	1.4	22	Pass	2	35	Fail
9.04-SB3	1.7	16	Pass	1.9	25	Pass	3	43	Fail
10.01-2B4P L/K	1	N/A	Pass	1.6	N/A	Pass	2.6	N/A	Pass
10.01-DB1	0	14	Pass	0	23	Pass	0	37	Fail
10.01-DB2	0.3	16	Pass	0.6	22	Pass	1.1	41	Fail
10.02-2B4P L/K	0.9	N/A	Pass	2.9	N/A	Pass	3	N/A	Fail
10.02-DB1	0	15	Pass	0.2	24	Pass	0.1	40	Fail
10.02-DB2	0.5	17	Pass	1.3	25	Pass	1.6	43	Fail
10.03-2B4P L/K	2	N/A	Pass	3.2	N/A	Fail	4.6	N/A	Fail
10.03-DB1	0.2	16	Pass	1.1	23	Pass	1.3	32	Pass
10.03-DB2	1.8	17	Pass	2.6	25	Pass	3.9	35	Fail
10.04-2B4P L/K	1.7	N/A	Pass	2.8	N/A	Pass	3.8	N/A	Fail
10.04-DB1	0.2	15	Pass	0.6	24	Pass	1.1	47	Fail
10.04-DB2	0.9	14	Pass	1.2	21	Pass	2.3	34	Fail

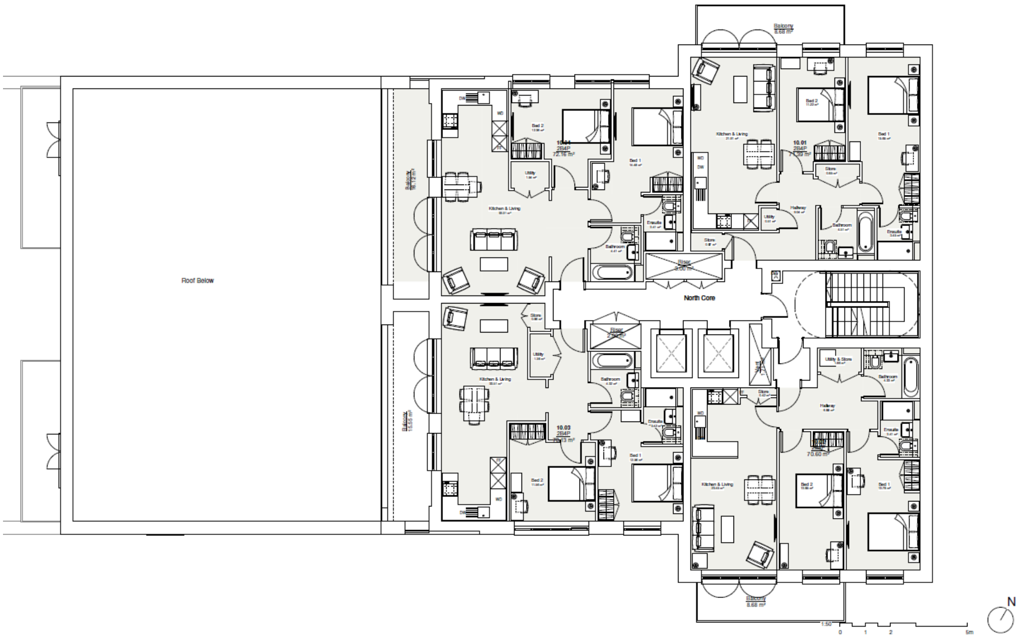
	DSY1			DSY2			DSY3		
	Crit. 1	Crit. 2		Crit. 1	Crit. 2		Crit. 1	Crit. 2	
Room	**≤ 3%**	**≤ 32hrs**	TM59	**≤ 3%**	**≤ 32hrs**	TM59	**≤ 3%**	**≤ 32hrs**	TM59
Living room/Kitchens	9/9	N/A	9/9	5/9	N/A	5/9	1/9	N/A	1/9
Double Bedrooms	20/20	20/20	20/20	19/20	18/20	17/20	1/20	1/20	1/20
Overall compliance % Pass			29/29 100%			22/29 76%			2/29 7%

APPENDIX B FLOOR LAYOUTS – ASSESSED UNITS

9th Floor



10th Floor



APPENDIX C SAP 2012 WORKSHEETS (TYPICAL FLAT)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: 7-04

Address : 9, Nestles Avenue, Hayes, HAYES, UB3 4SA

1. Overall dwelling dimensions:

	Area(m^2)		Av. Height(m)		Volume(m^3)	
Ground floor	50.31	(1a) x	2.55	(2a) =	128.29	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.31	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		128.29	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m^3 per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.16	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.41	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.4	0.39	0.39	0.35	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			6.62	x1/[1/(1.4)+ 0.04]		=	8.78			(27)
Windows Type 2			3.31	x1/[1/(1.4)+ 0.04]		=	4.39			(27)
Walls Type1	17.79	9.93	7.86	x	0.18	=	1.41			(29)
Walls Type2	17.79	2.15	15.64	x	0.18	=	2.82			(29)
Total area of elements, m²			35.58							(31)
Party wall			40.5	x	0	=	0			(32)
Party floor			50.31							(32a)
Party ceiling			50.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	19.54	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	16786	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		2.96	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	22.5	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	24.57	24.44	24.31	23.7	23.59	23.06	23.06	22.96	23.26	23.59	23.82	24.06	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	47.07	46.94	46.81	46.2	46.09	45.56	45.56	45.46	45.76	46.09	46.32	46.56	

Average = Sum(39)$_{1…12}$ /12= 46.2 (39)

TER WorkSheet: New dwelling design stage

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.94	0.93	0.93	0.92	0.92	0.91	0.91	0.9	0.91	0.92	0.92	0.93		
												Average = Sum(40)$_{1…12}$ /12=	0.92	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.56 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)														
(44)m=	82.01	79.03	76.05	73.07	70.08	67.1	67.1	70.08	73.07	76.05	79.03	82.01		
											Total = Sum(44)$_{1…12}$ =		894.68	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)														
(45)m=	121.62	106.37	109.77	95.7	91.82	79.24	73.42	84.26	85.26	99.36	108.46	117.78		
											Total = Sum(45)$_{1…12}$ =		1173.07	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)														
(46)m=	18.24	15.96	16.46	14.35	13.77	11.89	11.01	12.64	12.79	14.9	16.27	17.67		(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 1.39 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.75 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0.75 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	168.22	148.46	156.36	140.79	138.42	124.33	120.02	130.85	130.35	145.96	153.56	164.38	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	168.22	148.46	156.36	140.79	138.42	124.33	120.02	130.85	130.35	145.96	153.56	164.38	

Output from water heater (annual)$_{1 \ldots 12}$ 1721.69 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	77.72	69.04	73.77	67.89	67.81	62.42	61.69	65.29	64.42	70.31	72.14	76.44	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.05	12.48	10.15	7.68	5.74	4.85	5.24	6.81	9.14	11.61	13.55	14.44	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	148.04	149.58	145.7	137.46	127.06	117.28	110.75	109.21	113.09	121.33	131.73	141.51	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	(71)

Water heating gains (Table 5)

(72)m=	104.46	102.73	99.16	94.3	91.14	86.69	82.92	87.76	89.48	94.51	100.19	102.74	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	318.03	316.28	306.5	290.93	275.43	260.31	250.39	255.27	263.19	278.93	296.96	310.18	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast	0.9x	0.3	x	6.62	x	36.79	x	0.63	x	0.7	=	29	(77)
Southeast	0.9x	0.77	x	3.31	x	36.79	x	0.63	x	0.7	=	37.22	(77)
Southeast	0.9x	0.3	x	6.62	x	62.67	x	0.63	x	0.7	=	49.4	(77)
Southeast	0.9x	0.77	x	3.31	x	62.67	x	0.63	x	0.7	=	63.4	(77)
Southeast	0.9x	0.3	x	6.62	x	85.75	x	0.63	x	0.7	=	67.59	(77)

Southeast	0.9x	0.77	x	3.31	x	85.75	x	0.63	x	0.7	=	86.75	(77)
Southeast	0.9x	0.3	x	6.62	x	106.25	x	0.63	x	0.7	=	83.75	(77)
Southeast	0.9x	0.77	x	3.31	x	106.25	x	0.63	x	0.7	=	107.48	(77)
Southeast	0.9x	0.3	x	6.62	x	119.01	x	0.63	x	0.7	=	93.81	(77)
Southeast	0.9x	0.77	x	3.31	x	119.01	x	0.63	x	0.7	=	120.39	(77)
Southeast	0.9x	0.3	x	6.62	x	118.15	x	0.63	x	0.7	=	93.13	(77)
Southeast	0.9x	0.77	x	3.31	x	118.15	x	0.63	x	0.7	=	119.52	(77)
Southeast	0.9x	0.3	x	6.62	x	113.91	x	0.63	x	0.7	=	89.79	(77)
Southeast	0.9x	0.77	x	3.31	x	113.91	x	0.63	x	0.7	=	115.23	(77)
Southeast	0.9x	0.3	x	6.62	x	104.39	x	0.63	x	0.7	=	82.29	(77)
Southeast	0.9x	0.77	x	3.31	x	104.39	x	0.63	x	0.7	=	105.6	(77)
Southeast	0.9x	0.3	x	6.62	x	92.85	x	0.63	x	0.7	=	73.19	(77)
Southeast	0.9x	0.77	x	3.31	x	92.85	x	0.63	x	0.7	=	93.93	(77)
Southeast	0.9x	0.3	x	6.62	x	69.27	x	0.63	x	0.7	=	54.6	(77)
Southeast	0.9x	0.77	x	3.31	x	69.27	x	0.63	x	0.7	=	70.07	(77)
Southeast	0.9x	0.3	x	6.62	x	44.07	x	0.63	x	0.7	=	34.74	(77)
Southeast	0.9x	0.77	x	3.31	x	44.07	x	0.63	x	0.7	=	44.58	(77)
Southeast	0.9x	0.3	x	6.62	x	31.49	x	0.63	x	0.7	=	24.82	(77)
Southeast	0.9x	0.77	x	3.31	x	31.49	x	0.63	x	0.7	=	31.85	(77)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	66.22	112.8	154.34	191.23	214.2	212.65	205.02	187.88	167.12	124.67	79.32	56.67	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	384.26	429.08	460.84	482.16	489.63	472.96	455.41	443.15	430.31	403.6	376.28	366.85	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.97	0.91	0.8	0.6	0.44	0.47	0.7	0.92	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.21	20.35	20.55	20.77	20.92	20.99	21	21	20.97	20.79	20.47	20.19	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.14	20.14	20.15	20.15	20.16	20.16	20.16	20.16	20.15	20.15	20.15	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.96	0.89	0.74	0.53	0.36	0.39	0.63	0.89	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.1	19.3	19.58	19.89	20.08	20.16	20.16	20.16	20.14	19.93	19.47	19.07	(90)

fLA = Living area ÷ (4) = 0.4 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.54	19.72	19.96	20.24	20.42	20.49	20.5	20.5	20.47	20.27	19.87	19.51	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.54	19.72	19.96	20.24	20.42	20.49	20.5	20.5	20.47	20.27	19.87	19.51	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.89	0.76	0.56	0.39	0.42	0.66	0.9	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	379.85	419.53	439.34	429.63	372.83	264.52	177.13	185.67	282.17	362.05	366.93	363.52	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	717.56	695.66	630.24	523.95	401.79	268.21	177.47	186.2	291.55	445.67	591.5	713.02	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	251.25	185.56	142.03	67.92	21.54	0	0	0	0	62.22	161.69	260.03	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1152.24 (98)

Space heating requirement in kWh/m²/year 22.9 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.5	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	251.25	185.56	142.03	67.92	21.54	0	0	0	0	62.22	161.69	260.03		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	268.72	198.46	151.91	72.64	23.04	0	0	0	0	66.54	172.93	278.1		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1232.34	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

Output from water heater (calculated above)														
	168.22	148.46	156.36	140.79	138.42	124.33	120.02	130.85	130.35	145.96	153.56	164.38		
Efficiency of water heater													79.8	(216)
(217)m=	85.88	85.41	84.56	82.99	81.09	79.8	79.8	79.8	79.8	82.72	84.95	86.03		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	195.87	173.82	184.91	169.64	170.69	155.8	150.4	163.97	163.35	176.44	180.76	191.07		
Total = Sum(219a)$_{1...12}$ =													2076.72	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		1232.34

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Water heating fuel used			2076.72	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			248.14	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	266.19	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	448.57	(264)
Space and water heating	(261) + (262) + (263) + (264) =			714.76	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	128.78	(268)
Total CO2, kg/year		sum of (265)…(271) =		882.47	(272)

TER = 17.54 (273)

TFEE WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: 7-04

Address : 9, Nestles Avenue, Hayes, HAYES, UB3 4SA

1. Overall dwelling dimensions:

	Area(m²)			**Av. Height(m)**			**Volume(m³)**	
Ground floor	50.31	(1a)	x	2.55	(2a)	=	128.29	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	128.29	(5)

2. Ventilation rate:

	main heating		**secondary heating**		**other**		**total**		**m³ per hour**	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 20 ÷ (5) = 0.16 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) 0.41 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 3 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.78 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.31 (21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.4	0.39	0.39	0.35	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	1	=	2.15			(26)
Windows Type 1			6.62	x1/[1/(1.4)+ 0.04]		=	8.78			(27)
Windows Type 2			3.31	x1/[1/(1.4)+ 0.04]		=	4.39			(27)
Walls Type1	17.79	9.93	7.86	x	0.18	=	1.41			(29)
Walls Type2	17.79	2.15	15.64	x	0.18	=	2.82			(29)
Total area of elements, m²			35.58							(31)
Party wall			40.5	x	0	=	0			(32)
Party floor			50.31							(32a)
Party ceiling			50.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 19.54 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16786 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 2.96 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 22.5 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	24.57	24.44	24.31	23.7	23.59	23.06	23.06	22.96	23.26	23.59	23.82	24.06	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	47.07	46.94	46.81	46.2	46.09	45.56	45.56	45.46	45.76	46.09	46.32	46.56	

Average = Sum(39)$_{1…12}$ /12= 46.2 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.94	0.93	0.93	0.92	0.92	0.91	0.91	0.9	0.91	0.92	0.92	0.93

Average = Sum(40)$_{1…12}$ /12= 0.92 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.56 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	82.01	79.03	76.05	73.07	70.08	67.1	67.1	70.08	73.07	76.05	79.03	82.01

Total = Sum(44)$_{1…12}$ = 894.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.62	106.37	109.77	95.7	91.82	79.24	73.42	84.26	85.26	99.36	108.46	117.78

Total = Sum(45)$_{1…12}$ = 1173.07 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

TFEE WorkSheet: New dwelling design stage

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	103.38	90.42	93.3	81.34	78.05	67.35	62.41	71.62	72.47	84.46	92.19	100.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	103.38	90.42	93.3	81.34	78.05	67.35	62.41	71.62	72.47	84.46	92.19	100.12

Output from water heater (annual)$_{1...12}$ 997.11 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	25.84	22.6	23.33	20.34	19.51	16.84	15.6	17.9	18.12	21.11	23.05	25.03	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.05	12.48	10.15	7.68	5.74	4.85	5.24	6.81	9.14	11.61	13.55	14.44	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	148.04	149.58	145.7	137.46	127.06	117.28	110.75	109.21	113.09	121.33	131.73	141.51	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	(71)

Water heating gains (Table 5)

(72)m=	34.74	33.64	31.35	28.24	26.23	23.39	20.97	24.06	25.16	28.38	32.01	33.64	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	245.32	244.18	235.69	221.88	207.52	194.01	185.45	188.58	195.88	209.8	225.78	238.08	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast	0.9x	0.3	x	6.62	x	36.79	x	0.63	x	0.7	=	29	(77)
Southeast	0.9x	0.77	x	3.31	x	36.79	x	0.63	x	0.7	=	37.22	(77)
Southeast	0.9x	0.3	x	6.62	x	62.67	x	0.63	x	0.7	=	49.4	(77)
Southeast	0.9x	0.77	x	3.31	x	62.67	x	0.63	x	0.7	=	63.4	(77)
Southeast	0.9x	0.3	x	6.62	x	85.75	x	0.63	x	0.7	=	67.59	(77)

Southeast	0.9x	0.77	x	3.31	x	85.75	x	0.63	x	0.7	=	86.75	(77)
Southeast	0.9x	0.3	x	6.62	x	106.25	x	0.63	x	0.7	=	83.75	(77)
Southeast	0.9x	0.77	x	3.31	x	106.25	x	0.63	x	0.7	=	107.48	(77)
Southeast	0.9x	0.3	x	6.62	x	119.01	x	0.63	x	0.7	=	93.81	(77)
Southeast	0.9x	0.77	x	3.31	x	119.01	x	0.63	x	0.7	=	120.39	(77)
Southeast	0.9x	0.3	x	6.62	x	118.15	x	0.63	x	0.7	=	93.13	(77)
Southeast	0.9x	0.77	x	3.31	x	118.15	x	0.63	x	0.7	=	119.52	(77)
Southeast	0.9x	0.3	x	6.62	x	113.91	x	0.63	x	0.7	=	89.79	(77)
Southeast	0.9x	0.77	x	3.31	x	113.91	x	0.63	x	0.7	=	115.23	(77)
Southeast	0.9x	0.3	x	6.62	x	104.39	x	0.63	x	0.7	=	82.29	(77)
Southeast	0.9x	0.77	x	3.31	x	104.39	x	0.63	x	0.7	=	105.6	(77)
Southeast	0.9x	0.3	x	6.62	x	92.85	x	0.63	x	0.7	=	73.19	(77)
Southeast	0.9x	0.77	x	3.31	x	92.85	x	0.63	x	0.7	=	93.93	(77)
Southeast	0.9x	0.3	x	6.62	x	69.27	x	0.63	x	0.7	=	54.6	(77)
Southeast	0.9x	0.77	x	3.31	x	69.27	x	0.63	x	0.7	=	70.07	(77)
Southeast	0.9x	0.3	x	6.62	x	44.07	x	0.63	x	0.7	=	34.74	(77)
Southeast	0.9x	0.77	x	3.31	x	44.07	x	0.63	x	0.7	=	44.58	(77)
Southeast	0.9x	0.3	x	6.62	x	31.49	x	0.63	x	0.7	=	24.82	(77)
Southeast	0.9x	0.77	x	3.31	x	31.49	x	0.63	x	0.7	=	31.85	(77)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	66.22	112.8	154.34	191.23	214.2	212.65	205.02	187.88	167.12	124.67	79.32	56.67	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	311.54	356.98	390.03	413.11	421.72	406.65	390.47	376.46	363	334.47	305.1	294.75	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.95	0.87	0.69	0.51	0.55	0.79	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.08	20.22	20.43	20.68	20.88	20.98	21	20.99	20.95	20.69	20.34	20.05	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.14	20.14	20.14	20.15	20.15	20.16	20.16	20.16	20.16	20.15	20.15	20.15	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.98	0.94	0.82	0.61	0.41	0.45	0.72	0.95	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.29	19.44	19.64	19.89	20.07	20.15	20.16	20.16	20.13	19.91	19.56	19.27	(90)

fLA = Living area ÷ (4) = 0.4 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.6	19.75	19.95	20.2	20.39	20.48	20.49	20.49	20.45	20.22	19.87	19.58	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.6	19.75	19.95	20.2	20.39	20.48	20.49	20.49	20.45	20.22	19.87	19.58	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.98	0.94	0.84	0.64	0.45	0.49	0.75	0.95	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	310.33	353.73	381.25	387.21	352.23	260.4	176.65	184.87	271.9	317.22	302.34	293.91	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	720.46	697.06	629.85	522.33	400.57	267.91	177.43	186.14	290.82	443.55	591.53	716.23	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	305.14	230.72	184.96	97.29	35.96	0	0	0	0	93.99	208.22	314.21	

Total per year (kWh/year) = $\text{Sum}(98)_{1...5,9...12}$ = 1470.49 (98)

Space heating requirement in kWh/m²/year 29.23 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)													
(100)m=	0	0	0	0	0	428.26	337.14	345.51	0	0	0	0	(100)
Utilisation factor for loss hm													
(101)m=	0	0	0	0	0	0.96	0.98	0.98	0	0	0	0	(101)
Useful loss, hmLm (Watts) = (100)m x (101)m													
(102)m=	0	0	0	0	0	409.31	331.18	337.47	0	0	0	0	(102)
Gains (solar gains calculated for applicable weather region, see Table 10)													
(103)m=	0	0	0	0	0	586.35	564.58	545.55	0	0	0	0	(103)
Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m set (104)m to zero if (104)m < 3 × (98)m													
(104)m=	0	0	0	0	0	127.47	173.65	154.81	0	0	0	0	

Total = $\text{Sum}(104)_{6..8}$ = 455.93 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = $\text{Sum}(104)_{6..8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	31.87	43.41	38.7	0	0	0	0

Total = $\text{Sum}(107)_{6..8}$ = 113.98 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 2.27 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 31.49 (109)

Target Fabric Energy Efficiency (TFEE) 36.22 (109)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: 7-04

Address : 9, Nestles Avenue, Hayes, HAYES, UB3 4SA

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	50.31	(1a)	x	2.55	(2a)	=	128.29	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			128.29	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.15	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.12	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.05	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	2.2	=	4.73			(26)
Windows Type 1			6.62	x1/[1/(1.2)+ 0.04]		=	7.58			(27)
Windows Type 2			3.31	x1/[1/(1.2)+ 0.04]		=	3.79			(27)
Walls Type1	17.79	9.93	7.86	x	0.16	=	1.26			(29)
Walls Type2	17.79	2.15	15.64	x	0.15	=	2.35			(29)
Total area of elements, m²			35.58							(31)
Party wall			40.5	x	0	=	0			(32)
Party floor			50.31							(32a)
Party ceiling			50.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	19.71	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	16786	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		5.96	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	25.67	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.71	10.59	10.46	9.85	9.73	9.11	9.11	8.99	9.36	9.73	9.97	10.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	36.38	36.26	36.13	35.52	35.39	34.78	34.78	34.66	35.03	35.39	35.64	35.89	

Average = Sum(39)$_{1…12}$ /12= 35.49 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.72	0.72	0.72	0.71	0.7	0.69	0.69	0.69	0.7	0.7	0.71	0.71

Average = Sum(40)$_{1…12}$ /12= 0.71 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.56 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	82.01	79.03	76.05	73.07	70.08	67.1	67.1	70.08	73.07	76.05	79.03	82.01	

Total = Sum(44)$_{1…12}$ = 894.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.62	106.37	109.77	95.7	91.82	79.24	73.42	84.26	85.26	99.36	108.46	117.78

Total = Sum(45)$_{1…12}$ = 1173.07 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.24	15.96	16.46	14.35	13.77	11.89	11.01	12.64	12.79	14.9	16.27	17.67	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	176.9	156.3	165.04	149.19	147.1	132.73	128.7	139.53	138.76	154.64	161.96	173.06	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	176.9	156.3	165.04	149.19	147.1	132.73	128.7	139.53	138.76	154.64	161.96	173.06

Output from water heater (annual)$_{1…12}$ 1823.91 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.66	75.31	80.72	74.61	74.75	69.14	68.63	72.24	71.14	77.26	78.86	83.38	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.23	12.64	10.28	7.78	5.82	4.91	5.31	6.9	9.26	11.76	13.72	14.63	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	148.04	149.58	145.7	137.46	127.06	117.28	110.75	109.21	113.09	121.33	131.73	141.51	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	(71)

Water heating gains (Table 5)

(72)m=	113.79	112.07	108.49	103.63	100.47	96.03	92.25	97.09	98.81	103.84	109.53	112.08	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	324.55	322.77	312.96	297.36	281.84	266.71	256.8	261.69	269.64	285.42	303.47	316.7	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast	0.9x	0.3	x	6.62	x	36.79	x	0.4	x	0.66	=	17.36	(77)
Southeast	0.9x	0.77	x	3.31	x	36.79	x	0.4	x	0.66	=	22.28	(77)
Southeast	0.9x	0.3	x	6.62	x	62.67	x	0.4	x	0.66	=	29.57	(77)
Southeast	0.9x	0.77	x	3.31	x	62.67	x	0.4	x	0.66	=	37.95	(77)
Southeast	0.9x	0.3	x	6.62	x	85.75	x	0.4	x	0.66	=	40.46	(77)

Southeast 0.9x	0.77	x	3.31	x	85.75	x	0.4	x	0.66	=	51.93	(77)
Southeast 0.9x	0.3	x	6.62	x	106.25	x	0.4	x	0.66	=	50.14	(77)
Southeast 0.9x	0.77	x	3.31	x	106.25	x	0.4	x	0.66	=	64.34	(77)
Southeast 0.9x	0.3	x	6.62	x	119.01	x	0.4	x	0.66	=	56.16	(77)
Southeast 0.9x	0.77	x	3.31	x	119.01	x	0.4	x	0.66	=	72.07	(77)
Southeast 0.9x	0.3	x	6.62	x	118.15	x	0.4	x	0.66	=	55.75	(77)
Southeast 0.9x	0.77	x	3.31	x	118.15	x	0.4	x	0.66	=	71.55	(77)
Southeast 0.9x	0.3	x	6.62	x	113.91	x	0.4	x	0.66	=	53.75	(77)
Southeast 0.9x	0.77	x	3.31	x	113.91	x	0.4	x	0.66	=	68.98	(77)
Southeast 0.9x	0.3	x	6.62	x	104.39	x	0.4	x	0.66	=	49.26	(77)
Southeast 0.9x	0.77	x	3.31	x	104.39	x	0.4	x	0.66	=	63.22	(77)
Southeast 0.9x	0.3	x	6.62	x	92.85	x	0.4	x	0.66	=	43.81	(77)
Southeast 0.9x	0.77	x	3.31	x	92.85	x	0.4	x	0.66	=	56.23	(77)
Southeast 0.9x	0.3	x	6.62	x	69.27	x	0.4	x	0.66	=	32.69	(77)
Southeast 0.9x	0.77	x	3.31	x	69.27	x	0.4	x	0.66	=	41.95	(77)
Southeast 0.9x	0.3	x	6.62	x	44.07	x	0.4	x	0.66	=	20.8	(77)
Southeast 0.9x	0.77	x	3.31	x	44.07	x	0.4	x	0.66	=	26.69	(77)
Southeast 0.9x	0.3	x	6.62	x	31.49	x	0.4	x	0.66	=	14.86	(77)
Southeast 0.9x	0.77	x	3.31	x	31.49	x	0.4	x	0.66	=	19.07	(77)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.64	67.53	92.39	114.48	128.23	127.3	122.73	112.47	100.04	74.63	47.48	33.93	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	364.19	390.3	405.36	411.84	410.07	394.01	379.53	374.17	369.69	360.05	350.95	350.63	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.9	0.77	0.56	0.4	0.43	0.64	0.89	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.5	20.59	20.73	20.88	20.97	21	21	21	20.99	20.91	20.69	20.48	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.32	20.32	20.32	20.34	20.34	20.35	20.35	20.35	20.34	20.34	20.33	20.33	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.88	0.72	0.51	0.34	0.37	0.59	0.86	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.66	19.8	19.99	20.2	20.31	20.35	20.35	20.35	20.34	20.24	19.94	19.64	(90)

fLA = Living area ÷ (4) = 0.4 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.99	20.11	20.28	20.47	20.57	20.61	20.61	20.61	20.6	20.5	20.24	19.98	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.99	20.11	20.28	20.47	20.57	20.61	20.61	20.61	20.6	20.5	20.24	19.98	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.95	0.88	0.74	0.53	0.37	0.39	0.61	0.87	0.97	0.99	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	359.35	381.05	385.6	363.35	303.24	208.14	139.35	145.81	225.48	313.7	340.02	346.87	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	570.95	551.6	498.01	411.01	314.07	208.89	139.39	145.87	227.66	350.52	468.35	566.17	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	157.43	114.62	83.63	34.32	8.06	0	0	0	0	27.39	92.4	163.16

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 681 (98)

Space heating requirement in kWh/m²/year 13.54 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers 1 (303a)

Fraction of total space heat from Community boilers (302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.05 (306)

Space heating **kWh/year**

Annual space heating requirement 681

Space heat from Community boilers (98) x (304a) x (305) x (306) = 715.05 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0 (308

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = 0 (309)

Water heating

Annual water heating requirement 1823.91

If DHW from community scheme:
Water heat from Community boilers (64) x (303a) x (305) x (306) = 1915.1 (310a)

Electricity used for heat distribution 0.01 × [(307a)…(307e) + (310a)…(310e)] = 26.3 (313)

Cooling System Energy Efficiency Ratio 0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0) = (107) ÷ (314) = 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):
mechanical ventilation - balanced, extract or positive input from outside 119.34 (330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.34	(331)
Energy for lighting (calculated in Appendix L)		251.33	(332)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP)					
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel			95	(367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	=	598.01	(367)
Electrical energy for heat distribution	[(313) x	0.52	=	13.65	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)		=	611.66	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =			611.66	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	61.94	(378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	130.44	(379)
Total CO2, kg/year	sum of (376)…(382) =			804.04	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =			15.98	(384)
EI rating (section 14)				88.7	(385)

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User Details:

Assessor Name:	Panagiotis Dalapas	**Stroma Number:**	STRO030082
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.26

Property Address: 7-04

Address : 9, Nestles Avenue, Hayes, HAYES, UB3 4SA

1. Overall dwelling dimensions:

	Area(m²)			**Av. Height(m)**			**Volume(m³)**	
Ground floor	50.31	(1a)	x	2.55	(2a)	=	128.29	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.31	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			128.29	(5)

2. Ventilation rate:

	main heating		**secondary heating**		**other**		**total**		**m³ per hour**	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 20 ÷ (5) = 0.16 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.31	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.24	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.3	0.3	0.29	0.26	0.25	0.23	0.23	0.22	0.24	0.25	0.27	0.28

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.52	0.53	0.53	0.54	0.54	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.52	0.53	0.53	0.54	0.54	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	2.2	=	4.73			(26)
Windows Type 1			6.62	x1/[1/(1.2)+ 0.04]		=	7.58			(27)
Windows Type 2			3.31	x1/[1/(1.2)+ 0.04]		=	3.79			(27)
Walls Type1	17.79	9.93	7.86	x	0.16	=	1.26			(29)
Walls Type2	17.79	2.15	15.64	x	0.15	=	2.35			(29)
Total area of elements, m²			35.58							(31)
Party wall			40.5	x	0	=	0			(32)
Party floor			50.31							(32a)
Party ceiling			50.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 19.71 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16786 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.96 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 25.67 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.1	23.03	22.95	22.61	22.54	22.24	22.24	22.19	22.36	22.54	22.67	22.81	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	48.77	48.7	48.62	48.28	48.21	47.91	47.91	47.85	48.03	48.21	48.34	48.48	

Average = Sum(39)$_{1…12}$ /12= 48.28 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.97	0.97	0.97	0.96	0.96	0.95	0.95	0.95	0.95	0.96	0.96	0.96

Average = Sum(40)$_{1\ldots12}$ /12= 0.96 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.56 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	82.01	79.03	76.05	73.07	70.08	67.1	67.1	70.08	73.07	76.05	79.03	82.01

Total = Sum(44)$_{1\ldots12}$ = 894.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.62	106.37	109.77	95.7	91.82	79.24	73.42	84.26	85.26	99.36	108.46	117.78

Total = Sum(45)$_{1\ldots12}$ = 1173.07 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	0	0	0	0	0	0	0	0	0	0	0	0	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	103.38	90.42	93.3	81.34	78.05	67.35	62.41	71.62	72.47	84.46	92.19	100.12	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	103.38	90.42	93.3	81.34	78.05	67.35	62.41	71.62	72.47	84.46	92.19	100.12	

Output from water heater (annual)$_{1…12}$ 997.11 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	25.84	22.6	23.33	20.34	19.51	16.84	15.6	17.9	18.12	21.11	23.05	25.03	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.23	12.64	10.28	7.78	5.82	4.91	5.31	6.9	9.26	11.76	13.72	14.63	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	148.04	149.58	145.7	137.46	127.06	117.28	110.75	109.21	113.09	121.33	131.73	141.51	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	(71)

Water heating gains (Table 5)

(72)m=	34.74	33.64	31.35	28.24	26.23	23.39	20.97	24.06	25.16	28.38	32.01	33.64	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	245.5	244.34	235.82	221.98	207.59	194.07	185.52	188.67	196	209.95	225.95	238.26	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.3	x	6.62	x	36.79	x	0.4	x	0.66	=	17.36	(77)
Southeast 0.9x	0.77	x	3.31	x	36.79	x	0.4	x	0.66	=	22.28	(77)
Southeast 0.9x	0.3	x	6.62	x	62.67	x	0.4	x	0.66	=	29.57	(77)
Southeast 0.9x	0.77	x	3.31	x	62.67	x	0.4	x	0.66	=	37.95	(77)
Southeast 0.9x	0.3	x	6.62	x	85.75	x	0.4	x	0.66	=	40.46	(77)

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Southeast 0.9x	0.77	x	3.31	x	85.75	x	0.4	x	0.66	=	51.93	(77)
Southeast 0.9x	0.3	x	6.62	x	106.25	x	0.4	x	0.66	=	50.14	(77)
Southeast 0.9x	0.77	x	3.31	x	106.25	x	0.4	x	0.66	=	64.34	(77)
Southeast 0.9x	0.3	x	6.62	x	119.01	x	0.4	x	0.66	=	56.16	(77)
Southeast 0.9x	0.77	x	3.31	x	119.01	x	0.4	x	0.66	=	72.07	(77)
Southeast 0.9x	0.3	x	6.62	x	118.15	x	0.4	x	0.66	=	55.75	(77)
Southeast 0.9x	0.77	x	3.31	x	118.15	x	0.4	x	0.66	=	71.55	(77)
Southeast 0.9x	0.3	x	6.62	x	113.91	x	0.4	x	0.66	=	53.75	(77)
Southeast 0.9x	0.77	x	3.31	x	113.91	x	0.4	x	0.66	=	68.98	(77)
Southeast 0.9x	0.3	x	6.62	x	104.39	x	0.4	x	0.66	=	49.26	(77)
Southeast 0.9x	0.77	x	3.31	x	104.39	x	0.4	x	0.66	=	63.22	(77)
Southeast 0.9x	0.3	x	6.62	x	92.85	x	0.4	x	0.66	=	43.81	(77)
Southeast 0.9x	0.77	x	3.31	x	92.85	x	0.4	x	0.66	=	56.23	(77)
Southeast 0.9x	0.3	x	6.62	x	69.27	x	0.4	x	0.66	=	32.69	(77)
Southeast 0.9x	0.77	x	3.31	x	69.27	x	0.4	x	0.66	=	41.95	(77)
Southeast 0.9x	0.3	x	6.62	x	44.07	x	0.4	x	0.66	=	20.8	(77)
Southeast 0.9x	0.77	x	3.31	x	44.07	x	0.4	x	0.66	=	26.69	(77)
Southeast 0.9x	0.3	x	6.62	x	31.49	x	0.4	x	0.66	=	14.86	(77)
Southeast 0.9x	0.77	x	3.31	x	31.49	x	0.4	x	0.66	=	19.07	(77)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.64	67.53	92.39	114.48	128.23	127.3	122.73	112.47	100.04	74.63	47.48	33.93	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	285.14	311.87	328.22	336.46	335.82	321.37	308.25	301.14	296.04	284.58	273.43	272.19	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.95	0.83	0.66	0.7	0.9	0.98	1	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.98	20.09	20.27	20.51	20.75	20.92	20.98	20.98	20.87	20.57	20.23	19.95	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.11	20.11	20.11	20.12	20.12	20.12	20.12	20.12	20.12	20.12	20.12	20.11	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	1	0.99	0.98	0.92	0.76	0.54	0.58	0.84	0.98	1	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.17	19.28	19.46	19.7	19.93	20.08	20.12	20.12	20.05	19.77	19.43	19.15	(90)

fLA = Living area ÷ (4) = 0.4 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.49	19.6	19.78	20.03	20.26	20.42	20.46	20.46	20.37	20.09	19.75	19.47	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.49	19.6	19.78	20.03	20.26	20.42	20.46	20.46	20.37	20.09	19.75	19.47	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains, hm:

(94)m=	1	1	0.99	0.97	0.93	0.79	0.59	0.63	0.86	0.98	0.99	1	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	284.43	310.42	324.98	327.86	310.89	253.01	181.28	188.78	255.04	277.55	272.03	271.67	(95)

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)

Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]

(97)m=	740.91	715.89	645.84	537.09	412.52	278.79	185.12	194.33	301.36	457.43	611.31	740.19	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	339.62	272.47	238.72	150.64	75.62	0	0	0	0	133.83	244.28	348.58

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1803.76 (98)

Space heating requirement in kWh/m²/year 35.85 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Heat loss rate Lm (calculated using 25°C internal temperature and external temperature from Table 10)

(100)m=	0	0	0	0	0	450.36	354.54	363.7	0	0	0	0	(100)

Utilisation factor for loss hm

(101)m=	0	0	0	0	0	0.87	0.94	0.92	0	0	0	0	(101)

Useful loss, hmLm (Watts) = (100)m x (101)m

(102)m=	0	0	0	0	0	391.93	331.57	335.69	0	0	0	0	(102)

Gains (solar gains calculated for applicable weather region, see Table 10)

(103)m=	0	0	0	0	0	468.14	450.63	441.18	0	0	0	0	(103)

Space cooling requirement for month, whole dwelling, continuous (kWh) = 0.024 x [(103)m – (102)m] x (41)m
set (104)m to zero if (104)m < 3 × (98)m

(104)m=	0	0	0	0	0	54.87	88.58	78.48	0	0	0	0

Total = Sum(104)$_{6...8}$ = 221.93 (104)

Cooled fraction f C = cooled area ÷ (4) = 1 (105)

Intermittency factor (Table 10b)

(106)m=	0	0	0	0	0	0.25	0.25	0.25	0	0	0	0

Total = Sum(104)$_{6...8}$ = 0 (106)

Space cooling requirement for month = (104)m × (105) × (106)m

(107)m=	0	0	0	0	0	13.72	22.14	19.62	0	0	0	0

Total = Sum(107)$_{6...8}$ = 55.48 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 1.1 (108)

8f. Fabric Energy Efficiency (calculated only under special conditions, see section 11)

Fabric Energy Efficiency (99) + (108) = 36.96 (109)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: Panagiotis Dalapas
Stroma Number: STRO030082
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.26

Property Address: 7-04

Address : 9, Nestles Avenue, Hayes, HAYES, UB3 4SA

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	50.31	(1a)	x	2.55	(2a)	=	128.29	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.31	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	128.29	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 0 ÷ (5) = 0 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3 (17)

If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) 0.15 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 3 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.78 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.12 (21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.25	0.25	0.25	0.23	0.23	0.22	0.22	0.21	0.22	0.23	0.24	0.24	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2.15	x	2.2	=	4.73			(26)
Windows Type 1			6.62	x1/[1/(1.2)+ 0.04]		=	7.58			(27)
Windows Type 2			3.31	x1/[1/(1.2)+ 0.04]		=	3.79			(27)
Walls Type1	17.79	9.93	7.86	x	0.16	=	1.26			(29)
Walls Type2	17.79	2.15	15.64	x	0.15	=	2.35			(29)
Total area of elements, m²			35.58							(31)
Party wall			40.5	x	0	=	0			(32)
Party floor			50.31							(32a)
Party ceiling			50.31							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 19.71 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 16786 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.96 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 25.67 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	10.71	10.59	10.46	9.85	9.73	9.11	9.11	8.99	9.36	9.73	9.97	10.22	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	36.38	36.26	36.13	35.52	35.39	34.78	34.78	34.66	35.03	35.39	35.64	35.89	

Average = Sum(39)$_{1…12}$ /12= 35.49 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	0.72	0.72	0.72	0.71	0.7	0.69	0.69	0.69	0.7	0.7	0.71	0.71

Average = Sum(40)$_{1…12}$ /12= 0.71 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.7 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.56 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	82.01	79.03	76.05	73.07	70.08	67.1	67.1	70.08	73.07	76.05	79.03	82.01

Total = Sum(44)$_{1…12}$ = 894.68 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	121.62	106.37	109.77	95.7	91.82	79.24	73.42	84.26	85.26	99.36	108.46	117.78

Total = Sum(45)$_{1…12}$ = 1173.07 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.24	15.96	16.46	14.35	13.77	11.89	11.01	12.64	12.79	14.9	16.27	17.67	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 110 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	176.9	156.3	165.04	149.19	147.1	132.73	128.7	139.53	138.76	154.64	161.96	173.06	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	176.9	156.3	165.04	149.19	147.1	132.73	128.7	139.53	138.76	154.64	161.96	173.06	

Output from water heater (annual)$_{1\ldots12}$ 1823.91 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	84.66	75.31	80.72	74.61	74.75	69.14	68.63	72.24	71.14	77.26	78.86	83.38	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	84.96	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	14.23	12.64	10.28	7.78	5.82	4.91	5.31	6.9	9.26	11.76	13.72	14.63	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	148.04	149.58	145.7	137.46	127.06	117.28	110.75	109.21	113.09	121.33	131.73	141.51	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	-67.97	(71)

Water heating gains (Table 5)

(72)m=	113.79	112.07	108.49	103.63	100.47	96.03	92.25	97.09	98.81	103.84	109.53	112.08	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	324.55	322.77	312.96	297.36	281.84	266.71	256.8	261.69	269.64	285.42	303.47	316.7	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.3	x	6.62	x	36.79	x	0.4	x	0.66	=	17.36	(77)
Southeast 0.9x	0.77	x	3.31	x	36.79	x	0.4	x	0.66	=	22.28	(77)
Southeast 0.9x	0.3	x	6.62	x	62.67	x	0.4	x	0.66	=	29.57	(77)
Southeast 0.9x	0.77	x	3.31	x	62.67	x	0.4	x	0.66	=	37.95	(77)
Southeast 0.9x	0.3	x	6.62	x	85.75	x	0.4	x	0.66	=	40.46	(77)

Southeast	0.9x	0.77	x	3.31	x	85.75	x	0.4	x	0.66	=	51.93	(77)
Southeast	0.9x	0.3	x	6.62	x	106.25	x	0.4	x	0.66	=	50.14	(77)
Southeast	0.9x	0.77	x	3.31	x	106.25	x	0.4	x	0.66	=	64.34	(77)
Southeast	0.9x	0.3	x	6.62	x	119.01	x	0.4	x	0.66	=	56.16	(77)
Southeast	0.9x	0.77	x	3.31	x	119.01	x	0.4	x	0.66	=	72.07	(77)
Southeast	0.9x	0.3	x	6.62	x	118.15	x	0.4	x	0.66	=	55.75	(77)
Southeast	0.9x	0.77	x	3.31	x	118.15	x	0.4	x	0.66	=	71.55	(77)
Southeast	0.9x	0.3	x	6.62	x	113.91	x	0.4	x	0.66	=	53.75	(77)
Southeast	0.9x	0.77	x	3.31	x	113.91	x	0.4	x	0.66	=	68.98	(77)
Southeast	0.9x	0.3	x	6.62	x	104.39	x	0.4	x	0.66	=	49.26	(77)
Southeast	0.9x	0.77	x	3.31	x	104.39	x	0.4	x	0.66	=	63.22	(77)
Southeast	0.9x	0.3	x	6.62	x	92.85	x	0.4	x	0.66	=	43.81	(77)
Southeast	0.9x	0.77	x	3.31	x	92.85	x	0.4	x	0.66	=	56.23	(77)
Southeast	0.9x	0.3	x	6.62	x	69.27	x	0.4	x	0.66	=	32.69	(77)
Southeast	0.9x	0.77	x	3.31	x	69.27	x	0.4	x	0.66	=	41.95	(77)
Southeast	0.9x	0.3	x	6.62	x	44.07	x	0.4	x	0.66	=	20.8	(77)
Southeast	0.9x	0.77	x	3.31	x	44.07	x	0.4	x	0.66	=	26.69	(77)
Southeast	0.9x	0.3	x	6.62	x	31.49	x	0.4	x	0.66	=	14.86	(77)
Southeast	0.9x	0.77	x	3.31	x	31.49	x	0.4	x	0.66	=	19.07	(77)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	39.64	67.53	92.39	114.48	128.23	127.3	122.73	112.47	100.04	74.63	47.48	33.93	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	364.19	390.3	405.36	411.84	410.07	394.01	379.53	374.17	369.69	360.05	350.95	350.63	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.96	0.9	0.77	0.56	0.4	0.43	0.64	0.89	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.5	20.59	20.73	20.88	20.97	21	21	21	20.99	20.91	20.69	20.48	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.32	20.32	20.32	20.34	20.34	20.35	20.35	20.35	20.34	20.34	20.33	20.33	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.95	0.88	0.72	0.51	0.34	0.37	0.59	0.86	0.97	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.66	19.8	19.99	20.2	20.31	20.35	20.35	20.35	20.34	20.24	19.94	19.64	(90)

fLA = Living area ÷ (4) = 0.4 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.99	20.11	20.28	20.47	20.57	20.61	20.61	20.61	20.6	20.5	20.24	19.98	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.99	20.11	20.28	20.47	20.57	20.61	20.61	20.61	20.6	20.5	20.24	19.98	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.95	0.88	0.74	0.53	0.37	0.39	0.61	0.87	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	359.35	381.05	385.6	363.35	303.24	208.14	139.35	145.81	225.48	313.7	340.02	346.87	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	570.95	551.6	498.01	411.01	314.07	208.89	139.39	145.87	227.66	350.52	468.35	566.17	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	157.43	114.62	83.63	34.32	8.06	0	0	0	0	27.39	92.4	163.16	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 681 (98)

Space heating requirement in kWh/m²/year 13.54 (99)

9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none 0 (301)

Fraction of space heat from community system 1 – (301) = 1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump 0.8 (303a)

Fraction of community heat from heat source 2 0.2 (303b)

Fraction of total space heat from Community heat pump (302) x (303a) = 0.8 (304a)

Fraction of total space heat from community heat source 2 (302) x (303b) = 0.2 (304b)

Factor for control and charging method (Table 4c(3)) for community heating system 1 (305)

Distribution loss factor (Table 12c) for community heating system 1.08 (306)

Space heating **kWh/year**

Annual space heating requirement 681

Space heat from Community heat pump (98) x (304a) x (305) x (306) = 588.39 (307a)

Space heat from heat source 2 (98) x (304b) x (305) x (306) = 147.1 (307b)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0 (308

Space heating requirement from secondary/supplementary system (98) x (301) x 100 ÷ (308) = 0 (309)

Water heating

Annual water heating requirement 1823.91

If DHW from community scheme:

Water heat from Community heat pump (64) x (303a) x (305) x (306) = 1575.86 (310a)

Water heat from heat source 2 (64) x (303b) x (305) x (306) = 393.96 (310b)

Electricity used for heat distribution 0.01 × [(307a)…(307e) + (310a)…(310e)] = 27.05 (313)

DER WorkSheet: New dwelling design stage

Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	= (107) ÷ (314) =	0	(315)
Electricity for pumps and fans within dwelling (Table 4f): mechanical ventilation - balanced, extract or positive input from outside		119.34	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	=(330a) + (330b) + (330g) =	119.34	(331)
Energy for lighting (calculated in Appendix L)		251.33	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-32.93	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

12b. CO2 Emissions – Community heating scheme

		Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
CO2 from other sources of space and water heating (not CHP) Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				285	(367a)
Efficiency of heat source 2 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel				95	(367b)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.52	=	394.12	(367)
CO2 associated with heat source 2	[(307b)+(310b)] x 100 ÷ (367b) x		0.22	=	123.02	(368)
Electrical energy for heat distribution	[(313) x		0.52	=	14.04	(372)
Total CO2 associated with community systems	(363)…(366) + (368)...(372)			=	531.18	(373)
CO2 associated with space heating (secondary)	(309) x		0	=	0	(374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.52	=	0	(375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =				531.18	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x		0.52	=	61.94	(378)
CO2 associated with electricity for lighting	(332))) x		0.52	=	130.44	(379)
Energy saving/generation technologies (333) to (334) as applicable Item 1			0.52	x 0.01 =	-17.09	(380)
Total CO2, kg/year	sum of (376)…(382) =				706.47	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =				14.04	(384)
EI rating (section 14)					90.07	(385)

APPENDIX D GLA CO2 REPORTING SPREADSHEET

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 CO2 PERFORMANCE

SAP10 CO2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO₂ 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		REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - TER WORKSHEET						
				Calculated TER 2012 (kgCO2 / m2)	TER Worksheet TER 2012 (kgCO2 / m2)	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
G-07	*87.44*	*5*	*466.66*	**14.7**	**14.7**	*2388.25*	*Natural Gas*	*2454.67*	*Natural Gas*	*382.46*	*75*	
G-07M	*87.44*	*4*	*350.75*	**14.7**	**14.7**	*2388.25*	*Natural Gas*	*2454.67*	*Natural Gas*	*382.46*	*75*	
1-02	*59.58*	*7*	*381*	**20.8**	**20.8**	*2677.05*	*Natural Gas*	*2162.14*	*Natural Gas*	*299.02*	*75*	
1-02M	*59.58*	*1*	*71.49*	**19.8**	**19.8**	*2395.05*	*Natural Gas*	*2167.89*	*Natural Gas*	*299.02*	*75*	
7-04	*50.31*	*24*	*1234.23*	**17.5**	**17.5**	*1232.34*	*Natural Gas*	*2076.72*	*Natural Gas*	*248.14*	*75*	
7-04M	*50.31*	*26*	*1347.09*	**18.6**	**18.6**	*1485.16*	*Natural Gas*	*2067.33*	*Natural Gas*	*248.14*	*75*	
9-02	*70.75*	*8*	*565.96*	**17.5**	**17.5**	*2421.35*	*Natural Gas*	*2302.14*	*Natural Gas*	*340.95*	*75*	
9-02M	*70.75*	*8*	*551.12*	**18.5**	**18.5**	*2764.18*	*Natural Gas*	*2294.66*	*Natural Gas*	*340.95*	*75*	
9-03	*80.32*	*5*	*349.54*	**15.6**	**15.6**	*2399.49*	*Natural Gas*	*2401.26*	*Natural Gas*	*346.54*	*75*	
9-03M	*80.32*	*5*	*415.03*	**16.6**	**16.6**	*2779.62*	*Natural Gas*	*2392.39*	*Natural Gas*	*346.54*	*75*	
10-02	*70.6*	*1*	*70.6*	**19.4**	**19.4**	*3105.32*	*Natural Gas*	*2289.98*	*Natural Gas*	*317.54*	*75*	
10-02M	*70.6*	*1*	*70.39*	**21.2**	**21.2**	*3691.03*	*Natural Gas*	*2280.79*	*Natural Gas*	*317.54*	*75*	
10-03	*70.13*	*4*	*267.17*	**20.6**	**20.7**	*3478.82*	*Natural Gas*	*2278.15*	*Natural Gas*	*319.16*	*75*	
10-03M	*70.13*	*4*	*331.21*	**21.7**	**21.7**	*3827.39*	*Natural Gas*	*2273.28*	*Natural Gas*	*319.16*	*75*	
Sum	6,417	103	6,472	18.1	-	214,220	N/A	226,506	N/A	30,350	7,725	0

Unit identifier (e.g. plot number, dwelling type etc.)	REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.)						REGULATED CO2 EMISSIONS PER UNIT						
	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated TER SAP10 (kgCO2 / m2)
G-07	516	530	198	39		1,283	502	515	89	17		1,124	12.8
G-07M	516	530	198	39		1,283	502	515	89	17		1,124	12.8
1-02	578	467	155	39		1,239	562	454	70	17		1,103	18.5
1-02M	517	468	155	39		1,180	503	455	70	17		1,045	17.5
7-04	266	449	129	39		882	259	436	58	17		770	15.3
7-04M	321	447	129	39		935	312	434	58	17		821	16.3
9-02	523	497	177	39		1,236	508	483	79	17		1,089	15.4
9-02M	597	496	177	39		1,309	580	482	79	17		1,159	16.4
9-03	518	519	180	39		1,256	504	504	81	17		1,106	13.8
9-03M	600	517	180	39		1,336	584	502	81	17		1,184	14.7
10-02	671	495	165	39		1,369	652	481	74	17		1,224	17.3
10-02M	797	493	165	39		1,494	775	479	74	17		1,346	19.1
10-03	751	492	166	39		1,448	731	478	74	17		1,301	18.5
10-03M	827	491	166	39		1,522	804	477	74	17		1,373	19.6
Sum	46,272	48,925	15,752	4,009	0	*116,040*	44,986	47,566	7,072	1,800	0	*102,381*	16.0

NON-DOMESTIC ENERGY CONSUMPTION AND CO₂ ANALYSIS

Building Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK		REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) TER - SOURCE: BRUKL OUTPUT						
				Calculated TER 2012 (kgCO2 / m2)	BRUKL TER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling
Sum	0	0	0		-	0	0	0	0	0	0	0

Building Use	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) TER - SOURCE: BRUKL.INP or *SIM.CSV FILE						REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) - TER BRUKL					REGULATED CO2 EMISSIONS	
	Natural Gas	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)	Natural Gas	Grid Electricity				SAP10 CO2 emissions (kgCO2 p.a.)	BRUKL TER SAP10 (kgCO2 / m2)
	##############	##############					##############	##############					
Sum	0	0	N/A	N/A	N/A	*0*	0	0	N/A	N/A	N/A	*0*	#DIV/0!

SITE-WIDE ENERGY CONSUMPTION AND CO₂ ANALYSIS

Use	Total Area (m²)	Calculated TER 2012 (kgCO2 / m2)	-	REGULATED ENERGY CONSUMPTION								REGULATED CO2 EMISSIONS		REGULATED CO2 EMISSIONS PER UNIT	
				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.)		2012 CO2 emissions (kgCO2 p.a.)		SAP10 CO2 emissions (kgCO2 p.a.)	Calculated TER SAP10 (kgCO2 / m2)
Sum	6,472	17.9	-	214,220		226,506		30,350	7,725	0		*116,040*		*102,381*	15.8

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.

SAP 2012 CO2 PERFORMANCE

SAP10 CO2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO₂ 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		REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE LEAN' SAP DER WORKSHEET						
				Calculated DER 2012 (kgCO2 / m2)	DER Worksheet DER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling
					DER Sheet (Row 384)	DER Sheet [(Row 307a) ÷ (Row 367a x 0.01)]	Select fuel type	DER Sheet [(Row 310a) ÷ (Row 367a x 0.01)]	Select fuel type	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
G-07	87.44	5	466.66	13.6	13.6	1425.873684	Natural Gas	2383.4	Natural Gas	386.9	318.4181	0
G-07M	87.44	4	350.75	13.6	13.6	1425.873684	Natural Gas	2383.4	Natural Gas	386.9	318.4181	0
1-02	59.58	7	381	19.9	19.9	2206.347368	Natural Gas	2127.621053	Natural Gas	302.93	182.5027	0
1-02M	59.58	1	71.49	19.3	19.3	2027.052632	Natural Gas	2127.621053	Natural Gas	302.93	180.7994	0
7-04	50.31	24	1234.23	16.0	16.0	752.6842105	Natural Gas	2015.894737	Natural Gas	251.33	145.6415	0
7-04M	50.31	26	1347.09	16.6	16.6	898.2736842	Natural Gas	2015.894737	Natural Gas	251.33	147.0246	0
9-02	70.75	8	565.96	16.3	16.3	1725.957895	Natural Gas	2249.231579	Natural Gas	345.42	219.3543	0
9-02M	70.75	8	551.12	16.9	16.9	1939.968421	Natural Gas	2249.231579	Natural Gas	345.42	221.3874	0
9-03	80.32	5	349.54	13.9	13.9	1418.757895	Natural Gas	2333.789474	Natural Gas	347.3	241.7992	0
9-03M	80.32	5	415.03	14.5	14.5	1652.947368	Natural Gas	2333.789474	Natural Gas	347.3	244.024	0
10-02	70.6	1	70.6	19.0	19.0	2633.368421	Natural Gas	2247.757895	Natural Gas	320.44	227.5707	0
10-02M	70.6	1	70.39	20.2	20.2	3019.473684	Natural Gas	2247.757895	Natural Gas	320.44	231.2387	0
10-03	70.13	4	267.17	19.5	19.5	2776.536842	Natural Gas	2243.073684	Natural Gas	311.86	227.6763	0
10-03M	70.13	4	331.21	20.3	20.3	3057.905263	Natural Gas	2243.073684	Natural Gas	311.86	230.3493	0
Sum	6,417	103	6,472	16.6	-	145,400	N/A	221,032	N/A	30,608	19,888	0

DOMESTIC ENERGY DEMAND DATA

Unit identifier (e.g. plot number, dwelling type etc.)	REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.)						REGULATED CO2 EMISSIONS PER UNIT							Fabric Energy Efficiency (FEE)	REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.)				
	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)	Space Heating CO2 emissions (kgCO2 p.a.)	Domestic Hot Water CO2 emissions (kgCO2 p.a.)	Lighting CO2 emissions (kgCO2 p.a.)	Auxiliary CO2 emissions (kgCO2 p.a.)	Cooling CO2 emissions (kgCO2 p.a.)	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)	Dwelling Fabric Energy Efficiency (DFEE) (kWh/m²)	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
G-07	308	515	201	165	0	1,189	299	501	90	74	0	964	11.0	35.7	1290.07619	2156.409524	386.9	318.4181	0
G-07M	308	515	201	165	0	1,189	299	501	90	74	0	964	11.0	35.7	1290.07619	2156.409524	386.9	318.4181	0
1-02	477	460	157	95	0	1,188	463	447	71	43	0	1,023	17.2	56.7	1996.219048	1924.990476	302.93	182.5027	0
1-02M	438	460	157	94	0	1,148	426	447	71	42	0	985	16.5	53.9	1834	1924.990476	302.93	180.7994	0
7-04	163	435	130	76	0	804	158	423	59	34	0	674	13.4	37	681	1823.904762	251.33	145.6415	0
7-04M	194	435	130	76	0	836	189	423	59	34	0	705	14.0	40.2	812.7238095	1823.904762	251.33	147.0246	0
9-02	373	486	179	114	0	1,152	362	472	80	51	0	966	13.7	44.2	1561.580952	2035.019048	345.42	219.3543	0
9-02M	419	486	179	115	0	1,199	407	472	80	52	0	1,012	14.3	47.1	1755.209524	2035.019048	345.42	221.3874	0
9-03	306	504	180	125	0	1,116	298	490	81	56	0	925	11.5	36.4	1283.638095	2111.52381	347.3	241.7992	0
9-03M	357	504	180	127	0	1,168	347	490	81	57	0	975	12.1	39.6	1495.52381	2111.52381	347.3	244.024	0
10-02	569	486	166	118	0	1,339	553	472	75	53	0	1,153	16.3	55.5	2382.571429	2033.685714	320.44	227.5707	0
10-02M	652	486	166	120	0	1,424	634	472	75	54	0	1,235	17.5	60.7	2731.904762	2033.685714	320.44	231.2387	0
10-03	600	485	162	118	0	1,364	583	471	73	53	0	1,180	16.8	57.8	2512.104762	2029.447619	311.86	227.6763	0
10-03M	661	485	162	120	0	1,426	642	471	73	54	0	1,240	17.7	61.6	2766.67619	2029.447619	311.86	230.3493	0
Sum	31,406	47,743	15,885	10,322	0	106,344	30,534	46,417	7,132	4,634	0	89,553	14.0	43.03	131,553	199,981	30,608	19,888	0

NON-DOMESTIC ENERGY CONSUMPTION AND CO₂ ANALYSIS

NON-DOMESTIC ENERGY DEMAND

Building Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK		REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL OUTPUT							ULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL.INP or *SIM.CSV						REGULATED CO2 EMISSIONS PER UNIT						REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.)				
				Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	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.)	Natural Gas	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)	Natural Gas	Grid Electricity		SAP10 CO2 emissions (kgCO2 p.a.)	BRUKL BER SAP10 (kgCO2 / m2)		Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
													##############	##############					##############	##############				N/A					
Sum	0	0	0	#DIV/0!	-	0	N/A	0	N/A	0	0	0	0	0	N/A	N/A	N/A	0	0	0		0	#DIV/0!		0	0	0	0	0

SITE-WIDE ENERGY CONSUMPTION AND CO₂ ANALYSIS

Use	Total Area (m²)	Calculated BER 2012 (kgCO2 / m2)	-	REGULATED ENERGY CONSUMPTION							REGULATED CO2 EMISSIONS		REGULATED CO2 EMISSIONS			REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.)				
				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.)	2012 CO2 emissions (kgCO2 p.a.)		SAP10 CO2 emissions (kgCO2 p.a.)	Calculated BER SAP10 (kgCO2 / m2)	N/A	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Sum	6,472	16.4	-	145,400		221,032		30,608	19,888	0	106,344		89,553	13.8		131,553	199,981	30,608	19,888	0

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

				VALIDATION CHECK		REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE GREEN' SAP DER WORKSHEET														
Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m^2)	Number of units	Total area represented by model (m^2)	Calculated DER 2012 (kgCO2 / m2)	DER Worksheet DER 2012 (kgCO2 / m2)	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) if applicable	Fuel type Space Heating	Domestic Hot Water (Heat source 2) if applicable	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP if applicable	Fuel type CHP if applicable	Total Electricity generated by CHP (-) if applicable	Electricity generated by renewable (-) if applicable	Lighting	Auxiliary	Cooling
					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 307c ÷ (Row 367c x 0.01)]	Select fuel type	DER Sheet [Row 310c ÷ (Row 367c 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 380	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
G-07	87.44	5	466.66	11.9	11.9	391.0961404	Grid Electricity	653.7319298	Grid Electricity	293.3221053	Natural Gas	490.2989474	Natural Gas	0	Natural Gas	0	-65.87	386.9	319.452	0
G-07M	87.44	4	350.75	11.9	11.9	391.0961404	Grid Electricity	653.7319298	Grid Electricity	293.3221053	Natural Gas	490.2989474	Natural Gas	0	Natural Gas	0	-65.87	386.9	319.452	0
1-02	59.58	7	381	17.5	17.5	605.1677193	Grid Electricity	583.5761404	Grid Electricity	453.8757895	Natural Gas	437.6821053	Natural Gas	0	Natural Gas	0	-41.17	302.93	183.679	0
1-02M	59.58	1	71.49	16.8	16.8	555.9887719	Grid Electricity	583.5761404	Grid Electricity	416.9915789	Natural Gas	437.6821053	Natural Gas	0	Natural Gas	0	-49.4	302.93	181.927	0
7-04	50.31	24	1234.23	14.0	14.0	206.4533333	Grid Electricity	552.9319298	Grid Electricity	154.84	Natural Gas	414.6989474	Natural Gas	0	Natural Gas	0	-32.93	251.33	146.3931	0
7-04M	50.31	26	1347.09	14.6	14.6	246.3831579	Grid Electricity	552.9319298	Grid Electricity	184.7873684	Natural Gas	414.6989474	Natural Gas	0	Natural Gas	0	-32.93	251.33	147.8156	0
9-02	70.75	8	565.96	14.3	14.3	473.4063158	Grid Electricity	616.9347368	Grid Electricity	355.0547368	Natural Gas	462.7010526	Natural Gas	0	Natural Gas	0	-49.4	345.42	220.4334	0
9-02M	70.75	8	551.12	14.9	14.9	532.1066667	Grid Electricity	616.9347368	Grid Electricity	399.08	Natural Gas	462.7010526	Natural Gas	0	Natural Gas	0	-49.4	345.42	222.5246	0
9-03	80.32	5	349.54	12.2	12.2	389.1452632	Grid Electricity	640.1235088	Grid Electricity	291.8589474	Natural Gas	480.0926316	Natural Gas	0	Natural Gas	0	-49.4	347.3	242.8177	0
9-03M	80.32	5	415.03	12.7	12.7	453.3782456	Grid Electricity	640.1235088	Grid Electricity	340.0336842	Natural Gas	480.0926316	Natural Gas	0	Natural Gas	0	-57.63	347.3	245.106	0
10-02	70.6	1	70.6	16.6	16.6	722.2933333	Grid Electricity	616.5277193	Grid Electricity	541.72	Natural Gas	462.3957895	Natural Gas	0	Natural Gas	0	-49.4	320.44	228.8955	0
10-02M	70.6	1	70.39	17.6	17.6	828.1992982	Grid Electricity	616.5277193	Grid Electricity	621.1494737	Natural Gas	462.3957895	Natural Gas	0	Natural Gas	0	-49.4	320.44	232.6684	0
10-03	70.13	4	267.17	17.0	17.0	761.5663158	Grid Electricity	615.2421053	Grid Electricity	571.1747368	Natural Gas	461.4315789	Natural Gas	0	Natural Gas	0	-49.4	311.86	229.0388	0
10-03M	70.13	4	331.21	17.7	17.7	838.7396491	Grid Electricity	615.2421053	Grid Electricity	629.0547368	Natural Gas	461.4315789	Natural Gas	0	Natural Gas	0	-57.63	311.86	231.7881	0
Sum	6,417	103	6,472	14.5	-	39,881	N/A	60,626	N/A	0	N/A	45,469	N/A	0	N/A	0	-4,429	30,608	19,988	0

SAP 2012 CO2 PERFORMANCE

	REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.)								
Unit identifier (e.g. plot number, dwelling type etc.)	Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Electricity generated by renewable if applicable	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)
G-07	266	445	0	0	-34	201	166	0	1,044
G-07M	266	445	0	0	-34	201	166	0	1,044
1-02	412	397	0	0	-21	157	95	0	1,041
1-02M	379	397	0	0	-26	157	94	0	1,002
7-04	141	377	0	0	-17	130	76	0	706
7-04M	168	377	0	0	-17	130	77	0	734
9-02	322	420	0	0	-26	179	114	0	1,011
9-02M	362	420	0	0	-26	179	115	0	1,052
9-03	265	436	0	0	-26	180	126	0	982
9-03M	309	436	0	0	-30	180	127	0	1,022
10-02	492	420	0	0	-26	166	119	0	1,171
10-02M	564	420	0	0	-26	166	121	0	1,245
10-03	519	419	0	0	-26	162	119	0	1,193
10-03M	571	419	0	0	-30	162	120	0	1,242
Sum	27,159	41,286	0	0	-2,299	15,885	10,374	0	93,266

SAP10 CO2 PERFORMANCE

	REGULATED CO2 EMISSIONS PER UNIT									
Unit identifier (e.g. plot number, dwelling type etc.)	Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Electricity generated by renewable if applicable	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)
G-07	153	255	0	0	-15	90	74	0	557	6.4
G-07M	153	255	0	0	-15	90	74	0	557	6.4
1-02	236	228	0	0	-10	71	43	0	568	9.5
1-02M	217	228	0	0	-12	71	42	0	546	9.2
7-04	81	216	0	0	-8	59	34	0	382	7.6
7-04M	96	216	0	0	-8	59	34	0	397	7.9
9-02	185	241	0	0	-12	80	51	0	546	7.7
9-02M	208	241	0	0	-12	80	52	0	570	8.0
9-03	152	250	0	0	-12	81	57	0	528	6.6
9-03M	177	250	0	0	-13	81	57	0	552	6.9
10-02	282	241	0	0	-12	75	53	0	639	9.1
10-02M	323	241	0	0	-12	75	54	0	682	9.7
10-03	297	240	0	0	-12	73	53	0	652	9.3
10-03M	328	240	0	0	-13	73	54	0	681	9.7
Sum	15,574	23,674	0	0	-1,032	7,132	4,657	0	50,472	7.9

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

				VALIDATION CHECK		REGULATED ENERGY CONSUMPTION BY END USE (kWh/m^2 p.a.) 'BE GREEN' BER - SOURCE: BRUKL OUTPUT														
Use	Area per unit (m^2)	Number of units	Total area represented by model (m^2)	Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water							Electricity generated by CHP (-) if applicable	Electricity generated by renewable technology (-) if applicable	Lighting	Auxiliary	Cooling
					19.6	4.21019	Grid Electricity	1.94171	Grid Electricity	N/A	N/A	N/A	N/A	N/A	N/A	0	0	13.0966	10.9679	8.47211
Sum	0	0	0	#DIV/0!	-	0	N/A	0	N/A							0	0	0	0	0

REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m^2 p.a.) 'BE GREEN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE									REGULATED CO2 EMISSIONS PER UNIT									
Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	Electricity generated by renewable technology (-) if applicable	Enter Carbon Factor 1	Enter Carbon Factor 2	Enter Carbon Factor 3	2012 CO2 emissions (kgCO2 p.a.)	Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	Electricity generated by renewable technology (-) if applicable	Enter Carbon Factor 1	Enter Carbon Factor 2	Enter Carbon Factor 3	SAP10 CO2 emissions	BRUKL BER SAP10 (kgCO2 / m2)
##############	##############	##############	##############	##############	##############	##############	##############		##############	##############	##############	##############	##############	##############	##############	##############		
0	38	0	0	0	0	0	0	#VALUE!		38							#VALUE!	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

				REGULATED CO2 EMISSIONS														
Use	Total Area (m^2)	Calculated BER 2012 (kgCO2 / m2)	-	Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	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*	Electricity generated by renewable (kWh p.a.) *if applicable*	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Sum	6,472	0.0	-	39,881		60,626		0		45,469		0		0	-4,429	30,608	19,988	0

REGULATED CO2 EMISSIONS									REGULATED CO2 EMISSIONS PER UNIT									
Space Heating CO2 emissions	Domestic Hot Water CO2 emissions	Space Heating and DHW from CHP CO2 emissions if applicable	Electricity generated by CHP CO2 savings if applicable	Electricity generated by renewable CO2 savings if applicable	Lighting CO2 emissions	Auxiliary CO2 emissions	Cooling CO2 emissions	2012 CO2 emissions	Space Heating CO2 emissions	Domestic Hot Water CO2 emissions	Space Heating and DHW from CHP CO2 emissions if applicable	Electricity generated by CHP CO2 savings if applicable	Electricity generated by renewable CO2 savings if applicable	Lighting CO2 emissions	Auxiliary CO2 emissions	Cooling CO2 emissions	SAP10 CO2 emissions	Calculated BER SAP10 (kgCO2 / m2)
27,159	41,286	0	0	-2,299	15,885	10,374	0	93,266	15,574	23,674	0	0	-1,032	7,132	4,657	0	50,472	7.8

SAP 2012 PERFORMANCE

SAP10 PERFORMANCE

DOMESTIC

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

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	116	126
After energy demand reduction	106	114
After heat network / CHP	106	114
After renewable energy	93	114

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)	(%)
Savings from energy demand reduction	10	8%
Savings from heat network / CHP	0	0%
Savings from renewable energy	13	11%
Cumulative on site savings	**23**	**20%**
Annual savings from off-set payment	93	-
	(Tonnes CO2)	
Cumulative savings for off-set payment	**2,798**	-
Cash in-lieu contribution (£)	**167,878**	

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	102	57
After energy demand reduction	90	51
After heat network / CHP	90	51
After renewable energy	50	51

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)	(%)
Savings from energy demand reduction	13	13%
Savings from heat network / CHP	0	0%
Savings from renewable energy	39	38%
Cumulative on site savings	**52**	**51%**
Annual savings from off-set payment	50	-
	(Tonnes CO2)	
Cumulative savings for off-set payment	**1,514**	-
Cash in-lieu contribution (£)	**90,849**	

NON-DOMESTIC

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

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	0	0
After energy demand reduction	0	0
After heat network / CHP	0	0
After renewable energy	0	0

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)	(%)
Savings from energy demand reduction	0	#DIV/0!
Savings from heat network / CHP	0	#DIV/0!
Savings from renewable energy	0	#DIV/0!
Total Cumulative Savings	**0**	**#DIV/0!**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	**0**	-
Shortfall	0	0
Cash in-lieu contribution (£)	**0**	-

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

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	0	0
After energy demand reduction	0	0
After heat network / CHP	0	0
After renewable energy	0	0

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)	(%)
Savings from energy demand reduction	0	#DIV/0!
Savings from heat network / CHP	0	#DIV/0!
Savings from renewable energy	0	#DIV/0!
Total Cumulative Savings	**0**	**#DIV/0!**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	0	-
Shortfall	0	0
Cash in-lieu contribution (£)	**0**	-

SITE-WIDE

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	116		
Be lean	106	10	8%
Be clean	106	0	0%
Be green	93	13	11%
	-	**CO2 savings off-set (Tonnes CO2)**	-
Off-set	-	**2,798**	-

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	102		
Be lean	90	13	13%
Be clean	90	0	0%
Be green	50	39	38%
	-	**CO2 savings off-set (Tonnes CO2)**	-
Off-set	-	**1,514**	-

Building use	Energy demand following energy efficiency measures (MWh/year)						
	Space Heating	Hot Water	Lighting	Auxilary	Cooling	Unregulated electricity	Unregulated gas
Domestic	132	200	31	20	0	243	0
Non-domestic	0	0	0	0	0	0	0

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	44.94	43.03	4%

	Area weighted average non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	0	0
Notional	0	0

APPENDIX E ENERGY CENTRE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPE OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:

SIGNIFICANT RESIDUAL RISKS

THESE STATEMENTS RESULT FROM THE DESIGN RISK ASSESSMENTS CARRIED OUT BY THE DESIGNER. THE SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION IS INTENDED TO BE CONSISTENT WITH, BUT NOT REPLACE, THE HEALTH AND SAFETY INFORMATION ISSUED AS PART OF THE DOCUMENTATION PREPARED BY THE CDM–C. RISKS SHOWN ARE SIGNIFICANT RISKS ONLY I.E. THOSE WHICH AN EXPERIENCED CONTRACTOR MAY NOT REASONABLY ANTICIPATE.

CONSTRUCTION

SPECIFICS E.G.

CONTRACTOR TO ENSURE ALL OPERATIVES ARE TRAINED AND COMPETENT FOR WORKING AT HEIGHT.

CONTRACTOR TO ENSURE THAT LIFTING EQUIPMENT IS OPERATED BY QUALIFIED PERSONNEL AND IS SUITABLE FOR USE IN SITE CONDITIONS..

MAINTENENCE

SPECIFICS E.G.

Revision	Date	Description
P1	04/06/20	FOR COMMENT

Drawing Status:
PRELIMINARY

Architect
TATEHINDLE LIMITED

Client
MEADOW PARTNERS

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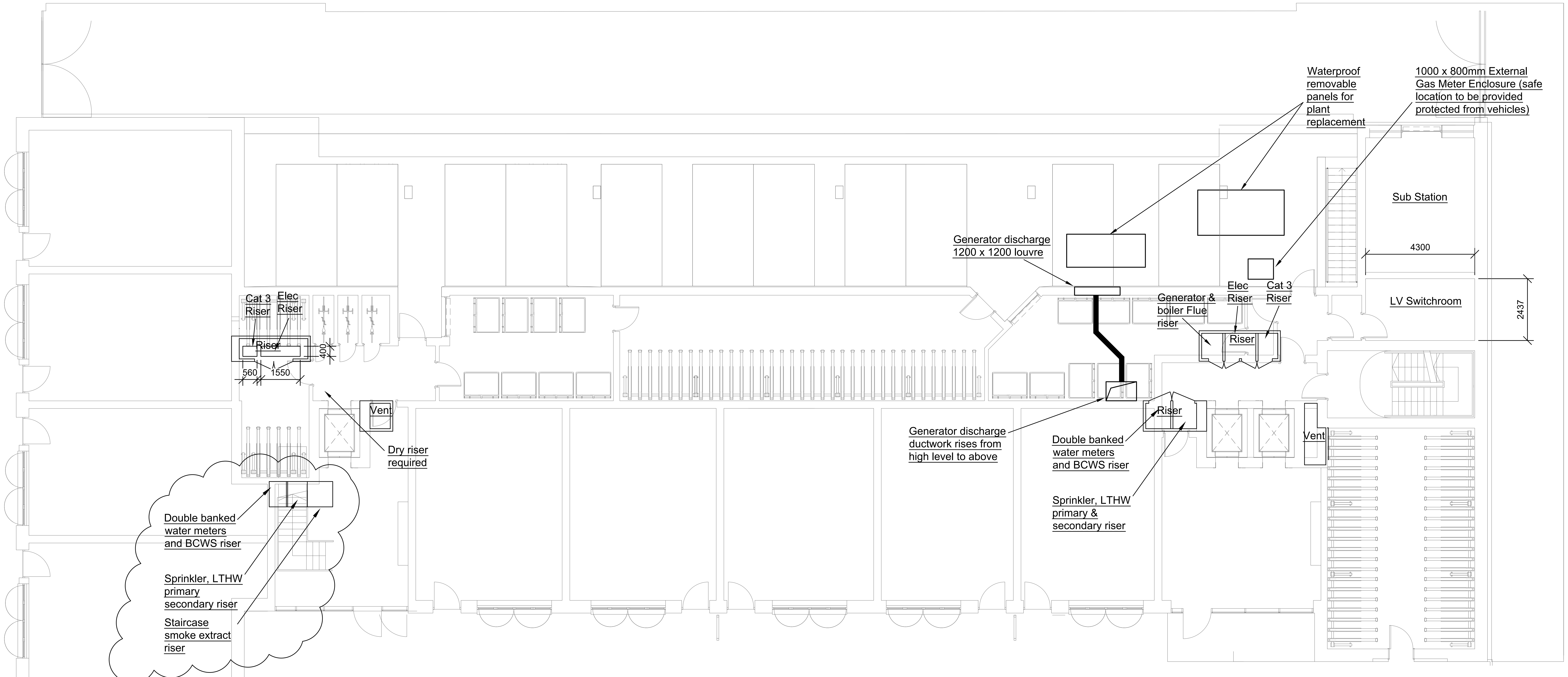
Project Title
9 NESTLES AVENUE
HAYES UB3 4SA

Drawing Title
ROOF PLANT SPACE REQUIREMENT

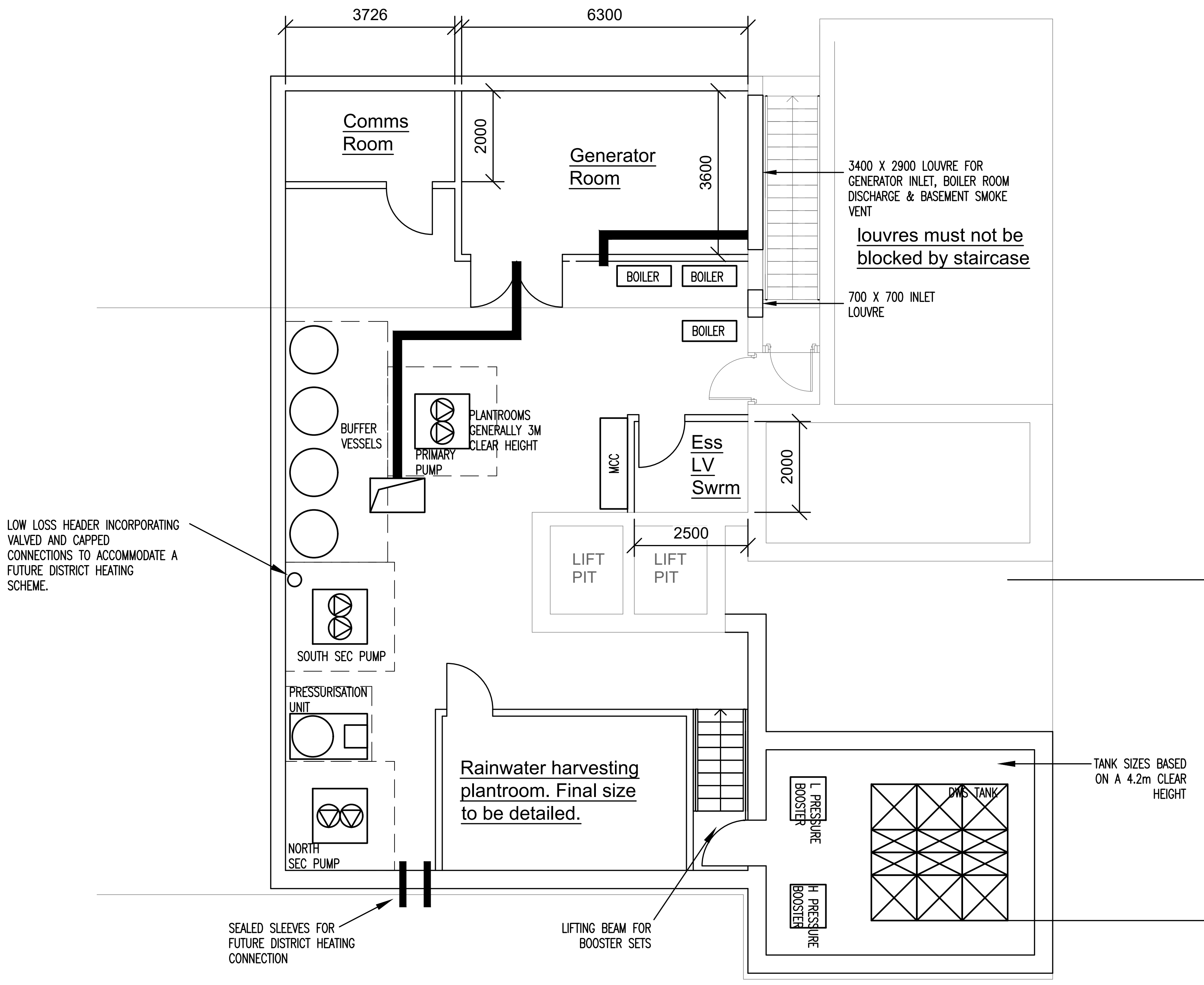
Date	Scale	Drawn	Checked	Revision
04/06/20	1:100@A1	AJM		P1

Drawing No: P18-117/MEP/SK/002 P1

APPENDIX F HEAT NETWORK ROUTE & POTENTIAL CONNECTION TO DISTRICT HEATING



GROUND FLOOR



BASEMENT

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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CONSTRUCTION

SPECIFICS E.G.

CONTRACTOR TO ENSURE ALL OPERATIVES ARE TRAINED AND COMPETENT FOR WORKING AT HEIGHT.

CONTRACTOR TO ENSURE THAT LIFTING EQUIPMENT IS OPERATED BY QUALIFIED PERSONNEL AND IS SUITABLE FOR USE IN SITE CONDITIONS..

MAINTENENCE

SPECIFICS E.G.

Revision	Date	Description
P6	31/07/20	DISTRICT HEATING CONNECTION SHOWN
P5	14/07/20	FOR COMMENT
P4	13/07/20	FOR COMMENT
P3	01/07/20	FOR COMMENT
P2	09/06/20	FOR COMMENT
P1	02/06/20	FOR COMMENT

Drawing Status:
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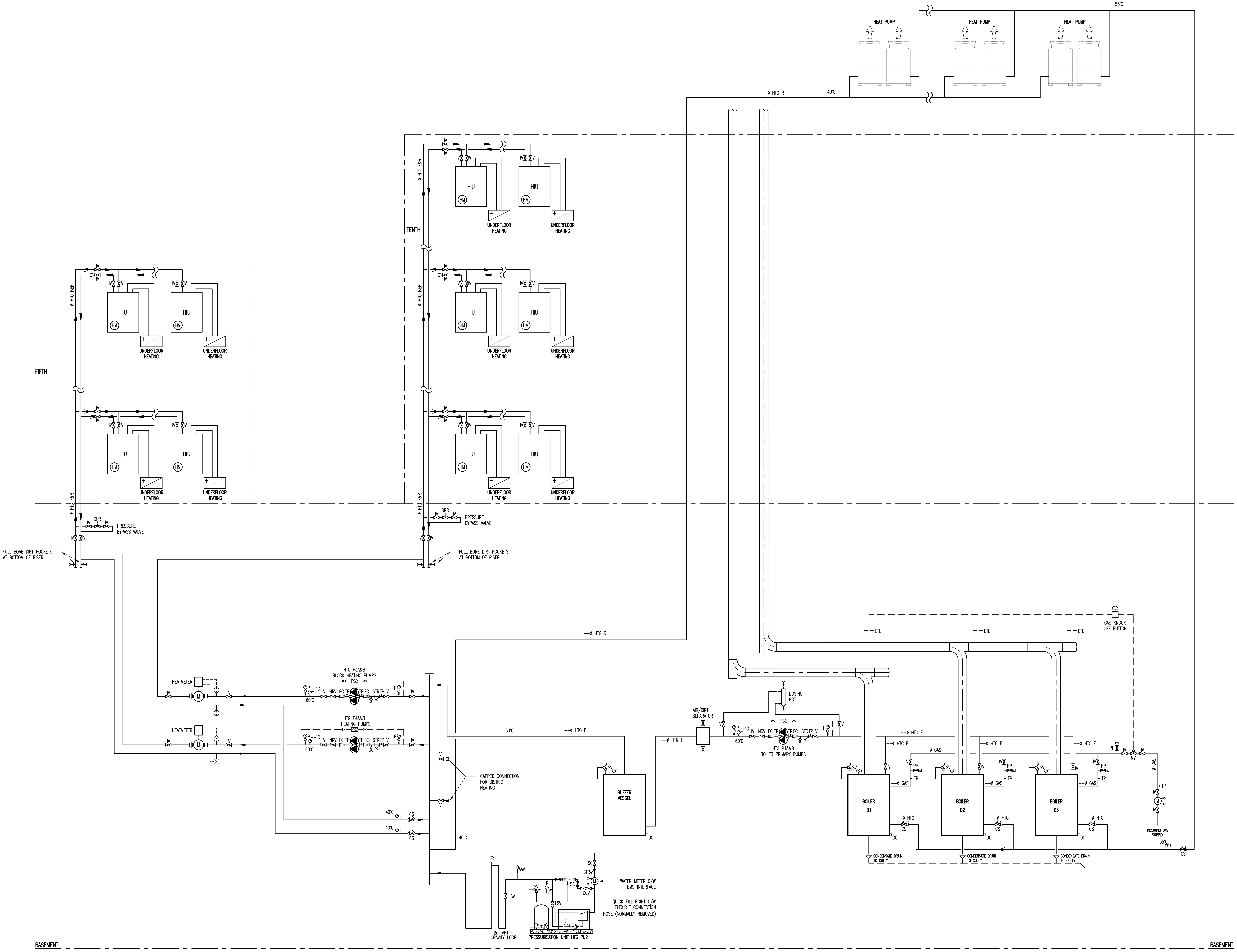
Drawing Title
BASEMENT AND GROUND FLOOR
PLANT SPACE REQUIREMENT

Date	Scale	Drawn	Checked	Revision
02/06/20	1:100@A1	AJM		P6

Drawing No: P18-117/MEP/SK/001

APPENDIX G LTHW SCHEMATIC



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

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CONSTRUCTION

SPECIFICS E.G.

CONTRACTOR TO ENSURE ALL OPERATIVES ARE TRAINED AND COMPETENT FOR WORKING AT HEIGHT.

CONTRACTOR TO ENSURE THAT LIFTING EQUIPMENT IS OPERATED BY QUALIFIED PERSONNEL AND IS SUITABLE FOR USE IN SITE CONDITIONS..

MAINTENENCE

SPECIFICS E.G.

NOTE:

1. –

LEGEND:

(HM)	INTEGRAL HEAT METER WITH REMOTE READING & LOGGING
PP	PURGE POINT
HIU	HEAT INTERFACE UNIT
HM	HEAT METER
IV	ISOLATING VALVE
SV	SAFETY VALVE
PP	PURGE POINT
NRV	NON RETURN VALVE
FC	FLEXIBLE CONNECTION
TP	TEST POINT
STR	STRAINER
DPR	DEFERENTIAL PRESSURE RELIEF VALVE (OPEN ON RISING PRESSURE).

Revision	Date	Description
P1	031/07/20	GLA ISSUE

Drawing Status:
PRELIMINARY

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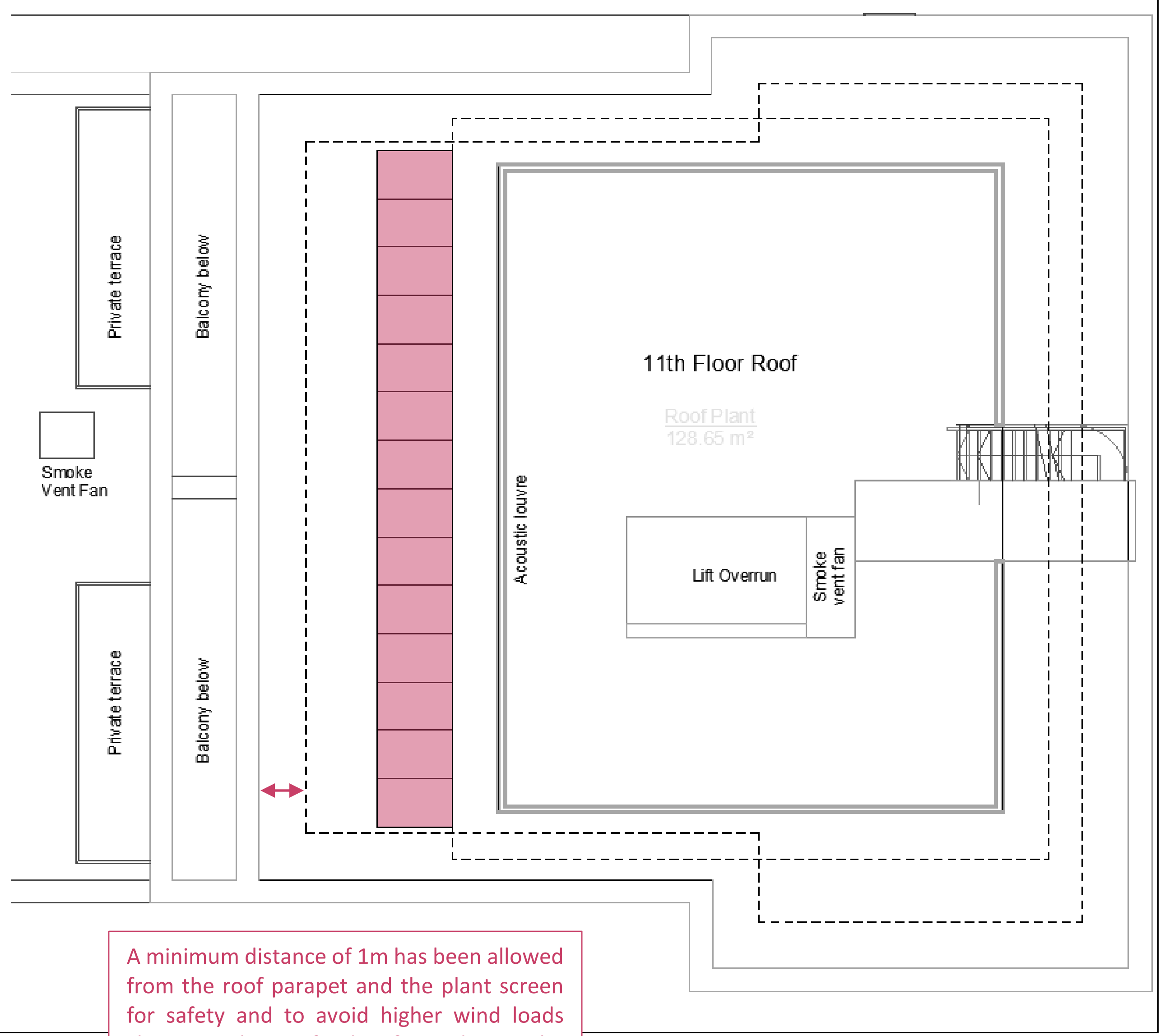
Drawing Title
LTHW SCHEMATIC

Date	Scale	Drawn	Checked	Revision
31/07/20	NTS@A1	AJM		P1

Drawing No: P18-117/M/3001

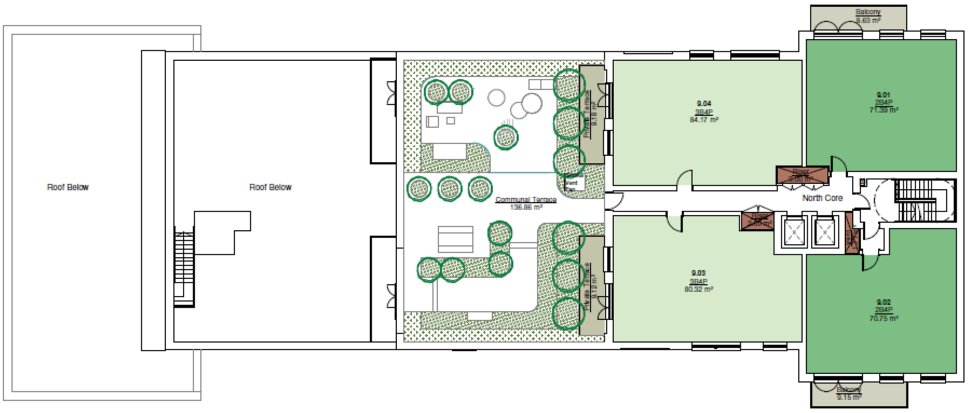
APPENDIX H ROOF LAYOUT WITH PROPOSED PV ARRAY

Level 11 – Energy centre & indicative position of PV array

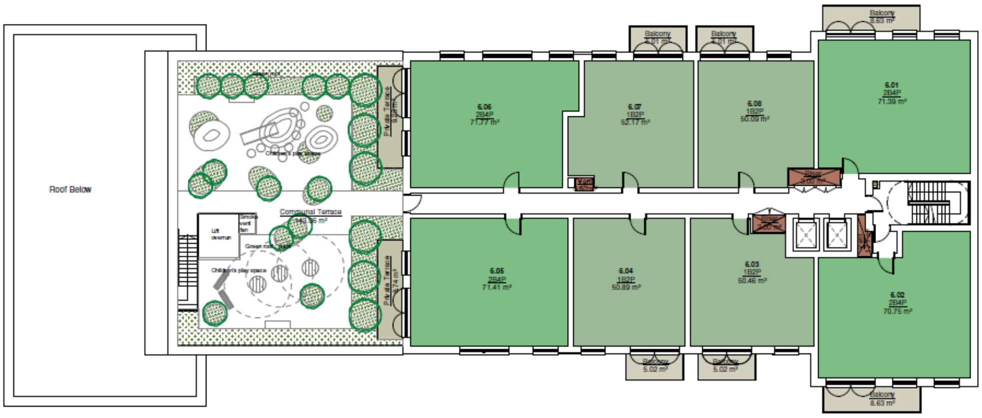


A minimum distance of 1m has been allowed from the roof parapet and the plant screen for safety and to avoid higher wind loads closer to the roof edge for reducing the impact of wind uplift. Only one row of PVs can be installed within the designated area (between the dotted lines) – a second row to the front would overshadow the panels.

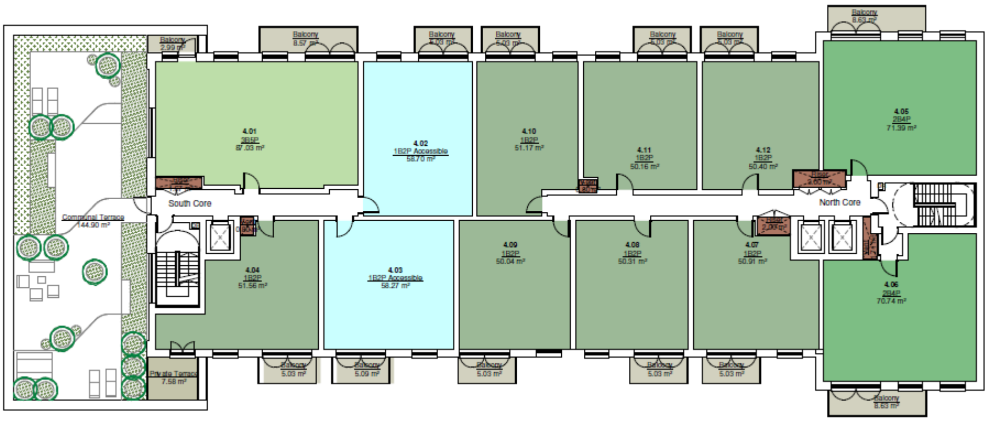
Level 9 – Communal terrace



Level 6 – Communal terrace & children's play space

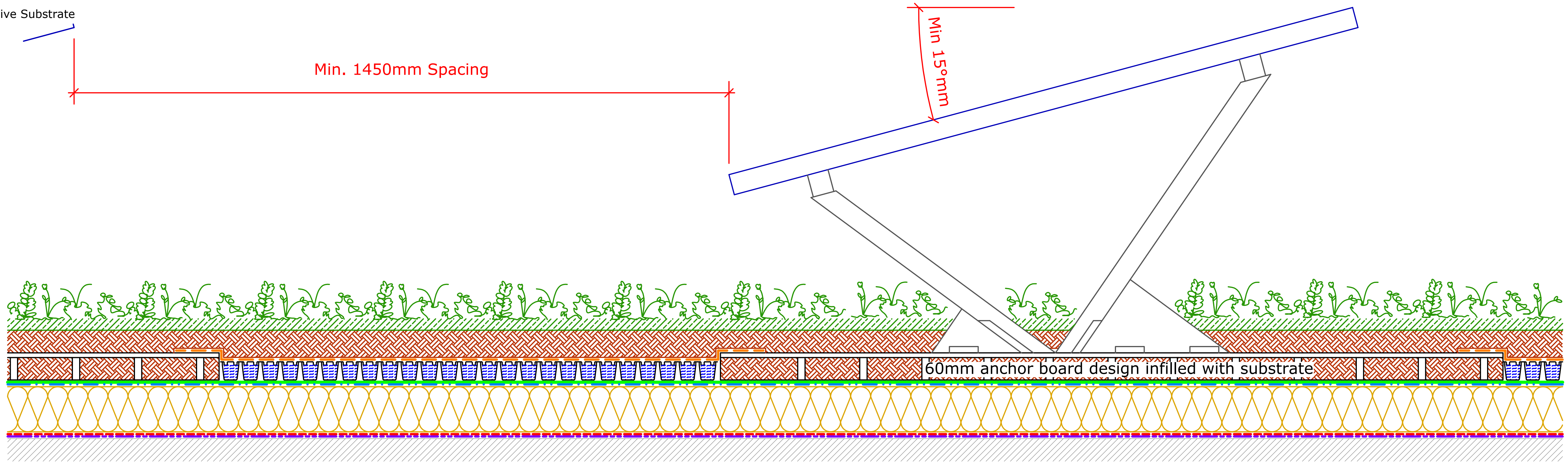


Level 4 – Communal terrace

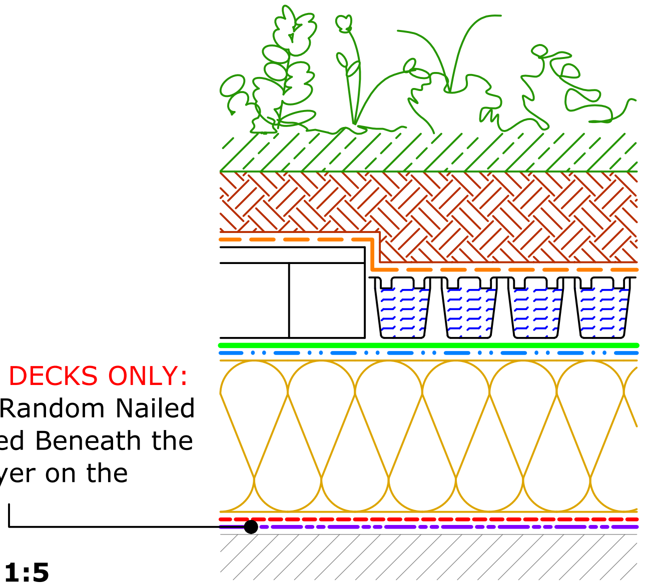


Key

- ━━ Bauder Root Resistant Capping Sheet
- ─·─·─ Bauder Underlayer
- ▨ Bauder Insulation
- - - - Bauder Vapour Control Layer
- ─·─·─ Bauder Random Nailed Layer used on TIMBER BOARDED DECKS ONLY
- - - - Bauder Filter Fleece
- ▨ Unknown Deck / Substrate
- ▨ Extensive Substrate



Bauder BioSolar Module Section - Scale 1:10



TIMBER BOARDED DECKS ONLY:
Additional Bauder Random Nailed Layer to be Installed Beneath the Vapour Control Layer on the Horizontal Only

Layer Build Up - Scale 1:5

Grid Arrangement 1:100

PV - BioSolar

IMPORTANT NOTES:

1. This detail is suitable for the following Bauder Systems: **Bauder Total Green Roof System, Bauderflex Green Roof System**
2. Do not scale to ascertain dimensions.
3. All dimensions are in millimetres and are to be checked and verified on site prior to commencement of work.
4. This drawing is to be read in conjunction with the specification and associated drawings.
5. This detail is a guideline only, representing typical detailing conditions and illustrate the correct application of the above Bauder System. It may be necessary to modify this detail to suit specific project design constraints and conditions.
6. **Refer to the Bauder Specification for the deck type, product description and method of application. For clarity the method of attachment has not been shown.**
7. Provision should be made by the installer for mechanically fixing the top leading edge of all upstand details in excess of 250mm in height using appropriate fasteners.

BITUMINOUS
STANDARD DETAIL

Scale:	Drawing Number:	Rev:
1:5 @ A3	D0000-00W_011-002	-

Drawn By:	Checked By:	Approved By:	Date:
KM	PCH	NB	Aug 2017

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APPENDIX I ASHP – SEASONAL EFFICIENCY

II Product Data

1. Capacity tables

(1) Correction by temperature

• CAHV-P500YA-HPB(-BS)

(1)-1 Efficiency Priority Mode

● Capacity

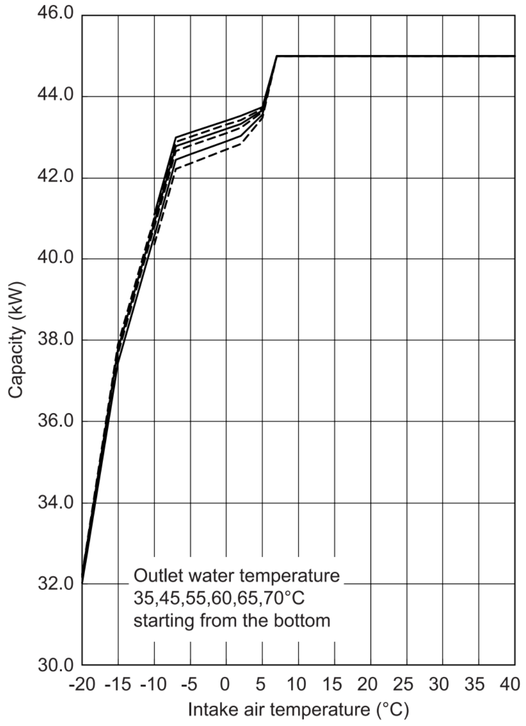
		Intake air temperature °C															
		-20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
Outlet water temperature °C	35	-	-	40.3	42.2	42.4	42.7	42.8	43.5	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	45	32.0	37.4	40.6	42.4	42.6	42.9	43.0	43.5	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	55	32.2	37.7	40.8	42.7	42.8	43.1	43.2	43.6	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	60	32.2	37.8	40.9	42.8	42.9	43.2	43.3	43.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	65	32.2	37.9	41.0	42.9	43.0	43.3	43.4	43.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
	70	-	-	41.1	43.0	43.1	43.4	43.5	43.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0

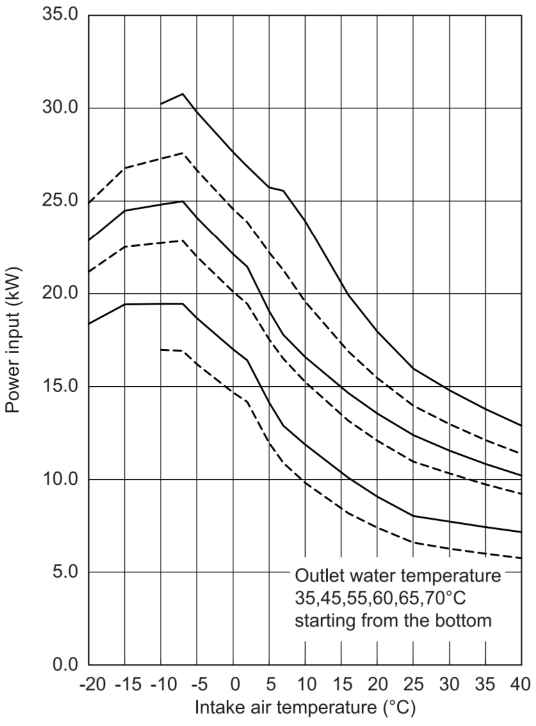
This table shows the capacity when the relative humidity is 85%.
The intake wet-bulb temperature is fixed to 32°C when the intake dry-bulb temperature is 35°C or higher.

● Power input

		Intake air temperature °C															
		-20	-15	-10	-7	-5	0	2	5	7	10	16	20	25	30	35	40
Outlet water temperature °C	35	-	-	17.0	16.9	16.2	14.7	14.2	12.0	10.9	9.82	8.20	7.40	6.60	6.30	6.02	5.77
	45	18.4	19.4	19.4	19.5	18.7	17.0	16.4	14.2	12.9	11.9	10.1	9.08	8.05	7.73	7.44	7.17
	55	21.2	22.5	22.7	22.8	22.0	20.1	19.5	17.5	16.5	15.2	13.2	12.1	11.0	10.3	9.75	9.24
	60	22.9	24.5	24.8	25.0	24.1	22.1	21.4	19.1	17.8	16.6	14.7	13.6	12.4	11.6	10.8	10.2
	65	24.9	26.8	27.3	27.6	26.7	24.6	23.9	22.2	21.3	19.6	16.9	15.4	14.0	13.0	12.1	11.4
	70	-	-	30.2	30.8	29.8	27.6	26.9	25.7	25.6	23.9	19.9	18.0	16.0	14.8	13.8	12.9

This table shows the power input when the relative humidity is 85%.
The intake wet-bulb temperature is fixed to 32°C when the intake dry-bulb temperature is 35°C or higher.





ENERG Y IJA IE IA

енергия · ενεργεια

MITSUBISHI ELECTRIC

Indoor unit	–
Outdoor unit	CAHV-P500YB-HPB(-BS)

55 °C	35 °C
A^{++}	A^{+}

- A^{++}
- A^{+}
- A
- B
- C
- D
- E
- F
- G

– dB

79 dB

	55 °C	35 °C
■	35	45
■	**45**	**45**
■	45	45
	kW	kW

2015

811/2013

KC79J379H03

		For medium-temperature application.																					For low-temperature application.																				
1	2	3	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Outdoor unit	Indoor unit	Medium-temperature application	Seasonal space heating energy efficiency class	Water heating energy efficiency class	Rated heat output under average climate conditions	For space heating, annual energy consumption under average climate conditions	For water heating, annual electricity consumption under average climate conditions	Seasonal space heating energy efficiency under average climate conditions	Water heating energy efficiency under average climate conditions	Sound power level L_{WA} indoor	Work only during off-peak hours	Rated heat output under colder climate conditions	Rated heat output under warmer climate conditions	For space heating, annual energy consumption under colder climate conditions	For space heating, annual energy consumption under warmer climate conditions	For water heating, annual energy consumption under colder climate conditions	For water heating, annual energy consumption under warmer climate conditions	Seasonal space heating energy efficiency under colder climate conditions	Seasonal space heating energy efficiency under warmer climate conditions	Water heating energy efficiency under colder climate conditions	Water heating energy efficiency under warmer climate conditions	Sound power level L_{WA} outdoor	Low-temperature application	Seasonal space heating energy efficiency class	Water heating energy efficiency class	Rated heat output under average climate conditions	For space heating, annual energy consumption under average climate conditions	For water heating, annual electricity consumption under average climate conditions	Seasonal space heating energy efficiency under average climate conditions	Water heating energy efficiency under average climate conditions	Sound power level L_{WA} indoor	Work only during off-peak hours	Rated heat output under colder climate conditions	Rated heat output under warmer climate conditions	For space heating, annual energy consumption under colder climate conditions	For space heating, annual energy consumption under warmer climate conditions	For water heating, annual energy consumption under colder climate conditions	For water heating, annual energy consumption under warmer climate conditions	Seasonal space heating energy efficiency under colder climate conditions	Seasonal space heating energy efficiency under warmer climate conditions	Water heating energy efficiency under colder climate conditions	Water heating energy efficiency under warmer climate conditions	Sound power level L_{WA} outdoor
					kW	kWh	kWh	%	%	dB		kW	kW	kWh	kWh	kWh	kWh	%	%	%	%	dB				kW	kWh	kWh	%	%	dB		kW	kW	kWh	kWh	kWh	kWh	%	%	%	%	dB
CRHV-P600YA-HPB	-	✓	A++	-	55.0	33710	-	127	-	-	-	55.0	55.0	49387	22517	-	-	102	123	-	-	72	✓	A++	-	60.0	30733	-	153	-	-	-	60.0	60.0	48415	20413	-	-	114	149	-	-	66
CAHV-P500YA-HPB(-BS)	-	✔	A++	-	45.0	29115	-	125	-	-	-	35.0	45.0	32339	17098	-	-	104	138	-	-	79	✔	A+	-	45.0	26240	-	139	-	-	-	45.0	45.0	41798	14626	-	-	103	161	-	-	76
CAHV-P500YB-HPB(-BS)	-	✔	A++	-	45.0	29115	-	125	-	-	-	35.0	45.0	32339	17098	-	-	104	138	-	-	79	✔	A+	-	45.0	26240	-	139	-	-	-	45.0	45.0	41798	14626	-	-	103	161	-	-	76

	English	Deutsch	Français	Italiano	Español
	Nederlands	Svenska	Dansk	Português	Ελληνικά
	suomi	Čeština	Български	Polski	-
1	Outdoor unit	Außengerät	unité extérieure	unità esterna	unidad exterior
	buitenunit	Utomhusenhet	Udendørs enhed	unidade exterior	Εξωτερική μονάδα
	Ulkoyksikkö	Venkovní jednotka	Външно тяло	jednostka zewnętrzna	-
2	Indoor unit	Innengerät	unité intérieure	unità interna	unidad interior
	binnenunit	Inomhusenhet	Indendørs enhed	unidade interior	Εσωτερική μονάδα
	Sisäyksikkö	Vnitřní jednotka	Вътрешно тяло	jednostka wewnętrzna	-
3	Medium-temperature application	Mitteltemperaturanwendung	l’application à moyenne température	le applicazioni a media temperatura	la aplicación de media temperatura
	middentemperatuur-toepassing	mediumtemperaturapplikation	middeltemperaturanvendelsen	a aplicação a média temperatura	η εφαρμογή σε μέση θερμοκρασία
	keskilämpötilan sovellus	středněteplotní aplikace	среднотемпературното приложение	zastosowania w średnich temperaturach	-
4	Low-temperature application	Niedertemperaturanwendung	l’application à basse température	le applicazioni a bassa temperatura	la aplicación de baja temperatura
	lagetemperatuur-toepassing	lågtemperaturapplikation	lavtemperaturanvendelsen	a aplicação a baixa temperatura	η εφαρμογή σε χαμηλή θερμοκρασία
	matalanlämpötilan sovellus	nízkoteplotní aplikace	нискотемпературни приложения	zastosowania w niskich temperaturach	-
5	Seasonal space heating energy efficiency class	die Klasse für die jahreszeitbedingte Raumheizungs-Energieeffizienz	la classe d’efficacité énergétique saisonnière, pour le chauffage des locaux	la classe di efficienza energetica stagionale del riscaldamento d’ambiente	la clase de eficiencia energética estacional de calefacción
	de seizoensgebonden energie-efficiëntieklasse voor ruimteverwarming	säsongsrelaterade energieffektivitetsklass vid rumsuppvärmning	klassen for årsvirkningsgrad ved rumopvarmning	A classe de eficiência energética do aquecimento ambiente sazonal	η τάξη ενεργειακής απόδοσης της εποχιακής θέρμανσης χώρου
	tilalämmityksen kausittainen energiatehokkuusluokka	třída sezonní energetické účinnosti vytápění	класът на сезонната отоплителна енергийна ефективност	klasa sezonowej efektywności energetycznej ogrzewania pomieszczeń	-
6	Water heating energy efficiency class	die Klasse für die Warmwasserbereitungs-Energieeffizienz	la classe d’efficacité énergétique, pour le chauffage de l’eau	la classe di efficienza energetica del riscaldamento dell’acqua	la clase de eficiencia energética del caldeo de agua
	de energie-efficiëntieklasse voor waterverwarming	energieffektivitetsklass vid vattenuppvärmning	klassen for årsvirkningsgrad ved vandopvarmning	A classe de eficiência energética do aquecimento de água	η τάξη ενεργειακής απόδοσης θέρμανσης νερού
	vedenlämmityksen energiatehokkuusluokka	třída energetické účinnosti ohřevu vody	класът на енергийната ефективност при подгряване на вода	klasa efektywności energetycznej podgrzewania wody	-
7	Rated heat output under average climate conditions	die Wärmenennleistung bei durchschnittlichen Klimaverhältnissen	la puissance thermique nominale dans les conditions climatiques moyennes	la potenza termica nominale(in condizioni climatiche medie)	la potencia calorífica nominal(en condiciones climáticas medias)
	de nominale warmteafgifte(onder gemiddelde klimaatomstandigheden)	Den nominella avgivna värmeeffekten(under genomsnittliga klimatförhållanden)	den nominelle nytteeffekt(under gennemsnitlige klimaforhold)	A potência calorífica nominal(em condições climáticas médias)	η ονομαστική θερμική ισχύς(υπό μέσες κλιματικές συνθήκες)
	nimellislämpöteho(keskimääräisissä ilmasto-olosuhteissa)	jmenovitý tepelný výkon(za průměrných klimatických podmínek)	номиналната топлинна мощност(при средни климатични условия)	znamionowa moc cieplna(w warunkach klimatu umiarkowanego)	-
8	For space heating, annual energy consumption under average climate conditions	für die Raumheizung, den jährlichen Energieverbrauch bei durchschnittlichen Klimaverhältnissen	pour le chauffage des locaux, la consommation annuelle d’énergie(dans les conditions climatiques moyennes)	per il riscaldamento d’ambiente, il consumo annuo di energia(in condizioni climatiche medie)	para calentar espacios, el consumo anual de energía(en condiciones climáticas medias)
	voor ruimteverwarming, het jaarlijkse energieverbruik(onder gemiddelde klimaatomstandigheden)	För rumsuppvärmning, årlig energiförbrukning(vid genomsnittliga klimatförhållanden)	for rumopvarmning det årlige energiforbrug(under gennemsnitlige klimaforhold)	Para o aquecimento ambiente, o consumo anual de energia(em condições climáticas médias)	για τη θέρμανση χώρου, η ετήσια κατανάλωση ενέργειας(υπό μέσες κλιματικές συνθήκες)
	tilalämmityksestä vuotuinen energiankulutus(keskimääräisissä ilmasto-olosuhteissa)	pro vytápění – roční spotřeba energie za průměrných klimatických podmínek	за отопление, годишното потребление на енергия(при средни климатични условия)	w odniesieniu do ogrzewania pomieszczeń, roczne zużycie energii(w warunkach klimatu umiarkowanego)	-
9	For water heating, annual electricity consumption under average climate conditions	für die Warmwasserbereitung, den jährlichen Stromverbrauch bei durchschnittlichen Klimaverhältnissen	pour le chauffage de l’eau, la consommation annuelle d’électricité(dans les conditions climatiques moyennes)	per il riscaldamento dell’acqua, il consumo annuo di energia(in condizioni climatiche medie)	para calentar agua, el consumo anual de electricidad(en condiciones climáticas medias)
	voor waterverwarming, het jaarlijkse elektriciteitsverbruik(onder gemiddelde klimaatomstandigheden)	För vattenuppvärmning, årlig elförbrukning(vid genomsnittliga klimatförhållanden)	for vandopvarmning det årlige elforbrug(under gennemsnitlige klimaforhold)	para o aquecimento de água, o consumo anual de eletricidade(em condições climáticas médias)	για την θέρμανση νερού, η ετήσια κατανάλωση ηλεκτρικής ενέργειας(υπό μέσες κλιματικές συνθήκες)
	vedenlämmityksestä vuotuinen sähkönkulutus(keskimääräisissä ilmasto-olosuhteissa)	pro ohřev vody – roční spotřeba elektrické energie za průměrných klimatických podmínek	за подгряване на вода, годишното потребление(при средни климатични условия)	w odniesieniu do podgrzewania wody, roczne zużycie energii elektrycznej(w warunkach klimatu umiarkowanego)	-
10	Seasonal space heating energy efficiency under average climate conditions	die jahreszeitbedingte Raumheizungs-Energieeffizienz bei durchschnittlichen Klimaverhältnissen	l’efficacité énergétique saisonnière pour le chauffage des locaux(dans les conditions climatiques moyennes)	l’efficienza energetica stagionale di riscaldamento d’ambiente(in condizioni climatiche medie)	la eficiencia energética estacional de calefacción(en condiciones climáticas medias)
	de seizoensgebonden energie-efficiëntie voor ruimteverwarming(onder gemiddelde klimaatomstandigheden)	Säsongsmedelverkningsgrad för rumsuppvärmning(vid genomsnittliga klimatförhållanden)	årsvirkningsgraden ved rumopvarmning(under gennemsnitlige klimaforhold)	A eficiência energética do aquecimento ambiente sazonal(em condições climáticas médias)	η ενεργειακή απόδοση της εποχιακής θέρμανσης χώρου(υπό μέσες κλιματικές συνθήκες)
	tilalämmityksen kausittainen energiatehokkuus(keskimääräisissä ilmasto-olosuhteissa)	sezonní energetická účinnost vytápění za průměrných klimatických podmínek	сезонната енергийна ефективност при отопление(при средни климатични условия)	sezonowa efektywność energetyczna ogrzewania pomieszczeń(w warunkach klimatu umiarkowanego)	-
11	Water heating energy efficiency under average climate conditions	die Warmwasserbereitungs-Energieeffizienz bei durchschnittlichen Klimaverhältnissen	l’efficacité énergétique pour le chauffage de l’eau(dans les conditions climatiques moyennes)	l’efficienza energetica di riscaldamento dell’acqua(in condizioni climatiche medie)	la eficiencia energética del caldeo de agua(en condiciones climáticas medias)
	de energie-efficiëntie voor waterverwarming(onder gemiddelde klimaatomstandigheden)	Energieffektivitet vid vattenuppvärmning(vid genomsnittliga klimatförhållanden)	energieffektiviteten ved vandopvarmning(under gennemsnitlige klimaforhold)	a eficiência energética do aquecimento de água(em condições climáticas médias)	η ενεργειακή απόδοση θέρμανσης νερού(υπό μέσες κλιματικές συνθήκες)
	vedenlämmityksen energiatehokkuus(keskimääräisissä ilmasto-olosuhteissa)	energetická účinnost ohřevu vody za průměrných klimatických podmínek	енергийната ефективност при подгряване на вода(при средни климатични условия)	efektywność energetyczna podgrzewania wody(w warunkach klimatu umiarkowanego)	-
12	Sound power level L_{WA} indoor	der Schallleistungspegel L_{WA}, in Gebäuden	le niveau de puissance acoustique L_{WA} , à l’intérieur	il livello di potenza sonora L $_{WA}$ all'interno	el nivel de potencia acústica L_{WA} en interiores
	het geluidsvermogensniveau L_{WA} binnen	Ljudeffektnivå L_{WA} i inomhus	lydeffektniveauet L_{WA} i inde	O nível de potência sonora L_{WA} no interior	η στάθμη ηχητικής ισχύος L_{WA} εσωτερικού χώρου
	äänitehotaso L_{WA} sisällä	hladina akustického výkonu L_{WA} ve vnitřním prostoru	нивото на звуковата мощност L_{WA} на закрито	poziom mocy akustycznej L_{WA} w pomieszczeniu	-
13	Work only during off-peak hours	dass ein ausschließlicher Betrieb des Kombiheizgerätes zu Schwachlastzeiten	fonctionner qu’en heures creuses	funzione soltanto durante le ore morte	funcionar solamente durante las horas de baja demanda
	werken uitsluitend in de daluren	drivas uteslutande under perioder med låg belastning	fungere uden for spidsbelastningsperioder	de funcionar unicamente fora das horas de pico	λειτουργία μόνο εκτός των ωρών αιχμής
	toimimaan ainoastaan kulutushuippujen ulkopuolella	provozu pouze mimo špičku	работи само в часовете извън върховото натоварване	pracować jedynie w godzinach poza szczytowym obciążeniem	-
14	Rated heat output under colder climate conditions	die Wärmenennleistung bei kälteren Klimaverhältnissen	la puissance thermique nominale, dans les conditions climatiques plus froides	la potenza termica nominale, in condizioni climatiche più fredde	la potencia calorífica nominal en condiciones climáticas más frías
	de nominale warmteafgifte, onder koudere klimaatomstandigheden	Nominell avgiven värmeeffekt vid kallare klimatförhållanden	den nominelle nytteeffekt under koldere klimaforhold	A potência calorífica nominal em condições climáticas mais frias	η ονομαστική θερμική ισχύς υπό ψυχρότερες κλιματικές συνθήκες
	nimellislämpöteho, kylmissä ilmasto-olosuhteissa	jmenovitý tepelný výkon za chladnějších klimatických podmínek	номиналната топлинна мощност при по-студени климатични условия	znamionowa moc cieplna w warunkach klimatu chłodnego	-
15	Rated heat output under warmer climate conditions	die Wärmenennleistung bei wärmeren Klimaverhältnissen	la puissance thermique nominale, dans les conditions climatiques plus chaudes	la potenza termica nominale, in condizioni climatiche più calde	la potencia calorífica nominal en condiciones climáticas más cálidas
	de nominale warmteafgifte, onder warmere klimaatomstandigheden	Nominell avgiven värmeeffekt vid varmare klimatförhållanden	den nominelle nytteeffekt under varmere klimaforhold	A potência calorífica nominal em condições climáticas mais quentes	η ονομαστική θερμική ισχύς υπό θερμότερες κλιματικές συνθήκες
	nimellislämpöteho, lämpimissä ilmasto-olosuhteissa	jmenovitý tepelný výkon za teplejších klimatických podmínek	номиналната топлинна мощност при по-топли климатични условия	znamionowa moc cieplna w warunkach klimatu ciepłego	-
16	For space heating, annual energy consumption under colder climate conditions	für die Raumheizung, der jährliche Energieverbrauch bei kälteren Klimaverhältnissen	pour le chauffage des locaux, la consommation annuelle d’énergie, dans les conditions climatiques plus froides	per il riscaldamento d’ambiente, il consumo annuo di energia, in condizioni climatiche più fredde	para calentar espacios, el consumo anual de energía en condiciones climáticas más frías
	voor ruimteverwarming, het jaarlijkse energieverbruik onder koudere klimaatomstandigheden	För rumsuppvärmning, årlig energiförbrukning under kallare klimatförhållanden	for rumopvarmning det årlige energiforbrug under koldere klimaforhold	Para o aquecimento ambiente, o consumo anual de energia em condições climáticas mais frias	για θέρμανση χώρου, η ετήσια κατανάλωση ενέργειας υπό ψυχρότερες κλιματικές συνθήκες
	tilalämmityksestä vuotuinen energiankulutus kylmissä ilmasto-olosuhteissa	pro vytápění – roční spotřeba energie za chladnějších klimatických podmínek	за отопление, годишното потребление на енергия при по-студени климатични условия	w odniesieniu do ogrzewania pomieszczeń, roczne zużycie energii w warunkach klimatu chłodnego	-
17	For space heating, annual energy consumption under warmer climate conditions	für die Raumheizung, der jährliche Energieverbrauch bei wärmeren Klimaverhältnissen	pour le chauffage des locaux, la consommation annuelle d’énergie, dans les conditions climatiques plus chaudes	per il riscaldamento d’ambiente, il consumo annuo di energia, in condizioni climatiche più calde	para calentar espacios, el consumo anual de energía en condiciones climáticas más cálidas
	voor ruimteverwarming, het jaarlijkse energieverbruik onder warmere klimaatomstandigheden	För rumsuppvärmning, årlig energiförbrukning under varmare klimatförhållanden	for rumopvarmning det årlige energiforbrug under varmere klimaforhold	Para o aquecimento ambiente, o consumo anual de energia em condições climáticas mais quentes	για θέρμανση χώρου, η ετήσια κατανάλωση ενέργειας υπό θερμότερες κλιματικές συνθήκες
	tilalämmityksestä vuotuinen energiankulutus lämpimissä ilmasto-olosuhteissa	pro vytápění – roční spotřeba energie za teplejších klimatických podmínek	за отопление, годишното потребление на енергия при по-топли климатични условия	w odniesieniu do ogrzewania pomieszczeń, roczne zużycie energii w warunkach klimatu ciepłego	-
18	For water heating, annual energy consumption under colder climate conditions	für die Warmwasserbereitung, der jährliche Stromverbrauch bei kälteren Klimaverhältnissen	pour le chauffage de l’eau, la consommation annuelle d’électricité, dans les conditions climatiques plus froides	per il riscaldamento dell’acqua, il consumo annuo di energia, in condizioni climatiche più fredde e più calde	para calentar agua, el consumo anual de electricidad en condiciones climáticas más frías
	voor waterverwarming, het jaarlijkse elektriciteitsverbruik onder koudere klimaatomstandigheden	För vattenuppvärmning, årlig elförbrukning under kallare klimatförhållanden	for vandopvarmning det årlige elforbrug under koldere klimaforhold	para o aquecimento de água, o consumo anual de eletricidade em condições climáticas mais frias	για θέρμανση νερού, η ετήσια κατανάλωση ηλεκτρικής ενέργειας υπό ψυχρότερες κλιματικές συνθήκες
	vedenlämmityksestä vuotuinen sähkönkulutus kylmissä ilmasto-olosuhteissa	pro ohřev vody – roční spotřeba elektrické energie za chladnějších klimatických podmínek	за подгряване на вода, годишното потребление на електроенергия при по-студени климатични условия	w odniesieniu do podgrzewania wody, roczne zużycie energii elektrycznej w warunkach klimatu chłodnego	-
19	For water heating, annual energy consumption under warmer climate conditions	für die Warmwasserbereitung, der jährliche Stromverbrauch bei wärmeren Klimaverhältnissen	pour le chauffage de l’eau, la consommation annuelle d’électricité, dans les conditions climatiques plus chaudes	per il riscaldamento dell’acqua, il consumo annuo di energia, in condizioni climatiche più fredde e più calde	para calentar agua, el consumo anual de electricidad en condiciones climáticas más cálidas
	voor waterverwarming, het jaarlijkse elektriciteitsverbruik onder warmere klimaatomstandigheden	För vattenuppvärmning, årlig elförbrukning under varmare klimatförhållanden	for vandopvarmning det årlige elforbrug under varmere klimaforhold	para o aquecimento de água, o consumo anual de eletricidade em condições climáticas mais quentes	για θέρμανση νερού, η ετήσια κατανάλωση ηλεκτρικής ενέργειας υπό θερμότερες κλιματικές συνθήκες
	vedenlämmityksestä vuotuinen sähkönkulutus lämpimissä ilmasto-olosuhteissa	pro ohřev vody – roční spotřeba elektrické energie za teplejších klimatických podmínek	за подгряване на вода, годишното потребление на електроенергия при по-топли климатични условия	w odniesieniu do podgrzewania wody, roczne zużycie energii elektrycznej w warunkach klimatu ciepłego	-
20	Seasonal space heating energy efficiency under colder climate conditions	die jahreszeitbedingte Raumheizungs-Energieeffizienz bei kälteren Klimaverhältnissen	l’efficacité énergétique saisonnière pour le chauffage des locaux, dans les conditions climatiques plus froides	l’efficienza energetica stagionale di riscaldamento d’ambiente in condizioni climatiche più fredde	la eficiencia energética estacional de calefacción en condiciones climáticas más frías
	de seizoensgebonden energie-efficiëntie voor ruimteverwarming onder koudere klimaatomstandigheden	Säsongsmedelverkningsgrad för rumsuppvärmning under kallare klimatförhållanden	årsvirkningsgraden ved rumopvarmning under koldere klimaforhold	A eficiência energética do aquecimento ambiente sazonal em condições climáticas mais frias	η ενεργειακή απόδοση της εποχιακής θέρμανσης χώρου υπό ψυχρότερες κλιματικές συνθήκες
	tilalämmityksen kausittainen energiatehokkuus kylmissä ilmasto-olosuhteissa	sezonní energetická účinnost vytápění za chladnějších klimatických podmínek	сезонната енергийна ефективност при отопление при по-студени климатични условия	sezonowa efektywność energetyczna ogrzewania pomieszczeń w warunkach klimatu chłodnego	-
21	Seasonal space heating energy efficiency under warmer climate conditions	die jahreszeitbedingte Raumheizungs-Energieeffizienz bei wärmeren Klimaverhältnissen	l’efficacité énergétique saisonnière pour le chauffage des locaux, dans les conditions climatiques plus chaudes	l’efficienza energetica stagionale di riscaldamento d’ambiente in condizioni climatiche più calde	la eficiencia energética estacional de calefacción en condiciones climáticas más cálidas
	de seizoensgebonden energie-efficiëntie voor ruimteverwarming onder warmere klimaatomstandigheden	Säsongsmedelverkningsgrad för rumsuppvärmning under varmare klimatförhållanden	årsvirkningsgraden ved rumopvarmning under varmere klimaforhold	A eficiência energética do aquecimento ambiente sazonal em condições climáticas mais quentes	η ενεργειακή απόδοση της εποχιακής θέρμανσης χώρου υπό θερμότερες κλιματικές συνθήκες
	tilalämmityksen kausittainen energiatehokkuus lämpimissä ilmasto-olosuhteissa	sezonní energetická účinnost vytápění za teplejších klimatických podmínek	сезонната енергийна ефективност при отопление при по-топли климатични условия	sezonowa efektywność energetyczna ogrzewania pomieszczeń w warunkach klimatu ciepłego	-
22	Water heating energy efficiency under colder climate conditions	die Warmwasserbereitungs-Energieeffizienz bei kälteren Klimaverhältnissen	l’efficacité énergétique pour le chauffage de l’eau, dans les conditions climatiques plus froides	l’efficienza energetica di riscaldamento dell'acqua in condizioni climatiche più fredde	la eficiencia energética de caldeo de agua en condiciones climáticas más frías
	de energie-efficiëntie voor waterverwarming onder koudere klimaatomstandigheden	Energieffektivitet vid vattenuppvärmning under kallare klimatförhållanden	energieffektiviteten ved vandopvarmning under koldere klimaforhold	a eficiência energética do aquecimento de água em condições climáticas mais frias	η ενεργειακή απόδοση της θέρμανσης νερού υπό ψυχρότερες κλιματικές συνθήκες
	vedenlämmityksen energiatehokkuus kylmissä ilmasto-olosuhteissa	energetická účinnost ohřevu vody za chladnějších klimatických podmínek	енергийната ефективност при подгряване на вода при по-студени климатични условия	efektywność energetyczna podgrzewania wody w warunkach klimatu chłodnego	-
23	Water heating energy efficiency under warmer climate conditions	die Warmwasserbereitungs-Energieeffizienz bei wärmeren Klimaverhältnissen	l’efficacité énergétique pour le chauffage de l’eau, dans les conditions climatiques plus chaudes	l’efficienza energetica di riscaldamento dell'acqua in condizioni climatiche più calde	la eficiencia energética de caldeo de agua en condiciones climáticas más cálidas
	de energie-efficiëntie voor waterverwarming onder warmere klimaatomstandigheden	Energieffektivitet vid vattenuppvärmning under varmare klimatförhållanden	energieffektiviteten ved vandopvarmning under varmere klimaforhold	a eficiência energética do aquecimento de água em condições climáticas mais quentes	η ενεργειακή απόδοση της θέρμανσης νερού υπό θερμότερες κλιματικές συνθήκες
	vedenlämmityksen energiatehokkuus kylmissä ilmasto-olosuhteissa	energetická účinnost ohřevu vody za teplejších klimatických podmínek	енергийната ефективност при подгряване на вода при по-топли климатични условия	efektywność energetyczna podgrzewania wody w warunkach klimatu ciepłego	-
24	Sound power level L_{WA} outdoor	der Schallleistungspegel L_{WA} im Freien	le niveau de puissance acoustique L_{WA} à l’extérieur	il livello di potenza sonora L $_{WA}$ all'esterno	el nivel de potencia acústica L_{WA} en exteriores
	het geluidsvermogensniveau L_{WA} buiten	Ljudeffektnivån L_{WA} i utomhus	lydeffektniveau L_{WA} i ude	O nível de potência sonora L_{WA} no exterior	η στάθμη ηχητικής ισχύος L_{WA} εξωτερικού χώρου
	äänitehotaso L_{WA} ulkona	hladina akustického výkonu L_{WA} ve venkovním prostoru	нивото на звуковата мощност L_{WA} на открито	poziom mocy akustycznej L_{WA} na zewnątrz	-

Model(s):	Outdoor unit:	CAHV-P500YB-HPB(-BS)
	Indoor unit:	-
Air-to-water heat pump:		yes
Water-to-water heat pump:		no
Brine-to-water heat pump:		no
Low-temperature heat pump:		no
Equipped with a supplementary heater:		no
Heat pump combination heater:		no
Parameters for		medium-temperature application.
Parameters for		average climate conditions.

Item	Symbol	Value	Unit
Rated heat output (*)	Prated	45	kW
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature T j			
Tj= - 7 ℃	Pdh	39.8	kW
Degradation co-efficient (**)	Cdh	0.9	-
Tj= + 2 ℃	Pdh	24.2	kW
Degradation co-efficient (**)	Cdh	0.9	-
Tj= + 7 ℃	Pdh	21.0	kW
Degradation co-efficient (**)	Cdh	0.9	-
Tj= +12 ℃	Pdh	25.3	kW
Degradation co-efficient (**)	Cdh	0.9	-
Tj= bivalent temperature	Pdh	39.8	kW
Tj= operation limit temperature	Pdh	45.0	kW
Tj = – 15 °C (if TOL < – 20 °C)	Pdh	-	kW
Bivalent temperature	Tbiv	-7	℃

Item	Symbol	Value	Unit
Seasonal space heating energy efficiency	ηs	125	%
Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj= - 7 ℃	COPd	2.40	-
Tj= + 2 ℃	COPd	3.29	-
Tj= + 7 ℃	COPd	3.89	-
Tj= +12 ℃	COPd	5.13	-
Tj= bivalent temperature	COPd	2.40	-
Tj= operation limit temperature	COPd	2.19	-
Tj = – 15 °C (if TOL < – 20 °C)	COPd	-	-
Operation limit temperature	TOL	-10	℃
Heating water operating limit temperature	WTOL	70	℃

Power consumption in modes other than active mode			
Off mode	P_{OFF}	0.105	kW
Thermostat-off mode	P_{TO}	0.105	kW
Stanby mode	P_{SB}	0.105	kW
Crankcase heater mode	P_{CK}	0.090	kW

Supplementary heater			
Rated heat output (*)	Psup	0.0	kW
Type of energy input			

Other items

Capacity control		variable	
Sound power level, indoors/outdoors	L_{WA}	-/79	dBA
Annual energy consumption	Q_{HE}	29115	kWh

Rated air flow rate, outdoors	-	8850	m^3/h

For heat pump combination heater:

Declared load profile		-	
Daily electricity consumption	Qelec	-	kW/h
Annual electricity consumption	AEC	-	kW/h

Water heating energy efficiency	ηwh	-	%

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(*) For heat pump space heaters and heat pump combination heaters, the rated heat output Prated is equal to the design load for heating Pdesignh, and the rated heat output of a supplementary heater Psup is equal to the supplementary capacity for heating sup(Tj).

(**) If Cdh is not determined by measurement then the default degradation coefficient is Cdh = 0,9.

Model(s):	Outdoor unit:	CAHV-P500YB-HPB(-BS)
	Indoor unit:	-
Air-to-water heat pump:		yes
Water-to-water heat pump:		no
Brine-to-water heat pump:		no
Low-temperature heat pump:		no
Equipped with a supplementary heater:		no
Heat pump combination heater:		no
Parameters for		low-temperature application.
Parameters for		average climate conditions.

Item	Symbol	Value	Unit	Item	Symbol	Value	Unit
Rated heat output (*)	Prated	45	kW	Seasonal space heating energy efficiency	ηs	139	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature T j				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj= - 7 ℃	Pdh	39.8	kW	Tj= - 7 ℃	COPd	2.75	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= + 2 ℃	Pdh	24.2	kW	Tj= + 2 ℃	COPd	3.74	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= + 7 ℃	Pdh	21.5	kW	Tj= + 7 ℃	COPd	4.25	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= +12 ℃	Pdh	25.5	kW	Tj= +12 ℃	COPd	5.28	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= bivalent temperature	Pdh	39.8	kW	Tj= bivalent temperature	COPd	2.75	-
Tj= operation limit temperature	Pdh	37.6	kW	Tj= operation limit temperature	COPd	2.75	-
Tj = – 15 °C (if TOL < – 20 °C)	Pdh	-	kW	Tj = – 15 °C (if TOL < – 20 °C)	COPd	-	-
Bivalent temperature	Tbiv	-7	℃	Operation limit temperature	TOL	-10	℃
				Heating water operating limit temperature	WTOL	70	℃
Power consumption in modes other than active mode				Supplementary heater			
Off mode	P_{OFF}	0.105	kW	Rated heat output (*)	Psup	7.4	kW
Thermostat-off mode	P_{TO}	0.105	kW				
Stanby mode	P_{SB}	0.105	kW	Type of energy input			
Crankcase heater mode	P_{CK}	0.090	kW				
Other items							
Capacity control	variable			Rated air flow rate, outdoors	-	8850	m^3/h
Sound power level, indoors/outdoors	L_{WA}	-/79	dBA				
Annual energy consumption	Q_{HE}	26240	kWh				
For heat pump combination heater:							
Declared load profile	-			Water heating energy efficiency	ηwh	-	%
Daily electricity consumption	Qelec	-	kW/h				
Annual electricity consumption	AEC	-	kW/h				

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(*) For heat pump space heaters and heat pump combination heaters, the rated heat output Prated is equal to the design load for heating Pdesignh, and the rated heat output of a supplementary heater Psup is equal to the supplementary capacity for heating sup(Tj).

(**) If Cdh is not determined by measurement then the default degradation coefficient is Cdh = 0,9.

Model(s):	Outdoor unit:	CAHV-P500YB-HPB(-BS)
	Indoor unit:	-
Air-to-water heat pump:		yes
Water-to-water heat pump:		no
Brine-to-water heat pump:		no
Low-temperature heat pump:		no
Equipped with a supplementary heater:		no
Heat pump combination heater:		no
Parameters for		medium-temperature application.
Parameters for		colder climate conditions.

Item	Symbol	Value	Unit	Item	Symbol	Value	Unit
Rated heat output (*)	Prated	35	kW	Seasonal space heating energy efficiency	ηs	104	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature T j				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj= - 7 ℃	Pdh	21.2	kW	Tj= - 7 ℃	COPd	2.53	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= + 2 ℃	Pdh	17.6	kW	Tj= + 2 ℃	COPd	3.09	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= + 7 ℃	Pdh	21.3	kW	Tj= + 7 ℃	COPd	4.05	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= +12 ℃	Pdh	25.5	kW	Tj= +12 ℃	COPd	5.16	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= bivalent temperature	Pdh	21.2	kW	Tj= bivalent temperature	COPd	2.53	-
Tj= operation limit temperature	Pdh	32.2	kW	Tj= operation limit temperature	COPd	1.54	-
Tj = – 15 °C (if TOL < – 20 °C)	Pdh	-	kW	Tj = – 15 °C (if TOL < – 20 °C)	COPd	-	-
Bivalent temperature	Tbiv	-7	℃	Operation limit temperature	TOL	-20	℃
				Heating water operating limit temperature	WTOL	65	℃
Power consumption in modes other than active mode				Supplementary heater			
Off mode	P_{OFF}	0.105	kW	Rated heat output (*)	Psup	35.0	kW
Thermostat-off mode	P_{TO}	0.105	kW				
Stanby mode	P_{SB}	0.105	kW	Type of energy input			
Crankcase heater mode	P_{CK}	0.090	kW				
Other items							
Capacity control	variable			Rated air flow rate, outdoors	-	8850	m^3/h
Sound power level, indoors/outdoors	L_{WA}	-/79	dBA				
Annual energy consumption	Q_{HE}	32339	kWh				
For heat pump combination heater:							
Declared load profile	-			Water heating energy efficiency	ηwh	-	%
Daily electricity consumption	Qelec	-	kW/h				
Annual electricity consumption	AEC	-	kW/h				

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(*) For heat pump space heaters and heat pump combination heaters, the rated heat output Prated is equal to the design load for heating Pdesignh, and the rated heat output of a supplementary heater Psup is equal to the supplementary capacity for heating sup(Tj).
(**) If Cdh is not determined by measurement then the default degradation coefficient is Cdh = 0,9.

Model(s):	Outdoor unit:	CAHV-P500YB-HPB(-BS)
	Indoor unit:	-
Air-to-water heat pump:		yes
Water-to-water heat pump:		no
Brine-to-water heat pump:		no
Low-temperature heat pump:		no
Equipped with a supplementary heater:		no
Heat pump combination heater:		no
Parameters for		low-temperature application.
Parameters for		colder climate conditions.

Item	Symbol	Value	Unit	Item	Symbol	Value	Unit
Rated heat output (*)	Prated	45	kW	Seasonal space heating energy efficiency	ηs	103	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature T j				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj= - 7 ℃	Pdh	27.2	kW	Tj= - 7 ℃	COPd	3.03	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= + 2 ℃	Pdh	18.0	kW	Tj= + 2 ℃	COPd	3.53	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= + 7 ℃	Pdh	21.6	kW	Tj= + 7 ℃	COPd	4.42	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= +12 ℃	Pdh	25.5	kW	Tj= +12 ℃	COPd	5.28	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= bivalent temperature	Pdh	27.2	kW	Tj= bivalent temperature	COPd	3.03	-
Tj= operation limit temperature	Pdh	30.8	kW	Tj= operation limit temperature	COPd	3.31	-
Tj = – 15 °C (if TOL < – 20 °C)	Pdh	-	kW	Tj = – 15 °C (if TOL < – 20 °C)	COPd	-	-
Bivalent temperature	Tbiv	-7	℃	Operation limit temperature	TOL	-10	℃
				Heating water operating limit temperature	WTOL	65	℃
Power consumption in modes other than active mode				Supplementary heater			
Off mode	P_{OFF}	0.105	kW	Rated heat output (*)	Psup	45.0	kW
Thermostat-off mode	P_{TO}	0.105	kW				
Stanby mode	P_{SB}	0.105	kW	Type of energy input			
Crankcase heater mode	P_{CK}	0.090	kW				
Other items							
Capacity control	variable			Rated air flow rate, outdoors	-	8850	m^3/h
Sound power level, indoors/outdoors	L_{WA}	-/79	dBA				
Annual energy consumption	Q_{HE}	41798	kWh				
For heat pump combination heater:							
Declared load profile	-			Water heating energy efficiency	ηwh	-	%
Daily electricity consumption	Qelec	-	kW/h				
Annual electricity consumption	AEC	-	kW/h				

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(*) For heat pump space heaters and heat pump combination heaters, the rated heat output Prated is equal to the design load for heating Pdesignh, and the rated heat output of a supplementary heater Psup is equal to the supplementary capacity for heating sup(Tj).
(**) If Cdh is not determined by measurement then the default degradation coefficient is Cdh = 0,9.

Model(s):	Outdoor unit:	CAHV-P500YB-HPB(-BS)
	Indoor unit:	-
Air-to-water heat pump:		yes
Water-to-water heat pump:		no
Brine-to-water heat pump:		no
Low-temperature heat pump:		no
Equipped with a supplementary heater:		no
Heat pump combination heater:		no
Parameters for		medium-temperature application.
Parameters for		warmer climate conditions.

Item	Symbol	Value	Unit	Item	Symbol	Value	Unit
Rated heat output (*)	Prated	45	kW	Seasonal space heating energy efficiency	ηs	138	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature T j				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj= - 7 ℃	Pdh	-	kW	Tj= - 7 ℃	COPd	-	-
Degradation co-efficient (**)	Cdh	-	-				
Tj= + 2 ℃	Pdh	45.0	kW	Tj= + 2 ℃	COPd	2.54	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= + 7 ℃	Pdh	28.9	kW	Tj= + 7 ℃	COPd	3.48	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= +12 ℃	Pdh	24.9	kW	Tj= +12 ℃	COPd	4.58	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= bivalent temperature	Pdh	28.9	kW	Tj= bivalent temperature	COPd	3.48	-
Tj= operation limit temperature	Pdh	45.0	kW	Tj= operation limit temperature	COPd	2.19	-
Tj = – 15 °C (if TOL < – 20 °C)	Pdh	-	kW	Tj = – 15 °C (if TOL < – 20 °C)	COPd	-	-
Bivalent temperature	Tbiv	7	℃	Operation limit temperature	TOL	-10	℃
				Heating water operating limit temperature	WTOL	70	℃
Power consumption in modes other than active mode				Supplementary heater			
Off mode	P_{OFF}	0.105	kW	Rated heat output (*)	Psup	0.0	kW
Thermostat-off mode	P_{TO}	0.105	kW				
Stanby mode	P_{SB}	0.105	kW	Type of energy input			
Crankcase heater mode	P_{CK}	0.090	kW				
Other items							
Capacity control	variable			Rated air flow rate, outdoors	-	8850	m^3/h
Sound power level, indoors/outdoors	L_{WA}	-/79	dBA				
Annual energy consumption	Q_{HE}	17098	kWh				
For heat pump combination heater:							
Declared load profile	-			Water heating energy efficiency	ηwh	-	%
Daily electricity consumption	Qelec	-	kW/h				
Annual electricity consumption	AEC	-	kW/h				

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(*) For heat pump space heaters and heat pump combination heaters, the rated heat output Prated is equal to the design load for heating Pdesignh, and the rated heat output of a supplementary heater Psup is equal to the supplementary capacity for heating sup(Tj).
(**) If Cdh is not determined by measurement then the default degradation coefficient is Cdh = 0,9.

Model(s):	Outdoor unit:	CAHV-P500YB-HPB(-BS)
	Indoor unit:	-
Air-to-water heat pump:		yes
Water-to-water heat pump:		no
Brine-to-water heat pump:		no
Low-temperature heat pump:		no
Equipped with a supplementary heater:		no
Heat pump combination heater:		no
Parameters for		low-temperature application.
Parameters for		warmer climate conditions.

Item	Symbol	Value	Unit	Item	Symbol	Value	Unit
Rated heat output (*)	Prated	45	kW	Seasonal space heating energy efficiency	ηs	161	%
Declared capacity for heating for part load at indoor temperature 20 °C and outdoor temperature T j				Declared coefficient of performance or primary energy ratio for part load at indoor temperature 20 °C and outdoor temperature Tj			
Tj= - 7 ℃	Pdh	-	kW	Tj= - 7 ℃	COPd	-	-
Degradation co-efficient (**)	Cdh	-	-				
Tj= + 2 ℃	Pdh	45.0	kW	Tj= + 2 ℃	COPd	3.45	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= + 7 ℃	Pdh	28.9	kW	Tj= + 7 ℃	COPd	4.34	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= +12 ℃	Pdh	25.3	kW	Tj= +12 ℃	COPd	5.08	-
Degradation co-efficient (**)	Cdh	0.9	-				
Tj= bivalent temperature	Pdh	28.9	kW	Tj= bivalent temperature	COPd	4.34	-
Tj= operation limit temperature	Pdh	37.6	kW	Tj= operation limit temperature	COPd	2.75	-
Tj = – 15 °C (if TOL < – 20 °C)	Pdh	-	kW	Tj = – 15 °C (if TOL < – 20 °C)	COPd	-	-
Bivalent temperature	Tbiv	7	℃	Operation limit temperature	TOL	-10	℃
				Heating water operating limit temperature	WTOL	70	℃
Power consumption in modes other than active mode				Supplementary heater			
Off mode	P_{OFF}	0.105	kW	Rated heat output (*)	Psup	0.0	kW
Thermostat-off mode	P_{TO}	0.105	kW				
Stanby mode	P_{SB}	0.105	kW	Type of energy input			
Crankcase heater mode	P_{CK}	0.090	kW				
Other items							
Capacity control	variable			Rated air flow rate, outdoors	-	8850	m^3/h
Sound power level, indoors/outdoors	L_{WA}	-/79	dBA				
Annual energy consumption	Q_{HE}	14626	kWh				
For heat pump combination heater:							
Declared load profile	-			Water heating energy efficiency	ηwh	-	%
Daily electricity consumption	Qelec	-	kW/h				
Annual electricity consumption	AEC	-	kW/h				

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(*) For heat pump space heaters and heat pump combination heaters, the rated heat output Prated is equal to the design load for heating Pdesignh, and the rated heat output of a supplementary heater Psup is equal to the supplementary capacity for heating sup(Tj).

(**) If Cdh is not determined by measurement then the default degradation coefficient is Cdh = 0,9.