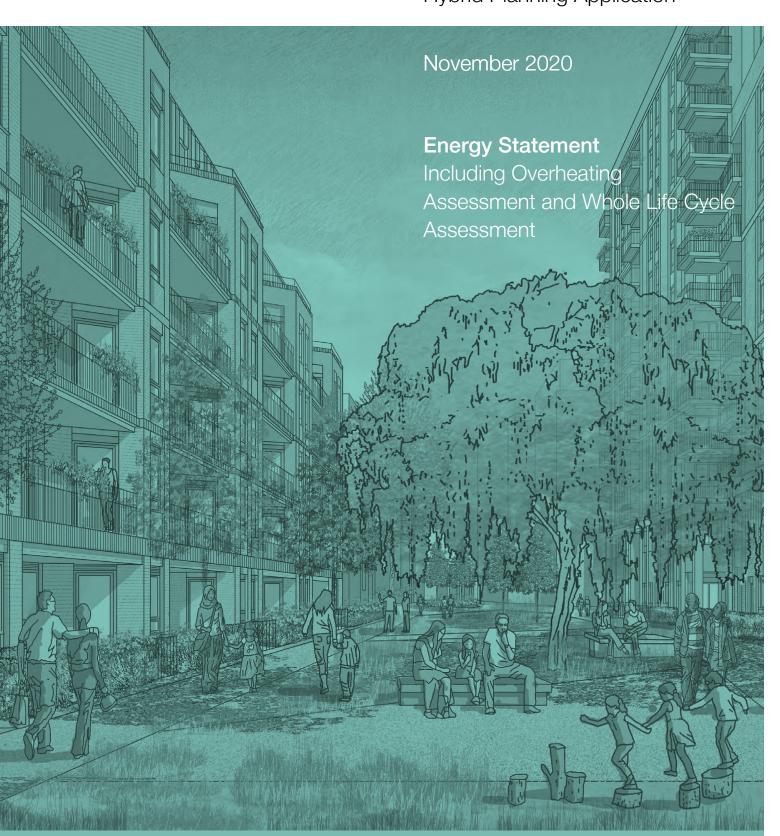
CAMBRIDGE ROAD ESTATE - PLANNING APPLICATION 20/02942/FUL ENERGY STATEMENT - NOVEMBER 2020

NOTE WHOLE LIFE CYCLE ASSESSMENT THAT WAS ORIGINALLY INCLUDED IN THE ENERGY STATEMENT HAS BEEN UPDATED IN OCTOBER 2021

Cambridge Road Estate Hybrid Planning Application









The Applicant

Cambridge Road (Kingston) Ltd

c/o Countryside Properties Aurora House 71-75 Uxbridge Road Ealing London W5 5SL

The project site

Cambridge Road Estate Project hub

2 Tadlow Washington Road Kingston Upon Thames Surrey KT1 3JL

Application forms

Covering letter

Application Form and Notices

CIL Additional Information Form

Design proposals

Planning Statement

Design and Access Statement

- Vol.1 The Masterplan
- Vol.2 The Detailed Component

The Masterplan

- Parameter Plans
- Illustrative Plans
- Design Guidelines

Phase 1 Architecture and Landscape

• GA Plans, Sections and Elevations

Supporting information

Statement of Community Involvement

Rehousing Strategy

Financial Viability Appraisal

Draft Estate Management Strategy

Transport Assessment
Phase 1 Travel Plan
Car Parking Management Plan
Servicing and Delivery Management Plan

Construction Logistics Plan
Construction Method Statement and Construction
Management Plan
Sustainable Design and Construction Statement
(Including Circular Economy Statement)

Environmental Statement

- Non Technical Summary
- Vol.1 Technical Reports
- Vol.2 Technical Appendices
- Vol.3 Townscape and Visual Impact Assessment

Energy Statement (Including Overheating Assessment and Whole Life Cycle Assessment)

Daylight and Sunlight Internal Assessment of the Detailed Component External Assessment of the Illustrative Masterplan

Extraction and Ventilation Strategy Noise Impact Assessment

Arboricultural Report and Tree Conditions Survey Arboricultural Impact Assessment & Method Statement

Preliminary Ecological and Bat Survey Report Biodiversity Net Gain Assessment

Archaeology and Heritage Assessment Ground Conditions Assessment

Utilities Report

Flood Risk Assessment Phase 1 Drainage Statement

Fire Strategy Report

Accessibility Audit Health Impact Assessment Equalities Impact Assessment





Energy Statement

Cambridge Road (RBK) LLP

Cambridge Road Estate

FINAL

Nikhil Doshi

Meng (Hons), CEng, MIMechE October 2020

Document Control Record Report Status: FINAL

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v.1	02/10/2020	Draft	ND	DS	ND
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v. 3	13/11/2020	Final minor comments	ND	DS	ND

About Hodkinson Consultancy

Our team of technical specialists offer advanced levels of expertise and experience to our clients. We have a wide experience of the construction and development industry and tailor teams to suit each individual project.

We are able to advise at all stages of projects from planning applications to handover.

Our emphasis is to provide innovative and cost-effective solutions that respond to increasing demands for quality and construction efficiency.

This report has been prepared by Hodkinson Consultancy using all reasonable skill, care and diligence and using evidence supplied by the design team, client and where relevant through desktop research.

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Executive Summary

The purpose of this Energy Statement is to demonstrate the commitments, key measures and CO₂ reductions identified at each stage of the energy strategy for the proposed Cambridge Road Estate development in the Royal Borough of Kingston Upon Thames.

This energy strategy has been formulated following the London Plan Energy Hierarchy: *Be Lean*, *Be Clean* and *Be Green*. The objective in the formulation of the strategy is to maximise the reductions in CO_2 emissions through the application of this Hierarchy with a cost-effective approach that is technically appropriate.

The development summarised in this application concerns:

- > Hybrid Outline Planning Application for a mixed use development, including demolition of existing buildings and erection of up to 2,170 residential units (Use Class C3), 290 m² of flexible office floorspace (Use Class E), 1,395 m² of flexible retail/commercial floorspace (Use Class E/Sui Generis), 1,250 m² community floorspace (Use Class F2);
- Detailed permission is sought for access, layout, scale, appearance and landscaping of Phase 1 for erection of 452 residential units (Use Class C3), 1,250 m² community floorspace (Use Class F2), 290 m² of flexible office floorspace (Use Class E), 395 m² of flexible retail/commercial floorspace (Use Class E/Sui Generis), new publicly accessible open space and associated access, servicing, parking, landscaping works including tree removal, refuse/recycling and bicycle storage, energy centre and works.

Following an examination of both local and national policy requirements, it has been determined that the proposed development is to target a reduction in CO_2 emissions of 35% beyond a determined Part L 2013 baseline case on site. For the purposes of this Energy Statement the SAP 10.0 carbon factors are to be utilised.

A range of *Be Lean* energy efficiency measures are proposed for the dwellings and Non-residential areas. This is in line with the London Plan Energy Hierarchy. They enable the proposed elements to meet the 10% and 15% improvement required from the residential and non-residential baseline cases, respectively, through energy efficiency alone. They further achieve the proposed requirements of the Draft London Plan by meeting the targeted energy efficiency requirements for this stage.

In accordance with the Energy Hierarchy, the feasibility of heating infrastructure as a *Be Clean* measure has also been carefully examined. Following a site analysis, a site wide heating network with a plant room located at the base of Block E will be present. This is to enable the connection to the wider heat network that is being developed by the Royal Borough of Kingston Upon Thames. This heat network is expected to utilise heat pumps for heat generation. This development is intended to be the anchor site and is likely to be connected to this wider network. This achieves the onsite carbon reductions (35%) required by Policy SI 2 of the Intend to Publish new London Plan.

In accordance with the Energy Hierarchy, the relevant **Be Green** renewable energy generating technologies have been evaluated. In line with Policy SI 2 renewables have been maximised through the application of low carbon heating and where safely and practicably feasible, application of photovoltaics.

The proposed design for the development will enable it to reduce its CO₂ emissions and go beyond the requirements of the London Plan representing a high level of sustainable design.

The onsite carbon emission reductions required by the London Plan have been achieved. The remaining carbon emissions are described in Table 4.

The tables below demonstrate the reduction in Regulated and Total ${\rm CO_2}$ reductions after each stage of the Energy Hierarchy showing energy policy requirements have been achieved. They are based on SAP 10.0 carbon factors.

Table 1: Residential Carbon Dioxide Emissions and Savings after each stage of the Energy Hierarchy						
Stage Carbon Dioxide Emissions (Tonnes CO ₂ per						
	Regulated	Unregulated				
Baseline: Part L 2013 Compliant Development	2,148	1,225				
After <i>Be Lean</i> Measures	1,860	1,225				
After <i>Be Clean</i> Measures	839	1,225				
After <i>Be Green</i> Measures	792	1,225				
Stage	Regulated Carbon Dioxide Savings					
	Tonnes CO ₂ per Annum	Percentage				
Savings from <i>Be Lean</i> Measures	288	13%				
Savings from <i>Be Clean</i> Measures	1,021	48%				
Savings from <i>Be Green</i> Measures	46	2%				
Cumulative On-Site Savings	1,355	63%				



Table 2: Non- Residential Carbon Dioxide Emissions and Savings after each stage of the Energy Hierarchy

Stage	Carbon Dioxide Emissions (Tonnes CO ₂ per Annum)			
	Regulated	Unregulated		
Baseline: Part L 2013 Compliant Development	33	7		
After Be Lean Measures	26	7		
After <i>Be Clean</i> Measures	26	7		
After Be Green Measures	17	7		
Stage	Regulated Carbon Dioxide Savings			
	Tonnes CO ₂ per Annum	Percentage		
Savings from Be Lean Measures	6	20%		
Savings from <i>Be Clean</i> Measures	0	0%		
Savings from <i>Be Green</i> Measures	9	28%		
Cumulative On-Site Savings	15	47%		

Table 3: Site Wide Carbon Dioxide Emissions and Cumulative Savings							
Stage	Regulated Carbon Dioxide Emissions	Regulated Carbon Dioxide Savings					
	(Tonnes CO ₂ per	Tonnes CO ₂ per	Percentage				
	Annum)	Annum					
Baseline: Part L 2013 Compliant Development	2,180						
After <i>Be Lean</i> Measures	1,886	294	14%				
After <i>Be Clean</i> Measures	865	1,021	47%				
After <i>Be Green</i> Measures	810	55	3%				
Cumulative On Site Savings		4 074	C20/				
Cumulative On-Site Savings		1,371	63%				

Table 4 Shortfall in Regulated Carbon dioxide emission savings (TCO ₂)						
		Annual	Over 30 years			
p	Domestic shortfall to Zero Carbon	166	4,988			
Detailed	Non-Domestic shortfall to 35% improvement	0	0			
Ω	Cash in lieu payment (£60/TCO2)		£299,271			
(I)	Domestic shortfall to Zero Carbon	626	18,785			
Outline	Non-Domestic shortfall to 35% improvement	0	0			
0	Cash in lieu payment (£60/TCO2)		£1,127,085			
	Domestic shortfall to Zero Carbon	792	23,773			
Entire	Non-Domestic shortfall to 35% improvement	0	0			
	Cash in lieu payment (£60/TCO2)		£1,426,356			



Contents

	Executive Summary	2			
1.	INTRODUCTION	7			
2.	DEVELOPMENT OVERVIEW	8			
3.	RELEVANT PLANNING POLICY	10			
	Summary of Policy Targets	16			
4.	BASELINE EMISSIONS ASSESSMENT	17			
5.	BE LEAN: DEMAND REDUCTION	19			
	Residential	19			
	Non-Residential	22			
	CO ₂ Emissions Following <i>Be Lean</i> Measures	23			
6.	BE CLEAN: HEATING INFRASTRUCTURE	26			
	CO ₂ Emissions Following <i>Be Clean</i> Measures	34			
7.	BE GREEN: RENEWABLE ENERGY	36			
	CO ₂ Emissions Following <i>Be Green</i> Measures	38			
8.	BE SEEN: ENERGY MONITORING	40			
9.	ZERO CARBON HOMES	41			
10	. SUMMARY	42			
۸D	DDENDICES				

1. INTRODUCTION

- 1.1 This Energy Statement has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development, appointed by Cambridge Road (RBK) LLP. This statement is in support of the planning application for the proposed development at Cambridge Road Estate, in the Royal Borough of Kingston Upon Thames.
- 1.2 The aim of this energy statement is to demonstrate that the energy strategy developed at planning for this development meets the requirements of the London Plan.
- **1.3** The hybrid application consists of:
 - Outline Planning Permission, with all matters reserved apart from access, layout and scale for demolition of existing buildings and erection of 2,170 residential units (Use Class C3), 1,775 m² community floorspace (Use Class F2), 698 m² of flexible office (Use Class E), 1,093 m² of flexible retail/commercial floorspace (Use Class E/F2), new publicly accessible open space and associated access, servicing, parking, landscaping and works; and
 - > Detailed Planning Permission for erection of 450 residential units (Use Class C3), 1,775 m² community floorspace (Use Class F2), 318 m² of flexible office (Use Class E), 204 m² of flexible retail/commercial floorspace (Use Class E/F2), new publicly accessible open space and associated access, servicing, parking, landscaping and works ("the Proposed Development").
- 1.4 The formulation of the energy statement is on the basis that it targets a viable reduction in carbon dioxide (CO₂) emissions through the application of the London Plan Energy Hierarchy with an affordable, deliverable, and technically appropriate strategy.
- This statement establishes a baseline assessment of the energy demands and associated CO₂ emissions for Cambridge Road Estate. It reflects the Approved Document Part L 1A (2013) and Part L 2A (2013) baseline for new build dwellings and non-domestic construction, respectively.
- 1.6 The report will then follow The London Plan Energy Hierarchy approach to enable the maximum viable reductions in Regulated and Total CO₂ emissions as follows:
 - > **Be Lean** minimum 10% reduction over Part L 2013 for residential areas, and 15% reduction from non-residential areas from energy efficiency measures alone;
 - > **Be Clean** use a decentralised heat network to supply heating and hot water;
 - > **Be Green** consideration of the feasibility of on-site renewable technology;
 - > A minimum on-site 35% reduction over Part L 2013, with any residual residential Regulated CO₂ emissions offset through a carbon offset payment to the local borough, to achieve the standard of **Zero Carbon**.



2. DEVELOPMENT OVERVIEW

2.1 The proposed development of Cambridge Road Estate is to take place within the Royal Borough of Kingston Upon Thames, as shown in

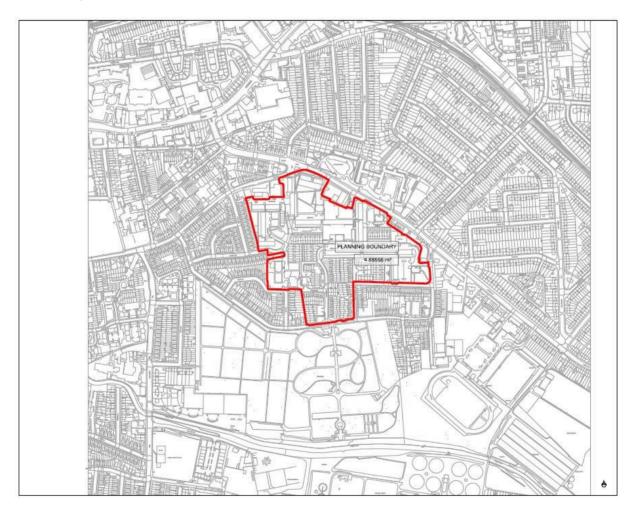


Figure 1: Site plan Courtesy of Patel Taylor

Development description

- **2.2** The application consists of:
 - > Hybrid Outline Planning Application for a mixed use development, including demolition of existing buildings and erection of up to 2,170 residential units (Use Class C3), 290 m² of flexible office floorspace (Use Class E), 1,395 m² of flexible retail/commercial floorspace (Use Class E/Sui Generis), 1,250 m² community floorspace (Use Class F2), new publicly accessible open space and associated access, servicing, landscaping and works.

- > Detailed permission is sought for access, layout, scale, appearance and landscaping of Phase 1 for erection of 452 residential units (Use Class C3), 1,250 m² community floorspace (Use Class F2), 290 m² of flexible office floorspace (Use Class E), 395 m² of flexible retail/commercial floorspace (Use Class E/Sui Generis), new publicly accessible open space and associated access, servicing, parking, landscaping works including tree removal, refuse/recycling and bicycle storage, energy centre and works ("the Proposed Development").
- **2.3** Figure 2 provides the proposed development site plan.
- 2.4 It should be noted that the non-domestic components will be designed to be shell and core only. This includes the community centre, of which the current designs can only be demonstrated to a shell specification. This is in the absence of an agreement with the community as to the required specification.

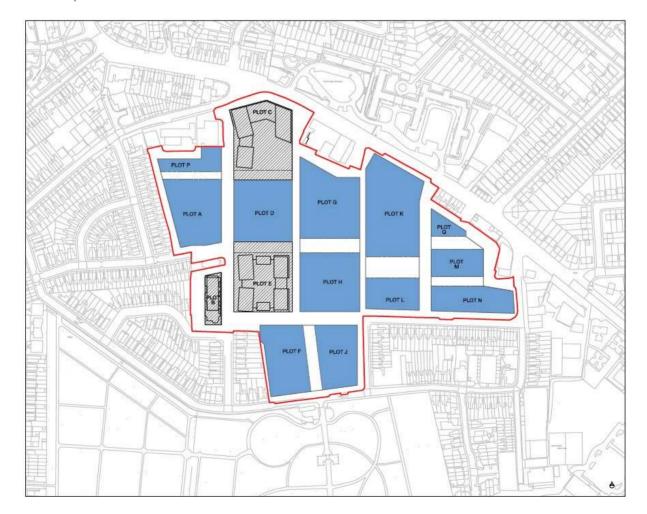


Figure 2: Proposed Masterplan Layout - Patel Taylor (October 2020)



3. RELEVANT PLANNING POLICY

3.1 The following planning policies and requirements have informed the sustainable design of the proposed development.

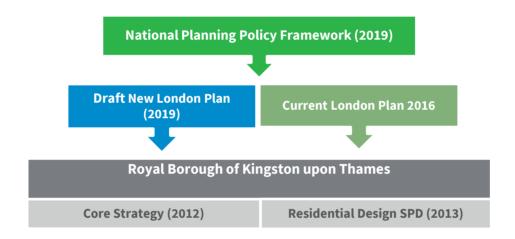


Figure 3: Relevant Planning Policy Documents

National Policy: NPPF

- 3.2 The revised National Planning Policy Framework (NPPF) was published on the 19th February 2019 and sets out the Government's planning policies for England.
- 3.3 The NPPF provides a framework for achieving sustainable development, which has been summarised as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Resolution 42/187 of the United National General Assembly). At the heart of the framework is a **presumption in favour of sustainable development**.
- 3.4 The document states that the planning system has three overarching objectives which are interdependent and need to be pursued in mutually supportive ways:
 - 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.

Regional Policy: The London Plan

Intend to Publish London Plan (2019)

- The Panel of Inspectors report into the draft London Plan was published in October 2019. The Mayor considered the Inspectors' recommendations and, in December 2019, issued to the Secretary of State the Intend to Publish London Plan. The Secretary of State responded to this in March 2020 and the Mayor is now considering the Secretary of State's response and taking the steps to finalise the plan.
- 3.6 The following policies in the Intend to Publish London Plan are considered relevant to the proposed development and this Statement:
- 3.7 Policy SI2 Minimising Greenhouse Gas Emissions states that major development should be net
 - zero-carbon. This is to be demonstrated through the application of the energy hierarchy demonstrated in Figure 4, which has an added step from those in previous versions of the London Plan. Though, at this stage still to be consulted upon, "Be Seen" intends to monitor, verify, and report on carbon emissions.
- **3.8** The requirement for major developments is to:
 - Achieve a 10% and 15% reduction in carbon emissions for residential and non-residential developments, respectively, through energy efficiency measures alone against a Part L baseline;

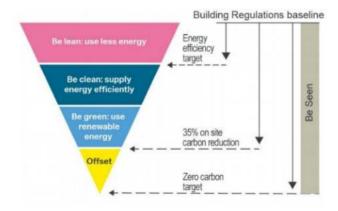


Figure 3: New London Plan Energy Hierarchy (GLA)

- > Maximise onsite renewable energy.
- > Achieve a minimum onsite reduction in carbon emissions of 35% beyond the Part L baseline.
- > Offset shortfalls between the onsite improvements and zero carbon emissions.



- **3.9** Where there is a requirement to offset onsite carbon emissions, it can be completed in two ways:
 - > Through a cash in lieu contribution to the borough's carbon offset fund;
 - > Or alternatively, off-site provided it is identifiable as a deliverable alternative.
- **3.10** This policy further discusses considering carbon emissions from other elements of the development and thereby conducting a life-cycle carbon assessment.
- 3.11 Policy SI3 Energy Infrastructure states that energy masterplans should be developed for large-scale development locations which establish the most effective energy supply options. The policy further discusses that energy masterplans should consider options to produce the most effective energy supply option. Developments within a Heat Network Priority Areas should have communal low-temperature heating systems, with heat sources from communal systems following a heating hierarchy as follows:
 - > Connect to local existing or planned heat network;
 - > Use zero-emission or local secondary heat sources in conjunction with heat pumps if required;
 - > Use Low Emission CHP;
 - > Use ultra-low NOx gas boilers
- **3.12** Such heat networks are expected to be designed in line with CIBSE / ADE Code of Practice CP1 or equivalent.
- **3.13 Policy SI4 Managing Heat Risk** states that major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the cooling hierarchy.

The Current London Plan (2016)

- **3.14** The following outlines key policies set out in the current London Plan which are relevant to the proposed development and this Energy Statement.
- 3.15 Policy 5.2 Minimising Carbon Dioxide Emissions requires that all residential and non-residential major developments achieve a specific improvement. The London Plan Sustainable Design and Construction SPG (2014) updates this target stating that the Mayor will adopt an onsite carbon dioxide improvement target beyond Part L 2013 of 35%. The Policy also states that all residential buildings built after 2016 must be zero carbon.
- **3.16** For residential developments, where zero carbon cannot be demonstrated on-site, any shortfall may be provided offsite or through a cash in lieu contribution to the relevant borough to be ring fenced to

- secure delivery of carbon dioxide savings elsewhere. The calculation would be based on a cash-in-lieu contribution of $\pm 60/TCO_2$.
- 3.17 Policy 5.3 Sustainable Design and Construction states that the highest standards of sustainable design and construction should be achieved in London to improve the environmental performance of new developments. Major development should meet the minimum standards outlined in the London Plan Supplementary Planning Guidance and this should be clearly demonstrated.
- 3.18 Policy 5.5 Decentralised Energy Networks states that the Mayor expects 25 per cent of the heat and power used in London to be generated using localised decentralised energy systems by 2025. The Mayor will prioritise the development of decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.
- **3.19 Policy 5.6 Decentralised Energy** requires that all developments should evaluate the feasibility of Combined Heat and Power (CHP) systems and examine the opportunities to extend the system beyond the site boundary to adjacent sites.
- **3.20 Policy 5.7 Renewable Energy** states that within the framework of the Energy Hierarchy, major development proposals should provide a reduction in expected carbon dioxide emissions using onsite renewable energy generation, where feasible. No specific target is provided in the policy.
- **3.21 Policy 5.8 Innovative Energy Technologies** encourages the more widespread use of innovative energy technologies to reduce use of fossil fuels and carbon dioxide emissions.
- **3.22 Policy 5.9 Overheating and cooling** 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.

Sustainable Design and Construction Supplementary Planning Guidance (2014)

- 3.23 The London Plan Sustainable Design and Construction SPG was adopted in April 2014 and provides detail and best practice guidance on how to implement the sustainable design and construction and wider environmental sustainability London Plan policies.
- 3.24 The SPG provides guidance on topics such as energy efficient design; meeting carbon dioxide reduction targets; decentralised energy; how to off-set carbon dioxide where the targets set out in the London Plan are not met; retro-fitting measures; monitoring energy use during occupation; air quality; resilience to flooding; urban greening; pollution control; basements and local food growing.

Energy Assessment Guidance (October 2020)



- 3.25 The Greater London Authority (GLA) have published their Energy Assessment Guidance. It provides advice on how the energy statement can demonstrate compliance with the London Plan Policy 5.2. The following are key points taken from the document:
 - > It provides guidance on the approach on how to complete the assessment for various planning application types. For instance, Reserved Matters applications should conform to the requirements set out in the Outline Planning Consent;
 - > The GLA encourage the use of SAP 10.0 carbon factors for referable schemes;
 - > The GLA signal future policy changes in the draft London Plan. It highlights the policy, which is not in place now, will require carbon emissions improvement because of energy efficiency, Be Lean, of 10% and 15% for domestic and non-domestic developments respectively;
 - > There are requirements to report energy demands and improvements in carbon emissions;
 - > Areas not considered as shells are required to complete cooling and overheating assessments under Be Lean;
 - > Greater detail on selecting energy systems with requirements to provide data for assessing air quality and limiting the impacts of combustion plant in terms of NO_X and PM_{10} .
- 3.26 This application will aim to achieve the GLA CO₂ targets by utilising the SAP 10.0 carbon emission factors.

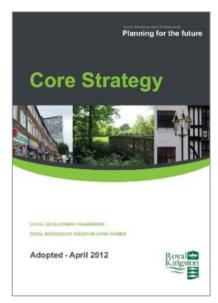
Local Policy: Royal Borough of Kingston Upon Thames

- 3.27 The Royal Borough of Kingston Upon Thames' Core Strategy document was adopted in April 2012. The following policies are considered relevant to this Statement:
- **3.28 Policy CS1 Climate Change Mitigation**: All development must be designed and built to make the most efficient use of resources, reduce its lifecycle impact on the environment and contribute to climate change mitigation and adaptation by:
 - > Reducing CO₂ emissions during construction and throughout the lifetime of the development;
 - > Building to the highest sustainable design and construction standards;

- **3.29 Policy CS2 Climate Change Adaptation**: The Council will ensure that future development takes into consideration the following:
 - > Hotter summers and therefore increased cooling demands;
 - > Warmer, wetter winters and increased flood risk;
 - > Water shortages and drought;
 - > Urban heat island effect.

3.30 Policy DM1 – Sustainable Design and Construction Standards:

The Council will require all new residential developments to achieve successively higher levels of the Code for Sustainable Homes Level category for energy/CO₂.



New development should minimise air, noise, and contaminated land impacts in line with industry best practice. Development proposals for contaminated land should include remediation measures.

The Council will promote good carbon management by monitoring CO_2 emissions to ensure the development is operated within the CO_2 emissions standards of the as-built specification and those outlined within the Council's Sustainable Design and Construction SPD. Measures to ensure these standards are maintained will be monitored by the Council.

Where appropriate, other new build developments over 500 m² are encouraged to achieve higher levels of the appropriate BREEAM standard.

- 3.31 For reference to the policy text above, since the publication of the Royal Borough of Kingston Upon Thames' Core Strategy Document in April 2012, the Code for Sustainable Homes was formally wound down following a technical housing standard review. This was announced by the Ministerial Statement by Rt. Honourable Eric Pickles on 25th March 2015 and the Government withdrew the Code for Sustainable Homes on 22nd April 2015.
- **3.32 Policy DM2 Low Carbon Development**: The development of energy generating infrastructure will be fully encouraged by the Council providing that any opportunities for generating heat simultaneously with power are fully exploited.

Residential Design Supplementary Planning Document (SPD)

3.33 The Royal Borough of Kingston Upon Thames' Residential Design SPD document was adopted in July 2013. The following policies are considered relevant to this Statement:

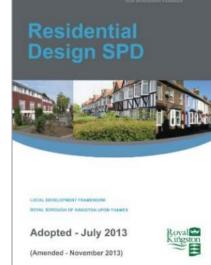


- 3.34 Policy Guidance 3 Sustainable Design: Developers are encouraged to exceed statutory requirements as set out in London Plan policy 5.3, the Mayor's Housing SPG, and in Core Strategy Policies DM1 and DM3 with particular attention given to:
 - > Minimising energy and CO₂ emissions;
 - > Efficient use of natural resources (including water);

Since the publication of the Royal Borough of Kingston Upon

- > Design of streets and siting of buildings;
- > Optimising building density;
- > Incorporation of green/blue infrastructure.
- Thames' Residential Design SPD in July 2013, the Code for

 Sustainable Homes was formally wound down following a technical housing standard review. This was announced by the Ministerial Statement by Rt. Honourable Eric Pickles on 25th March 2015 and the Government withdrew the Code for Sustainable Homes on 22nd April 2015.



Summary of Policy Targets

- 3.36 Achieve 35% Regulated CO₂ reduction over Part L 2013 onsite.
- 3.37 Implement the **Energy Hierarchy**: *Be Lean* (energy efficiency); *Be Clean* (heating infrastructure); and *Be Green* (renewable energy technologies).
- **3.38** Use SAP 10.0 carbon factors to determine carbon and energy savings, while ensuring compliance with Part L 2013.
- **3.39** The **GLA Zero Carbon Homes** policy will apply to the residential units only.
- **3.40** The cash-in-lieu sum based on RBKUT's £60 current cost per ton

3.35

4. BASELINE EMISSIONS ASSESSMENT

Methodology

4.1 The GLA's Energy Assessment Guidance document suggests using SAP 10.0 carbon emission factors to estimate CO₂ performance of the proposed development. This application will follow this approach.

Residential

- 4.2 The estimated energy demand for the residential portion of the development has been calculated using Standard Assessment Procedure (SAP 2012) methodology. SAP calculated the Regulated energy demand for residential dwellings.
- **4.3** SAP calculations have been carried out for representative dwelling types in Phase 1 (the detailed component). These encompass ground, mid, and top floor flats and represent a fair aggregation of the expected unit mix of the development.
- 4.4 To calculate the energy demands across the entire scheme, the illustrative accommodation schedule has been used to extrapolate the results from the modelled units. This has been done for both the detailed and outline parts of the application.
- The Unregulated energy demands for the residential units have been calculated using the methodology outlined in the SAP 2012 document (version 9.92 October 2013). This calculates the CO_2 emissions associated with appliances and cooking.

Non-Residential

- The estimated energy demand for the non-residential elements of the development has been calculated using Simplified Building Energy Model (SBEM) software, using the National Calculation Method (NCM 2013 Edition). SBEM calculates the Regulated energy demands associated with hot water, space heating and fixed electrical items, as well as Unregulated energy demands.
- **4.7** Sample SBEM calculations have been carried out on example units of the expected use types for the proposed development. For the outline scheme, these are not fixed, but sample calculations have been extrapolated to gain energy demand estimates for the whole scheme.
- 4.8 As discussed earlier the non-residential elements of the development are shells and as such suitable assumptions have been applied for the purposes of this statement.



Baseline Carbon Emissions

Table 5, below, shows the baseline Regulated and Unregulated CO₂ emissions for the development. A summary of these calculations is shown in Appendix A. TER and BRUKL Worksheets supporting these calculations are shown in Appendices B and D, respectively.

Table 5: Carbon Dioxide Emissions Baseline for Residential and Non-Residential Areas							
Application	plication Usage SAP 10.0 Carbon Dioxide Emissions (Tonnes CO ₂ per Annum						
Component		Residential	Non-Residential	Cumulative			
Datailad	Regulated	450	16	466			
Detailed	Unregulated	257	5	262			
Outline	Regulated	1,698	16	1,714			
	Unregulated	968	2	970			
Entire Scheme	Regulated	2,148	33	2,180			
	Unregulated	1,225	7	1,232			

5. BE LEAN: DEMAND REDUCTION

- The first stage of the London Plan Energy Hierarchy is demand reduction from energy efficiency measures. Passive design measures as well as active energy efficient design measures will go above and beyond Part L 2013 CO₂ emission requirements, and aim for the new London Plan target of a 10% CO₂ reduction for residential areas, and 15% CO₂ reduction in non-residential areas at the *Be Lean* stage of the Energy Hierarchy.
- The fabric energy efficiency strategy should be reviewed at each detailed stage of the development, to ensure that the most recent policy targets are being achieved.

Residential

Building Fabric

- 5.3 The following fabric energy efficiency targets have been assumed to estimate the energy performance for the proposed development. This is an example of an energy strategy that will achieve the Intend to Publish London Plan requirements:
 - > External wall U-values of 0.17 W/m²K (based on a wall thickness of approximately 450 mm);
 - > Corridor wall U-values of 0.20 W/m²K;
 - > Party walls to be fully filled and sealed to achieve a U-value of 0.00 W/m²K;
 - > Flat roof U-values of 0.13 W/m²K;
 - > Exposed floor U-values of 0.10 W/m²K;
 - > High performance double glazing with U-values of 1.30 W/m²K, a g-values depending on façade.

Air Tightness and Ventilation

Dwellings are likely to be fitted with an efficient Mechanical Ventilation with Heat Recovery(MVHR) system. This provides a whole dwelling ventilation system that supplies and extracts air,



reusing heat that would have been lost as illustrated in Figure 6. The dwelling MVHR unit is suggested to target a specific fan power (SFP) of 0.53 -0.88 W/l/s and a heat recovery efficiency at least 84%.

- 5.5 At this stage, a target design air permeability of 3 m³/hr.m² has been assumed as appropriate.
- 5.6 Additionally, where possible, dwellings will have openable windows and be able to naturally ventilate if required. This will facilitate convective ventilation and night purging of heat.

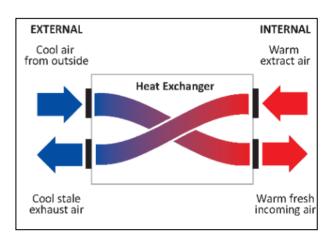


Figure 4: Mechanical Ventilation with Heat Recovery

Thermal Bridging

- 5.7 In well insulated buildings, as much as 30% of heat loss can occur through thermal bridges, which arise when elements are disrupted by changes in construction or penetration through the insulation layer, as shown in Figure 5.
- 5.8 Part L1A places increased importance on addressing heat losses through thermal bridging. As such, the Applicant is committed to develop a building fabric where these are minimised as far as practical. Bespoke calculations to improve on default psi values should be targeted.
- 5.9 At this stage of the design it is intended that the proposed structure will be a concrete frame. Based on this and prior experience indicative psi values that may be required for each junction are presented in Table 6. This should be reviewed at each detailed stage of the development.

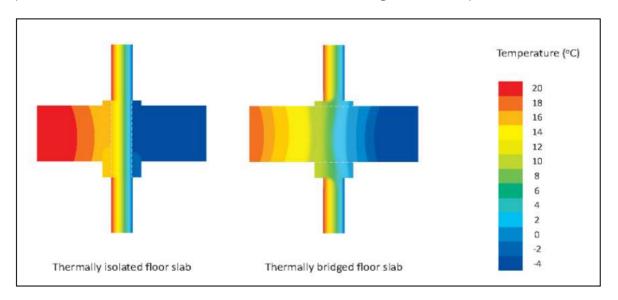


Figure 5: Thermal Bridges

Table 6: Indicative Thermal Bridging Psi Value Targets						
SAP Ref.	Junction	Default value	Target value			
E1	Lintels	1.00	0.10			
E3	Sill	0.08	0.04			
E4	Jamb	0.10	0.05			
E20	Exposed floor to external wall	0.32	0.15			
E7	Intermediate Floor	0.14	0.20			
E23	Balconies	1.00	0.25			
E15	Flat roof with parapet	0.56	0.35			
E16	External corner	0.18	0.05			
E17	Inverted corner	0.00	-0.05			
E18	Party corner	0.12	0.03			
P7	Party exposed floor	0.16	0.05			
P4	Party roof	0.24	0.03			

Space Heating and Hot Water

5.10 At the *Be Lean* stage, it is assumed that the heating and hot water is supplied by a communal gas boiler network, with an efficiency of 89.5%. All homes are expected to be connected to the heat network with Heat Interface Units (HIU).

Unregulated Energy Demands

5.11 Unregulated energy demands include energy needed for cooking and powering appliances within the home. The energy associated with these uses are dependent on the occupant of the home and can vary substantially. However, the Applicant is committed to ensuring that all efforts are made to enable the residents to minimise their unregulated energy consumption.

Mitigation Against Summer Overheating

5.12 A Summer Overheating Mitigation report has been prepared for the proposed development and is presented in Appendix E. Through the application of the cooling hierarchy overheating can be mitigated by the application of the proposed optimised fabric, shading devices such as balconies and an appropriate ventilation strategy maximising natural ventilation with minimum ventilation rates guaranteed through mechanical means.



Non-Residential

5.13 The following specification is based on the non-domestic units being considered as shells in line with discussion in Chapter 2. This means that the specifications noted below can only be assumptions.

Building Fabric

- **5.14** An example fabric energy efficiency strategy for the non-residential units is as follows:
 - > External wall U-value of 0.17 W/m²K;
 - > Ground floor U-value of 0.12 W/m²K;
 - > Exposed floor U-value of 0.14 W/m²K;
 - > Roof U-value of 0.12 W/m²K;
 - > Glazing U-value of 1.20 W/m²K, with a g-value of 0.30 and light transmittance of 0.60.

Ait tightness & Ventilation

- **5.15** The targeted air permeability rate at this stage is $5 \text{ m}^3/\text{m}^2$.hr.
- **5.16** It is expected that ventilation will be provided mechanically. The units are likely to have a specific fan power of around 1.40 W/l/s and likely to benefit, from heat recovery of around 89% with a summer bypass.

Lighting

5.17 The non-residential units are proposed to have high efficiency LED lighting with a luminance of 100 lm/W. It is assumed photoelectric lighting with dimming will be in perimeter zones and occupation sensor auto on/off control will be utilised.

Metering and Controls

5.18 Sub-metering of the non-domestic units is to be applied in line with the requirements of Part L.

Heating and Hot Water

5.19 At the *Be Lean* stage, it is assumed that heating and hot water is supplied by a communal gas boiler, with an efficiency of 91%.

Cooling

- 5.20 The commercial units are small shells therefore the design team has sought to minimise cooling requirements through the application of the cooling hierarchy. As a result of careful fabric and window selection and efficient lighting the heat gains have been minimised. This in turn ensures that cooling will be minimise as shown in Table 7.
- 5.21 It is assumed that the cooling demands of the non-residential units are met by an Air Source Heat Pump. The assumed efficiency of this system is a SEER of 6.5 and an EER of 4.2.

Table 7: Cooling Demands for Non-Residential Areas					
Scheme Component	Area weighted average non-residential cooling demand (MJ/m²)				
Actual	38.1				
Notional	48.7				

CO₂ Emissions Following Be Lean Measures

- Table 8, below, shows the site wide estimated Regulated CO₂ emissions following the *Be Lean* measures outlined above. As shown, these measures result in a CO₂ emissions reduction of 13% over Part L 2013 baseline for residential development, and 20% for non-residential development, which complies with Intend to Publish London Plan policy.
- **5.23** A summary of these calculations is shown in Appendix A. DER worksheets and BRUKL to support these calculations are shown in Appendices C and D, respectively.



Table 8: Regulated Carbon Dioxide Emissions at Be Lean Stage						
	Stage	SAP 10.0 Carbon Dioxide Emissions (Tonnes CO₂ per Annum)				
		Residential	Non-Residential	Cumulative		
	Baseline	450	16	466		
p	After <i>Be Lean</i> Measures	390	13	403		
Detailed	Total Emissions Reduction	60	3	63		
	Percentage Reduction after Be Lean	13%	20%	14%		
	Baseline	1,698	16	1,714		
Je	After <i>Be Lean</i> Measures	1,470	13	1,483		
Outline	Total Emissions Reduction	228	3	231		
	Percentage Reduction after Be Lean	13%	0%	13%		
	Baseline	2,148	33	2,180		
Ф	After <i>Be Lean</i> Measures	1,860	26	1,886		
Entire	Total Emissions Reduction	288	6	294		
	Percentage Reduction after Be Lean	13%	20%	14%		

Table 9, below, shows the total energy demand (MWh/year) for each building use of the proposed development. This is the delivered energy requirement at point of use and is assuming both the detailed and outline parts of the scheme are included.

Table 9: Energy demand following energy efficiency measures (MWh/year)						
Building Use	Space Heating	Hot Water	Lighting	Auxiliary	Cooling	Unregulated electricity
Residential Total	3,568	4,168	640	369	0	5,257
Non-residential Total	33	1	23	7	7	30

5.25 Table 10 and Appendix A demonstrates the fabric energy efficiency attained by the proposed design.

Table 10: Fabric Energy Efficiency				
	Target Fabric Energy Efficiency (kWh/m²/year)	Design Fabric Energy Efficiency (kWh/m²/year)	Improvement (%)	
Development Total	47.16	41.16	13	

Whole Life Cycle Assessment

5.26 A Whole Life Cycle Carbon Assessment has been undertaken to give early consideration of how to minimise embodied carbon in the construction of the development. The report can be found in Appendix F.



6. BE CLEAN: HEATING INFRASTRUCTURE

- 6.1 In line with the current London Plan Policy 5.6 and the Intend to Publish London Plan Policy SI3 (Energy Infrastructure), the heating and hot water provision has been considered in line with the following heating hierarchy from SI 3:
 - > Connect to local existing or planned heat networks;
 - > Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required);
 - > Use low-emission combined heat and power (CHP);
 - > Use ultra-low NOx boilers.

Connect to local existing or planned heat networks

- The proposed development is within proximity of a planned heat network. Following the hierarchy mentioned above, this opportunity was considered in detail.
- 6.3 The planned Royal Borough of Kingston Upon Thames (RBKUT) district wide network (DEN) is in the advanced stages of its design having completed initial feasibility and having received additional grant funding to complete wider detailed technical studies.
- The applicant's design team have engaged with the RBKUT DEN for the purposes of promoting an enabling environment for the connection to the network.

RBKUT DEN

- The RBKUT DEN is designed to utilise heat from a local water facility on the Hogsmill river. Currently the wastewater from this facility is leading to higher water temperatures in the local environment. This excess heat can be used to provide renewable heat with the use of water source heat pumps. The heat source is south of the development beyond the cemetery.
- 6.6 Following consultation with the RBKUT DEN, they have confirmed that the Cambridge Road Estate is likely to be its anchor node. They further confirmed various parameter associated with the DEN, as described in Table 11.

Table 11: RBKUT DEN parameter				
Parameter	RBKUT DEN	On development		
Technology	Water Source Heat Pump	Gas fired boilers		
Technology heating efficiency	350%	89%		
Proportion of heat generated for	99%	1%		
development				
Fuel use	Electricity	Natural gas		
Air quality impacts	n/a	8.8 MWh heating		
SAP 10.0 Carbon factor	0.233 kg CO₂/kWh	0.210 kg CO₂/kWh		
Thermal stores	No			
Heat loss	Based on Industry standards (CIBSE CP1: Heat Networks code of			
	practice for the UK) – 25% heat loss			
Heat cost Competitive with alternative strategy (see later)		ative strategy (see later)		

- Discussions with the RBKUT DEN have suggested that 99% of the annual heat requirements for the development can be provided. A 100% guarantee is not available because the RBKUT have outlined that they will not be providing any back up heating plant and will therefore require downtime for the purposes of proactive maintenance. As a result, full peak capacity plant would be required on site.
- To produce the remaining heat, a central Energy Centre at the base of Block E is proposed, see Figure 6 and Appendix G. The following spatial parameters have been provided following consultation with the building services engineers appointed at this stage of the works. It is expected that the dimensions will be sufficient for the proposed heat strategy.
 - > Area: 449 m²
 - > Average height: 3.75 m
 - > Maximum height: 5.15 m
- Through discussions with RBKUT, it is expected that the RBKUT DEN heat costs would be competitive with an onsite alternative. As an early estimate that will be developed further, variable heat costs could be around 6 p/kWh. It should be noted that the financial model that will be utilised for the RBKUT DEN is still to be fully developed. As this develops, greater clarity will be realised in terms of the associated heat costs. It would be expected that the fixed charges would be in alignment with the discussions provided by the Heat Trust.
- 6.10 Figure 7 and Appendix H shows the district heat network for the development, which will distribute heat from the energy centre in Block E to the rest of the development. It is expected that the heat loss associated with the heat network will be calculated in line with CIBSE CP1: Heat Networks code of practice for the UK. At this stage of the design, the heat loss has been demonstrated to be less than 25% of delivered heat.



- 6.11 As consulted, and agreed, with the GLA and RBKUT this energy centre will house gas boilers capable of delivering the required heat for the entire development. This energy centre will also act as the central location for connecting to the RBKUT DEN with the use of a plate heat exchangers.
- 6.12 It is estimated that 6.8 MW of gas boilers capacity will be required to produce the required heat for the development. Figure 8 and Appendix H provides an indicative plant room layout for the strategy described. The heat generated will be predominantly for the dwellings and potentially for the commercial units. The commercial units are small and are shells. As such they could be offered an opportunity to connect but for the purposes of this energy statement are not considered to connect to the heat network.



Figure 6: Block E energy centre plan and section courtesy of Patel Taylor



Figure 7: Cambridge Road Estate Heat Network with DEN connection courtesy of AWA Building Services

Consultants





Figure 8: Indicative Block E energy centre layout courtesy of AWA Building Services Consultants

- The RBKUT DEN is not able to verify the timings for completing works and providing a connection.

 Therefore, to maximise the opportunity for connecting to the RBKUT DEN a mean time solution is proposed. The deadline for confirming connection to the RBKUT DEN would be expected to be up to a year before development completion.
- 6.14 The mean time solution is currently expected to utilise the proposed gas boilers until a connection to the RBKUT DEN is presented or confirmed as not possible. To facilitate this connection a safe guarded route for the RBKUT DEN through the development is considered as described by Figure 9 and in greater detail within the parameter plans provided by Patel Taylor.

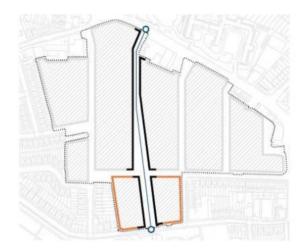


Figure 9: Safe guarded route for RBKUT DEN courtesy of Patel Taylor

Alternative heating strategy

- 6.15 If the RBKUT DEN connection is not possible, the alternative heating strategy is proposed as a heat pump led solution. This has been considered and expected to be a heat pump led solution. As discussed above, this alternative strategy would not be expected to be installed unless the RBKUT DEN were to be ruled out within the development's last year of completion.
- 6.16 In line with the hierarchy discussed earlier, the proposed alternative strategy maximises the opportunity to connect to the planned wider heat network. At this stage, the preferential alternative heating strategy would be led by air source heat pumps and supported by gas boilers.
- An air source heat pump (ASHP) led heating strategy has an ability to be a plug and use technology without requirement for significant alteration to building design or hinderance to connecting to wider network. This technology provides flexibility for the last phases considered in the outline for use to hold the external plant required for the development. This plant could be located on the roof of future blocks and directed back to the central energy centre in Block E. Potential blocks for this are shown in Figure 10 and in Appendix I.
- **6.18** Figure 10 and in Appendix I further demonstrates the safe guarded routes that would allow heat from the ASHP to be directed back to the Block E energy centre for providing heat to the development, should the alternative strategy be required.





Figure 10: Indicative roof plant areas for the alternative strategy and safe guarded route back to energy centre courtesy of AWA Building Services Consultants

- 6.19 The following spatial parameters of the energy centre are expected to be sufficient for the proposed heat strategy and the alternative should the proposed strategy not be possible.
 - > Area: 449 m²
 - > Average height: 3.75 m
 - > Maximum height: 5.15 m
- 6.20 In addition to this, it is expected that the alternative energy strategy will require circa 260 m² of roof space for the ASHP plant.
- **6.21** Figure 11 provides an indicative energy centre layout for the alternative energy strategy.

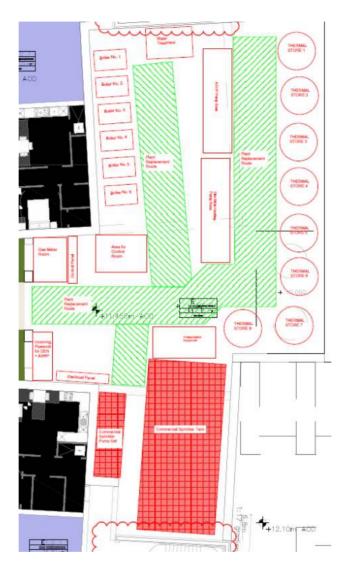


Figure 11: Indicative energy centre layout for the alternative strategy courtesy of AWA Building Services

Consultants

6.22 Table 12 provides an estimated of the plant requirements should the alternative heating strategy be required.



Table 12: Alternative heating stra	tegy parameter	
Parameter	Heat technology 1	Heat technology 2
Technology	Air Source Heat Pump	Gas fired boilers
Capacity	1.8 MW	6.8 MW
Technology heating efficiency	260%	89%
Proportion of heat generated for	67%	33%
development		
Fuel use	Electricity	Natural gas
Air quality impacts	n/a	291 MWh heating
SAP 10.0 Carbon factor	0.233 kg CO₂/kWh	0.210 kg CO₂/kWh
Thermal stores	Ye	es

6.23 A development led heat pump heating strategy would require a greater proportion of heat from the gas boilers. This is a result of the technological constraints associated with air source heat pumps such as efficiency, and reliance on a variable heat source, air. As a result, it would only be expected to achieve the 35% on site requirements.

CO₂ Emissions Following Be Clean Measures

- Table 13 shows the site wide Regulated CO₂ emissions of the development after the connection to the RBKUT DEN with on-site gas fired boilers as detailed above. A 60% reduction is now anticipated over the base case. Through measures at *Be Clean*, the mandatory reduction of 35% through onsite measures has been accomplished
- 6.25 A summary of these calculations can be found in Appendix J. Full DER worksheets for the *Be Clean* stage can be found in Appendices K.

Tal	ble 13: Regulated Carbon Dioxide Emiss	sions at <i>Be Clean</i> Stage		
	Stans	SAP 10.0 Carbon Dioxide E	missions (Tonnes CO ₂	per Annum)
	Stage	Residential	Non-Residential	Cumulative
	Baseline	450	16	466
-	After <i>Be Lean</i> Measures	390	13	403
Detailed	After <i>Be Clean</i> Measures	176	13	189
Det				
	Total Emissions Reduction	274	3	277
	Percentage Reduction after Be Clean	61%	20%	59%
	Baseline	1,698	16	1,714
	After <i>Be Lean</i> Measures	1,470	13	1,483
Outline	After <i>Be Clean</i> Measures	663	13	676
Out				
	Total Emissions Reduction	1,035	3	1,038
	Percentage Reduction after <i>Be Clean</i>	61%	20%	61%
	Baseline	2,148	33	2,180
	After <i>Be Lean</i> Measures	1,860	26	1,886
Entire	After <i>Be Clean</i> Measures	839	26	865
П				
	Total Emissions Reduction	1,309	6	1,315
	Percentage Reduction after <i>Be Clean</i>	61%	20%	60%



7. BE GREEN: RENEWABLE ENERGY

- 7.1 The *Be Green* stage of the London Plan Energy Hierarchy seeks for renewable energy technologies to be specified to provide, where feasible, a reduction in expected CO₂ emissions.
- 7.2 The development achieved the requirements of the London Plan because of the measures described in *Be Clean*. However, in line with good practice and Policy SI 2, the feasibility and maximisation of several renewable technologies have been considered and outlined below.

Biomass

- **7.3** Biomass boilers generate heat on a renewable basis as they are run on biomass fuel which is virtually carbon neutral.
- 7.4 Biomass boilers are best suited to supply the base heating demand of the development. This would conflict with the proposed heat strategy of connecting to the wider heat network. Further Biomass boilers also require storage and regular fuel deliveries, which would likely be delivered by heavy good vehicles which will have a negative impact on local air quality.
- 7.5 It has therefore been concluded that biomass is not the most suitable technology.

Wind Turbines

- 7.6 Urban rooftop wind turbines do not generally perform sufficiently to well to warrant their installation, due to the low and turbulent wind conditions present. They are therefore likely to remain technically unfeasible.
- 7.7 It has therefore been concluded that wind turbines are not a suitable technology for this site.

Heat Pumps

- 7.8 Heat pumps reduce energy consumption and replace gas as the heating fuel with electricity. They can offer substantial reductions in CO₂ emissions. The only natural sources of heat by the development are ground and air.
- **7.9** Ground Source Heat Pumps (GSHP) require extensive groundworks and have considerable upfront capital cost and design considerations. A GSHP is not appropriate for this application as it would preclude connection to the RBKUT DEN. It has therefore not been considered for this application to ensure priority is placed on connecting to the planned heat network.
- **7.10** Air Source Heat Pumps (ASHP) can be a more economical alternative. This technology was discussed as a part of *Be Clean* as a part of the alternative energy strategy, with its potential impact demonstrated in Appendix Q.

7.11 The technology is a practical and a well-recognised technology for commercial units. As explained in 'Be Clean' the commercial units are small and as shells could be offered to connect to the heat network, however as described in the GLA Energy Assessment Guidance they would not be expected to do so. ASHPs are therefore proposed, as a part of this assessment, to provide the heating demand of the non-residential development in the event they do not connect. It is assumed that the heat pumps will have a SCOP of 4.50.

Solar Photovoltaics (PV)

- **7.12** PV panels generate electricity from solar radiation. The generating potential of PV panels is dependent on the availability of roof space and ensuring that they are not overshaded.
- 7.13 There are several roof spaces which are flat and available for the installation of PV. The electricity generated from the PV is expected to be connected back to the landlord supply.
- 7.14 Within Phase 1 (the detailed component), the upper roof levels of Blocks B, C, and E could be utilised for solar PV where they are not shaded. Indicative plans showing suggested locations for solar PV are shown in Figure 12 and Appendix L. Allowing for sufficient spacing between panels, maintenance access and amenity space, it is estimated that 55 kWp of solar PV could be provided within Phase 1. Based on the SAP 2012 methodology this is expected to generate circa 41 MWh of electricity annually.
- **7.15** Based on the current outline a rudimentary estimate based on Phase 1 can be applied to determine the impact of PV across the entire development. Though a detailed assessment of the availability for solar PV for future phases should be considered at the time of each Reserved Matters Application, at this time an estimate of up to 210 kWp for the outline is potentially feasible.



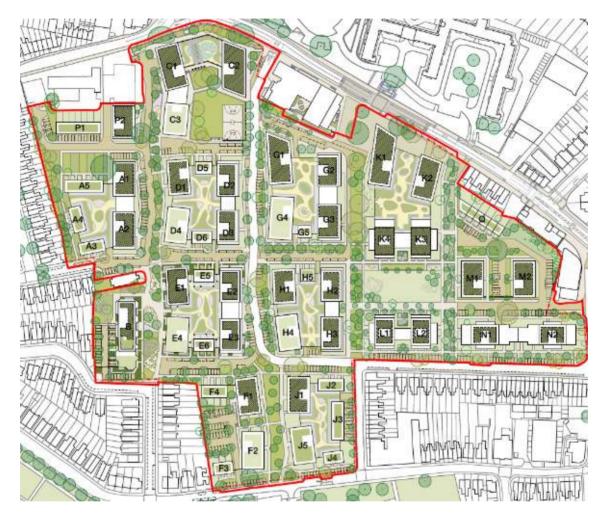


Figure 12: Indicative roof plan with PV area maximised

CO₂ Emissions Following *Be Green* Measures

7.16 Table 14, below, shows the expected Regulated CO₂ emissions following the inclusion of the proposed *Be Green* measures. A summary of these results can be found in Appendix N with full DER worksheets and BRUKL in Appendix N and O respectively. As shown, these result in a total 62% reduction over the *Be Lean* stage.

	Chang	SAP 10.0 Carbon D	ioxide Emissions (Tonn	es CO₂ per Annum
	Stage	Residential	Non-Residential	Cumulative
	Baseline	450	16	466
	After <i>Be Lean</i> Measures	390	13	403
_	After <i>Be Clean</i> Measures	176	13	189
Detailed	After <i>Be Green</i> Measures	166	9	175
Dei				
	Total Emissions Reduction	283	8	291
	Percentage Reduction after Be Green	63%	47%	62%
	Baseline	1,698	16	1,714
Outline	After <i>Be Lean</i> Measures	1,470	13	1,483
	After <i>Be Clean</i> Measures	663	13	676
	After <i>Be Green</i> Measures	626	9	635
ō				
	Total Emissions Reduction	1,072	8	1,080
	Percentage Reduction after Be Green	63%	47%	63%
	Baseline	2,148	33	2,180
	After <i>Be Lean</i> Measures	1,860	26	1,886
	After <i>Be Clean</i> Measures	839	26	865
Entire	After <i>Be Green</i> Measures	792	17	810
Ш				
	Total Emissions Reduction	1,355	15	1,371
	Percentage Reduction after Be Green	63%	47%	63%



8. BE SEEN: ENERGY MONITORING

- 8.1 The Intend to Publish London Plan introduces a fourth stage to the energy hierarchy; the *Be Seen* stage, which proposes monitoring and reporting of the actual operational energy performance of major developments for at least five years.
- 8.2 An effectively implemented post-construction monitoring regime can have several benefits including environmental (e.g. reduced grid infrastructure strain, carbon emissions reduction) and socioeconomic (e.g. reduced occupants bills and raised awareness around energy use).
- **8.3** The *Be Seen* stage aims to monitor that the actual energy and carbon performance of buildings is aligned with the estimate figures. This is expected to assist with achieving a zero-carbon London.
- 8.4 The full details of this stage are still to be consulted on and therefore have not been transposed into policy. However, standard monitoring of the Energy Centre and heat network will be undertaken during operation. It is expected that the following will be metered:
 - > Gas, electricity, and water used in the Energy Centre;
 - > Heat leaving the Energy Centre;
 - > Heat entering each block;
 - > Final customer heat consumption.
- **8.5** The metering and controls strategy will be further developed during the detailed design process.

9. ZERO CARBON HOMES

- 9.1 London Plan policy requires that all major residential developments are subject to an additional offset payment to meet a 100% reduction in Regulated CO₂ emissions to achieve the standard of *Zero Carbon.* This payment is made to the local borough's Carbon Offsetting Fund and is expected to be allocated to carbon reduction savings elsewhere in the borough.
- **9.2** There is currently no requirement for non-residential development to meet the *Zero Carbon* target.
- 9.3 The current adopted GLA carbon offsetting policy sets the offset payment price for residential development at £60 per tonne of Regulated CO₂ per year, for a period of 30 years.
- 9.4 The estimated remaining residential Regulated CO₂ emissions after the *Be Lean*, *Be Clean* and *Be Green* stages are described below in Table 15 for detailed, outline and entire development.
- **9.5** These calculations should be refined at each detailed stage of the development.

Tabl	e 15 Shortfall in Regulated Carbon dioxide emis	sion savings (TCO ₂)	
		Annual	Over 30 years
р	Domestic shortfall to Zero Carbon	166	4,988
Detailed	Non-Domestic shortfall to 35% improvement	0	0
	Cash in lieu payment (£60/TCO2)		£299,271
(I)	Domestic shortfall to Zero Carbon	626	18,785
Outline	Non-Domestic shortfall to 35% improvement	0	0
00	Cash in lieu payment (£60/TCO2)		£1,127,085
a ,	Domestic shortfall to Zero Carbon	792	23,773
Entire	Non-Domestic shortfall to 35% improvement	0	0
	Cash in lieu payment (£60/TCO2)		£1,426,356



10. SUMMARY

- 10.1 The purpose of this Energy Statement is to demonstrate the commitments, key measures and CO₂ reductions identified at each stage of the energy strategy for the proposed Cambridge Road Estate development in the Royal Borough of Kingston Upon Thames.
- This energy strategy has been formulated following the London Plan Energy Hierarchy: *Be Lean*, *Be Clean* and *Be Green*. The objective in the formulation of the strategy is to maximise the reductions in CO₂ emissions through the application of this Hierarchy with a cost-effective approach that is technically appropriate.
- **10.3** The development summarised in this application concerns:
 - > Hybrid Outline Planning Application for a mixed use development, including demolition of existing buildings and erection of up to 2,170 residential units (Use Class C3), 290 m² of flexible office floorspace (Use Class E), 1,395 m² of flexible retail/commercial floorspace (Use Class E/Sui Generis), 1,250 m² community floorspace (Use Class F2);
 - Detailed permission is sought for access, layout, scale, appearance and landscaping of Phase 1 for erection of 452 residential units (Use Class C3), 1,250 m² community floorspace (Use Class F2), 290 m² of flexible office floorspace (Use Class E), 395 m² of flexible retail/commercial floorspace (Use Class E/Sui Generis), new publicly accessible open space and associated access, servicing, parking, landscaping works including tree removal, refuse/recycling and bicycle storage, energy centre and works.
- Following an examination of both local and national policy requirements, it has been determined that the proposed development is to target a reduction in CO₂ emissions of 35% beyond a determined Part L 2013 baseline case on site. For the purposes of this Energy Statement the SAP 10.0 carbon factors are to be utilised.
- 10.5 A range of *Be Lean* energy efficiency measures are proposed for the dwellings and Non-residential areas. This is in line with the London Plan Energy Hierarchy. They enable the proposed elements to meet the 10% and 15% improvement required from the residential and non-residential baseline cases, respectively, through energy efficiency alone. They further achieve the proposed requirements of the Draft London Plan by meeting the targeted energy efficiency requirements for this stage.
- In accordance with the Energy Hierarchy, the feasibility of heating infrastructure as a *Be Clean* measure has also been carefully examined. Following a site analysis, a site wide heating network with a plant room located at the base of Block E will be present. This is to enable the connection to the wider heat network that is being developed by the Royal Borough of Kingston Upon Thames. This heat network is expected to utilise heat pumps for heat generation. This development is

- intended to be the anchor site and is likely to be connected to this wider network. This achieves the onsite carbon reductions (35%) required by Policy SI 2 of the Intend to Publish new London Plan.
- 10.7 In accordance with the Energy Hierarchy, the relevant **Be Green** renewable energy generating technologies have been evaluated. In line with Policy SI 2 renewables have been maximised through the application of low carbon heating and where safely and practicably feasible, application of photovoltaics.
- 10.8 The proposed design for the development will enable it to reduce its CO₂ emissions and go beyond the requirements of the London Plan representing a high level of sustainable design.
- 10.9 The onsite carbon emission reductions required by the London Plan have been achieved. The remaining carbon emissions are described in Table 4.
- 10.10 The tables below demonstrate the reduction in Regulated and Total CO_2 reductions after each stage of the Energy Hierarchy showing energy policy requirements have been achieved. They are based on SAP 10.0 carbon factors.

Table 16: Residential Carbon Dioxide Emissions an	d Savings after each stage of the	Energy Hierarchy
Stage	Carbon Dioxide Emissions	s (Tonnes CO ₂ per Annum)
	Regulated	Unregulated
Baseline: Part L 2013 Compliant Development	2,148	1,225
After Be Lean Measures	1,860	1,225
After <i>Be Clean</i> Measures	839	1,225
After <i>Be Green</i> Measures	792	1,225
Stage	Regulated Carbon	n Dioxide Savings
	Tonnes CO ₂ per Annum	Percentage
Savings from <i>Be Lean</i> Measures	288	13%
Savings from <i>Be Clean</i> Measures	1,021	48%
Savings from <i>Be Green</i> Measures	46	2%
Cumulative On-Site Savings	1,355	63%



Table 17: Non- Residential Carbon Dioxide Emissions and Savings after each stage of the Energy Hierarchy

,								
Stage	Carbon Dioxide Emissions (Tonnes CO ₂ per Annum)							
	Regulated	Unregulated						
Baseline: Part L 2013 Compliant Development	33	7						
After Be Lean Measures	26	7						
After <i>Be Clean</i> Measures	26	7						
After Be Green Measures	17	7						
Stage	Regulated Carbon	n Dioxide Savings						
	Tonnes CO ₂ per Annum	Percentage						
Savings from <i>Be Lean</i> Measures	6	20%						
Savings from <i>Be Clean</i> Measures	0	0%						
Savings from <i>Be Green</i> Measures	9	28%						
Cumulative On-Site Savings	15	47%						

Table 18: Site Wide Carbon Dioxide Emissions a	and Cumulative Savin	gs	
Stage	Regulated Carbon Dioxide Emissions	Regulated Ca Sav	rbon Dioxide ings
	(Tonnes CO ₂ per	Tonnes CO ₂ per	Percentage
	Annum)	Annum	
Baseline: Part L 2013 Compliant Development	2,180		
After <i>Be Lean</i> Measures	1,886	294	14%
After <i>Be Clean</i> Measures	865	1,021	47%
After <i>Be Green</i> Measures	810	55	3%
Cumulative On-Site Savings		1 271	C204
Cullidative Oil-Site Saviligs		1,371	63%

Tabl	Table 19 Shortfall in Regulated Carbon dioxide emission savings (TCO2)												
		Annual	Over 30 years										
p	Domestic shortfall to Zero Carbon	166	4,988										
Detailed	Non-Domestic shortfall to 35% improvement	0	0										
Ω	Cash in lieu payment (£60/TCO2)	£299,271											
(I)	Domestic shortfall to Zero Carbon	626	18,785										
Outline	Non-Domestic shortfall to 35% improvement	0	0										
0	Cash in lieu payment (£60/TCO2)		£1,127,085										
	Domestic shortfall to Zero Carbon	792	23,773										
Entire	Non-Domestic shortfall to 35% improvement	0	0										
_	Cash in lieu payment (£60/TCO2)		£1,426,356										



APPENDICES

Appendix A CO₂ Emissions Summary – Be Lean

Appendix B TER Worksheets

Appendix C DER Worksheets - Be Lean

Appendix D BRUKL - Be Lean

Appendix E Dynamic Overheating Assessment

Appendix F Whole Life Cycle Carbon Assessment

Appendix G Indicative Energy Centre Layouts (GA / Section)

Appendix H Preferred energy strategy - Indicative Energy Centre Layouts, Connection, Heat network Layout

Appendix I Alternative energy strategy - Indicative Energy Centre Layouts, Connection, Heat network Layout

Appendix J CO₂ Emissions Summary - Be Clean

Appendix K DER Worksheets - Be Clean

Appendix L Indicative PV Locations

Appendix M BREEAM ENE 04 review

Appendix N CO₂ Emissions Summary – Be Green

Appendix O DER Worksheets - Be Green

Appendix P BRUKL - Be Green

Appendix Q CO₂ Emissions Summary – Be Green- Alternative energy strategy

Appendix A CO2 Emissions Summary – Be Lean

Column C	The applicant should	complete all	II the light blue	cells including	information on th	e 'be lean' energy o	consumption figures	s, the 'be lean' DER,	the DFEE and the re	gulated energy dem	and of the 'be lear	n' scenario.				SAP 2012 CO2	PERFORMANCE					SAI	P10 CO2 PERFORM	ANCE								
The column is a section of the column is a secti	DOMESTIC ENE	RGY CON	NSUMPTIO	N AND CO2	ANALYSIS		,															DOI	MESTIC ENERG	GY DEMAND D	ATA							
The section of the content of the co	Unit identifier	Model total	Nbef				Constitution						Carllan	Const Heatler					2012 002	Constitution	D				CADAG CO3	Coloniana	Efficiency (FEE)					
Part	number, dwelling type etc.)			by model	DER 2012	DER 2012	Space Heating			Domestic Hot	Lighting	Auxiliary	Cooling	Space Heating		Lighting	Auxiliary	Cooling	emissions	CO2 emissions	Water CO2 emissions	CO2 emissions	CO2 emissions	CO2 emissions	emissions	DER SAP10	Energy Efficiency	(kWh p.a.)	Water	(kWh p.a.)	(kWh p.a.)	Cooling (kWh p.a
State Stat							[(Row 307a) ÷	Select fuel type	[(Row 310a) ÷																							
Column C	1B2P - Mid Floor	50.88		6665.28		16.2	0.01)] 1468.815642		0.01)] 1763.843575	Natural Gas				250	380	129	66		825	243	370	58			700			1,158	1,761	248	128	
State Stat	2B3P - Top Floor B	64.62	53	3424.86	19.5	19.5	2756.603352	Natural Gas	1932.927374	Natural Gas	290.37	187.7927		595	418	151	97		1,261	579	406	68	44		1,096	17.0	54.95205384	2,757	1,933	290	188	
West		72.42	4	289.68	16.0	16.0	2143.407821	Natural Gas	2018.24581	Natural Gas	320.59	181.8032		463	436	166	94		1,160	450	424	75	42		991	13.7	44.18403989	2,143	2,018	321	182	
**************************************	3B6P - Top Floor	94.73	7	663.11	15.4	15.4	2967.452514	Natural Gas	2185.575419	Natural Gas	408.17	260.6134		641	472	212	135		1,460	623	459	95	61		1,238	13.1	44.22994758	2,967	2,186	408	261	

Part	ım	29,750	452	29,750	15.5		748,363	N/A	872,031	N/A	134,313	77,844	0	161,646	188,359	69,708	40,401	0	460,114	157,156	183,126	31,295	18,138	0	389,715	13.1	40.54	748,363	872,031	134,313	77,844	0
Hallow 1 and 1 an	ION-DOMESTI	C ENERGY	Y CONSUM		1		REG	GULATED ENERGY CO	ONSUMPTION BY FN	D USF (kWh/m² n.a.)	'BE LEAN' BER - S	OURCE: BRUKL OUT	PUT	LATED ENERGY CO	NSUMPTION BY F	UFL TYPE (kWh/m	² n.a.) 'BE LEAN' BE	FR - SOURCE: BRL	IKL.INP or *SIM.CS	l		REGULA.	TED CO2 EMISSION	S PER LINIT								n.a.)
The content of the	Building Use A	rea per unit (m²)	Number of units	represented by model	Calculated	BRUKL	Space Heating	Fuel type	Domestic Hot	Fuel type	Lighting	Auxiliary	Cooling	Natural Gas		OLE TIPE (KWII) III	p.a., DE LEAN DE	EN -300NCE. BNC	2012 CO2		Grid Electricity	REGULA	TED COZ EWISSION	S PER UNIT			1	Space Heating	Domestic Hot	Lighting	Auxiliary	Cooling
**************************************	ommercial	1935	1		(kgCO2 / m2)	(kgCO2 / m2)			(kWh/m² p.a.)	Water				***************************************	***************************************					***************************************	***************************************					(kgCO2 / m2)	-		(kWh p.a.)			
1.935 1 2.474 1.13 . 21.479 N/A 890 N/A 14.938 4.315 4.431 1.2 1.2 N/A N/A N/A 21.887 1.2 1.2 1.2 1.2 1.3 1.004 6.8 21.479 890 14.538 4.315																													'			
1.935 1 2.474 1.13 . 21.479 N/A 890 N/A 14.938 4.315 4.431 1.2 1.2 N/A N/A N/A 21.887 1.2 1.2 1.2 1.2 1.3 1.004 6.8 21.479 890 14.538 4.315																																
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1.935 1 2.474 1.13 . 21.479 N/A 890 N/A 14.938 4.315 4.431 1.2 1.2 N/A N/A N/A 21.887 1.2 1.2 1.2 1.2 1.3 1.004 6.8 21.479 890 14.538 4.315																																
F-WIDE ENERGY CONSUMPTION AND CO2 ANALYSIS REGULATED CO2 EMISSIONS REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.) Space Heating (kWh p.a.) REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.) REGULATED ENERGY DEMAND PER UNIT PER ANNU																											MA					
F-WIDE ENERGY CONSUMPTION AND CO2 ANALYSIS REGULATED CO2 EMISSIONS REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.) Space Heating (kWh p.a.) REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.) REGULATED ENERGY DEMAND PER UNIT PER ANNU																																
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Use Total Area (m²) EMISSIONS Calculated BER 2012 - (kg CO2 / m²)	TE-WIDE ENE						21,479	N/A	890	N/A	14,938	4,315	4,431	12	12	N/A	N/A	N/A	21,897	12	12				13,064	6.8		21,479	890	14,938	4,315	4,43
Space Heating (kWh p.a.) Space Heating (kWh p.a.) (kWh											MPTION								EMISSIONS									REG	ULATED ENERGY D	DEMAND PER UNIT P	ER ANNUM (kWh	p.a.)
	Use	1	rotal Area (m²	7				zul ^a	Water	nl ^p									emissions						emissions	BER SAP10	MIA		Water		Auxiliary (kWh p.a.)	Cooling (kWh p.a
32,225 15.0 - 769,842 872,921 149,251 82,159 4,431 49,251 82,159 4,631 482,012 482,012 12.5 769,842 872,921 149,251 82,159 4,641 149,251 82,159 149,251 82,159 149,251 82,159 149,251 82,159 149,251 82,159 149,251 82,159 149,251 82,159 149,25					-			+			140.351	92 150	4.424															769 842		140.354		4,431

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NON-DOMESTIC ENERGY CONSUMPTION AND CO2 ANALYSIS Total area [m²] V
NON-DOMESTIC ENERGY CONSUMPTION AND CO2 ANALYSIS Building Use Area per unit Number of (m²) Units Energy Ene
NON-DOMESTIC ENERGY CONSUMPTION AND CO2 ANALYSIS Building Use Area per unit Number of (m²) Units Br 2012 (kgCO2 /m2) (kgCO2 /m2
VALIDATION CHECK REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL OUT PUT ATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL LINP or "SIM.CS" REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL LINP or "SIM.CS" REGULATED COZ EMISSIONS PER UNT ***Total area per unit (m²)** ***Principle*** ***Total area per unit (m²)** ***Principle*** ***Principle** ***Principle*** ***Principle** ***Principle*
Are per unit winds with winds wit
(kgC02/m2)
Sum 1,000 1 2,474 21.9 - 11,100 N/A 460 N/A 7,720 2,230 2,290 12 12 N/A N/A N/A 21,897 12 12 12 13,064 13.1 11,100 460 7,720 2,23 SITE-WIDE ENERGY CONSUMPTION AND CO2 ANALYSIS
SITE-WIDE ENERGY CONSUMPTION AND CO2 ANALYSIS REGULATED CO2 EMISSIONS
SITE-WIDE ENERGY CONSUMPTION AND CO2 ANALYSIS REGULATED CO2 EMISSIONS



Appendix B TER Worksheets

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	1B2P, Kingston upon Thames, KT1		

Address	1B2P, Kingston upon Thames,	KT1		
1. Overall dwelling o	dimensions			
		Area (m²)	Average storey height (m)	Volume (m³)
Lowest occupied		51.12 (1a) x	2.50 (2a) =	127.80 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)	(1n) = 51.12 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)(3	3n) = 127.80 (5)
2. Ventilation rate				
				m³ per hour
Number of chimneys			0 x 40 =	0 (6a)
Number of open flues	5		0 x 20 =	0 (6b)
Number of intermitte	ent fans		2 x 10 =	: 20 (7a)
Number of passive ve	ents		0 x 10 =	0 (7b)
Number of flueless ga	as fires		0 x 40 =	0 (7c)
				Air changes per hour
Infiltration due to chi	mneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) +	+ (7c) = 20 ÷ (5) =	0.16 (8)
If a pressurisation tes	t has been carried out or is intended, p	proceed to (17), otherwise contir	nue from (9) to (16)	
Air permeability value	e, q50, expressed in cubic metres per h	our per square metre of envelo	pe area	5.00 (17)
If based on air perme	ability value, then (18) = $[(17) \div 20] + ($	8), otherwise (18) = (16)		0.41 (18)
Number of sides on w	hich the dwelling is sheltered			1 (19)
Shelter factor			1 - [0.075 x (1	9)] = 0.93 (20)
Infiltration rate incorp	porating shelter factor		(18) x (2	20) = 0.38 (21)

Number of sides off which the dwelling is sheltered			(1
Shelter factor	1 - [0.075 x (19)] =	0.93	(2
Infiltration rate incorporating shelter factor	(18) x (20) =	0.38	(2
and the second s			

Infiltration rate r	modified fo	r monthly v	wind speed	:									
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average	e wind spee	ed from Tab	ole U2										
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)	m ÷ 4												
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltrat	tion rate (a	llowing for	shelter and	d wind facto	or) (21) x (2	2a)m							
	0.48	0.47	0.46	0.41	0.40	0.36	0.36	0.35	0.38	0.40	0.42	0.44	(22b)
Calculate effective	ve air chan	ge rate for t	the applica	ble case:									_

	0.48	0.47	0.46	0.41	0.40	0.36	0.36	0.35	0.38	0.40	0.42	0.44	(22b)
Calculate effecti	ve air chan	ge rate for t	the applical	ole case:									
If mechanical	ventilation	: air chang	e rate throu	ıgh system								N/A	(23a)
If balanced w	ith heat red	covery: effi	ciency in %	allowing fo	r in-use fac	ctor from T	able 4h					N/A	(23c)
d) natural vei	ntilation or	whole hou	se positive	input ventil	ation from	loft							
	0.61	0.61	0.61	0.59	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.60	(24d)

0.56

0.56

0.56

0.57

0.58



0.61

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

0.61

0.59

0.58

0.61

0.60

0.59

(25)

Element	and heat lo			Gross	Openings	Net	area	U-value	AxUW	/K κ-value,	Α x к,	
			;	area, m²	m²	Α,		W/m²K		kJ/m².K	kJ/K	
Window						8.:	18 x	1.33	= 10.84			(27)
Door						1.8	30 x	1.00	= 1.80			(26)
Ground floor						51.	12 x	0.13	= 6.65			(28
External wall						46.	40 x	0.18	= 8.35			(29
Party wall						17.	80 x	0.00	= 0.00			(32)
Total area of ext	ernal elem	ents ∑A, m²				107	.50					(31)
abric heat loss,	W/K = ∑(A	× U)							(26	5)(30) + (32) =	27.64	(33
Heat capacity Cn	n = ∑(A x к)							(28)	(30) + (32) +	- (32a)(32e) =	N/A	(34
Thermal mass pa	arameter (T	MP) in kJ/n	1²K								250.00	(35
Thermal bridges	: Σ(L x Ψ) ca	alculated us	ing Apper	ndix K							7.49	(36
Total fabric heat	loss									(33) + (36) =	35.13	(37
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct Nov	Dec	_
Ventilation heat	loss calcula	ated month	ly 0.33 x ((25)m x (5)								
	25.93	25.75	25.56	24.69	24.53	23.78	23.78	23.64	24.07	24.53 24.86	25.20	(38
Heat transfer co	efficient, W	//K (37)m +	(38)m									_
	61.06	60.87	60.69	59.82	59.66	58.91	58.91	58.77	59.20	59.66 59.99	60.33	1
		•		•	'				Average = Σ	(39)112/12 =	59.82]] (39
Heat loss param	eter (HLP),	W/m²K (39)m ÷ (4)									
·	1.19	1.19	1.19	1.17	1.17	1.15	1.15	1.15	1.16	1.17 1.17	1.18	7
		_				\		-		(40)112/12 =	1.17]] (40
Number of days	in month (Table 1a)							2			_ ` -
,	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00 30.00	31.00	(40
	32.00		02.00	1 33.55	02.00	33.33	02.00	02.00	00.00	32.00	02.00] (.0
4. Water heatir	ng energy r	equirement	t									
Assumed occupa	ancy, N										1.72	(42
Annual average l	hot water ເ	ısage in litre	es per day	Vd,average	= (25 x N) +	36					75.12	(43
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct Nov	Dec	
Hot water usage	in litres pe	r day for ea	ch month	Vd,m = fact	tor from Tabl	le 1c x (43)					
	82.64	79.63	76.63	73.62	70.62	67.61	67.61	70.62	73.62	76.63 79.63	82.64	
										∑(44)112 =	901.49	(44
Energy content o	of hot wate	r used = 4.1	.8 x Vd,m	x nm x Tm/3	3600 kWh/m	onth (see	Tables 1b	, 1c 1d)				
	122.55	107.18	110.60	96.42	92.52	79.84	73.98	84.90	85.91	100.12 109.29	118.68	
										∑(45)112 =	1181.99	(45
	0.45 /45											
Distribution loss	0.15 x (45)m										
Distribution loss	18.38)m 16.08	16.59	14.46	13.88	11.98	11.10	12.73	12.89	15.02 16.39	17.80	(46
	18.38	16.08		1			11.10	12.73	12.89	15.02 16.39	17.80 3.00	_
storage volume	18.38 (litres) inclu	16.08		1			11.10	12.73	12.89	15.02 16.39	<u> </u>	_
Storage volume Water storage lo	18.38 (litres) incluoss:	16.08 uding any so	olar or WV	WHRS storag	e within sam		11.10	12.73	12.89	15.02 16.39	<u> </u>	(47
Storage volume Water storage lo	18.38 (litres) incluoss: er's declare	16.08 uding any so	olar or WV	WHRS storag	e within sam		11.10	12.73	12.89	15.02 16.39	3.00	(47
Storage volume Water storage lo a) If manufacture	18.38 (litres) incluoss: er's declare	16.08 uding any so ed loss facto n Table 2b	olar or WV	WHRS storag	e within sam		11.10	12.73	12.89	15.02 16.39	3.00 0.26	(47 (48) (49
Storage volume Water storage lo a) If manufacture Temperature Energy lost fr	18.38 (litres) inclusess: er's declared factor from water s	16.08 uding any so ed loss facto n Table 2b	olar or WV	WHRS storag	e within sam		11.10	12.73	12.89	15.02 16.39	3.00 0.26 0.54	(47) (48) (49) (50
Energy lost fr Enter (50) or (54	18.38 (litres) inclusoss: er's declared factor from water states in (55)	16.08 uding any so d loss facto n Table 2b storage (kW	olar or WV	VHRS storag	e within sam		11.10	12.73	12.89	15.02 16.39	3.00 0.26 0.54 0.14	(47) (48) (49) (50
Storage volume Water storage lo a) If manufacture Temperature Energy lost fr	18.38 (litres) incluses: er's declared factor from water sell) in (55)	16.08 uding any so d loss facto n Table 2b storage (kW	olar or WV r is known h/day) (4 month (5	WHRS storag n (kWh/day) 18) x (49) 55) x (41)m	e within sam	ne vessel					3.00 0.26 0.54 0.14 0.14	(47) (48) (49) (50) (55
Storage volume Water storage lo a) If manufacture Temperature Energy lost fr Enter (50) or (54 Water storage lo	18.38 (litres) inclusors: er's declared factor from water soll) in (55) oss calculated 4.36	16.08 uding any so d loss facto n Table 2b storage (kW) ed for each 3.93	olar or WV or is known h/day) (4 month (5 4.36	WHRS storag n (kWh/day) 88) x (49) 55) x (41)m 4.21	e within sam	ne vessel	4.36	4.36	4.21	15.02 16.39	3.00 0.26 0.54 0.14	(46) (47) (48) (49) (50) (55) (56)
Storage volume Water storage lo a) If manufacture Temperature Energy lost fr	18.38 (litres) inclusors: er's declared factor from water soll) in (55) oss calculated 4.36	16.08 uding any so d loss facto n Table 2b storage (kW) ed for each 3.93	olar or WV or is known h/day) (4 month (5 4.36	WHRS storag n (kWh/day) 88) x (49) 55) x (41)m 4.21	e within sam	ne vessel	4.36	4.36			3.00 0.26 0.54 0.14 0.14	(47) (48) (49) (50) (55

Primary circuit los	s for each	month fro	m Table 3										
	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 for each	ch month	from Table	3a, 3b or 3	С								•	_
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat require	d for wate	er heating o	calculated f	or each mo	onth 0.85 x	(45)m + (4	6)m + (57)r	n + (59)m +	+ (61)m				_
	150.16	132.13	138.22	123.15	120.14	106.57	101.60	112.51	112.64	127.74	136.02	146.30	(62)
Solar DHW input of	calculated	using Appe	endix G or A	Appendix H									_
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from wate	er heater f	or each mo	nth (kWh/ı	month) (62	2)m + (63)m	1		•					_
	150.16	132.13	138.22	123.15	120.14	106.57	101.60	112.51	112.64	127.74	136.02	146.30]
		•		•		•	•	•		∑(64)1	.12 = 1	507.17	(64)
Heat gains from w	ater heat	ing (kWh/n	nonth) 0.25	5 × [0.85 ×	(45)m + (61	.)m] + 0.8 ×	: [(46)m + (5	57)m + (59))m]				
	62.84	55.59	58.87	53.44	52.86	47.93	46.69	50.32	49.95	55.38	57.72	61.56	(65)
											_		
5. Internal gains													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)												
	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	(66)
Lighting gains (cal	culated in	Appendix	L, equation	L9 or L9a),	also see Ta	able 5							
	13.96	12.40	10.09	7.64	5.71	4.82	5.21	6.77	9.08	11.54	13.46	14.35	(67)
Appliance gains (c	alculated	in Appendi	x L, equatio	on L13 or L	13a), also s	ee Table 5							
	150.14	151.70	147.77	139.42	128.87	118.95	112.32	110.77	114.69	123.05	133.60	143.52	(68)
Cooking gains (cal	culated in	Appendix	L, equation	L15 or L15	a), also see	Table 5							
	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	(69)
Pump and fan gai	ns (Table !	5a)											
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evapor	ration (Tal	ble 5)											
	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	(71)
Water heating gai	ns (Table	5)											
	84.46	82.73	79.12	74.23	71.05	66.57	62.76	67.64	69.37	74.44	80.17	82.74	(72)
Total internal gair	ns (66)m +	+ (67)m + (6	58)m + (69)	m + (70)m	+ (71)m + (72)m							
	300.42	298.68	288.83	273.12	257.47	242.18	232.14	237.02	244.99	260.87	279.08	292.45	(73)
6. Solar gains							-						
			Access f		Area m²		ar flux V/m²	spec	g ific data	FF specific o	data	Gains W	
			10.010				-,	-	able 6b	or Table			
West			0.7	7 x	8.18	x 1	9.64 x	0.9 x	0.63 x	0.70	= [49.10	(80)
Solar gains in wat	ts ∑(74)m	ı(82)m											J · '
	49.10	96.05	158.18	230.69	282.72	289.42	275.54	236.68	183.97	113.97	61.22	40.38	(83)
Total gains - inter							•		•				_ · ′
	349.52	394.73	447.01	503.82	540.19	531.60	507.67	473.70	428.96	374.84	340.30	332.83	(84)
													/
7. Mean interna	l tempera	ture (heati	ng season)										
Temperature duri	ng heating	g periods in	the living	area from T	Table 9, Th1	L(°C)						21.00	(85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor	for gains f	or living are	ea n1,m (se	e Table 9a))								
	1.00	0.99	0.98	0.94	0.84	0.67	0.50	0.56	0.81	0.97	0.99	1.00	(86)
Mean internal ten	np of livin	g area T1 (s	steps 3 to 7	in Table 9	c)								

		1	1			1	T	1	I	1	1	T .	1
	19.78	19.93	20.20	20.54	20.82	20.96	20.99	20.99	20.89	20.53	20.09	19.75	(87)
Temperature d	_			_			1	1	1	1	1	1	1
	19.92	19.93	19.93	19.94	19.95	19.96	19.96	19.96	19.95	19.95	19.94	19.94	(88)
Utilisation factor	_			Т			_		1	1		_	1
	1.00	0.99	0.98	0.92	0.79	0.58	0.39	0.44	0.73	0.95	0.99	1.00	(89)
Mean internal	temperature	in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	9c)						,
	18.31	18.53	18.92	19.42	19.77	19.93	19.96	19.96	19.87	19.41	18.78	18.28	(90)
Living area frac	tion								Li	ving area ÷	(4) =	0.47	(91)
Mean internal	temperature	for the wh	ole dwellin	ng fLA x T1 -	+(1 - fLA) x	Т2							
	19.00	19.19	19.52	19.95	20.26	20.41	20.44	20.44	20.35	19.93	19.40	18.97	(92)
Apply adjustme	ent to the m	ean interna	l temperat	ure from Ta	able 4e whe	ere appropr	riate					_	_
	19.00	19.19	19.52	19.95	20.26	20.41	20.44	20.44	20.35	19.93	19.40	18.97	(93)
8. Space heat	ing requirem	nent .											
o. Space near	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor			IVIAI	Дрі	iviay	Juli	Jui	Aug	Зер	Ott	1404	Dec	
Othisation racti	0.99	0.99	0.97	0.92	0.81	0.62	0.44	0.49	0.77	0.95	0.99	1.00	(94)
Useful gains, ηι		1	1	0.92	0.61	0.02	0.44	0.49	0.77	0.95	0.99	1.00	[(94)
Oserui gairis, iți				464.00	126.71	220.00	224.17	222.70	220.64	255.00	226.26	221.10	1 (05)
Monthly average	347.36	390.15	434.67	464.89	436.71	328.08	224.17	233.70	328.64	355.89	336.26	331.19	(95)
Monthly averag	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	1410	10.00	7.10	4.20	1 (00)
Heat loss rate f				1	!	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
rieat ioss rate i	897.45	869.65	790.05	660.93	510.97	342.53	226.36	237.44	369.90	FF6 90	737.69	891.37	1 (07)
Space heating r		1	1	1	1		220.30	237.44	369.90	556.80	/37.09	891.37] (97)
Space neating i	409.27	322.23	264.41	141.15	55.25	0.00	0.00	0.00	0.00	149.47	289.03	416.78	1
	409.27	322.23	204.41	141.15	33.23	0.00	0.00	0.00		3)15, 10	-	2047.57]] (98)
Space heating i		1414 /m2/1	005						7(30		÷ (4)	40.05	(99) (99)
Space fleating i	equirement	KVVII/III / y	Cai							(36)	· (4)	40.03] (33)
9a. Energy red	quirements -	individual	heating sy	stems inclu	uding micro	-CHP							
Space heating													
Fraction of spa	ce heat from	secondary	/suppleme	ntary syste	m (table 11	.)						0.00	(201)
Fraction of spa	ce heat from	main syste	em(s)							1 - (20	01) =	1.00	(202)
Fraction of spa	ce heat from	main syste	em 2									0.00	(202)
Fraction of tota	al space heat	from main	system 1						(20)2) x [1- (20	3)] =	1.00	(204)
Fraction of tota	al space heat	from main	system 2							(202) x (20	03) =	0.00	(205)
Efficiency of ma	ain system 1	(%)										93.50	(206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	-
Space heating f	fuel (main sy	stem 1), kV	Vh/month										
	437.72	344.63	282.79	150.96	59.09	0.00	0.00	0.00	0.00	159.86	309.12	445.75]
		•				•	•	•	∑(21:	1)15, 10	.12 = 2	2189.92	(211)
Water heating													_
Efficiency of wa	ater heater												
	87.36	87.10	86.52	85.18	82.89	79.80	79.80	79.80	79.80	85.23	86.78	87.45	(217)
Water heating			•	•	•	•	•	•	•	•	•	•	•
· ·	•					122.54	127.32	140.99	141.15	149.87	156.74	167.29	1
	171.90	151.69	159.76	144.58	144.94	133.54	127.32	140.55	1 171.13	175.07	130.74	107.29	
	171.90	151.69	159.76	144.58	144.94	133.54	127.32	140.33	141.13			1	(219)
Annual totals	171.90	151.69	159.76	144.58	144.94	133.54	127.32	140.55	141.13	∑(219a)1		1789.77]] (219)
			159.76	144.58	144.94	133.54	127.32	140.33	141.13		.12 =	1789.77]] (219)]
Annual totals Space heating f			159.76	144.58	144.94	133.54	127.32	140.55	141.13		.12 =	1]] (219)]

Page 4

Water heating fuel		1789.77	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		246.61	(232)
Total delivered energy for all uses	(211)(221) + (231) + (232)(237b)	= 4301.30	(238)

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2189.92	x	3.48	x 0.01 =	76.21	(240)
Water heating	1789.77	x	3.48	x 0.01 =	62.28	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	246.61	x	13.19	x 0.01 =	32.53	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242) +	(245)(254) =	300.91	(255)

11a. SAP rating - individual heating systems including micro-CHP		
Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.31	(257)
SAP value	81.66]
SAP rating (section 13)	82	(258)
SAP band	В]

12a. CO₂ emissions - individual heating systems inc	cluding micro-CHP					
	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO₂/year	
Space heating - main system 1	2189.92	x	0.216	= [473.02	(261)
Water heating	1789.77	x	0.216	= [386.59	(264)
Space and water heating			(261) + (262) +	(263) + (264) = [859.61	(265)
Pumps and fans	75.00	x	0.519	= [38.93	(267)
Electricity for lighting	246.61	X	0.519	= [127.99	(268)
Total CO ₂ , kg/year				(265)(271) = [1026.53	(272)
Dwelling CO₂ emission rate				(272) ÷ (4) = [20.08	(273)
El value					85.69	
El rating (section 14)					86	(274)
EI band					В	

	Energy kWh/year		Primary factor		Primary Energy kWh/year	′
Space heating - main system 1	2189.92	х	1.22	=	2671.70	(261)
Water heating	1789.77	х	1.22	=	2183.52	(264)
Space and water heating			(261) + (262) + (263) + (264) =	4855.22	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	246.61	х	3.07	=	757.11	(268)
Primary energy kWh/year					5842.57	(272)
Owelling primary energy rate kWh/m2/year					114.29	(273)

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	1B2P, Kingston upon Thames, KT1		

Cheffe							LC	ist infoamed	•	30,0	7,2020	
Address	1B2P, Ki	ngston upo	n Thames, K	T1								
1. Overall dwelling din	nensions											
				Aı	rea (m²)			rage storey eight (m)		V	olume (m³)	
owest occupied					50.88	(1a) x		2.50] (2a) =		127.20	(3a
otal floor area	(1a)) + (1b) + (1	c) + (1d)(1	n) =	50.88	(4)						
Owelling volume							(3a) + (3b) + (3	c) + (3d)(3	n) =	127.20	(5)
2. Ventilation rate												
2. Ventilation rate											3	
									7	m	1 ³ per hour	_
Number of chimneys								0	x 40 =		0	(6
Number of open flues								0	x 20 =		0	(6
Number of intermittent								2	x 10 =		20	(7
Number of passive vent	S							0	x 10 =		0	(7
Number of flueless gas f	rires							0	x 40 =		0	(7
										Air	changes pe hour	r
nfiltration due to chimr	neys, flues, fan	ıs, PSVs		(6a)	+ (6b) + (7a	a) + (7b) + (7c) =	20	÷ (5) =		0.16	(8
f a pressurisation test h	as been carrie	ed out or is i	ntended, pro	oceed to (1	7), otherw	ise continu	e from (9)	to (16)				
Air permeability value, o	ק50, expressed	d in cubic m	etres per ho	ur per squ	are metre	of envelope	e area				5.00	(1
f based on air permeab	ility value, the	n (18) = [(1	7) ÷ 20] + (8), otherwis	e (18) = (16	5)					0.41	(1
Number of sides on whi	ch the dwellin	g is sheltere	ed								3	(1
helter factor								1 -	· [0.075 x (19)] =	0.78	(2
nfiltration rate incorpo	rating shelter f	factor							(18) x (2	0) =	0.32	(2
nfiltration rate modifie	d for monthly	wind speed	:									
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind s	peed from Tal	ble U2										
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(2
Vind factor (22)m ÷ 4												
1.28	3 1.25	1.23	1.10	1.08	0.95	0.95	1	1.00	1.08	1.13	1.18	_

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average	wind spee	ed from Tab	ole U2										
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)	m ÷ 4												
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltrat	ion rate (a	llowing for	shelter and	wind facto	or) (21) x (2	2a)m							
	0.40	0.39	0.39	0.35	0.34	0.30	0.30	0.29	0.32	0.34	0.36	0.37	(22b)
Calculate effective	ve air chan	ge rate for	the applica	ble case:									
If mechanical	ventilation	n: air chang	e rate thro	igh system								N/A	(23a)

If mechanical ventilation: air change rate through system	

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h

N/A

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

	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)
char	ge rate - e	nter (24a) d	or (24b) or ((24c) or (24	d) in (25)								

Effective air cl

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



	nd heat lo	oo paramo.											
Element			ā	Gross area, m²	Openings m ²	Net A,		U-value W/m²K	AxUW	-	value, I/m².K	Αxκ, kJ/K	
Vindow						7.	76 x	1.33	= 10.29)			(2
oor						1.3	80 x	1.00	= 1.80				(2
xternal wall						51	.45 x	0.18	= 9.26				(2
arty wall						11	.68 x	0.00	= 0.00				(3
otal area of exte	ernal elem	ents ∑A, m²	2			61	.01						(3
abric heat loss, V	W/K = ∑(A	× U)							(20	5)(30) + ((32) =	21.35	(3
eat capacity Cm	ı = ∑(A x κ)							(28)	.(30) + (32)	+ (32a)(3	32e) =	N/A	(3
hermal mass par	rameter (T	TMP) in kJ/n	n²K									250.00	(3
hermal bridges:	Σ(L x Ψ) ca	alculated us	sing Appen	ıdix K								5.08	(3
otal fabric heat I	loss									(33) + ((36) =	26.43	_ (3
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	_
entilation heat l	oss calcula	ated month	ly 0.33 x (25)m x (5)									
	24.39	24.25	24.13	23.52	23.40	22.87	22.87	22.78	23.08	23.40	23.63	23.87	(3
leat transfer coe	efficient, W	//K (37)m +	+ (38)m	•									_
	50.81	50.68	50.55	49.95	49.83	49.30	49.30	49.20	49.51	49.83	50.06	50.30	
_		1		•	<u> </u>				Average = 2	(39)112	/12 =	49.94	_ (3
eat loss parame	ter (HLP),	W/m²K (39	9)m ÷ (4)							- ,	, <u> </u>		`
. [1.00	1.00	0.99	0.98	0.98	0.97	0.97	0.97	0.97	0.98	0.98	0.99	
_		1	1	•	<u> </u>				Average = 2	(40)112	/12 =	0.98	(4
umber of days in	n month (Table 1a)							2	_(,	, <u></u>		
		I able Tal											
			31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(4
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(4
4. Water heatinչ	31.00	28.00		30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(4
4. Water heating	31.00 g energy r	28.00		30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(4:
ssumed occupar	31.00 g energy r	28.00 equiremen	t				31.00	31.00	30.00	31.00	30.00		
ssumed occupar	31.00 g energy r	28.00 equiremen	t				31.00 Jul	31.00	30.00 Sep	31.00 Oct	30.00	1.72	(4
ssumed occupar nnual average h	31.00 g energy r ncy, N not water u	28.00 equiremen	t es per day Mar	Vd,average Apr	= (25 x N) + May	36 Jun	Jul					1.72 74.96	(4
ssumed occupar nnual average h	31.00 g energy r ncy, N not water u	28.00 equiremen	t es per day Mar	Vd,average Apr	= (25 x N) + May	36 Jun	Jul					1.72 74.96	(4
ssumed occupar	31.00 g energy r ncy, N oot water t Jan in litres pe	equiremen usage in litro Feb er day for ea	es per day Mar ach month	Vd,average Apr Vd,m = fact	= (25 x N) + May or from Tab	36 Jun e 1c x (43	Jul)	Aug	Sep	Oct	Nov 79.45	1.72 74.96 Dec	(4 (4
ssumed occupar nnual average h ot water usage i	31.00 g energy r ncy, N not water t Jan in litres pe	equiremen usage in litro Feb er day for ea	es per day Mar ach month 76.45	Vd,average Apr Vd,m = fact 73.46	= (25 x N) + May or from Table 70.46	36 Jun e 1c x (43 67.46	Jul) 67.46	Aug 70.46	Sep	Oct 76.45	Nov 79.45	1.72 74.96 Dec	(4 (4
ssumed occupar nnual average h ot water usage i	31.00 g energy r ncy, N not water t Jan in litres pe 82.45	equiremen usage in litro Feb er day for ea	es per day Mar ach month 76.45	Vd,average Apr Vd,m = fact 73.46	= (25 x N) + May or from Table 70.46	36 Jun e 1c x (43 67.46	Jul) 67.46	Aug 70.46	Sep	Oct 76.45	Nov 79.45	1.72 74.96 Dec 82.45 899.47	(4 (4
ssumed occupar nnual average h lot water usage i	31.00 g energy r ncy, N not water u Jan in litres pe 82.45 f hot wate	28.00 equiremen usage in litro Feb er day for ea 79.45 er used = 4.1	es per day Mar ach month 76.45	Vd,average Apr Vd,m = fact 73.46 x nm x Tm/3	= (25 x N) +	36 Jun de 1c x (43 67.46 onth (see	Jul) 67.46 Tables 1b	Aug 70.46	Sep 73.46	Oct 76.45 Σ(44)1.	Nov 79.4512 = 109.04	1.72 74.96 Dec 82.45 899.47	(4
issumed occupar innual average h lot water usage i [nergy content of	31.00 g energy r ncy, N not water u Jan in litres pe 82.45 f hot wate	28.00 equiremen usage in litro Feb er day for ea 79.45 er used = 4.1 106.94	es per day Mar ach month 76.45	Vd,average Apr Vd,m = fact 73.46 x nm x Tm/3	= (25 x N) +	36 Jun de 1c x (43 67.46 onth (see	Jul) 67.46 Tables 1b	Aug 70.46	Sep 73.46	Oct 76.45 Σ(44)1.	Nov 79.4512 = 109.04	1.72 74.96 Dec 82.45 899.47	(4
ssumed occupar nnual average h lot water usage i [nergy content of	31.00 g energy r ncy, N not water u Jan in litres pe 82.45 f hot wate	28.00 equiremen usage in litro Feb er day for ea 79.45 er used = 4.1 106.94	es per day Mar ach month 76.45	Vd,average Apr Vd,m = fact 73.46 x nm x Tm/3	= (25 x N) +	36 Jun de 1c x (43 67.46 onth (see	Jul) 67.46 Tables 1b	Aug 70.46	Sep 73.46	Oct 76.45 Σ(44)1.	Nov 79.4512 = 109.04	1.72 74.96 Dec 82.45 899.47	(4)
ssumed occupar nnual average h ot water usage i nergy content of	31.00 g energy r ncy, N not water t Jan in litres pe 82.45 f hot wate 122.27 0.15 x (45 18.34	28.00 equiremen usage in litro Feb er day for ea 79.45 er used = 4.1 106.94)m 16.04	es per day Mar ach month 76.45 18 x Vd,m x 110.35	Vd,average	= (25 x N) + May or from Tabl 70.46 8600 kWh/m 92.31	36 Jun de 1c x (43 67.46 onth (see 79.66	Jul) 67.46 Tables 1b 73.82	Aug 70.46 , 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1. 99.90 Σ(45)1.	Nov 79.4512 = 109.0412 = 1	1.72 74.96 Dec 82.45 899.47 118.41 1179.35	(4)
ssumed occupar nnual average h ot water usage i nergy content of istribution loss	31.00 g energy r ncy, N not water u Jan in litres pe 82.45 f hot wate 122.27 0.15 x (45 18.34 litres) includes	28.00 equiremen usage in litro Feb er day for ea 79.45 er used = 4.1 106.94)m 16.04	es per day Mar ach month 76.45 18 x Vd,m x 110.35	Vd,average	= (25 x N) + May or from Tabl 70.46 8600 kWh/m 92.31	36 Jun de 1c x (43 67.46 onth (see 79.66	Jul) 67.46 Tables 1b 73.82	Aug 70.46 , 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1. 99.90 Σ(45)1.	Nov 79.4512 = 109.0412 = 1	1.72 74.96 Dec 82.45 899.47 118.41 1179.35	(4)
ssumed occupar nnual average h ot water usage i nergy content of istribution loss torage volume (I	31.00 g energy r ncy, N not water to Jan in litres pe 82.45 f hot wate 122.27 0.15 x (45 18.34 litres) incluses:	28.00 equiremen usage in litro Feb er day for ea 79.45 or used = 4.1 106.94)m 16.04 uding any so	es per day Mar ach month 76.45 18 x Vd,m x 110.35	Vd,average Apr Vd,m = fact 73.46 x nm x Tm/3 96.21 14.43 VHRS storage	= (25 x N) + May or from Tabl 70.46 8600 kWh/m 92.31 13.85 te within sam	36 Jun de 1c x (43 67.46 onth (see 79.66	Jul) 67.46 Tables 1b 73.82	Aug 70.46 , 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1. 99.90 Σ(45)1.	Nov 79.4512 = 109.0412 = 1	1.72 74.96 Dec 82.45 899.47 118.41 1179.35	(4) (4) (4) (4)
ssumed occupar nnual average h ot water usage i nergy content of istribution loss torage volume (I	31.00 g energy r ncy, N not water u Jan in litres pe 82.45 f hot wate 122.27 0.15 x (45 18.34 litres) incluses:	28.00 equiremen usage in litro Feb er day for ea 79.45 r used = 4.1 106.94)m 16.04 uding any so	es per day Mar ach month 76.45 18 x Vd,m x 110.35	Vd,average Apr Vd,m = fact 73.46 x nm x Tm/3 96.21 14.43 VHRS storage	= (25 x N) + May or from Tabl 70.46 8600 kWh/m 92.31 13.85 te within sam	36 Jun de 1c x (43 67.46 onth (see 79.66	Jul) 67.46 Tables 1b 73.82	Aug 70.46 , 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1. 99.90 Σ(45)1.	Nov 79.4512 = 109.0412 = 1	1.72 74.96 Dec 82.45 899.47 118.41 1179.35 17.76 3.00	(4)
ssumed occupar nnual average h lot water usage i nergy content of listribution loss torage volume (I Vater storage los) If manufacture	31.00 g energy r ncy, N not water to Jan in litres pe 82.45 f hot wate 122.27 0.15 x (45 18.34 litres) incluses: ar's declare	28.00 equiremen usage in litro Feb er day for ea 79.45 rr used = 4.1 106.94)m 16.04 uding any so ed loss factor n Table 2b	es per day Mar ach month 76.45 18 x Vd,m x 110.35 16.55 olar or WW	Vd,average Apr Vd,m = fact 73.46 x nm x Tm/3 96.21 14.43 VHRS storag	= (25 x N) + May or from Tabl 70.46 8600 kWh/m 92.31 13.85 te within sam	36 Jun de 1c x (43 67.46 onth (see 79.66	Jul) 67.46 Tables 1b 73.82	Aug 70.46 , 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1. 99.90 Σ(45)1.	Nov 79.4512 = 109.0412 = 1	1.72 74.96 Dec 82.45 899.47 118.41 1179.35 17.76 3.00	(4 (4 (4 (4 (4 (4 (4
Assumed occupared in the state of the state	31.00 g energy r ncy, N not water to Jan in litres pe 82.45 f hot wate 122.27 0.15 x (45 18.34 litres) incluses: er's declared factor from water s	28.00 equiremen usage in litro Feb er day for ea 79.45 rr used = 4.1 106.94)m 16.04 uding any so ed loss factor n Table 2b	es per day Mar ach month 76.45 18 x Vd,m x 110.35 16.55 olar or WW	Vd,average Apr Vd,m = fact 73.46 x nm x Tm/3 96.21 14.43 VHRS storag	= (25 x N) + May or from Tabl 70.46 8600 kWh/m 92.31 13.85 te within sam	36 Jun de 1c x (43 67.46 onth (see 79.66	Jul) 67.46 Tables 1b 73.82	Aug 70.46 , 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1. 99.90 Σ(45)1.	Nov 79.4512 = 109.0412 = 1	1.72 74.96 Dec 82.45 899.47 118.41 1179.35 17.76 3.00 0.26 0.54 0.14	(4 (4 (4 (4 (4 (4 (5
innual average had to water usage if the state of the sta	31.00 g energy r ncy, N not water to Jan in litres pe 82.45 f hot wate 122.27 0.15 x (45 18.34 litres) incluses: ar's declared factor from water s in (55)	28.00 equiremen usage in litro Feb er day for ea 79.45 r used = 4.1 106.94)m 16.04 uding any so ed loss factor m Table 2b storage (kW	es per day Mar ach month 76.45 18 x Vd,m x 110.35 16.55 olar or WW	Vd,average	= (25 x N) + May or from Tabl 70.46 8600 kWh/m 92.31 13.85 te within sam	36 Jun de 1c x (43 67.46 onth (see 79.66	Jul) 67.46 Tables 1b 73.82	Aug 70.46 , 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1. 99.90 Σ(45)1.	Nov 79.4512 = 109.0412 = 1	1.72 74.96 Dec 82.45 899.47 118.41 1179.35 17.76 3.00 0.26 0.54	(4 (4 (4 (4 (4 (4 (5
Assumed occupared in the state of the state	31.00 g energy r ncy, N not water to Jan in litres pe 82.45 f hot wate 122.27 0.15 x (45 18.34 litres) incluses: er's declared factor from water so in (55) ss calculate	28.00 equiremen usage in litro Feb er day for ea 79.45 r used = 4.1 106.94)m 16.04 uding any so ed loss factor m Table 2b storage (kW)	es per day Mar ach month 76.45 18 x Vd,m x 110.35 16.55 olar or WW or is known /h/day) (4	Vd,average	= (25 x N) + May or from Table 70.46 8600 kWh/m 92.31 13.85 te within sam	36 Jun de 1c x (43 67.46 onth (see 79.66 11.95 de vessel	Jul) 67.46 Tables 1b 73.82	Aug 70.46 , 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1. 99.90 Σ(45)1. 14.98	Nov 79.4512 = 109.0412 = 16.36	1.72 74.96 Dec 82.45 899.47 118.41 1179.35 17.76 3.00 0.26 0.54 0.14 0.14	(4 (4 (4 (4 (4 (4 (5) (5
ssumed occupar nnual average h lot water usage i nergy content of sistribution loss torage volume (I Vater storage los) If manufacture Temperature f Energy lost fro nter (50) or (54) Vater storage los	31.00 g energy r ncy, N not water to Jan in litres pe 82.45 f hot wate 122.27 0.15 x (45 18.34 litres) incluses: ar's declared factor from water s in (55) ss calculate 4.36	28.00 equiremen usage in litro Feb er day for ea 79.45 r used = 4.1 106.94)m 16.04 uding any so ed loss factor m Table 2b storage (kW) ed for each 3.93	es per day Mar ach month 76.45 18 x Vd,m x 110.35 16.55 olar or WW or is known /h/day) (4 month (5 4.36	Vd,average	= (25 x N) + May or from Table 70.46 8600 kWh/m 92.31 13.85 re within sam 4.36	36 Jun e 1c x (43 67.46 onth (see 79.66 11.95 ne vessel	Jul) 67.46 Tables 1b 73.82 11.07	Aug 70.46 , 1c 1d) 84.71 12.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1. 99.90 Σ(45)1.	Nov 79.4512 = 109.0412 = 1	1.72 74.96 Dec 82.45 899.47 118.41 1179.35 17.76 3.00 0.26 0.54 0.14	(4 (4 (4 (5 (5 (5 (5 (5 (5 (5 (5 (5 (5 (5 (5 (5
ssumed occupar nnual average h ot water usage i nergy content of sistribution loss torage volume (I Vater storage los) If manufacture Temperature f Energy lost fro nter (50) or (54)	31.00 g energy r ncy, N not water to Jan in litres pe 82.45 f hot wate 122.27 0.15 x (45 18.34 litres) incluses: ar's declared factor from water s in (55) ss calculate 4.36	28.00 equiremen usage in litro Feb er day for ea 79.45 r used = 4.1 106.94)m 16.04 uding any so ed loss factor m Table 2b storage (kW) ed for each 3.93	es per day Mar ach month 76.45 18 x Vd,m x 110.35 16.55 olar or WW or is known /h/day) (4 month (5 4.36	Vd,average	= (25 x N) + May or from Table 70.46 8600 kWh/m 92.31 13.85 re within sam 4.36	36 Jun e 1c x (43 67.46 onth (see 79.66 11.95 ne vessel	Jul) 67.46 Tables 1b 73.82 11.07	Aug 70.46 , 1c 1d) 84.71 12.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1. 99.90 Σ(45)1. 14.98	Nov 79.4512 = 109.0412 = 16.36	1.72 74.96 Dec 82.45 899.47 118.41 1179.35 17.76 3.00 0.26 0.54 0.14 0.14	(4

	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 for e	each month	from Table	3a, 3b or 3	3c									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61
otal heat requi	ired for wat	er heating (ralculated	for each mo	nth 0.85 x	(45)m + (4	16)m + (57)r	n + (59)m +	- (61)m		l		٠, ٦
otal ficat requi		_	т	Т					1	127.51	125 77	146.02	٦ ، د
	149.89	131.89	137.97	122.94	119.93	106.39	101.43	112.32	112.44	127.51	135.77	146.03	(62
olar DHW inpu	it calculated	using Appe	endix G or	Appendix H			_					_	_
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63
Output from wa	ater heater	or each mc	onth (kWh/	month) (6	2)m + (63)n	า							
	149.89	131.89	137.97	122.94	119.93	106.39	101.43	112.32	112.44	127.51	135.77	146.03]
			•		•		•			Σ(64)1	12 =	1504.52	(64
leat gains from	water heat	ing (k\Mh/n	nonth) 0.2	5 v [N 85 v	(15)m ± (61	\ml + 0.8 \	((46)m ± (57\m ± (50)	lml	2(0.)=] (
icat gains noin		1			1		1			T == a.			٦ , ۵.
	62.75	55.51	58.79	53.37	52.79	47.87	46.64	50.26	49.88	55.31	57.64	61.47	(65
5. Internal gair	ne												
J. Internal gair		F.L.	20.	A			11		6	0.4	A 1	D	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	(Table 5)												
	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	(66
ighting gains (c	calculated in	Appendix !	L, equatior	n L9 or L9a),	, also see Ta	able 5							
	14.04	12.47	10.14	7.68	5.74	4.85	5.24	6.81	9.14	11.60	13.54	14.43	(67
ppliance gains	(calculated	1	x Leguati	on I 13 or I	13a) also s	ee Table 5							٠, ٦
.pp.iai.iee gaii.ie		1		1			111.06	110.21	114 22	122.54	122.05	142.02	7 (6)
	149.52	151.07	147.16	138.84	128.33	118.46	111.86	110.31	114.22	122.54	133.05	142.92	(68
ooking gains (c	calculated ir	ı Appendix	L, equation	n L15 or L15	oa), also see	lable 5							_
	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	(69
ump and fan g	ains (Table	5a)											
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70
osses e.g. evap	oration (Ta	ble 5)											-
	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	7 (7:
Vater heating g		!	00.04	00.04	00.04	00.04	00.04	00.04	00.04	00.04	00.04	00.04] (, -
vater neating g		,	l	1						T =		T	٦
	84.34	82.61	79.01	74.13	70.95	66.48	62.69	67.55	69.28	74.34	80.05	82.62	(72
otal internal ga	ains (66)m	+ (67)m + (6	58)m + (69))m + (70)m	+ (71)m + (72)m							
	299.64	297.89	288.06	272.38	256.76	241.53	231.52	236.41	244.37	260.22	278.38	291.71	(73
6. Solar gains													
			Access		Area		lar flux V/m²		g	FF .c.		Gains	
			T-1-1	nd e	m²			Spec	ific data	specific o		W	
			Table	- ou		•	v /!!!	-		or Table	6c		7
								or T	able 6b	or Table			
lorth			0.7		4.56			or T			= 6c =	14.82	(74
				77 x [_ x1	10.63 x	or T	able 6b	0.70	= [14.82 19.21	_
ast	atts ∑(74)n	ı(82)m	0.7	77 x	4.56	_ x1	10.63 x	or T	0.63 x	0.70	= [_
ast	atts ∑(74)m 34.03	n(82)m	0.7	77 x	4.56	_ x1	10.63 x	or T	0.63 x	0.70	= [76
ast olar gains in wa	34.03	65.89	0.7	77 x [4.56	x 1 x 1	10.63 x 19.64 x	0.9 x (0.9 x (0.	0.63 x 0.63 x	0.70	= [19.21	76
ast olar gains in wa	34.03 ernal and so	65.89 blar (73)m +	0.7 0.7 110.00 (83)m	x [77 x [77 x [4.56 3.20 214.72	x 1 x 1	10.63 x 19.64 x	0.9 x 0.9 x 175.15	20.63 x 20.63 x 129.82	0.70 0.70 78.29	= = = = 42.23	19.21	(76
ast olar gains in wa	34.03	65.89	0.7	77 x [4.56	x 1 x 1	10.63 x 19.64 x	0.9 x (0.9 x (0.	0.63 x 0.63 x	0.70	= [19.21	(76
ast olar gains in wa otal gains - inte	34.03 ernal and so 333.67	65.89 blar (73)m +	0.7 0.7 110.00 (83)m 398.06	x x x x x x x x x x x x x x x x x x x	4.56 3.20 214.72	x 1 x 1	10.63 x 19.64 x	0.9 x 0.9 x 175.15	20.63 x 20.63 x 129.82	0.70 0.70 78.29	= = = = 42.23	19.21	(76
ast olar gains in wa otal gains - inte 7. Mean intern	34.03 ernal and so 333.67 nal tempera	65.89 blar (73)m + 363.79	0.7 0.7 110.00 (83)m 398.06	x x x x 167.54 439.92	4.56 3.20 214.72 471.49	x 1 x 1 224.69	10.63 x 19.64 x	0.9 x 0.9 x 175.15	20.63 x 20.63 x 129.82	0.70 0.70 78.29	= = = = 42.23	19.21 28.15 319.86	(83
iast iolar gains in wa iotal gains - inte 7. Mean intern	34.03 ernal and so 333.67 nal tempera	65.89 blar (73)m + 363.79 sture (heating periods in	0.7 0.7 110.00 (83)m 398.06 ng season	x 27 x 27 x 167.54 439.92 area from 7	4.56 3.20 214.72 471.49	x 1 x 1 224.69 466.21	10.63 x 19.64 x 211.86	or T 0.9 x 0.9 x 175.15 411.56	able 6b 0.63 x 0.63 x 129.82	78.29 338.52	=	19.21 28.15 319.86 21.00	(83
iast folar gains in wa fotal gains - inte 7. Mean intern femperature du	34.03 ernal and so 333.67 nal tempera uring heatin Jan	65.89 clar (73)m + 363.79 sture (heating periods in Feb	0.7 0.7 110.00 (83)m 398.06 ng season the living Mar	x x x x 167.54 439.92 Apr	4.56 3.20 214.72 471.49 Table 9, Thi	x 1 x 1 224.69	10.63 x 19.64 x	0.9 x 0.9 x 175.15	20.63 x 20.63 x 129.82	0.70 0.70 78.29	= = = = 42.23	19.21 28.15 319.86	(83
iast folar gains in wa fotal gains - inte 7. Mean intern femperature du	34.03 ernal and so 333.67 nal tempera uring heatin Jan	65.89 clar (73)m + 363.79 sture (heating periods in Feb	0.7 0.7 110.00 (83)m 398.06 ng season the living Mar	x x x x 167.54 439.92 Apr	4.56 3.20 214.72 471.49 Table 9, Thi	x 1 x 1 224.69 466.21	10.63 x 19.64 x 211.86	or T 0.9 x 0.9 x 175.15 411.56	able 6b 0.63 x 0.63 x 129.82	78.29 338.52	=	19.21 28.15 319.86 21.00	(74) (76) (83) (84) (85)
North East Solar gains in wa Fotal gains - inte 7. Mean intern Femperature du Utilisation facto	34.03 ernal and so 333.67 nal tempera uring heatin Jan	65.89 clar (73)m + 363.79 sture (heating periods in Feb	0.7 0.7 110.00 (83)m 398.06 ng season the living Mar	x x x x 167.54 439.92 Apr	4.56 3.20 214.72 471.49 Table 9, Thi	x 1 x 1 224.69 466.21	10.63 x 19.64 x 211.86	or T 0.9 x 0.9 x 175.15 411.56	able 6b 0.63 x 0.63 x 129.82	78.29 338.52	=	19.21 28.15 319.86 21.00	(83

			ı				T	1	ı	1			1
	20.02	20.14	20.35	20.64	20.88	20.98	21.00	20.99	20.93	20.64	20.28	20.00	(87)
Temperature d	_		1			1	1	1	1	1	T	1	1
	20.08	20.09	20.09	20.10	20.10	20.11	20.11	20.11	20.11	20.10	20.10	20.09	(88)
Utilisation factor	_			1			1		1	_	ı	_	1
	1.00	0.99	0.98	0.93	0.80	0.57	0.39	0.44	0.74	0.95	0.99	1.00	(89)
Mean internal t	temperature	in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	9c) 						1
	18.78	18.95	19.26	19.68	19.98	20.09	20.11	20.11	20.05	19.68	19.17	18.75	(90)
Living area frac	tion								Li	ving area ÷	(4) =	0.45	(91)
Mean internal t	temperature	for the wh	ole dwellir	ng fLA x T1 -	+(1 - fLA) x	T2							
	19.34	19.49	19.76	20.12	20.39	20.50	20.51	20.51	20.45	20.12	19.68	19.32	(92)
Apply adjustme	ent to the m	ean interna	l temperat	ure from Ta	able 4e whe	ere appropr	iate						_
	19.34	19.49	19.76	20.12	20.39	20.50	20.51	20.51	20.45	20.12	19.68	19.32	(93)
8. Space heati	ing requirem	nent											
o. Space near	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto			IVIAI	Дрі	iviay	Juli	Jui	Aug	Зер	Ott	NOV	Dec	
Othisation facto	0.99	0.99	0.98	0.93	0.81	0.61	0.43	0.49	0.77	0.95	0.99	1.00	(94)
Useful gains, ŋr		1		0.93	0.81	0.01	0.43	0.49	0.77	0.95	0.99	1.00	[(94)
Oserui gairis, iți				410.41	202.10	202.27	101.00	200.50	207.67	222.02	217.22	210.51	1 (05)
Monthly average	331.90	360.39	389.32	410.41	383.18	283.27	191.99	200.59	287.67	322.83	317.22	318.51	(95)
Monthly averag	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	1410	10.00	7.10	4.20	1 (00)
Heat loss rate f				1	!	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
rieat 1055 rate i	764.43	739.46	670.27	560.41	432.91	290.72	192.89	202.29	314.27	474.17	620.52	760.61	(97)
Space heating r		1		1			192.89	202.29	314.27	4/4.1/	629.53	760.61	[(97)
Space nearing i	321.80	254.73	209.03	108.00	37.00	0.00	0.00	0.00	0.00	112.59	224.86	328.92	1
	321.80	254.75	209.03	108.00	37.00	0.00	0.00	0.00		8)15, 10		1596.93] (98)
Space heating r	roquiromont	101/h/m²/v	oor						7(30	•	÷ (4)	31.39	(99)
Space neating i	equirement	KVVII/III / y	cai							(36)	- (4)	31.33	[(33)
9a. Energy red	quirements -	· individual	heating sy	stems inclu	uding micro	-CHP							
Space heating													
Fraction of space	ce heat from	ı secondary	/suppleme	ntary syste	m (table 11	L)						0.00	(201)
Fraction of space	ce heat from	ı main syste	em(s)							1 - (20	01) =	1.00	(202)
Fraction of space	ce heat from	ı main syste	em 2									0.00	(202)
Fraction of tota	ıl space heat	from main	system 1						(20)2) x [1- (20	3)] =	1.00	(204)
Fraction of tota	al space heat	from main	system 2							(202) x (20	03) =	0.00	(205)
Efficiency of ma	ain system 1	(%)										93.50	(206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating f	uel (main sy	stem 1), kV	Vh/month										
	344.17	272.44	223.56	115.51	39.57	0.00	0.00	0.00	0.00	120.42	240.49	351.79]
							•	•	∑(21:	1)15, 10	12 = 2	1707.95	(211)
Water heating													
Efficiency of wa	ater heater												
			05.00	84.47	82.09	79.80	79.80	79.80	79.80	84.48	86.15	86.92	(217)
	86.80	86.54	85.92	07.77			•			•	•		
Water heating			85.92	04.47	'								
Water heating			160.58	145.54	146.10	133.32	127.11	140.76	140.91	150.93	157.60	168.01]
Water heating	fuel, kWh/m	onth			146.10	133.32	127.11	140.76	140.91			1]] (219)
Water heating Annual totals	fuel, kWh/m	onth			146.10	133.32	127.11	140.76	140.91	150.93 ∑(219a)1		168.01 1795.93]] (219)
Annual totals	fuel, kWh/m 172.68	152.40			146.10	133.32	127.11	140.76	140.91		12 =	1795.93]] (219)
	fuel, kWh/m 172.68	152.40			146.10	133.32	127.11	140.76	140.91		12 =	1]] (219)

Water heating fuel		1795.93]
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		247.99	(232)
Total delivered energy for all uses	(211)(221) + (231) + (232)(237b) =	3826.87	(238)

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1707.95	x	3.48	x 0.01 =	59.44	(240)
Water heating	1795.93	x	3.48	x 0.01 =	62.50	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	247.99	x	13.19	x 0.01 =	32.71	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242) +	(245)(254) =	284.54	(255)

11a. SAP rating - individual heating systems including micro-CHP		
Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.25	(257)
SAP value	82.61	
SAP rating (section 13)	83	(258)
SAP band	В]

12a. CO ₂ emissions - individual heating systems	including micro-CHP					
	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO₂/year	
Space heating - main system 1	1707.95	x	0.216	=	368.92	(261)
Water heating	1795.93	x	0.216	=	387.92	(264)
Space and water heating			(261) + (262) + (263)	- (264) =	756.84	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	247.99	х	0.519	=	128.71	(268)
Total CO ₂ , kg/year			(265).	(271) =	924.47	(272)
Dwelling CO₂ emission rate			(27)	2) ÷ (4) =	18.17	(273)
El value					87.08]
El rating (section 14)					87	(274)
El band					В]

	Energy kWh/year		Primary factor		Primary Energy kWh/year	′
Space heating - main system 1	1707.95	x	1.22	=	2083.70	(261
Water heating	1795.93	x	1.22	=	2191.04	(264
Space and water heating			(261) + (262) + (263) + (264) =	4274.74	(265
Pumps and fans	75.00	x	3.07	=	230.25	(267
Electricity for lighting	247.99	x	3.07	=	761.32	(268
Primary energy kWh/year					5266.31	(272
Dwelling primary energy rate kWh/m2/year					103.50	(273

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	1B2P, Kingston upon Thames, KT1		

	rage storey eight (m)	(2a) =	Vo	olume (m³)	
Area (m²) Aver	eight (m)	(2a) -	Vo	lume (m³)	
Area (m²) Aver	eight (m)	(22) -	Vo	lume (m³)	
he	eight (m)	(22) -	Vo	lume (m³)	
Lowest occupied 50.32 (1a) x	2.50	(22) -			
		(20) -		125.80	(3a)
Total floor area $(1a) + (1b) + (1c) + (1d)(1n) = 50.32$ (4)					
Dwelling volume (3a)	+ (3b) + (3c)) + (3d)(3r	1) =	125.80	(5)
2. Ventilation rate					
			m	³ per hour	
Number of chimneys	0	x 40 =		0	(6a)
Number of open flues	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 pe hour	r
Infiltration due to chimneys, flues, fans, PSVs (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	o (16)				
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area				5.00	(17)
If based on air permeability value, then $(18) = [(17) \div 20] + (8)$, otherwise $(18) = (16)$				0.41	(18)
Number of sides on which the dwelling is sheltered				2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor		(18) x (20)) =	0.35	(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 U2					
5.10 5.00 4.90 4.40 4.30 3.80 3.80 3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4					
1.28 1.25 1.23 1.10 1.08 0.95 0.95 0.93	1.00	1.08	1.13	1.18	(22a
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m					
0.44 0.43 0.43 0.38 0.37 0.33 0.33 0.32	0.35	0.37	0.39	0.41	(22b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly avera	ge wind spe	ed from Tab	le U2										
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (2	2)m ÷ 4												
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltr	ation rate (a	llowing for	shelter and	wind facto	or) (21) x (2	2a)m							
	0.44	0.43	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41	(22b)
Calculate effec	tive air chan	ge rate for	the applical	ble case:									
If mechanic	al ventilation	n: air chang	e rate throu	ugh system	ı							N/A	(23a)
If balanced	with heat re	covery: effi	ciency in %	allowing fo	or in-use fac	ctor from Ta	able 4h					N/A	(23c)

ii iiicciiaiiicai ve	erremations an err	ange rate time.	agn system	
والمغارب المستمين والمسارك		- ff: -: · · · · · · · · · · · · · · ·	- II	64-

0.59

N/A	(23
<u> </u>	」 '

0.58

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

0.59

0.57

0.57

													_
	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(24d)
Effective air char	nge rate - e	nter (24a) c	or (24b) or	(24c) or (24	d) in (25)								

0.55

0.55

0.56

0.57

0.60

0.58

0.55

(25)

3. Heat losses and heat loss parameter									
Element	Gross area, m²	Openings m ²	Net a		U-value W/m²K	AxUW	/K κ-value, kJ/m².K	Ахк, kJ/K	
Window			7.8	6 x	1.33	= 10.42			(27)
Door			1.8	0 x	1.00	= 1.80			(26)
External wall			30.8	82 x	0.18	= 5.55			(29a)
Party wall			34.4	43 x	0.00	= 0.00			(32)
Roof			50.3	32 x	0.13	= 6.54			(30)
Total area of external elements ∑A, m²			90.8	80					(31)
Fabric heat loss, W/K = Σ (A × U)						(26	5)(30) + (32) =	24.31	(33)
Heat capacity Cm = $\sum (A \times \kappa)$					(28)	.(30) + (32) +	- (32a)(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K								250.00	(35)
Thermal bridges: $\Sigma(L \times \Psi)$ calculated using Ap	pendix K							9.32	(36)
Total fabric heat loss							(33) + (36) =	33.62	(37)
Jan Feb Ma	r Apr	May	Jun	Jul	Aug	Sep	Oct Nov	Dec	
Ventilation heat loss calculated monthly 0.33	x (25)m x (5)								
24.83 24.68 24.5	2 23.79	23.66	23.02	23.02	22.90	23.27	23.66 23.93	24.22	(38)
Heat transfer coefficient, W/K (37)m + (38)m									
58.46 58.30 58.1	5 57.42	57.28	56.65	56.65	56.53	56.89	57.28 57.56	57.85	
						Average = ∑	(39)112/12 =	57.42	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4	1)								
1.16 1.16 1.1	5 1.14	1.14	1.13	1.13	1.12	1.13	1.14 1.14	1.15	
						Average = ∑	(40)112/12 =	1.14	(40)
Number of days in month (Table 1a)									
31.00 28.00 31.0	0 30.00	31.00	30.00	31.00	31.00	30.00	31.00 30.00	31.00	(40)
4. Water heating energy requirement									
Assumed occupancy, N								1.70	(42)
Annual average hot water usage in litres per o	lay Vd,average	= (25 x N) +	36					74.56	(43)
Jan Feb Ma	r Apr	May	Jun	Jul	Aug	Sep	Oct Nov	Dec	
Hot water usage in litres per day for each mo	nth Vd,m = fact	tor from Tab	le 1c x (43)						
82.02 79.04 76.0	6 73.07	70.09	67.11	67.11	70.09	73.07	76.06 79.04	82.02	
							∑(44)112 =	894.76	(44)
Energy content of hot water used = 4.18 x Vd	m x nm x Tm/3	3600 kWh/m	onth (see	Γables 1b,	1c 1d)				
121.63 106.38 109.	78 95.71	91.83	79.24	73.43	84.26	85.27	99.37 108.47	7 117.80	
Div 1 1 1 0 45 (45)							∑(45)112 =	1173.18	(45)
Distribution loss 0.15 x (45)m		1 10 == 1				10.70		1	٦ (۵ ۵)
18.25 15.96 16.4		13.77	11.89	11.01	12.64	12.79	14.91 16.27		(46)
Storage volume (litres) including any solar or	WWHRS storag	ge within sam	ne vessel					3.00	(47)
Water storage loss:									7 ()
a) If manufacturer's declared loss factor is kno	own (kWh/day)							0.26	(48)
Temperature factor from Table 2b							L	0.54	(49)
Energy lost from water storage (kWh/day)	(48) x (49)							0.14	(50) (50)
Enter (50) or (54) in (55)	(55) (55)							0.14	(55)
Water storage loss calculated for each month					1	, · · · · ·			٦.
4.36 3.93 4.3		4.36	4.21	4.36	4.36	4.21	4.36 4.21	4.36	(56)
If the vessel contains dedicated solar storage	1				1	1 1			٦,,
4.36 3.93 4.3	5 4.21	4.36	4.21	4.36	4.36	4.21	4.36 4.21	4.36	(57)

Primary circuit loss for each	h month fro	m Table 3										
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 for each month	-1		!] (/
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat required for wa	-1					1		1	0.00	0.00	0.00] (0-)
149.25	131.33	137.39	122.43	119.45	105.97	101.05	111.88	112.00	126.99	135.20	145.41	(62)
Solar DHW input calculate					103.57	101.03	111.00	112.00	120.55	155.20	143.41] (02)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from water heater	-		1			0.00	0.00	0.00	0.00	0.00	0.00] (03)
149.25	1		1		1	101.05	111 00	112.00	126.00	125.20	145 41	٦
149.23	131.33	137.39	122.43	119.45	105.97	101.05	111.88	112.00	126.99	135.20	145.41]] (64)
Heat gains from water hea	ıting (kWh/n	nonth) 0.25	5 × [0.85 ×	(45)m + (61	.)m] + 0.8 ×	[(46)m + (5	57)m + (59)	m]	∑(64)1	.12 =1	498.35	<u> </u> (64)
62.54	55.33	58.59	53.20	52.63	47.73	46.51	50.11	49.73	55.14	57.45	61.26	(65)
5. Internal gains			_								_	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)		т										٦.
84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	(66)
Lighting gains (calculated i			1							1		٦.
13.84	12.29	10.00	7.57	5.66	4.78	5.16	6.71	9.00	11.43	13.34	14.22	(67)
Appliance gains (calculated	in Appendi	x L, equation	on L13 or L1	13a), also se	e Table 5							_
148.07	149.60	145.73	137.49	127.08	117.30	110.77	109.23	113.11	121.35	131.75	141.53	(68)
Cooking gains (calculated	n Appendix	L, equation	L15 or L15	a), also see	Table 5							_
31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	(69)
Pump and fan gains (Table	5a)											
3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Ta	able 5)											
-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	(71)
Water heating gains (Table	≥ 5)											
84.06	82.33	78.76	73.89	70.74	66.29	62.51	67.35	69.07	74.11	79.79	82.34	(72)
Total internal gains (66)m	+ (67)m + (6	58)m + (69)r	m + (70)m ·	+ (71)m + (4.							
297.45	T			. (/ =/ (.	72)m							
	295.72	285.97	270.44	254.97	72)m 239.86	229.94	234.79	242.68	258.38	276.38	289.59	(73)
C Coloursian	295.72	285.97	270.44			229.94	234.79	242.68	258.38	276.38	289.59	(73)
6. Solar gains	295.72			254.97	239.86		234.79			276.38		(73)
6. Solar gains	295.72	Access f	factor	254.97 Area	239.86 Sol i	ar flux		g	FF		Gains	(73)
6. Solar gains	295.72		factor	254.97	239.86 Sol i		spec			lata		(73)
6. Solar gains West	295.72	Access f	factor 6d	254.97 Area	239.86 Soli W	ar flux V/m²	spec or T	g ific data	FF specific o	lata : 6c	Gains	(73)
		Access f Table	factor 6d	254.97 Area m²	239.86 Soli W	ar flux V/m²	spec or T	g ific data able 6b	FF specific o	lata : 6c	Gains W	7
West	m(82)m	Access f Table	factor 6d	254.97 Area m² 7.86	239.86 Sola W	ar flux J/m²	spec or T	g ific data able 6b	FF specific o or Table	data : 6c =	Gains W	(80)
West Solar gains in watts ∑(74) 47.18	m(82)m	Access f Table	factor 6d	254.97 Area m²	239.86 Soli W	ar flux V/m²	spec or T	g ific data able 6b	FF specific o	lata : 6c	Gains W	7
West Solar gains in watts ∑(74)i 47.18 Total gains - internal and s	m(82)m 92.29 solar (73)m +	Access f Table 0.77 151.99 (83)m	7 x 221.67	254.97 Area m² 7.86 271.66	239.86 Sola W x 1: 278.09	ar flux V/m² 9.64 x (spec or T 0.9 x (g ific data able 6b 0.63 x	FF specific c or Table 0.70	data 6c = 58.83	Gains W 47.18] (80)] (83)
West Solar gains in watts ∑(74)i 47.18 Total gains - internal and s 344.63	m(82)m 92.29 solar (73)m + 388.01	Access f Table 0.77 151.99 (83)m 437.96	factor 6d	254.97 Area m² 7.86	239.86 Sola W	ar flux J/m²	spec or T	g ific data able 6b	FF specific o or Table	data : 6c =	Gains W	(80)
West Solar gains in watts ∑(74)i 47.18 Total gains - internal and s 344.63 7. Mean internal temper	m(82)m 92.29 colar (73)m + 388.01 ature (heatin	Access f Table 0.77 151.99 (83)m 437.96	factor 6d x 221.67	254.97 Area m² 7.86 271.66	239.86 Soli W x 1: 278.09	ar flux V/m² 9.64 x (spec or T 0.9 x (g ific data able 6b 0.63 x	FF specific c or Table 0.70	stata	Gains W 47.18 38.80 328.38] (80)] (83)] (84)
West Solar gains in watts ∑(74) 47.18 Total gains - internal and s 344.63 7. Mean internal temper Temperature during heating	m(82)m 92.29 solar (73)m + 388.01 ature (heating periods in	Access f Table 0.77 151.99 (83)m 437.96 ng season) the living a	factor 6d 7 x 221.67 492.11	254.97 Area m² 7.86 271.66 526.63	239.86 Sola W 278.09 517.96	ar flux V/m² 9.64 x 264.76	spec or T 0.9 x (g ific data able 6b 0.63 x 176.77	FF specific o or Table 0.70 109.51 367.89	stata state stat	Gains W 47.18 38.80 328.38] (80)] (83)
West Solar gains in watts ∑(74)i 47.18 Total gains - internal and s 344.63 7. Mean internal temper Temperature during heatin Jan	m(82)m 92.29 colar (73)m + 388.01 ature (heating periods in Feb	Access f Table 0.77 151.99 (83)m 437.96 In the living a Mar	factor 6d 7 x 221.67 221.67 492.11 Apr	254.97 Area m² 7.86 271.66 526.63 Table 9, Th1 May	239.86 Soli W x 1: 278.09	ar flux V/m² 9.64 x (spec or T 0.9 x (g ific data able 6b 0.63 x	FF specific c or Table 0.70	stata	Gains W 47.18 38.80 328.38] (80)] (83)] (84)
West Solar gains in watts ∑(74) 47.18 Total gains - internal and s 344.63 7. Mean internal temper Temperature during heatin Jan Utilisation factor for gains	m(82)m 92.29 solar (73)m + 388.01 ature (heating periods in Feb for living are	Access f Table 0.77 151.99 (83)m 437.96 In g season) In the living a Mar ea n1,m (sea	factor 6d 7 x 221.67 492.11 area from T Apr e Table 9a)	254.97 Area m² 7.86 271.66 526.63 Table 9, Th1 May	239.86 Sola W 278.09 517.96 Jun	ar flux J/m² 9.64 x 264.76 494.69	spec or T 0.9 x (227.42 462.21	g ific data able 6b 0.63 x 176.77 419.45	FF specific c or Table 0.70 109.51 367.89	data 6c =	Gains W 47.18 38.80 328.38 21.00 Dec] (80)] (83)] (84)
West Solar gains in watts ∑(74)i 47.18 Total gains - internal and s 344.63 7. Mean internal temper Temperature during heatin Jan	m(82)m 92.29 colar (73)m + 388.01 ature (heating periods in Feb for living are	Access f Table 0.77 151.99 (83)m 437.96 In the living a Mar ea n1,m (see 0.98	7 x 221.67 492.11 area from T Apr e Table 9a) 0.94	254.97 Area m² 7.86 271.66 526.63 Table 9, Th1 May 0.84	239.86 Sola W 278.09 517.96	ar flux V/m² 9.64 x 264.76	spec or T 0.9 x (g ific data able 6b 0.63 x 176.77	FF specific o or Table 0.70 109.51 367.89	stata state stat	Gains W 47.18 38.80 328.38] (80)] (83)] (84)

19.82	19.97	20.23	20.57	20.83	20.96	20.99	20.99	20.90	20.55	20.13	19.80	(87)
Temperature during heatir	ng periods ir	n the rest o	f dwelling f	rom Table 9	9, Th2(°C)							
19.95	19.95	19.96	19.97	19.97	19.98	19.98	19.98	19.98	19.97	19.97	19.96	(88)
Utilisation factor for gains	for rest of d	lwelling n2,	,m									
1.00	0.99	0.98	0.92	0.79	0.57	0.39	0.43	0.73	0.95	0.99	1.00	(89)
Mean internal temperature	e in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	Эс)			•	•	•	
18.39	18.61	18.99	19.47	19.81	19.96	19.98	19.98	19.90	19.46	18.85	18.36	(90)
Living area fraction									ving area ÷		0.55	(91)
Mean internal temperature	e for the wh	nole dwellin	ng fl A x T1 -	+(1 - fl A) x ⁻	Т2					()		(/
19.17	19.35	19.66	20.07	20.37	20.51	20.53	20.53	20.44	20.05	19.54	19.14	(92)
Apply adjustment to the m		1	1	1			20.55	20.44	20.03	15.54	13.14	(32)
	1		1			1	20.53	20.44	20.05	10.54	10.14	7 (02)
19.17	19.35	19.66	20.07	20.37	20.51	20.53	20.53	20.44	20.05	19.54	19.14	(93)
8. Space heating requirer	nent											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains,	ηm											
0.99	0.99	0.97	0.92	0.81	0.62	0.45	0.50	0.77	0.95	0.99	1.00	(94)
Useful gains, ηmGm, W (9			0.52	0.02	0.02	05	0.50	0.7.7	0.55	0.55	1 2.00	(0 .)
342.56	383.61	426.10	454.54	426.33	320.89	220.60	229.84	321.86	349.48	331.30	326.81	(95)
Monthly average external				420.55	320.83	220.00	223.04	321.80	343.46	331.30	320.61	_ (33)
			1	11.70	14.60	16.60	16.40	1410	10.00	7.10	4.20	7 (06)
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean int		1	1				T		T = =	l	1	7 (2-)
869.34	842.43	765.43	641.24	496.41	334.50	222.68	233.39	360.89	541.42	716.29	864.49	(97)
Space heating requirement		1	1						1	1		7
391.93	308.32	252.46	134.42	52.14	0.00	0.00	0.00	0.00	142.80	277.19	400.04	_
								∑(98	3)15, 10	.12 =	1959.30	(98)
Space heating requirement	t kWh/m²/y	rear							(98)	÷ (4)	38.94	(99)
9a. Energy requirements	- individual	heating sy	stems inclu	iding micro	-CHP							
Space heating	marriadar	neuting 37										
		/sunnlama	ntanı susta	m (table 11	1						0.00	7 (201)
Fraction of space heat from	·		miary syste	m (table 11	·)				4 (2)	24)	0.00	(201)
Fraction of space heat from	•								1 - (20)1) = [1.00	(202)
Fraction of space heat from	•										0.00	(202)
Fraction of total space hea								(20)2) x [1- (20		1.00	(204)
Fraction of total space hea		system 2							(202) x (20	03) =	0.00	(205)
Efficiency of main system 1											93.50	(206)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main sy	/stem 1), kV	Wh/month					_				_	_
419.17	329.76	270.01	143.77	55.76	0.00	0.00	0.00	0.00	152.73	296.46	427.85	
								∑(21	1)15, 10	.12 =	2095.50	(211)
Water heating												
Efficiency of water heater												
87.27	87.01	86.42	85.06	82.77	79.80	79.80	79.80	79.80	85.13	86.69	87.38	(217)
Water heating fuel, kWh/n	nonth											
171.02	150.92	158.99	143.93	144.31	132.80	126.63	140.20	140.35	149.18	155.96	166.42	
	1		•		•	•			∑(219a)1		1780.70	_ (219)
									_,,			_
Annual totals												
Annual totals Snace heating fuel - main s	vstem 1										2095 50	7
Annual totals Space heating fuel - main s	ystem 1										2095.50	

Water heating fuel		1780.70	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		244.38	(232)
Total delivered energy for all uses	(211)(221) + (231) + (232)(237b) =	4195.58	(238)

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2095.50	x	3.48	x 0.01 =	72.92	(240)
Water heating	1780.70	x	3.48	x 0.01 =	61.97	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	244.38	х	13.19	x 0.01 =	32.23	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242) +	(245)(254) =	297.02	(255)

11a. SAP rating - individual heating systems including micro-CHP		
Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.31	(257)
SAP value	81.74]
SAP rating (section 13)	82	(258)
SAP band	В]

12a. CO ₂ emissions - individual heating systems inclu	ding micro-CHP					
	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO₂/year	
Space heating - main system 1	2095.50	x	0.216	=	452.63	(261)
Water heating	1780.70	x	0.216	=	384.63	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	837.26	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	244.38	x	0.519	=	126.83	(268)
Total CO₂, kg/year				(265)(271) =	1003.02	(272)
Dwelling CO₂ emission rate				(272) ÷ (4) =	19.93	(273)
El value					85.90	
El rating (section 14)					86	(274)
EI band					В	

	Energy kWh/year		Primary factor		Primary Energy kWh/year	,
Space heating - main system 1	2095.50	x	1.22	=	2556.52	(261)
Water heating	1780.70	x	1.22	=	2172.45	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	4728.97	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	244.38	x	3.07	=	750.24	(268)
Primary energy kWh/year					5709.46	(272)
Dwelling primary energy rate kWh/m2/year					113.46	(273)

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	2B3P, Kingston upon Thames, KT1		

		Area (m²)	Average storey height (m)		Volume (m³)	
owest occupied		64.62 (1a) x	2.50	2a) =	161.55	(3
otal floor area	(1a) + (1b) + (1c) + (1d)(1n) =	64.62 (4)				
Owelling volume			(3a) + (3b) + (3c) +	+ (3d)(3n) =	161.55	(5
2. Ventilation rate						
					m³ per hour	
lumber of chimneys			0	x 40 =	0	(6
lumber of open flues			0	x 20 =	0	(6
lumber of intermittent fans			2	x 10 =	20	(7
lumber of passive vents			0	x 10 =	0	(7
lumber of flueless gas fires			0	x 40 =	0	(7
					Air changes per	٢

Infiltration due to chimneys, flues, fans, PSVs (6a) + (6b) + (7a) + (7b) + (7c) = 20 $\div (5) = 0.12$

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

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

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

Number of sides on which the dwelling is sheltered

Infiltration rate incorporating shelter factor

Shelter factor

, , , , , , , , , , , ,

Infiltration rate modified for monthly wind speed:

		, .	····a opeca	•									
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average	e wind spee	ed from Tab	le U2										
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)	m ÷ 4												
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltrat	tion rate (a	llowing for	shelter and	wind facto	or) (21) x (2	2a)m							
	0.41	0.40	0.39	0.35	0.34	0.30	0.30	0.29	0.32	0.34	0.36	0.37	(22b)
Calculate effective	ve air chan	ge rate for t	the applica	ble case:									

If mechanical ventilation: air change rate through system

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h

		•	•	_									
d) natural ver	ntilation or	whole hou	se positive	input venti	lation from	loft							
	0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.56	0.57	(24d)
Effective air char	nge rate - e	nter (24a) d	or (24b) or	(24c) or (24	d) in (25)								
	0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.56	0.57	(25)



N/A

N/A

5.00

0.37

0.85

0.32

1 - [0.075 x (19)] =

 $(18) \times (20) =$

(17)

(19)

(20)

(21)

(23a)

(23c)

Element				Gross	Openings	Net	area	U-value	A x U W	/К к-value.	Ахк,	
			;	area, m²	m ²	A,		W/m ² K	AXUW	kJ/m².K	kJ/K	
Window						14.	37 x	1.33	= 19.05			(27)
Door						1.8	30 x	1.00	= 1.80			(26)
External wall						54.	23 x	0.18	= 9.76			(29a
Party wall						14.	88 x	0.00	= 0.00			(32)
Roof						64.	62 x	0.13	= 8.40			(30)
Total area of ext	ernal elem	ents ∑A, m²				135	.02					(31)
Fabric heat loss,	W/K = ∑(A	× U)							(20	5)(30) + (32) =	39.01	(33)
Heat capacity Cn	n = ∑(A x к)							(28)	.(30) + (32)	+ (32a)(32e) =	N/A	(34)
Thermal mass pa	arameter (T	MP) in kJ/n	1²K								250.00	(35)
Thermal bridges:	: ∑(L x Ѱ) ca	alculated us	ing Apper	ndix K							17.71	(36)
Total fabric heat	loss									(33) + (36) =	56.72	(37
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct Nov	Dec	
Ventilation heat	loss calcula	ated month	ly 0.33 x ((25)m x (5)	-				·			
	31.03	30.86	30.69	29.91	29.77	29.08	29.08	28.96	29.35	29.77 30.06	30.37	(38)
Heat transfer co								1 20.00] (,
	87.76	87.59	87.42	86.64	86.49	85.81	85.81	85.68	86.07	86.49 86.79	87.10	1
	67.76	07.55	07.12	00.01	00.15	03.01	05.01	1 03.00		(39)112/12 =	86.64	」] (39)
Heat loss parame	eter (HIP)	W/m²K (39))m ÷ (4)						Average - 2	(33)112/12 -	00.04] (33)
icat 1033 param	1.36	1.36	1.35	1.34	1.34	1.33	1.33	1.33	1.33	1.34 1.34	1.35	1
	1.50	1.30	1.33	1.54	1.54	1.55	1.55	1.55		(40)112/12 =	1.34	」](40)
Number of days	in month /	Table 1a)							Average – Z	(40)112/12 -	1.54] (40)
Nulliber of days	,		24.00	20.00	24.00	20.00	24.00	24.00	20.00	24.00 20.00	24.00	7 (40)
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00 30.00	31.00	(40)
4. Water heatir	ng energy r	equiremen	t									
Assumed occupa	ancy, N										2.11	(42)
Annual average l	hot water ເ	usage in litre	es per day	Vd,average	= (25 x N) +	36					84.28	(43)
								_				_
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct Nov	Dec	
Hot water usage					•			Aug	Sep	Oct Nov	Dec	
Hot water usage	in litres pe	er day for ea	ich month	Vd,m = fact	tor from Tab	le 1c x (43)					1
Hot water usage					•			79.23	Sep 82.60	85.97 89.34	92.71] (44)
_	92.71	er day for ea	85.97	Vd,m = fact 82.60	tor from Tab	le 1c x (43 75.86	75.86	79.23]] (44)
_	92.71 of hot wate	89.34 89.34 er used = 4.1	85.97 8 x Vd,m	82.60 x nm x Tm/3	79.23 79.23 8600 kWh/m	le 1c x (43 75.86 onth (see	75.86 Tables 1b	79.23 , 1c 1d)	82.60	85.97 89.34 Σ(44)112 =	92.71]] (44)]
_	92.71	er day for ea	85.97	Vd,m = fact 82.60	tor from Tab	le 1c x (43 75.86	75.86	79.23		85.97 89.34 Σ(44)112 = 112.33 122.62	92.71 1011.41 1 133.15]
Energy content o	92.71 of hot wate	89.34 er used = 4.1 120.25	85.97 8 x Vd,m	82.60 x nm x Tm/3	79.23 79.23 8600 kWh/m	le 1c x (43 75.86 onth (see	75.86 Tables 1b	79.23 , 1c 1d)	82.60	85.97 89.34 Σ(44)112 =	92.71]
Energy content o	92.71 of hot wate 137.49 0.15 x (45)	89.34 89.34 r used = 4.1 120.25	85.97 8 x Vd,m 124.09	x nm x Tm/3	79.23 8600 kWh/m	75.86 onth (see	75.86 Tables 1b	79.23 , 1c 1d) 95.25	96.39	85.97 89.34 Σ (44)112 =	92.71 1011.41 1 133.15 1326.12] (45)
Energy content o	92.71 of hot wate 137.49 0.15 x (45) 20.62	er day for ea 89.34 er used = 4.1 120.25)m	85.97 8 x Vd,m 124.09	x nm x Tm/3 108.18	79.23 3600 kWh/m 103.80	75.86 nonth (see 89.57	75.86 Tables 1b	79.23 , 1c 1d)	82.60	85.97 89.34 Σ(44)112 = 112.33 122.62	92.71 1011.41 1 133.15 1326.12]] (45)] (46)
Energy content of Distribution loss	92.71 of hot wate 137.49 0.15 x (45) 20.62 (litres) include	er day for ea 89.34 er used = 4.1 120.25)m	85.97 8 x Vd,m 124.09	x nm x Tm/3 108.18	79.23 3600 kWh/m 103.80	75.86 nonth (see 89.57	75.86 Tables 1b	79.23 , 1c 1d) 95.25	96.39	85.97 89.34 Σ (44)112 =	92.71 1011.41 1 133.15 1326.12]] (45)] (46)
Energy content of Distribution loss Storage volume (92.71 of hot wate 137.49 0.15 x (45) 20.62 (litres) incluses:	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so	.8 x Vd,m 124.09 18.61	x nm x Tm/3 108.18 16.23 WHRS storage	79.23 3600 kWh/m 103.80 15.57 ge within sam	75.86 nonth (see 89.57	75.86 Tables 1b	79.23 , 1c 1d) 95.25	96.39	85.97 89.34 Σ (44)112 =	92.71 1011.41 1 133.15 1326.12 19.97 3.00] (45)] (46)] (47)
Energy content of Distribution loss Storage volume (Water storage loss) If manufacture	of hot wate 137.49 0.15 x (45 20.62 (litres) incluses: er's declare	89.34 er used = 4.1 120.25)m 18.04 uding any so	.8 x Vd,m 124.09 18.61	x nm x Tm/3 108.18 16.23 WHRS storage	79.23 3600 kWh/m 103.80 15.57 ge within sam	75.86 nonth (see 89.57	75.86 Tables 1b	79.23 , 1c 1d) 95.25	96.39	85.97 89.34 Σ (44)112 =	92.71 1011.41 1 133.15 1326.12 19.97 3.00] (45)] (46)] (47)
Energy content of Distribution loss Storage volume of Water storage lotal if manufacture Temperature	of hot wate 137.49 0.15 x (45) 20.62 (litres) incluses: er's declared factor from	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so ed loss factor m Table 2b	85.97 8 x Vd,m 124.09 18.61 blar or WV	x nm x Tm/3 108.18 16.23 WHRS storag	79.23 3600 kWh/m 103.80 15.57 ge within sam	75.86 nonth (see 89.57	75.86 Tables 1b	79.23 , 1c 1d) 95.25	96.39	85.97 89.34 Σ (44)112 =	92.71 1011.41 1 133.15 1326.12 19.97 3.00 0.26 0.54] (45)] (46)] (47)] (48)] (49)
Energy content of Distribution loss Storage volume (Water storage loa) If manufacture Temperature Energy lost fr	of hot wate 137.49 0.15 x (45) 20.62 (litres) incluses: er's declared factor from water serior	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so ed loss factor m Table 2b	85.97 8 x Vd,m 124.09 18.61 blar or WV	x nm x Tm/3 108.18 16.23 WHRS storag	79.23 3600 kWh/m 103.80 15.57 ge within sam	75.86 nonth (see 89.57	75.86 Tables 1b	79.23 , 1c 1d) 95.25	96.39	85.97 89.34 Σ (44)112 =	92.71 1011.41 1 133.15 1326.12 19.97 3.00 0.26 0.54 0.14] (45)] (46)] (47)] (48)] (49)] (50)
Energy content of Distribution loss Storage volume of Water storage load of Temperature Energy lost frenter (50) or (54)	of hot wate 137.49 0.15 x (45) 20.62 (litres) incluses: er's declared factor from water seeds on the company of the company	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so ed loss facto m Table 2b storage (kW	85.97 8 x Vd,m 124.09 18.61 blar or WV	108.18 16.23 VHRS storage (kWh/day)	79.23 3600 kWh/m 103.80 15.57 ge within sam	75.86 nonth (see 89.57	75.86 Tables 1b	79.23 , 1c 1d) 95.25	96.39	85.97 89.34 Σ (44)112 =	92.71 1011.41 1 133.15 1326.12 19.97 3.00 0.26 0.54] (45)] (46)] (47)] (48)] (49)] (50)
Energy content of Distribution loss Storage volume (Water storage loa) If manufacture Temperature Energy lost frenter (50) or (54)	of hot wate 137.49 0.15 x (45) 20.62 (litres) incluses: er's declared factor from water section (55)	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so ed loss facto m Table 2b storage (kW	85.97 8 x Vd,m 124.09 18.61 blar or WV	108.18 16.23 VHRS storage (kWh/day)	79.23 3600 kWh/m 103.80 15.57 ge within sam	75.86 nonth (see 89.57	75.86 Tables 1b	79.23 , 1c 1d) 95.25	96.39	85.97 89.34 Σ (44)112 =	92.71 1011.41 1 133.15 1326.12 19.97 3.00 0.26 0.54 0.14 0.14] (45)] (46)] (47)] (48)] (49)] (50)
Energy lost fr Enter (50) or (54 Water storage lo	on litres per 92.71 of hot wate 137.49 0.15 x (45) 20.62 (litres) incluses: er's declared factor from water services calculated 4.36	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so ed loss facto m Table 2b storage (kW) ed for each 3.93	85.97 8 x Vd,m 124.09 18.61 blar or WV r is known th/day) (4 month (5	108.18 16.23 WHRS storage (kWh/day) 18) x (49) 15) x (41)m 4.21	tor from Tab 79.23 8600 kWh/m 103.80 15.57 ge within sam	75.86 onth (see 89.57 13.44 ne vessel	75.86 Tables 1b 83.00 12.45	79.23 , 1c 1d) 95.25 14.29	96.39	85.97 89.34 Σ (44)112 =	92.71 1011.41 1 133.15 1326.12 19.97 3.00 0.26 0.54 0.14] (44)] (45)] (45)] (46)] (47)] (48)] (50)] (55)
Energy content of Distribution loss Storage volume of Water storage load of Temperature Energy lost frenter (50) or (54)	on litres per 92.71 of hot wate 137.49 0.15 x (45) 20.62 (litres) incluses: er's declared factor from water services calculated 4.36	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so ed loss facto m Table 2b storage (kW) ed for each 3.93	85.97 8 x Vd,m 124.09 18.61 blar or WV r is known th/day) (4 month (5	108.18 16.23 WHRS storage (kWh/day) 18) x (49) 15) x (41)m 4.21	tor from Tab 79.23 8600 kWh/m 103.80 15.57 ge within sam	75.86 onth (see 89.57 13.44 ne vessel	75.86 Tables 1b 83.00 12.45	79.23 , 1c 1d) 95.25 14.29	96.39	85.97 89.34 Σ(44)112 = 112.33 122.62 Σ(45)112 = 16.85 18.39	92.71 1011.41 1 133.15 1326.12 19.97 3.00 0.26 0.54 0.14 0.14] (45)] (45)] (47)] (48)] (49)] (50)

Primary circuit	t loss for each	n month fro	m Table 3										
	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 for	r each month	from Table	3a, 3b or 3	3c	•	•				•	•		-
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requ	uired for wat	er heating o	calculated 1	for each m	onth 0.85	x (45)m + (4	l6)m + (57)	m + (59)m +	· (61)m			•	_
	165.11	145.19	151.70	134.91	131.42	116.30	110.62	122.87	123.11	139.95	149.34	160.77	(62)
Solar DHW inp	put calculated	using Appe	endix G or <i>i</i>	Appendix F	1								-
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from w	water heater	for each mo	nth (kWh/	month) (6	2)m + (63)r	m	•	•					•
	165.11	145.19	151.70	134.91	131.42	116.30	110.62	122.87	123.11	139.95	149.34	160.77	1
				•	•		•	•		∑(64)1	.12 = 1	1651.29	(64)
Heat gains fror	m water heat	ing (kWh/n	nonth) 0.2	5 × [0.85 ×	(45)m + (6	1)m] + 0.8 >	< [(46)m + (57)m + (59)	m]				
	67.81	59.94	63.35	57.35	56.61	51.16	49.69	53.76	53.43	59.44	62.15	66.37	(65)
		'									<u>'</u>		
5. Internal ga	ains												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gain	ns (Table 5)												
	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	(66)
Lighting gains	(calculated in	Appendix	L, equation	1 L9 or L9a)	, also see T	able 5							
	16.44	14.60	11.88	8.99	6.72	5.67	6.13	7.97	10.70	13.58	15.85	16.90	(67)
Appliance gain	ns (calculated	in Appendi	ix L, equati	on L13 or L	.13a), also s	see Table 5							
	184.43	186.34	181.52	171.25	158.29	146.11	137.98	136.06	140.88	151.15	164.11	176.29	(68)
Cooking gains	(calculated in	n Appendix	L, equatior	1 L15 or L15	5a), also se	e Table 5							
	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	33.54	(69)
Pump and fan	gains (Table	5a)											
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. eva	aporation (Ta	ble 5)											
	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	-84.35	(71)
Water heating	g gains (Table	5)											
	91.14	89.19	85.15	79.66	76.09	71.06	66.79	72.26	74.21	79.90	86.32	89.20	(72)
Total internal g	gains (66)m	+ (67)m + (6	58)m + (69)	m + (70)m	+ (71)m + ((72)m							
	349.65	347.78	336.18	317.53	298.73	280.48	268.53	273.93	283.42	302.26	323.92	340.03	(73)
6. Solar gains	S		_										
			Access Table		Area m²		lar flux V/m²	spec	g ific data	FF specific (data	Gains W	
							•	-	able 6b	or Table			
North			0.7	77 x	7.83	x 1	10.63 x	0.9 x).63 >	0.70	=	25.45	(74)
East			0.7	7 x	6.54	x 1	L9.64 x	0.9 x	0.63	0.70		39.26	(76)
Solar gains in v	watts ∑(74)m	n(82)m							<u> </u>				
	64.70	125.42	209.09	317.16	404.83	422.79	398.99	331.00	246.43	149.00	80.34	53.49	(83)
Гotal gains - in		1			-		•	•		•		1	. · ,
-	414.35	473.19	545.28	634.70	703.57	703.27	667.52	604.93	529.85	451.27	404.25	393.52	(84)
				1 == 0	1 22.07	,				,,	,		_ ()
7. Mean inter	ernal tempera	ture (heati	ng season)										
					Table 9, Th	1(°C)						21.00	(85)
7. Mean inter					Table 9, Th May	1(°C) Jun	Jul	Aug	Sep	Oct	Nov	21.00 Dec	(85)
Temperature c	during heatin Jan	g periods ir Feb	the living	area from [·] Apr	May		Jul	Aug	Sep	Oct	Nov		(85)
	during heatin Jan	g periods ir Feb	the living	area from [·] Apr	May		Jul 0.55	Aug	Sep 0.86	Oct 0.98	Nov		[(85)] (86)

	emp of livin	g area T1 (s	teps 3 to 7	7 in Table 9	c)								
	19.53	19.68	19.98	20.38	20.73	20.92	20.98	20.97	20.81	20.36	19.87	19.50	(87
Temperature du	ring heatin	g periods in	the rest o	of dwelling f	rom Table 9	϶, Th2(°C)							
	19.80	19.80	19.80	19.81	19.81	19.82	19.82	19.82	19.82	19.81	19.81	19.80	(88
Jtilisation factor	r for gains f	or rest of d	welling n2	,m									
	1.00	0.99	0.98	0.94	0.82	0.60	0.41	0.47	0.79	0.96	0.99	1.00	(89
Mean internal te	emperature	in the rest	of dwellin	g T2 (follow	steps 3 to	7 in Table 9	Эс)						
	17.85	18.08	18.51	19.09	19.55	19.77	19.81	19.81	19.66	19.07	18.36	17.82	(90
iving area fracti	ion								Li	ving area ÷	(4) =	0.42	(9:
Mean internal te	emperature	for the wh	ole dwellir	ng fLA x T1 +	+(1 - fLA) x ⁻	Г2							
	18.55	18.75	19.12	19.63	20.04	20.25	20.30	20.29	20.14	19.60	18.99	18.52	(9:
Apply adjustmer	nt to the me	ean internal	l temperat	ure from Ta	ble 4e whe	re appropr	iate						
	18.55	18.75	19.12	19.63	20.04	20.25	20.30	20.29	20.14	19.60	18.99	18.52	(93
											•		
8. Space heatin	ig requirem												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor	r for gains,	ηm										1	,
	0.99	0.99	0.98	0.93	0.83	0.64	0.47	0.53	0.81	0.96	0.99	1.00	(94
Useful gains, ηm				1								1	1
	412.22	468.65	532.79	592.59	581.71	452.29	311.41	322.74	428.84	433.71	400.42	391.90	(9
Monthly average	e external t	emperature	from Tab	le U1									,
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96
Heat loss rate fo	r mean inte	ernal tempe	rature, Lm	n, W [(39)m	ı x [(93)m -	(96)m]							,
	1250.55	1213.11	1103.38	929.26	721.26	484.95	317.45	333.46	519.66	778.71	1032.08	1247.01	(9
Space heating re	quirement	, kWh/mon	th 0.024 x	((97)m - (9	5)m] x (41)	m							
	623.72	500.28	424.52	242.40	103.82	0.00	0.00	0.00	0.00	256.68	454.79	636.20	
									∑(98	8)15, 10	.12 = 3	3242.41	(98
Space heating re	quirement	kWh/m²/ye	ear							(98)	÷ (4)	50.18	(99
9a. Energy requ	uirements :	- individual	heating sy	stems inclu	ding micro	-CHP							
Space heating													
Fraction of space	e heat from	secondary	/sunnleme	antary syste	m (table 11	,						0.00	(20
Fraction of space		•	• • •	intary syste	III (tabic 11	,				1 - (2	01) =	1.00) (20] (20
Fraction of space		-								1 (2	01)	0.00) (20] (20
·													1 (4)
Eraction of total	cnace heat								(20	12) v [1_ /2(13/1 -		120
	•	from main	system 1						(20)2) x [1- (20		1.00	1
Fraction of total	space heat	from main	system 1						(20	02) x [1- (20 (202) x (2		1.00 0.00	(20
Fraction of total Fraction of total Efficiency of mai	space heat in system 1	from main from main (%)	system 1 system 2	Anr	May	luo	lul	Διισ		(202) x (2	03) =	1.00 0.00 93.50	(20 (20 (20
Fraction of total Efficiency of mai	space heat in system 1 Jan	from main from main (%) Feb	system 1 system 2 Mar	Apr	May	Jun	Jul	Aug	(20 Sep			1.00 0.00	(20
Fraction of total Efficiency of mai	space heat in system 1 Jan uel (main sy	from main from main (%) Feb estem 1), kW	system 1 system 2 Mar Vh/month						Sep	(202) x (2 Oct	03) = Nov	1.00 0.00 93.50 Dec	(20
Fraction of total Efficiency of mai	space heat in system 1 Jan	from main from main (%) Feb	system 1 system 2 Mar	•	May	Jun 0.00	Jul 0.00	Aug 0.00	Sep	(202) x (2 Oct 274.52	Nov 486.41	1.00 0.00 93.50 Dec	(20 (20
Fraction of total Efficiency of mai Space heating fu	space heat in system 1 Jan uel (main sy	from main from main (%) Feb estem 1), kW	system 1 system 2 Mar Vh/month						Sep	(202) x (2 Oct	Nov 486.41	1.00 0.00 93.50 Dec	[] [20] [20]
Fraction of total Efficiency of mai Space heating fu Water heating	space heat in system 1 Jan uel (main sy 667.08	from main from main (%) Feb estem 1), kW	system 1 system 2 Mar Vh/month						Sep	(202) x (2 Oct 274.52	Nov 486.41	1.00 0.00 93.50 Dec] (20] (20
Fraction of total Efficiency of mai Space heating fu Water heating	space heat in system 1 Jan uel (main sy 667.08	r from main from main (%) Feb rstem 1), kW	system 1 system 2 Mar Vh/month 454.04	259.25	111.04	0.00	0.00	0.00	Sep 0.00 Σ(21:	Oct 274.52 1)15, 10	Nov 486.41 .12 = 3	1.00 0.00 93.50 Dec 680.43 3467.81] (2)
Fraction of total Efficiency of mai Space heating fu Water heating Efficiency of wat	space heat in system 1 Jan uel (main sy 667.08 ter heater 88.03	from main from main (%) Feb estem 1), kW 535.06	system 1 system 2 Mar Vh/month						Sep	(202) x (2 Oct 274.52	Nov 486.41	1.00 0.00 93.50 Dec] (20
Fraction of total Efficiency of mai Space heating fu	space heat in system 1 Jan uel (main sy 667.08 ter heater 88.03 uel, kWh/m	from main from main (%) Feb rstem 1), kW 535.06	system 1 system 2 Mar Vh/month 454.04	259.25	84.19	79.80	79.80	79.80	Sep 0.00 Σ(21:	Oct 274.52 1)15, 10	Nov 486.41 .12 = 3	1.00 0.00 93.50 Dec 680.43 3467.81	(20
Fraction of total Efficiency of mai Space heating fu Water heating Efficiency of wat	space heat in system 1 Jan uel (main sy 667.08 ter heater 88.03	from main from main (%) Feb estem 1), kW 535.06	system 1 system 2 Mar Vh/month 454.04	259.25	111.04	0.00	0.00	0.00	Sep 0.00 Σ(21:	Oct 274.52 1)15, 10	Nov 486.41 .12 = 3 87.60	1.00 0.00 93.50 Dec 680.43 3467.81] (2)

Space heating fuel - main system 1		3467.81]
Water heating fuel		1946.19]
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		290.39	(232)
Total delivered energy for all uses	(211)(221) + (231) + (232)(237b) =	5779.39	(238)
10a. Fuel costs - individual heating systems including micro-CHP			

Total electricity for the above, kWh/year					75.00	(231)
Electricity for lighting (Appendix L)					290.39	(232)
Total delivered energy for all uses		(211)	(221) + (231) + (2	232)(237b) =	5779.39	(238)
10a. Fuel costs - individual heating systems including micro-CHP	•					
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3467.81	х	3.48	x 0.01 =	120.68	(240)
Water heating	1946.19	х	3.48	x 0.01 =	67.73	(247)
Pumps and fans	75.00	х	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	290.39	x	13.19	x 0.01 =	38.30	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242) +	(245)(254) =	356.60	(255)
11a. SAP rating - individual heating systems including micro-CH	n.					
					0.42	7 (25.6)
Energy cost deflator (Table 12)				l	0.42	(256)
Energy cost factor (ECF)					1.37	(257)
SAP value					80.94	
SAP rating (section 13)					81	(258)
SAP band					В	
120 CO emissions individual heating systems including micro	AU.					

12a. CO ₂ emissions - individual heating systems including r	micro-CHP					
	Energy kWh/year		Emission factor kg CO₂/kWh		Emissions kg CO₂/year	
Space heating - main system 1	3467.81	x	0.216	=	749.05	(261)
Water heating	1946.19	x	0.216	=	420.38	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	1169.42	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	290.39	x	0.519	=	150.71	(268)
Total CO ₂ , kg/year				(265)(271) =	1359.06	(272)
Dwelling CO₂ emission rate				(272) ÷ (4) =	21.03	(273)
El value					83.39	
El rating (section 14)					83	(274)
El band					В	

	Energy kWh/year		Primary factor		Primary Energy kWh/year	1
Space heating - main system 1	3467.81	x	1.22	=	4230.73	(261
Water heating	1946.19	х	1.22	=	2374.35	(264
Space and water heating			(261) + (262) +	(263) + (264) =	6605.09	(265
Pumps and fans	75.00	х	3.07	=	230.25	(267
Electricity for lighting	290.39	х	3.07	=	891.49	(268
Primary energy kWh/year					7726.83	(272
Dwelling primary energy rate kWh/m2/year					119.57	(273

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	2B4P, Kingston upon Thames, KT1		

1. Overal	ونالمسلم ا	an dima	ncione
T. Overai	ı uwellii	ig uiine	пэюпз

		Area (m²)		Average storey height (m)		Volume (m³)
Lowest occupied		73.74	(1a) x	2.50	(2a) =	184.35 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) =	73.74	(4)			

Dwelling volume	(3a) + ((3b) + (3c) + (3d)(3n) =	184.35	(5)
-----------------	----------	-----------------	-----------	--------	-----

2. Ventilation rate				
			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	3	x 10 =	30	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)
Number of open flues Number of intermittent fans Number of passive vents	0	x 20 = x 10 = x 10 =	0	(6a) (6b) (7a) (7b)

(6a) + (6b) + (7a) + (7b) + (7c) =

Jul

Aug

Sep

Air changes per	
hour	
0.16	(8

5.00

0.41 2

Dec

(17)

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

Apr

May

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

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

Mar

Number of sides on which the dwelling is sheltered

Shelter factor

Infiltration due to chimneys, flues, fans, PSVs

Infiltration rate incorporating shelter factor

Jan

		•
1 - [0.075 x (19)] =	0.85	(20)

Nov

 \div (5) =

Oct

$$(18) \times (20) = 0.35$$
 (2)

Infiltration rate modified for monthly wind speed:

Feb

					,			,	- J				
Monthly average	wind spee	ed from Tab	le U2										
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)	m ÷ 4												
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltrat	ion rate (a	llowing for	shelter and	wind facto	or) (21) x (2	2a)m							
	0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.32	0.35	0.38	0.39	0.41	(22b)

Jun

najastea minitrat	ion rate (ai	iowing ioi	Silcitor and	willa lacte	// (ZI) / (Z.	Zujiii							
	0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.32	0.35	0.38	0.39	0.41	(22b)
Calculate effective	ve air chang	ge rate for t	the applica	ble case:									
If mechanical	ventilation	ı: air chang	e rate thro	ugh system								N/A	(23a)

If balanced w	ith heat red	covery: effic	ciency in %	allowing fo	or in-use fac	ctor from Ta	able 4h					N/A	(23c)
d) natural ve	ntilation or	whole hou	se positive	input venti	lation from	loft							
	0.60	0.60	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.58	(24d)
Effective air cha	nge rate - e	nter (24a) d	or (24b) or	(24c) or (24	ld) in (25)								
	0.60	0.60	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.58	(25)



Element				Gross	Openings		area	U-value	A x U W		alue,	Ахк,	
			a	irea, m²	m²		m²	W/m²K			/m².K	kJ/K	
Window							.42 x	1.33	= 20.44				(2
Door							80 x [1.00	= 1.80				(2
External wall						59	.21 x	0.18	= 10.66				(2
Party wall						15	.83 x [0.00	= 0.00				(3
Total area of exte		_ :				76	.43						_ (3
abric heat loss, '	W/K = ∑(A	× U)								5)(30) + (3		32.90	_] (3
Heat capacity Cm	n = ∑(A x κ)							(28)	.(30) + (32) -	+ (32a)(3	2e) =	N/A	_] (3
Thermal mass pa	rameter (٦	ΓMP) in kJ/n	n²K									250.00	(3
Thermal bridges:		alculated us	ing Appen	dix K								6.52	(3
Total fabric heat	loss									(33) + (3	36) =	39.42	(3
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
entilation heat	loss calcul	ated month	ly 0.33 x (25)m x (5)									_
	36.50	36.27	36.04	34.95	34.74	33.80	33.80	33.62	34.16	34.74	35.16	35.59	(3
Heat transfer coe	efficient, W	V/K (37)m +	(38)m										_
	75.92	75.69	75.45	74.37	74.16	73.22	73.22	73.04	73.58	74.16	74.57	75.01	╛
									Average = 2	(39)112	/12 =	74.37	(3
Heat loss parame	eter (HLP),	W/m ² K (39	9)m ÷ (4)										
	1.03	1.03	1.02	1.01	1.01	0.99	0.99	0.99	1.00	1.01	1.01	1.02	
									Average = 2	(40)112	/12 =	1.01	(4
Number of days i	in month (Table 1a)											
l	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(4
4 Water heatin				30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(4
	ng energy r			30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00		_ `
Assumed occupa	ng energy r	equiremen	t				31.00	31.00	30.00	31.00	30.00	2.33	(4 (4
Assumed occupa	ng energy r ncy, N not water u	requirement	t es per day	Vd,average	= (25 x N) +	36			7			2.33 89.62	_ `
Assumed occupa Annual average h	ng energy r incy, N not water u Jan	requirement usage in litre Feb	t es per day Mar	Vd,average Apr	= (25 x N) + May	36 Jun	Jul	31.00	30.00 Sep	31.00 Oct	30.00 Nov	2.33	(4
Assumed occupa Annual average h	ng energy r incy, N not water u Jan in litres pe	requirement usage in litro Feb er day for ea	es per day Mar ach month	Vd,average Apr Vd,m = fact	= (25 x N) + May tor from Tab	36 Jun le 1c x (43	Jul)	Aug	Sep	Oct	Nov	2.33 89.62 Dec	(4
ssumed occupa Innual average h	ng energy r incy, N not water u Jan	requirement usage in litre Feb	t es per day Mar	Vd,average Apr	= (25 x N) + May	36 Jun	Jul		7	Oct 91.41	Nov 95.00	2.33 89.62 Dec	(4 (4
Assumed occupa Annual average h Hot water usage	ng energy r incy, N not water u Jan in litres pe	requirement usage in litre Feb er day for ea 95.00	es per day Mar ich month 91.41	Vd,average Apr Vd,m = fact 87.83	= (25 x N) + May tor from Table 84.24	36 Jun le 1c x (43 80.66	Jul) 80.66	Aug 84.24	Sep	Oct	Nov 95.00	2.33 89.62 Dec	(4 (4
Assumed occupa Annual average h Hot water usage	ng energy r ency, N not water t Jan in litres pe 98.58	requirementusage in litro Feber day for ea 95.00	es per day Mar ach month 91.41	Vd,average Apr Vd,m = fact 87.83	= (25 x N) +	36 Jun le 1c x (43 80.66 onth (see	Jul) 80.66 Tables 1b	Aug 84.24	Sep 87.83	Oct 91.41 Σ(44)1	Nov 95.00	2.33 89.62 Dec 98.58 1075.42	(4
Assumed occupa Annual average h Hot water usage	ng energy r incy, N not water u Jan in litres pe	requirement usage in litre Feb er day for ea 95.00	es per day Mar ich month 91.41	Vd,average Apr Vd,m = fact 87.83	= (25 x N) + May tor from Table 84.24	36 Jun le 1c x (43 80.66	Jul) 80.66	Aug 84.24	Sep	Oct 91.41 Σ(44)1	Nov 95.00 .12 =	2.33 89.62 Dec 98.58 1075.42	
Assumed occupa Annual average h Hot water usage Energy content o	ng energy rancy, Not water using litres per 98.58 of hot water 146.19	requirementusage in litro Feber day for ea 95.00 er used = 4.1	es per day Mar ach month 91.41	Vd,average Apr Vd,m = fact 87.83	= (25 x N) +	36 Jun le 1c x (43 80.66 onth (see	Jul) 80.66 Tables 1b	Aug 84.24	Sep 87.83	Oct 91.41 Σ(44)1	Nov 95.00 .12 =	2.33 89.62 Dec 98.58 1075.42	(4 (4
Assumed occupa Annual average h Hot water usage Energy content o	ng energy r incy, N not water t Jan in litres pe 98.58 of hot wate 146.19	requirementusage in litre Feb er day for ea 95.00 er used = 4.1 127.86	Mar Mar och month 91.41 .8 x Vd,m x	Vd,average	= (25 x N) + May for from Table 84.24 8600 kWh/m 110.37	36 Jun le 1c x (43 80.66 onth (see	Jul) 80.66 Tables 1b 88.26	Aug 84.24 , 1c 1d) 101.28	Sep 87.83	Oct 91.41 Σ(44)1 119.44 Σ(45)1	Nov 95.00 .12 =	2.33 89.62 Dec 98.58 1075.42	(4
Assumed occupa Annual average h Hot water usage Energy content o	ng energy rancy, Nonet water using litres per 98.58 of hot water 146.19 0.15 x (45 21.93	requirement usage in litre	es per day Mar och month 91.41 8 x Vd,m x 131.94	Vd,average	= (25 x N) + May for from Table 84.24 3600 kWh/m 110.37	36 Jun le 1c x (43 80.66 onth (see 95.24	Jul) 80.66 Tables 1b	Aug 84.24	Sep 87.83	Oct 91.41 Σ(44)1	Nov 95.00 .12 =	2.33 89.62 Dec 98.58 1075.42 141.58 1410.04	
Assumed occupa Annual average h Hot water usage Energy content o Distribution loss Storage volume (ng energy r incy, N not water to Jan in litres per 98.58 of hot water 146.19 0.15 x (45) 21.93 (litres) incli	requirement usage in litre	es per day Mar och month 91.41 8 x Vd,m x 131.94	Vd,average	= (25 x N) + May for from Table 84.24 3600 kWh/m 110.37	36 Jun le 1c x (43 80.66 onth (see 95.24	Jul) 80.66 Tables 1b 88.26	Aug 84.24 , 1c 1d) 101.28	Sep 87.83	Oct 91.41 Σ(44)1 119.44 Σ(45)1	Nov 95.00 .12 =	2.33 89.62 Dec 98.58 1075.42	
Assumed occupa Annual average had to water usage Energy content of the content of	g energy rancy, N not water u Jan in litres pe 98.58 of hot wate 146.19 0.15 x (45 21.93 (litres) incluses:	requirement usage in litre Feb er day for ea 95.00 er used = 4.1 127.86)m 19.18 uding any so	es per day Mar ach month 91.41 8 x Vd,m x 131.94 19.79 blar or WW	Vd,average	= (25 x N) + May for from Table 84.24 3600 kWh/m 110.37 16.56 ge within sam	36 Jun le 1c x (43 80.66 onth (see 95.24	Jul) 80.66 Tables 1b 88.26	Aug 84.24 , 1c 1d) 101.28	Sep 87.83	Oct 91.41 Σ(44)1 119.44 Σ(45)1	Nov 95.00 .12 =	2.33 89.62 Dec 98.58 1075.42 141.58 1410.04 21.24 3.00	
Assumed occupa Annual average h Hot water usage Energy content o Distribution loss Storage volume (Water storage lose) If manufacture	in litres per series (45 and 146.19) 0.15 x (45 and 146.19) 0.15 x (45 and 146.19) 0.15 x (45 and 146.19)	requirement usage in litre Feb er day for ea 95.00 er used = 4.1 127.86)m 19.18 uding any so	es per day Mar ach month 91.41 8 x Vd,m x 131.94 19.79 blar or WW	Vd,average	= (25 x N) + May for from Table 84.24 3600 kWh/m 110.37 16.56 ge within sam	36 Jun le 1c x (43 80.66 onth (see 95.24	Jul) 80.66 Tables 1b 88.26	Aug 84.24 , 1c 1d) 101.28	Sep 87.83	Oct 91.41 Σ(44)1 119.44 Σ(45)1	Nov 95.00 .12 =	2.33 89.62 Dec 98.58 1075.42 141.58 1410.04 21.24 3.00 0.26	
Annual average hannual average hannual average Hot water usage Energy content of Distribution loss Atorage volume (Vater storage lower) If manufacture Temperature	ng energy r incy, N not water to Jan in litres per 98.58 of hot water 146.19 0.15 x (45) 21.93 (litres) incluses:	requirement usage in litre Feb er day for ea 95.00 er used = 4.1 127.86 19.18 uding any so ed loss factor m Table 2b	Mar Mar och month 91.41 .8 x Vd,m x 131.94 19.79 olar or WW	Vd,average	= (25 x N) + May for from Table 84.24 3600 kWh/m 110.37 16.56 ge within sam	36 Jun le 1c x (43 80.66 onth (see 95.24	Jul) 80.66 Tables 1b 88.26	Aug 84.24 , 1c 1d) 101.28	Sep 87.83	Oct 91.41 Σ(44)1 119.44 Σ(45)1	Nov 95.00 .12 =	2.33 89.62 Dec 98.58 1075.42 141.58 1410.04 21.24 3.00 0.26 0.54	
Assumed occupa Annual average h Hot water usage Energy content o Distribution loss Storage volume (Water storage lose) If manufacture	ng energy r incy, N not water to Jan in litres per 98.58 of hot water 146.19 0.15 x (45) 21.93 (litres) incluses:	requirement usage in litre Feb er day for ea 95.00 er used = 4.1 127.86 19.18 uding any so ed loss factor m Table 2b	Mar Mar och month 91.41 .8 x Vd,m x 131.94 19.79 olar or WW	Vd,average	= (25 x N) + May for from Table 84.24 3600 kWh/m 110.37 16.56 ge within sam	36 Jun le 1c x (43 80.66 onth (see 95.24	Jul) 80.66 Tables 1b 88.26	Aug 84.24 , 1c 1d) 101.28	Sep 87.83	Oct 91.41 Σ(44)1 119.44 Σ(45)1	Nov 95.00 .12 =	2.33 89.62 Dec 98.58 1075.42 141.58 1410.04 21.24 3.00 0.26	
Assumed occupa Annual average h Hot water usage Energy content o Distribution loss Storage volume (Water storage lose) If manufacture Energy lost from the content of the	in litres per 98.58 of hot water 146.19 0.15 x (45 21.93 (litres) incluses: er's declared factor from water 19) in (55)	requirement usage in litre Feb er day for ea 95.00 er used = 4.1 127.86 199.18 uding any so ed loss factor m Table 2b storage (kW	es per day Mar ach month 91.41 8 x Vd,m x 131.94 19.79 plar or WW	Vd,average	= (25 x N) + May for from Table 84.24 3600 kWh/m 110.37 16.56 ge within sam	36 Jun le 1c x (43 80.66 onth (see 95.24	Jul) 80.66 Tables 1b 88.26	Aug 84.24 , 1c 1d) 101.28	Sep 87.83	Oct 91.41 Σ(44)1 119.44 Σ(45)1	Nov 95.00 .12 =	2.33 89.62 Dec 98.58 1075.42 141.58 1410.04 21.24 3.00 0.26 0.54	
Assumed occupa Annual average h Hot water usage Energy content o Distribution loss Storage volume (Water storage lose) If manufacture Temperature Energy lost from the content of the con	in litres per 98.58 of hot water 146.19 0.15 x (45 21.93 (litres) incluses: er's declared factor from water 19) in (55)	requirement usage in litre Feb er day for ea 95.00 er used = 4.1 127.86 199.18 uding any so ed loss factor m Table 2b storage (kW	es per day Mar ach month 91.41 8 x Vd,m x 131.94 19.79 plar or WW	Vd,average	= (25 x N) + May for from Table 84.24 3600 kWh/m 110.37 16.56 ge within sam	36 Jun le 1c x (43 80.66 onth (see 95.24	Jul) 80.66 Tables 1b 88.26	Aug 84.24 , 1c 1d) 101.28	Sep 87.83	Oct 91.41 Σ(44)1 119.44 Σ(45)1	Nov 95.00 .12 =	2.33 89.62 Dec 98.58 1075.42 141.58 1410.04 21.24 3.00 0.26 0.54 0.14	
	in litres per 98.58 of hot water 146.19 0.15 x (45 21.93 (litres) incluses: er's declared factor from water 19) in (55)	requirement usage in litre Feb er day for ea 95.00 er used = 4.1 127.86 199.18 uding any so ed loss factor m Table 2b storage (kW	es per day Mar ach month 91.41 8 x Vd,m x 131.94 19.79 plar or WW	Vd,average	= (25 x N) + May for from Table 84.24 3600 kWh/m 110.37 16.56 ge within sam	36 Jun le 1c x (43 80.66 onth (see 95.24	Jul) 80.66 Tables 1b 88.26	Aug 84.24 , 1c 1d) 101.28	Sep 87.83	Oct 91.41 Σ(44)1 119.44 Σ(45)1	Nov 95.00 .12 =	2.33 89.62 Dec 98.58 1075.42 141.58 1410.04 21.24 3.00 0.26 0.54 0.14	
Assumed occupa Annual average h Hot water usage Energy content o Distribution loss Storage volume (Water storage lose) If manufacture Temperature Energy lost from the content of the con	in litres per series declare factor from water series calculate 4.36	requirement usage in litre Feb er day for ea 95.00 er used = 4.1 127.86)m 19.18 uding any so ed loss factor m Table 2b storage (kW) ed for each 3.93	Mar sch month 91.41 18 x Vd,m x 131.94 19.79 plar or WW or is known (h/day) (4) month (5) 4.36	Vd,average	= (25 x N) + May for from Table 84.24 8600 kWh/m 110.37 16.56 ge within sam	36 Jun le 1c x (43 80.66 onth (see 95.24 14.29 ne vessel	Jul) 80.66 Tables 1b 88.26 13.24	Aug 84.24 , 1c 1d) 101.28	Sep 87.83 102.49 15.37	Oct 91.41 Σ(44)1 119.44 Σ(45)1 17.92	Nov 95.00 .12 = 130.37 .12 = 19.56	2.33 89.62 Dec 98.58 1075.42 141.58 1410.04 21.24 3.00 0.26 0.54 0.14 0.14	
Assumed occupa Annual average h Hot water usage Energy content o Distribution loss Storage volume (Water storage lose) If manufacture Energy lost from Enter (50) or (54) Water storage lose Water storage lose Enter (50) or (54)	in litres per series declare factor from water series calculate 4.36	requirement usage in litre Feb er day for ea 95.00 er used = 4.1 127.86)m 19.18 uding any so ed loss factor m Table 2b storage (kW) ed for each 3.93	Mar sch month 91.41 18 x Vd,m x 131.94 19.79 plar or WW or is known (h/day) (4) month (5) 4.36	Vd,average	= (25 x N) + May for from Table 84.24 8600 kWh/m 110.37 16.56 ge within sam	36 Jun le 1c x (43 80.66 onth (see 95.24 14.29 ne vessel	Jul) 80.66 Tables 1b 88.26 13.24	Aug 84.24 , 1c 1d) 101.28	Sep 87.83 102.49 15.37	Oct 91.41 Σ(44)1 119.44 Σ(45)1 17.92	Nov 95.00 .12 = 130.37 .12 = 19.56	2.33 89.62 Dec 98.58 1075.42 141.58 1410.04 21.24 3.00 0.26 0.54 0.14 0.14	

	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 for e	ach month	from Table	3a, 3b or 3	,C									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61
otal heat requi	red for wat	er heating o	calculated f	or each mo	onth 0.85 x	(45)m + (4	6)m + (57)	m + (59)m ·	+ (61)m			!	
	173.81	152.80	159.56	141.76	137.99	121.97	115.87	128.89	129.21	147.05	157.10	169.20	(62
olor DLIM innu			1		1	121.97	113.67	120.03	123.21	147.03	137.10	109.20] (02
olar DHW inpu							T	1					1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63
output from wa	ter heater f		nth (kWh/	month) (62	2)m + (63)m	1							,
	173.81	152.80	159.56	141.76	137.99	121.97	115.87	128.89	129.21	147.05	157.10	169.20	
										∑(64)1	12 = 1	1735.22	(64
leat gains from	water heat	ing (kWh/m	nonth) 0.2!	5 × [0.85 ×	(45)m + (61	L)m] + 0.8 ×	د [(46)m + ا	(57)m + (59)m]				
	70.70	62.47	65.96	59.63	58.79	53.05	51.44	55.77	55.46	61.81	64.73	69.17	(65
						•							-
5. Internal gair	ıs												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
letabolic gains	(Table 5)												
	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	(66
ghting gains (c	alculated in	Appendix	L, equation	L9 or L9a),	also see Ta	able 5						•	
	18.41	16.35	13.30	10.07	7.53	6.35	6.86	8.92	11.98	15.21	17.75	18.92	(67
opliance gains			1		1		1 0.00	1 0.32	11.50	13.21	17.73	10.52] (0,
ppilatice gains						1	154.01	151.07	157.26	100.72	102.10	100.70	1,00
	205.86	208.00	202.62	191.16	176.69	163.09	154.01	151.87	157.26	168.72	183.18	196.78	[68
ooking gains (c													,
	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	(69
ump and fan ga	ains (Table !	5a)											
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70
osses e.g. evap	oration (Tal	ole 5)											
	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	(71
Vater heating g	ains (Table	5)											
	95.03	92.96	88.66	82.82	79.02	73.68	69.14	74.96	77.02	83.07	89.90	92.97	(72
otal internal ga													, ,
	380.30	378.31	365.58	345.04	324.24	304.13	291.02	296.76	307.26	328.00	351.84	369.67	(73
	380.30	378.31	303.38	343.04	324.24	304.13	291.02	230.70	307.20	328.00	331.64	303.07] (/-
6. Solar gains													
			Access 1	factor	Area	Sol	lar flux		g	FF		Gains	
			Table	6d	m²	V	V/m²	•	ific data	specific d		W	
								or 1	able 6b	or Table	6c		_
ast			0.7	7 x	10.90	x 1	L9.64 x	(0.9 x	0.63	0.70	=	65.43	(76
130				7 x	2.22	x 4	16.75 x	(0.9 x	0.63	0.70	=	31.72	(78
			0.7									12.01	(80
outh			0.7		2.30	x 1	19.64 x	(0.9 x	0.63	c 0.70	=	13.81	1 (00
outh /est	atts ∑(74)m	(82)m			2.30	x1	9.64	(0.9 x	0.63	0.70	=	13.81] (00
outh /est			0.7	7 ×									1
outh /est olar gains in wa	110.95	206.94	321.42		2.30	x 1	19.64 ×	453.10	365.99	239.94	136.39	92.56	1
outh /est olar gains in wa	110.95 ernal and so	206.94 plar (73)m +	0.7 321.42 (83)m	7 x 447.06	534.16	542.03	517.91	453.10	365.99	239.94	136.39	92.56	[83
outh /est olar gains in wa	110.95	206.94	321.42	7 ×] (83
outh Vest olar gains in wa otal gains - inte	110.95 ernal and so 491.25	206.94 blar (73)m + 585.25	0.7 321.42 (83)m 687.00	7 x 447.06	534.16	542.03	517.91	453.10	365.99	239.94	136.39	92.56	[83
outh Vest olar gains in wa otal gains - inte	110.95 ernal and so 491.25 nal tempera	206.94 blar (73)m + 585.25 ture (heatin	0.7 321.42 (83)m 687.00	7 x 447.06	534.16 858.40	542.03 846.16	517.91	453.10	365.99	239.94	136.39	92.56] (83] (84
outh Vest olar gains in wa otal gains - inte	110.95 ernal and so 491.25 hal tempera	206.94 olar (73)m + 585.25 ture (heating periods in	0.7 321.42 (83)m 687.00 ng season)	7 x 447.06 792.10	534.16 858.40 Table 9, Th1	542.03 846.16	517.91	453.10 749.85	365.99	239.94	136.39	92.56] (83] (84
outh Vest olar gains in wa otal gains - inte 7. Mean intern emperature du	110.95 ernal and so 491.25 all tempera	206.94 olar (73)m + 585.25 ture (heating periods in Feb	0.7 321.42 (83)m 687.00 ng season) the living a	7 x 447.06 792.10 area from T	534.16 858.40 Table 9, Th1	542.03 846.16	517.91	453.10	365.99	239.94	136.39	92.56] (83] (84] (85
outh /est olar gains in wa otal gains - inte	110.95 ernal and so 491.25 all tempera	206.94 olar (73)m + 585.25 ture (heating periods in Feb	0.7 321.42 (83)m 687.00 ng season) the living a	7 x 447.06 792.10 area from T	534.16 858.40 Table 9, Th1	542.03 846.16	517.91	453.10 749.85	365.99	239.94	136.39	92.56] (83] (84

19.99 20.17 20.44 20.75 20.93 20.99 21.00 21.00 20.96 20.69 20.28 19.96
20.06 20.06 20.08 20.08 20.08 20.09 20.09 20.09 20.09 20.08 20.07 20.07 20.07
Utilisation factor for gains for rest of dwelling n2,m 1.00 0.99 0.96 0.87 0.69 0.47 0.32 0.36 0.63 0.92 0.99 1.00 Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) 18.71 18.97 19.37 19.80 20.02 20.08 20.09 20.09 20.06 19.74 19.15 18.67 Living area fraction Mean internal temperature for the whole dwelling fLA x T1 +{1 - fLA} x T2 19.23 19.46 19.81 20.19 20.39 20.45 20.46 20.46 20.42 20.13 19.61 19.20 Apply adjustment to the mean internal temperature from Table 4e where appropriate 19.23 19.46 19.81 20.19 20.39 20.45 20.46 20.46 20.42 20.13 19.61 19.20 3. Space heating requirement 19.23 19.46 19.81 20.19 20.39 20.45 20.46 20.46 20.42 20.13 19.61 19.20 3. Space heating requirement 19.23 19.46 19.81 20.19 20.39 20.45 20.46 20.46 20.42 20.13 19.61 19.20 3. Space heating requirement 19.23 19.46 19.81 20.19 20.39 20.45 20.46 20.46 20.42 20.13 19.61 19.20 3. Space heating requirement 19.23 19.46 19.81 20.19 20.39 20.45 20.46 20.46 20.42 20.13 19.61 19.20 3. Space heating requirement 19.24 19.25 19.26 19.26 19.26 19.26 19.26 20.45 20.46 20.46 20.42 20.13 19.61 19.20 3. Space heating requirement 19.29 0.99 0.96 0.87 0.71 0.50 0.35 0.39 0.66 0.92 0.99 1.00 Useful gains, ηmGm, W (94)m x (84)m 18.8.43 576.72 657.89 690.53 606.51 423.95 282.07 295.57 445.78 525.00 481.85 460.28 Monthly average external temperature from Table U1 18.30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m] 1133.47 1102.02 1004.03 839.47 644.45 428.48 282.54 296.50 465.37 706.46 932.71 1124.82
1.00 0.99 0.96 0.87 0.69 0.47 0.32 0.36 0.63 0.92 0.99 1.00
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) 18.71
18.71 18.97 19.37 19.80 20.02 20.08 20.09 20.09 20.06 19.74 19.15 18.67
Living area fraction Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2 19.23 19.46 19.81 20.19 20.39 20.45 20.46 20.46 20.46 20.42 20.13 19.61 19.20 Apply adjustment to the mean internal temperature from Table 4e where appropriate 19.23 19.46 19.81 20.19 20.39 20.45 20.46 20.46 20.46 20.42 20.13 19.61 19.20 8. Space heating requirements Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, nm 0.99 0.99 0.96 0.87 0.71 0.50 0.35 0.39 0.66 0.92 0.99 1.00 Useful gains, nmGm, W (94)m x (84)m 488.43 576.72 657.89 690.53 606.51 423.95 282.07 295.57 445.78 525.00 481.85 460.28 Monthly average external temperature from Table U1 4.30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2 19.23
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2 19.23
19.23 19.46 19.81 20.19 20.39 20.45 20.46 20.46 20.42 20.13 19.61 19.20 Apply adjustment to the mean internal temperature from Table 4e where appropriate 19.23 19.46 19.81 20.19 20.39 20.45 20.46 20.46 20.42 20.13 19.61 19.20 8. Space heating requirement Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, ηm 0.99 0.99 0.96 0.87 0.71 0.50 0.35 0.39 0.66 0.92 0.99 1.00 Useful gains, ηmGm, W (94)m x (84)m 488.43 576.72 657.89 690.53 606.51 423.95 282.07 295.57 445.78 525.00 481.85 460.28 Monthly average external temperature from Table U1 4.30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]
Apply adjustment to the mean internal temperature from Table 4e where appropriate 19.23 19.46 19.81 20.19 20.39 20.45 20.46 20.46 20.42 20.13 19.61 19.20 8. Space heating require work Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, ηπ 0.99 0.99 0.96 0.87 0.71 0.50 0.35 0.39 0.66 0.92 0.99 1.00 Useful gains, ηπ Gm, W (94)m x (84)m 488.43 576.72 657.89 690.53 606.51 423.95 282.07 295.57 445.78 525.00 481.85 460.28 Monthly average external temperature from Table U1 4.30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m] 1133.47 1102.02 1004.03 839.47 644.45 428.48 282.54 296.50 465.37 706.46 932.71 1124.82
8. Space heating requirement Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, ηπ 0.99 0.99 0.96 0.87 0.71 0.50 0.35 0.39 0.66 0.92 0.99 1.00 Useful gains, ηπGm, W (94)m x (84)m 488.43 576.72 657.89 690.53 606.51 423.95 282.07 295.57 445.78 525.00 481.85 460.28 Monthly average external temperature from Table U1 4.30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m] 1133.47 1102.02 1004.03 839.47 644.45 428.48 282.54 296.50 465.37 706.46 932.71 1124.82
8. Space heating requirement Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, ηm 0.99 0.99 0.96 0.87 0.71 0.50 0.35 0.39 0.66 0.92 0.99 1.00 Useful gains, ηmGm, W (94)m x (84)m 488.43 576.72 657.89 690.53 606.51 423.95 282.07 295.57 445.78 525.00 481.85 460.28 Monthly average external temperature from Table U1 4.30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m] 1133.47 1102.02 1004.03 839.47 644.45 428.48 282.54 296.50 465.37 706.46 932.71 1124.82
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Utilisation factor for gains, ηm 0.99 0.99 0.96 0.87 0.71 0.50 0.35 0.39 0.66 0.92 0.99 1.00
0.99 0.99 0.96 0.87 0.71 0.50 0.35 0.39 0.66 0.92 0.99 1.00 Useful gains, ηmGm, W (94)m x (84)m 488.43 576.72 657.89 690.53 606.51 423.95 282.07 295.57 445.78 525.00 481.85 460.28 Monthly average external temperature from Table U1 4.30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m] 1133.47 1102.02 1004.03 839.47 644.45 428.48 282.54 296.50 465.37 706.46 932.71 1124.82
Useful gains, ηmGm, W (94)m x (84)m 488.43 576.72 657.89 690.53 606.51 423.95 282.07 295.57 445.78 525.00 481.85 460.28 Monthly average external temperature from Table U1 4.30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m] 1133.47 1102.02 1004.03 839.47 644.45 428.48 282.54 296.50 465.37 706.46 932.71 1124.82
488.43 576.72 657.89 690.53 606.51 423.95 282.07 295.57 445.78 525.00 481.85 460.28 Monthly average external temperature from Table U1 4.30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m] 1133.47 1102.02 1004.03 839.47 644.45 428.48 282.54 296.50 465.37 706.46 932.71 1124.82
Monthly average external temperature from Table U1 4.30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m] 1133.47 1102.02 1004.03 839.47 644.45 428.48 282.54 296.50 465.37 706.46 932.71 1124.82
4.30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m] 1133.47 1102.02 1004.03 839.47 644.45 428.48 282.54 296.50 465.37 706.46 932.71 1124.82
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m] 1133.47 1102.02 1004.03 839.47 644.45 428.48 282.54 296.50 465.37 706.46 932.71 1124.82
1133.47 1102.02 1004.03 839.47 644.45 428.48 282.54 296.50 465.37 706.46 932.71 1124.82
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m
479.91 353.00 257.53 107.23 28.23 0.00 0.00 0.00 0.00 135.01 324.62 494.42
Σ(98)15, 1012 = 2179.95
Space heating requirement kWh/m²/year $(98) \div (4)$ 29.56
9a. Energy requirements - individual heating systems including micro-CHP
Space heating
Fraction of space heat from secondary/supplementary system (table 11) 0.00
Fraction of space heat from main system(s) $1 - (201) = \boxed{1.00}$
Fraction of space heat from main system 2 0.00
Fraction of total space heat from main system 1 $(202) \times [1-(203)] = 1.00$
Fraction of total space heat from main system 2 $(202) \times (203) = 0.00$
Efficiency of main system 1 (%)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Space heating fuel (main system 1), kWh/month
513.27 377.54 275.44 114.69 30.19 0.00 0.00 0.00 144.39 347.19 528.79
Σ(211)15, 1012 = 2331.50
Water heating
Efficiency of water heater
87.38 86.98 86.08 84.08 81.44 79.80 79.80 79.80 84.59 86.71 87.51
Water heating fuel, kWh/month
198.90 175.68 185.35 168.59 169.45 152.84 145.21 161.52 161.92 173.85 181.18 193.35
Σ(219a)112 = 2067.85
Annual totals

			_
Space heating fuel - main system 1		2331.50	
Water heating fuel		2067.85	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		325.11	(232)
Total delivered energy for all uses	(211)(221) + (231) + (232)(237b) = [4799.45	(238)
10a. Fuel costs - individual heating systems including micro-CHP			

Electricity for lighting (Appendix L)					323.11	_ (232)
Total delivered energy for all uses		(21	.1)(221) + (231) +	(232)(237b) =	4799.45	(238)
10a. Fuel costs - individual heating systems inclu	uding micro-CHP					
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2331.50	x	3.48	x 0.01 =	81.14	(240)
Water heating	2067.85	x	3.48	x 0.01 =	71.96	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	325.11	x	13.19	x 0.01 =	42.88	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242) +	- (245)(254) =	325.87	(255)
11a. SAP rating - individual heating systems incl	uding micro-CHP					
Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					1.15	(257)
SAP value					83.92	
SAP rating (section 13)					84	(258)
SAP band					В	

12a. CO₂ emissions - individual heating systems includin	g micro-CHP					
	Energy kWh/year		Emission factor kg CO₂/kWh		Emissions kg CO₂/year	
Space heating - main system 1	2331.50	x	0.216	=	503.60	(261)
Water heating	2067.85	x	0.216	=	446.66	(264)
Space and water heating			(261) + (262) + (263) -	+ (264) =	950.26	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	325.11	x	0.519	=	168.73	(268)
Total CO ₂ , kg/year			(265).	(271) =	1157.91	(272)
Dwelling CO₂ emission rate			(272	2) ÷ (4) =	15.70	(273)
El value					86.93	
El rating (section 14)					87	(274)
El band					В	

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2331.50	x	1.22	=	2844.43	(261
Water heating	2067.85	x	1.22	=	2522.78	(264
Space and water heating			(261) + (262) +	(263) + (264) =	5367.20	(265
Pumps and fans	75.00	x	3.07	=	230.25	(267
Electricity for lighting	325.11	x	3.07	=	998.08	(268
Primary energy kWh/year					6595.53	(272
Dwelling primary energy rate kWh/m2/year					89.44	(273

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	2B3P, Kingston upon Thames, KT1		

Client							L	ast modified	l	30/09	9/2020	
Address	2B3P, Kii	ngston upor	n Thames,	KT1								
1. Overall dwelling dimens	sions											
				А	rea (m²)			erage storey eight (m)		V	olume (m³)	
Lowest occupied					74.00	(1a) x		2.50	(2a) =		185.00	(3a)
Total floor area	(1a)	+ (1b) + (1d	c) + (1d)(1n) =	74.00	(4)						
Dwelling volume							(3a	a) + (3b) + (3	c) + (3d)(3n) =	185.00	(5)
2. Ventilation rate												
										m	n³ per hour	
Number of chimneys								0	x 40 =	=	0	(6a)
Number of open flues								0	x 20 =	=	0	(6b)
Number of intermittent fans	5							3	x 10 =	=	30	(7a)
Number of passive vents								0	x 10 =	=	0	(7b)
Number of flueless gas fires								0	x 40 =	=	0	(7c)
										Air	changes pe	r
Infiltration due to chimneys,	fluor fan	c DSVc		(62)	+ (6b) + (7:	a) + (7b) + (76) -	30	÷ (5) :		0.16	(8)
If a pressurisation test has b			ntended n] . (5) .		0.10	(0)
Air permeability value, q50,								10 (10)			5.00	(17)
If based on air permeability	value, the	n (18) = [(17	7) ÷ 20] + (8	8), otherwis	se (18) = (1	6)					0.41	(18)
Number of sides on which th	ne dwelling	g is sheltere	ed								2	(19)
Shelter factor								1 -	- [0.075 x (1	.9)] =	0.85	(20)
Infiltration rate incorporatin	ıg shelter f	actor							(18) x (20) =	0.35	(21)
Infiltration rate modified for	monthly	wind speed	:									
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spee	d from Tak	ole U2										
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4												
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a
Adjusted infiltration rate (al	lowing for	shelter and	wind fact	or) (21) x (2	2a)m							
0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.32	0.35	0.38	0.39	0.41	(22b
Calculate effective air chang	e rate for	the applical	ble case:									
If an a should sale and that an				_							N1 / A	7 (22-

If mechanical ventilation: air change rate through system												N/A	(23a)
If balanced w	ith heat red	covery: effic	ciency in %	allowing fo	or in-use fac	ctor from Ta	able 4h					N/A	(23c)
d) natural ver	ntilation or	whole hous	se positive	input venti	lation from	loft							
	0.60											0.58	(24d)
Effective air char	nge rate - e	nter (24a) c	or (24b) or ((24c) or (24	ld) in (25)								
	0.60	0.60	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.58	(25)



	and heat lo												
Element			á	Gross area, m²	Openings m ²		area m²	U-value W/m²K	AxUW	•	alue, /m².K	Αxκ, kJ/K	
Vindow						16	.71 x	1.33	= 22.15				(2
oor						1.3	80 x	1.00	= 1.80				(2
xternal wall						34.	.34 x	0.18	= 6.18				(2
arty wall						32	.15 x	0.00	= 0.00				(3
otal area of ext	ernal elem	ents ∑A, m²	2			52	.85			<u> </u>			(3
abric heat loss,	W/K = ∑(A	× U)							(26	5)(30) + (3	32) =	30.13	(3
eat capacity Cr	n = ∑(A x к)							(28)	.(30) + (32) +	+ (32a)(32	2e) =	N/A	(3
hermal mass pa	arameter (T	MP) in kJ/r	n²K									250.00	(3
hermal bridges	: ∑(L x Ѱ) ca	alculated us	sing Apper	ıdix K								6.08	(3
otal fabric heat	loss									(33) + (3	36) =	36.21	(3
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	_
entilation heat	loss calcula	ated month	ly 0.33 x (25)m x (5)									
	36.62	36.38	36.15	35.06	34.85	33.91	33.91	33.73	34.27	34.85	35.27	35.70	(3
eat transfer co	efficient, W	//K (37)m +	+ (38)m										_
	72.83	72.59	72.36	71.27	71.07	70.12	70.12	69.94	70.48	71.07	71.48	71.91	
			•						Average = ∑	(39)112/	12 =	71.27	(3
eat loss param	eter (HLP),	W/m²K (39	9)m ÷ (4)										
	0.98	0.98	0.98	0.96	0.96	0.95	0.95	0.95	0.95	0.96	0.97	0.97	
		•	•	•					Average = ∑	(40)112/	12 =	0.96	 (4
umber of days	in month (Table 1a)											
	21.00												
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(4
4. Water heati		1		30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(4
	ng energy r	1		30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00		
4. Water heati	ng energy r ancy, N	equiremen	t				31.00	31.00	30.00	31.00	30.00	2.34	(4
ssumed occupa	ng energy r ancy, N hot water u	equiremen	t es per day	Vd,average	= (25 x N) +	36						2.34	(4
ssumed occupa	ng energy r ancy, N hot water u Jan	equiremen usage in litro Feb	t es per day Mar	Vd,average Apr	= (25 x N) + May	36 Jun	Jul	31.00 Aug	30.00 Sep	31.00 Oct	30.00	2.34	(4
ssumed occupa	ng energy r ancy, N hot water u Jan	equiremenusage in litro Feb er day for ea	es per day Mar ach month	Vd,average Apr Vd,m = fact	= (25 x N) + May or from Tab	36 Jun le 1c x (43	Jul)	Aug	Sep	Oct	Nov	2.34 89.76 Dec	(4
ssumed occupa	ng energy r ancy, N hot water u Jan	equiremen usage in litro Feb	t es per day Mar	Vd,average Apr	= (25 x N) + May	36 Jun	Jul			Oct 91.55	Nov 95.14	2.34 89.76 Dec	(4 (4
ssumed occupa nnual average ot water usage	ng energy r ancy, N hot water u Jan e in litres pe	equirements usage in litro Feb er day for ea	es per day Mar ach month 91.55	Vd,average Apr Vd,m = fact 87.96	= (25 x N) + May or from Table 84.37	36 Jun le 1c x (43 80.78	Jul) 80.78	Aug 84.37	Sep	Oct	Nov 95.14	2.34 89.76 Dec	(4 (4
ssumed occupa nnual average ot water usage	ng energy r ancy, N hot water u Jan in litres pe 98.73	equiremenusage in litro Feber day for ea 95.14	es per day Mar ach month 91.55	Vd,average Apr Vd,m = fact 87.96	= (25 x N) +	36 Jun le 1c x (43 80.78 onth (see	Jul) 80.78 Tables 1b	Aug 84.37	Sep 87.96	Oct 91.55 Σ(44)1	Nov 95.14 12 =	2.34 89.76 Dec 98.73	(4 (4
ssumed occupa nnual average ot water usage	ng energy r ancy, N hot water u Jan e in litres pe	equirements usage in litro Feb er day for ea	es per day Mar ach month 91.55	Vd,average Apr Vd,m = fact 87.96	= (25 x N) + May or from Table 84.37	36 Jun le 1c x (43 80.78	Jul) 80.78	Aug 84.37	Sep	Oct 91.55 Σ(44)1	Nov 95.14 12 =	2.34 89.76 Dec 98.73 1077.07	(4
ssumed occupa nnual average lot water usage nergy content o	ng energy r ancy, N hot water u Jan in litres pe 98.73 of hot wate	equiremenusage in litro Feber day for ea 95.14 er used = 4.1	es per day Mar ach month 91.55	Vd,average Apr Vd,m = fact 87.96	= (25 x N) +	36 Jun le 1c x (43 80.78 onth (see	Jul) 80.78 Tables 1b	Aug 84.37	Sep 87.96	Oct 91.55 Σ(44)1	Nov 95.14 12 =	2.34 89.76 Dec 98.73	(4
ssumed occupa nnual average ot water usage nergy content o	ng energy r ancy, N hot water u Jan e in litres pe 98.73 of hot wate 146.42	equiremenusage in litro Feb er day for ea 95.14 er used = 4.2 128.06	es per day Mar ach month 91.55 18 x Vd,m x	Vd,average	= (25 x N) + May or from Table 84.37 8600 kWh/m 110.54	36 Jun le 1c x (43 80.78 onth (see	Jul) 80.78 Tables 1b 88.39	Aug 84.37 , 1c 1d) 101.43	Sep 87.96	Oct 91.55 Σ(44)1 119.62 Σ(45)1	Nov 95.14 12 = 130.57 12 =	2.34 89.76 Dec 98.73 1077.07	(4
ssumed occupa nnual average ot water usage nergy content o	ng energy r ancy, N hot water u Jan e in litres pe 98.73 of hot wate 146.42 0.15 x (45 21.96	equiremenusage in litro Feb er day for ea 95.14 er used = 4.3 128.06)m	es per day Mar ach month 91.55 18 x Vd,m : 132.14	Vd,average	= (25 x N) + May or from Tabl 84.37 8600 kWh/m 110.54	36 Jun de 1c x (43 80.78 onth (see 95.39	Jul) 80.78 Tables 1b	Aug 84.37	Sep 87.96	Oct 91.55 Σ(44)1	Nov 95.14 12 =	2.34 89.76 Dec 98.73 1077.07 141.80 1412.21	(4)
nnual average ot water usage nergy content of istribution loss	ng energy r ancy, N hot water u Jan e in litres pe 98.73 of hot wate 146.42 10.15 x (45 21.96 (litres) include	equiremenusage in litro Feb er day for ea 95.14 er used = 4.3 128.06)m	es per day Mar ach month 91.55 18 x Vd,m : 132.14	Vd,average	= (25 x N) + May or from Tabl 84.37 8600 kWh/m 110.54	36 Jun de 1c x (43 80.78 onth (see 95.39	Jul) 80.78 Tables 1b 88.39	Aug 84.37 , 1c 1d) 101.43	Sep 87.96	Oct 91.55 Σ(44)1 119.62 Σ(45)1	Nov 95.14 12 = 130.57 12 =	2.34 89.76 Dec 98.73 1077.07	(4)
nnual average ot water usage nergy content of istribution loss torage volume /ater storage lo	ng energy r ancy, N hot water u Jan e in litres pe 98.73 of hot wate 146.42 0.15 x (45 21.96 (litres) incluses:	equirement usage in litro Feb er day for early 95.14 er used = 4.3 128.06 er used = 128.06	es per day Mar ech month 91.55 18 x Vd,m : 132.14 19.82 olar or WV	Vd,average Apr Vd,m = fact 87.96 x nm x Tm/3 115.21 17.28 VHRS storage	= (25 x N) + May for from Table 84.37 8600 kWh/m 110.54 16.58 1e within sam	36 Jun de 1c x (43 80.78 onth (see 95.39	Jul) 80.78 Tables 1b 88.39	Aug 84.37 , 1c 1d) 101.43	Sep 87.96	Oct 91.55 Σ(44)1 119.62 Σ(45)1	Nov 95.14 12 = 130.57 12 =	2.34 89.76 Dec 98.73 1077.07 1412.21 21.27 3.00	(4)
nnual average ot water usage nergy content of corage volume /ater storage lo	ng energy r ancy, N hot water u Jan e in litres pe 98.73 of hot wate 146.42 0.15 x (45 21.96 (litres) incluses: er's declare	equiremenusage in litro Feb er day for ea 95.14 er used = 4.2 128.06)m 19.21 uding any seed loss factor	es per day Mar ech month 91.55 18 x Vd,m : 132.14 19.82 olar or WV	Vd,average Apr Vd,m = fact 87.96 x nm x Tm/3 115.21 17.28 VHRS storage	= (25 x N) + May for from Table 84.37 8600 kWh/m 110.54 16.58 1e within sam	36 Jun de 1c x (43 80.78 onth (see 95.39	Jul) 80.78 Tables 1b 88.39	Aug 84.37 , 1c 1d) 101.43	Sep 87.96	Oct 91.55 Σ(44)1 119.62 Σ(45)1	Nov 95.14 12 = 130.57 12 =	2.34 89.76 Dec 98.73 1077.07 141.80 1412.21 21.27 3.00 0.26	(4) (4) (4) (4) (4)
nnual average ot water usage nergy content of istribution loss torage volume Vater storage lo) If manufactur Temperature	ng energy r ancy, N hot water u Jan e in litres pe 98.73 of hot wate 146.42 10.15 x (45 21.96 (litres) incluses: er's declare	equirement usage in litro Feb er day for ea 95.14 er used = 4.3 128.06 er used loss factor Table 2b	es per day Mar ach month 91.55 18 x Vd,m x 132.14 19.82 olar or WV	Vd,average Apr Vd,m = fact 87.96 x nm x Tm/3 115.21 17.28 VHRS storag	= (25 x N) + May for from Table 84.37 8600 kWh/m 110.54 16.58 1e within sam	36 Jun de 1c x (43 80.78 onth (see 95.39	Jul) 80.78 Tables 1b 88.39	Aug 84.37 , 1c 1d) 101.43	Sep 87.96	Oct 91.55 Σ(44)1 119.62 Σ(45)1	Nov 95.14 12 = 130.57 12 =	2.34 89.76 Dec 98.73 1077.07 141.80 1412.21 21.27 3.00 0.26 0.54	(4 (4 (4 (4 (4 (4 (4
ssumed occupa nnual average lot water usage nergy content of sistribution loss torage volume Vater storage lo) If manufactur Temperature Energy lost fr	ng energy r ancy, N hot water u Jan e in litres pe 98.73 of hot wate 146.42 c 0.15 x (45 21.96 (litres) incluses: er's declared affector from water se	equirement usage in litro Feb er day for ea 95.14 er used = 4.3 128.06 er used loss factor Table 2b	es per day Mar ach month 91.55 18 x Vd,m x 132.14 19.82 olar or WV	Vd,average Apr Vd,m = fact 87.96 x nm x Tm/3 115.21 17.28 VHRS storag	= (25 x N) + May for from Table 84.37 8600 kWh/m 110.54 16.58 1e within sam	36 Jun de 1c x (43 80.78 onth (see 95.39	Jul) 80.78 Tables 1b 88.39	Aug 84.37 , 1c 1d) 101.43	Sep 87.96	Oct 91.55 Σ(44)1 119.62 Σ(45)1	Nov 95.14 12 = 130.57 12 =	2.34 89.76 Dec 98.73 1077.07 141.80 1412.21 21.27 3.00 0.26 0.54 0.14	(4 (4 (4 (4 (4 (4 (5
innual average Innual average Iot water usage Inergy content of Distribution loss torage volume Vater storage lo I f manufactur Temperature Energy lost finter (50) or (54	ng energy r ancy, N hot water u Jan e in litres pe 98.73 of hot wate 146.42 10.15 x (45 21.96 (litres) incluses: er's declare efactor from water s u) in (55)	equirement usage in litro Feb er day for ea 95.14 er used = 4.3 128.06 er used loss factor Table 2b storage (kW	es per day Mar ach month 91.55 18 x Vd,m x 132.14 19.82 olar or WV or is known	Vd,average	= (25 x N) + May for from Table 84.37 8600 kWh/m 110.54 16.58 1e within sam	36 Jun de 1c x (43 80.78 onth (see 95.39	Jul) 80.78 Tables 1b 88.39	Aug 84.37 , 1c 1d) 101.43	Sep 87.96	Oct 91.55 Σ(44)1 119.62 Σ(45)1	Nov 95.14 12 = 130.57 12 =	2.34 89.76 Dec 98.73 1077.07 141.80 1412.21 21.27 3.00 0.26 0.54	(4 (4 (4 (4 (4 (4 (5
innual average Innual average Into water usage Intergy content of Distribution loss torage volume Vater storage lo) If manufacture Temperature	ng energy r ancy, N hot water to Jan e in litres per 98.73 of hot water 146.42 c 0.15 x (45 21.96 (litres) incluses: er's declared affector from water sell in (55) poss calculate	equiremenusage in litro Feb er day for ea 95.14 r used = 4.2 128.06)m 19.21 uding any so ed loss factor m Table 2b storage (kW) ed for each	es per day Mar ach month 91.55 18 x Vd,m x 132.14 19.82 olar or WV or is known /h/day) (4	Vd,average	= (25 x N) + May for from Table 84.37 8600 kWh/m 110.54 16.58 The within same and the same are also as a same are a same are also as a same are a sa	36 Jun de 1c x (43 80.78 onth (see 95.39 14.31 ne vessel	Jul) 80.78 Tables 1b 88.39	Aug 84.37 , 1c 1d) 101.43	Sep 87.96 102.64	Oct 91.55 Σ(44)1 119.62 Σ(45)1 17.94	Nov 95.14 12 = 130.57 12 = 19.59	2.34 89.76 Dec 98.73 1077.07 141.80 1412.21 21.27 3.00 0.26 0.54 0.14 0.14	(4 (4 (4 (4 (4 (4 (5) (5
ssumed occupa nnual average lot water usage nergy content of sistribution loss torage volume Vater storage lo) If manufactur Temperature Energy lost fi nter (50) or (54	ng energy r ancy, N hot water u Jan e in litres per 98.73 of hot wate 146.42 10.15 x (45) 21.96 (litres) includes: e factor from water s e factor from w	r used = 4.2 128.06 199.14 199.11	es per day Mar ach month 91.55 18 x Vd,m x 132.14 19.82 olar or WV or is known /h/day) (4 month (5 4.36	Vd,average	= (25 x N) + May for from Table 84.37 8600 kWh/m 110.54 16.58 fe within same 4.36	36 Jun le 1c x (43 80.78 onth (see 95.39 14.31 ne vessel	Jul) 80.78 Tables 1b 88.39 13.26	Aug 84.37 , 1c 1d) 101.43	Sep 87.96	Oct 91.55 Σ(44)1 119.62 Σ(45)1	Nov 95.14 12 = 130.57 12 =	2.34 89.76 Dec 98.73 1077.07 141.80 1412.21 21.27 3.00 0.26 0.54 0.14	(4 (4 (4 (4 (4 (4 (5) (5
ssumed occupa nnual average lot water usage nergy content of sistribution loss torage volume Vater storage lo) If manufactur Temperature Energy lost fi nter (50) or (54	ng energy r ancy, N hot water to Jan e in litres per 98.73 of hot water 146.42 c 0.15 x (45 21.96 (litres) incluses: er's declared affector from water services and the company of the c	r used = 4.2 128.06 199.14 199.11	es per day Mar ach month 91.55 18 x Vd,m x 132.14 19.82 olar or WV or is known /h/day) (4 month (5 4.36	Vd,average	= (25 x N) + May for from Table 84.37 8600 kWh/m 110.54 16.58 fe within same 4.36	36 Jun le 1c x (43 80.78 onth (see 95.39 14.31 ne vessel	Jul) 80.78 Tables 1b 88.39 13.26	Aug 84.37 , 1c 1d) 101.43	Sep 87.96 102.64	Oct 91.55 Σ(44)1 119.62 Σ(45)1 17.94	Nov 95.14 12 = 130.57 12 = 19.59	2.34 89.76 Dec 98.73 1077.07 141.80 1412.21 21.27 3.00 0.26 0.54 0.14 0.14	(4 (4 (4 (5 (5 (5 (5 (5 (5 (5 (5 (5 (5 (5 (5 (5
ssumed occupa nnual average lot water usage nergy content of sistribution loss torage volume Vater storage lo) If manufactur Temperature Energy lost fi nter (50) or (54	ng energy r ancy, N hot water u Jan e in litres per 98.73 of hot wate 146.42 10.15 x (45) 21.96 (litres) includes: e factor from water s e factor from w	r used = 4.2 128.06 199.14 199.11	es per day Mar ach month 91.55 18 x Vd,m x 132.14 19.82 olar or WV or is known /h/day) (4 month (5 4.36	Vd,average	= (25 x N) + May for from Table 84.37 8600 kWh/m 110.54 16.58 fe within same 4.36	36 Jun le 1c x (43 80.78 onth (see 95.39 14.31 ne vessel	Jul) 80.78 Tables 1b 88.39 13.26	Aug 84.37 , 1c 1d) 101.43	Sep 87.96 102.64	Oct 91.55 Σ(44)1 119.62 Σ(45)1 17.94	Nov 95.14 12 = 130.57 12 = 19.59	2.34 89.76 Dec 98.73 1077.07 141.80 1412.21 21.27 3.00 0.26 0.54 0.14 0.14	(4 (4 (4 (4 (5 (5 (5 (5 (5 (5 (5 (5 (5 (5 (5 (5 (5

								1			1	_	_
	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)
ombi loss for		_		_	T		T	1	1	1			٦,,,
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61
otal heat requ		_					1			1	1	Г	_
	174.03	153.00	159.76	141.93	138.16	122.12	116.01	129.05	129.37	147.24	157.30	169.41	(62
olar DHW inp	ut calculated	l using Appe	endix G or <i>i</i>	Appendix H	·							_	_
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63
Output from w	ater heater	for each mo	nth (kWh/	month) (62	2)m + (63)n 	n							_
	174.03	153.00	159.76	141.93	138.16	122.12	116.01	129.05	129.37	147.24	157.30	169.41	
										∑(64)1	.12 =	1737.39	(64
leat gains fror	m water heat	ting (kWh/m	nonth) 0.2	5 × [0.85 ×	(45)m + (61	1)m] + 0.8	× [(46)m + ([57)m + (59	9)m]				_
	70.78	62.53	66.03	59.69	58.85	53.10	51.48	55.82	55.51	61.87	64.80	69.24	(65
5. Internal ga	ins												
Ba	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1etabolic gain				•	•								
retare ne gam	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66
ghting gains (1		1	1	110.50	110.50	110.50	110.50	110.50	110.50	(00
Puring Pania (18.40	16.34	13.29	10.06	7.52	6.35	6.86	8.92	11.97	15.20	17.74	18.91	(67
ppliance gain						1		0.32	11.57	15.20	17.74	10.91	(07
ррпансс ван	206.45	208.59	203.19	191.70	177.19	163.56	154.45	152.30	157.70	169.20	183.70	197.34	(68
ooking gains (1				154.45	132.30	137.70	103.20	183.70	137.34	(00
OOKIIIG GUIIIS (34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	(69
ump and fan			34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	(03
amp and ran ;	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70
osses e.g. eva			3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(/0
03363 6.8. 644	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	7 (71
Vater heating			33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	33.37	(/ -
	95.13	93.06	88.75	82.90	79.10	73.75	69.20	75.03	77.10	83.16	90.00	93.07	(72
otal internal g							05.20	73.03	77.10	03.10	30.00	33.07	(/ _
otal internal g	381.07	379.08	366.32	345.75	324.90	304.74	291.60	297.34	307.86	328.64	352.53	370.41	(73
	301.07	373.00	300.32	343.73	324.30	304.74	231.00	257.54	307.00	320.04	332.33	370.41	(/3
6. Solar gains	:												
			Access		Area		olar flux		g	FF	_	Gains	
			Table	± 6d	m²	'	W/m²	-	cific data Table 6b	specific o		W	
lovth			0.7	77	F 67	7, —	10.62				=	10.42	(74
lorth					5.67	= =				x 0.70		18.43	╡`
lorthEast			0.7		2.98					x 0.70	= [10.28	(75 □ (86
Vest olar gains in v	watte 5/74\~	n (82)m	0.7	77 x L	8.06	x	19.64 x	0.9 x	0.63	x 0.70	=	48.38	(80
oiai gailis III V	77.08	150.77	253.38	385.31	491.24	512.46	483.86	402.02	299.13	179.77	95.98	63.54	(83
otal gains - in				303.31	431.24	J12.40	403.80	402.02	233.13	1/3.//	35.98	03.54	(83
otai gairis - III	458.15	529.85	619.70	731.06	816.13	817.20	775.46	699.36	606.99	508.42	448.51	433.94	(84
	430.13	723.83	015.70	/31.00	010.13	017.20	1/3.40	סכ.ככט ן	1 000.33	JU0.42	440.31	433.34	(64
7. Mean inter	rnal tempera	iture (heatii	ng season)										
emperature d	during heatin	g periods in	the living	area from 7	Table 9, Th:	1(°C)						21.00	(85
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	-
	Jan												
Jtilisation fact				e Table 9a))								
Jtilisation fact				ee Table 9a)	0.75	0.54	0.40	0.46	0.75	0.96	0.99	1.00	(86

Mean internal	temp of livin	ig area T1 (s	steps 3 to 7	in Table 9c	:)								
	20.01	20.16	20.42	20.74	20.94	20.99	21.00	21.00	20.96	20.67	20.28	19.98	(87)
Temperature d		g periods in	the rest of	dwelling fr	om Table 9	9, Th2(°C)		!	!	•	!		_ ` '
	20.10	20.10	20.10	20.11	20.12	20.13	20.13	20.13	20.12	20.12	20.11	20.11	(88)
Utilisation fact			I.		-				-	-	_		_ (/
	1.00	0.99	0.97	0.89	0.70	0.47	0.32	0.37	0.67	0.94	0.99	1.00	(89)
Mean internal								1 0.07	0.07	1 0.5 .	0.55	1.00] (00)
	18.77	18.99	19.37	19.83	20.06	20.12	20.13	20.13	20.09	19.74	19.18	18.74	(90)
Living area frac		10.55	20.07	23.00					1	ving area ÷		0.48	(91)
Mean internal		for the wh	ole dwellin	g fl A x T1 +	·(1 - fl A) x ī	Т2				ing area :	(.,	0.10] (31)
	19.37	19.56	19.88	20.27	20.48	20.54	20.55	20.55	20.51	20.19	19.71	19.34	(92)
Apply adjustme		1						20.33	20.31	20.23	13.71	13.31] (32)
, ,pp.,, aajaa	19.37	19.56	19.88	20.27	20.48	20.54	20.55	20.55	20.51	20.19	19.71	19.34	(93)
	15.57	15.50	13.00	20.27	20.40	20.54	20.55	20.55	20.51	20.13	15.71	13.54] (33)
8. Space heat	ing requiren	nent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation fact	or for gains,	ηm											
	1.00	0.99	0.97	0.89	0.72	0.51	0.36	0.41	0.71	0.95	0.99	1.00	(94)
Useful gains, η	mGm, W (94	4)m x (84)m											
	456.31	524.87	601.52	652.99	587.50	412.81	276.47	289.24	428.16	481.28	444.53	432.64	(95)
Monthly avera	ge external t	emperature	e from Tabl	e U1									
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate f	for mean into	ernal tempe	erature, Lm	, W [(39)m	x [(93)m -	(96)m]							
	1097.28	1063.94	968.05	810.37	624.23	416.73	276.89	290.19	451.72	681.55	901.51	1088.88	(97)
Space heating	requirement	, kWh/mon	th 0.024 x	[(97)m - (95	5)m] x (41)	m							
	476.88	362.25	272.69	113.31	27.33	0.00	0.00	0.00	0.00	149.00	329.03	488.24	
									∑(9	8)15, 10	.12 = 🗀	2218.74	(98)
Space heating	requirement	kWh/m²/y	ear							(98)	÷ (4)	29.98	(99)
On Employers		ا مرانينا ما	hooting ou	otomo inclu	dina misus	CLID							
9a. Energy re	quirements ·	- individual	neating sys	stems inclu	aing micro	-СПР							
Space heating			, ,		/: II 44	,						0.00	7 (204)
Fraction of spa		•	• • •	ntary syster	m (table 11	-)				4 (2)	24)	0.00	(201)
Fraction of spa		-								1 - (20	01) = [1.00	(202)
Fraction of spa									101	20) [4 (00		0.00	(202)
Fraction of tota	•								(20)2) x [1- (20		1.00	(204)
Fraction of tota			system 2							(202) x (20	03) = [0.00	(205)
Efficiency of m	-					_		_				93.50	(206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating						1	1	1	1		1	1	7
	510.03	387.44	291.65	121.19	29.23	0.00	0.00	0.00	0.00	159.36	351.90	522.19]
									∑(21	1)15, 10	.12 =	2372.99	(211)
Water heating													
Efficiency of w		1 .				1	T		I		l	1 -	٦,,,
M-4 ! ··	87.37	87.03	86.23	84.22	81.39	79.80	79.80	79.80	79.80	84.85	86.74	87.48	(217)
Water heating			T	l		1	1 .	1	1	T	l	1	٦
	199.20	175.79	185.28	168.52	169.75	153.03	145.38	161.72	162.12	173.54	181.35	193.66]
										∑(219a)1	.12 =	2069.33	(219)
Annual totals													

			_
Space heating fuel - main system 1		2372.99	
Water heating fuel		2069.33]
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		324.98	(232)
Total delivered energy for all uses	(211)(221) + (231) + (232)(237b) =	4842.30	(238)
10a. Fuel costs - individual heating systems including micro-CHP			

Electricity for lighting (Appendix L)					324.98	(232)
Total delivered energy for all uses		(21:	1)(221) + (231) + ((232)(237b) =	4842.30	(238)
10a. Fuel costs - individual heating systems including micr	ro-CHP		<u> </u>			
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2372.99	x	3.48	x 0.01 =	82.58	(240)
Water heating	2069.33	х	3.48	x 0.01 =	72.01	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	324.98	x	13.19	x 0.01 =	42.86	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242) +	- (245)(254) =	327.35	(255)
11a. SAP rating - individual heating systems including mic	ro-CHP					
Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					1.16	(257)
SAP value					83.88	
SAP rating (section 13)					84	(258)
SAP band					В	

12a. CO ₂ emissions - individual heating systems includ	ing micro-CHP					
	Energy kWh/year		Emission factor kg CO₂/kWh		Emissions kg CO₂/year	
Space heating - main system 1	2372.99	×	0.216	=	512.57	(261)
Water heating	2069.33	x	0.216	=	446.98	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	959.54	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	324.98	x	0.519	=	168.66	(268)
Total CO ₂ , kg/year				(265)(271) =	1167.13	(272)
Dwelling CO₂ emission rate				(272) ÷ (4) =	15.77	(273)
El value					86.86	
El rating (section 14)					87	(274)
El band					В	

	Energy kWh/year		Primary factor		Primary Energy kWh/year	r
Space heating - main system 1	2372.99	x	1.22	=	2895.04	(261
Water heating	2069.33	х	1.22	=	2524.58	(264
Space and water heating			(261) + (262) +	(263) + (264) =	5419.63	(265
Pumps and fans	75.00	х	3.07	=	230.25	(267
Electricity for lighting	324.98	х	3.07	=	997.69	(268
Primary energy kWh/year					6647.56	(272
Dwelling primary energy rate kWh/m2/year					89.83	(273

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	3B4P, Kingston upon Thames, KT1		

Client							La	st modified		30/09	/2020	
Address	3B4P, Ki	ngston upor	Thames, k	(T1								
1. Overall dwelling dime	ensions			_	4 2)		_				. , 2)	
				А	rea (m²)			rage storey eight (m)		Vo	lume (m³)	
Lowest occupied					72.42] (1a) x		2.50] (2a) =		181.05	(3a)
Total floor area	(1a)) + (1b) + (1d	c) + (1d)(1	Ln) =	72.42	(4)						
Dwelling volume							(3a)) + (3b) + (3	c) + (3d)(3	3n) =	181.05	(5)
2. Ventilation rate												
										m	³ per hour	
Number of chimneys								0	x 40 =	=	0	(6a)
Number of open flues								0	x 20 =	=	0	(6b)
Number of intermittent fa	ans							3	x 10 =	=	30	(7a)
Number of passive vents								0	x 10 =	=	0	(7b)
Number of flueless gas fir	es							0	x 40 =	=	0	(7c)
										Air	changes pe hour	r
Infiltration due to chimne	ys, flues, fan	s, PSVs		(6a)	+ (6b) + (7a	a) + (7b) + (7c) =	30	÷ (5) =	=	0.17	(8)
If a pressurisation test ha	s been carrie	d out or is in	ntended, pr	oceed to (17), otherw	ise continu	e from (9) t	to (16)				
Air permeability value, q5	60, expressed	l in cubic me	etres per ho	our per squ	are metre	of envelope	e area				5.00	(17)
If based on air permeabili	ty value, the	n (18) = [(17	') ÷ 20] + (8), otherwi	se (18) = (16	5)					0.42	(18)
Number of sides on which	n the dwellin	g is sheltere	d								2	(19)
Shelter factor								1 -	[0.075 x (1	9)] =	0.85	(20)
Infiltration rate incorpora	ting shelter f	factor							(18) x (20) =	0.35	(21)
Infiltration rate modified	for monthly	wind speed:	:									
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind sp	eed from Tal	ole U2										
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4												
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate	(allowing for	shelter and	wind facto	or) (21) x (2	!2a)m							_
0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	0.40	0.42	(22b)

	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13
Adjusted infiltrat	tion rate (al	lowing for	shelter and	wind facto	r) (21) x (2	2a)m					
	0.45	0.44	0.43	0.39	0.38	0.34	0.34	0.33	0.35	0.38	0.40
						-					

0.57

Calculate effective air change rate for the applicable cas	e:
--	----

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

0.60

i mediamedi vermationi un enange rate timoagn system
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h

0.59

0.58

If mechanical	chanical ventilation: air change rate through system										N/A	(23a)	
If balanced w	ith heat red	covery: effic	ciency in %	allowing fo	r in-use fac	tor from Ta	able 4h					N/A	(23c)
d) natural ver	ntilation or	whole hous	se positive	input venti	ation from	loft							
	0.60	0.60	0.59	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

BSI	مشہ

0.60

0.59 (25)

0.58

0.56

0.56

0.55

0.56

0.57

Element				Gross	Openings	Not	araa	II valua	A v 11 \A	/K κ-value.	Λνν	
				Gross area, m²	openings m²	A,	area m²	U-value W/m²K	AxUW	/K K-value, kJ/m².K	Ахк, kJ/K	
Window						15	.02 x	1.33	= 19.91			(27)
Door						1.3	80 x	1.00	= 1.80			(26)
External wall						40	.46 x	0.18	= 7.28			(29
Party wall						32	.93 x	0.00	= 0.00			(32)
Roof						72	.42 x	0.13	= 9.41			(30
Total area of ext	ernal elem	ents ∑A, m²				129	0.70					(31
abric heat loss,	W/K = ∑(A	× U)							(26	5)(30) + (32) =	38.41	(33
Heat capacity Cn	n = ∑(A x к)							(28)	.(30) + (32)	+ (32a)(32e) =	N/A	(34
Thermal mass pa	arameter (T	IMP) in kJ/n	n²K								250.00	(35
Thermal bridges	: ∑(L x Ѱ) ca	alculated us	sing Appe	ndix K							16.00	(36
Гotal fabric heat	loss									(33) + (36) =	54.41	_ (37
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct Nov	Dec	
Ventilation heat	loss calcula	ated month	ly 0.33 x	(25)m x (5)	·				•			
	35.94	35.70	35.47	34.39	34.18	33.24	33.24	33.06	33.60	34.18 34.59	35.02	(38
Heat transfer co		!										
	90.35	90.12	89.89	88.80	88.60	87.65	87.65	87.48	88.02	88.60 89.01	89.44	1
	30.00				00.00		07.00	1 071.0		(39)112/12 =	88.80	_ (39
Heat loss param	eter (HIP)	W/m²K (39	a)m ÷ (4)						Average – Z	(33)112/12 -	00.00	(33
icat 1033 param	1.25	1.24	1.24	1.23	1.22	1.21	1.21	1.21	1.22	1.22 1.23	1.23	٦
	1.23	1.24	1.24	1.25	1.22	1.21	1.21			(40)112/12 = \(\big \)	1.23	_ ☐ (40
Number of days	in month /	Table 1a\							Average – Z	(40)112/12 -	1.25	(40
Number of days			24.00	T 20.00		20.00	24.00	24.00	1 20.00	24.00	24.00	٦,,,,
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00 30.00	31.00	(40
4. Water heatir	ng energy r	equiremen	t									
Assumed occupa	ancy, N										2.30	(42
Annual average l	hot water u	usage in litre	es per day	Vd,average	= (25 x N) +	36					88.91	(43
_	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct Nov	Dec	
				_				_			DCC	
Hot water usage	in litres pe	r day for ea	ich month	Vd,m = fact		le 1c x (43)				Dec	
Hot water usage		· · · · · · · · · · · · · · · · · · ·	1		tor from Tabl			83.57				7
Hot water usage	97.80	er day for ea	90.68	87.13		le 1c x (43 80.02	80.02	83.57	87.13	90.68 94.24	97.80]] (44
_	97.80	94.24	90.68	87.13	tor from Tabl	80.02	80.02	1				(44
_	97.80	94.24 er used = 4.1	90.68 18 x Vd,m	87.13 x nm x Tm/3	83.57 8600 kWh/m	80.02 onth (see	80.02 Tables 1b	, 1c 1d)	87.13	90.68 94.24 Σ(44)112 =	1066.87]] (44
_	97.80	94.24	90.68	87.13	tor from Tabl	80.02	80.02	1		90.68 94.24 Σ(44)112 = 118.49 129.3	97.80 1066.87 4 140.45	
Energy content o	97.80 of hot wate	94.24 er used = 4.1 126.84	90.68 18 x Vd,m	87.13 x nm x Tm/3	83.57 8600 kWh/m	80.02 onth (see	80.02 Tables 1b	, 1c 1d)	87.13	90.68 94.24 Σ(44)112 =	1066.87] (44] (45
Energy content o	97.80 of hot wate 145.03	94.24 er used = 4.1 126.84	90.68 18 x Vd,m 130.89	87.13 x nm x Tm/3 114.11	83.57 8600 kWh/ma	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	87.13	90.68 94.24 $\Sigma(44)112 = \square$ 118.49 129.3 $\Sigma(45)112 = \square$	97.80 1066.87 4 140.45 1398.84	
Energy content of the	97.80 of hot wate 145.03 0.15 x (45) 21.75	94.24 er used = 4.1 126.84)m	90.68 18 x Vd,m 130.89	87.13 x nm x Tm/3 114.11	83.57 8600 kWh/me 109.50	80.02 onth (see 94.49	80.02 Tables 1b	, 1c 1d)	87.13	90.68 94.24 Σ(44)112 = 118.49 129.3	97.80 1066.87 4 140.45 1398.84	(45
Energy content of Distribution loss	97.80 of hot wate 145.03 0.15 x (45) 21.75 (litres) include	94.24 er used = 4.1 126.84)m	90.68 18 x Vd,m 130.89	87.13 x nm x Tm/3 114.11	83.57 8600 kWh/me 109.50	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	87.13	90.68 94.24 $\Sigma(44)112 = \square$ 118.49 129.3 $\Sigma(45)112 = \square$	97.80 1066.87 4 140.45 1398.84	(45
Energy content of Distribution loss Storage volume Water storage lo	97.80 of hot wate 145.03 0.15 x (45) 21.75 (litres) incluses:	94.24 er used = 4.1 126.84)m 19.03 uding any so	90.68 18 x Vd,m 130.89 19.63 olar or WV	87.13 x nm x Tm/3 114.11 17.12 WHRS storage	83.57 8600 kWh/me 109.50 16.42 ge within sam	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	87.13	90.68 94.24 $\Sigma(44)112 = \square$ 118.49 129.3 $\Sigma(45)112 = \square$	97.80 1066.87 4 140.45 1398.84 0 21.07 3.00	(45) (46) (47)
Energy content of Distribution loss Storage volume (Vater storage lo	97.80 of hot wate 145.03 0.15 x (45) 21.75 (litres) incluses: er's declare	94.24 er used = 4.1 126.84)m 19.03 uding any so	90.68 18 x Vd,m 130.89 19.63 olar or WV	87.13 x nm x Tm/3 114.11 17.12 WHRS storage	83.57 8600 kWh/me 109.50 16.42 ge within sam	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	87.13	90.68 94.24 $\Sigma(44)112 = \square$ 118.49 129.3 $\Sigma(45)112 = \square$	97.80 1066.87 4	(45) (46) (47)
Energy content of Distribution loss Storage volume (Nater storage loss) If manufacture Temperature	97.80 of hot wate 145.03 0.15 x (45) 21.75 (litres) incluses: er's declared factor from	94.24 er used = 4.1 126.84)m 19.03 uding any so	90.68 18 x Vd,m 130.89 19.63 polar or WV	87.13 x nm x Tm/3 114.11 17.12 WHRS storag n (kWh/day)	83.57 8600 kWh/me 109.50 16.42 ge within sam	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	87.13	90.68 94.24 $\Sigma(44)112 = \square$ 118.49 129.3 $\Sigma(45)112 = \square$	97.80 1066.87 4	(45) (46) (47) (48) (49)
Energy content of Distribution loss Storage volume (Nater storage loss) If manufacture	97.80 of hot wate 145.03 0.15 x (45) 21.75 (litres) incluses: er's declared factor from	94.24 er used = 4.1 126.84)m 19.03 uding any so	90.68 18 x Vd,m 130.89 19.63 polar or WV	87.13 x nm x Tm/3 114.11 17.12 WHRS storag n (kWh/day)	83.57 8600 kWh/me 109.50 16.42 ge within sam	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	87.13	90.68 94.24 $\Sigma(44)112 = \square$ 118.49 129.3 $\Sigma(45)112 = \square$	97.80 1066.87 4	(45) (46) (47) (48) (49) (50)
Energy content of Distribution loss Storage volume (Water storage loss) If manufacture Temperature Energy lost frenter (50) or (54)	97.80 of hot wate 145.03 0.15 x (45) 21.75 (litres) incluses: er's declared factor from water seems water see	94.24 er used = 4.1 126.84)m 19.03 uding any so ed loss facto m Table 2b storage (kW	90.68 18 x Vd,m 130.89 19.63 olar or WV or is known	87.13 x nm x Tm/3 114.11 17.12 WHRS storag n (kWh/day)	83.57 8600 kWh/me 109.50 16.42 ge within sam	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	87.13	90.68 94.24 $\Sigma(44)112 = \square$ 118.49 129.3 $\Sigma(45)112 = \square$	97.80 1066.87 4	(45) (46) (47) (48) (49) (50)
Energy content of Distribution loss Storage volume (Water storage loss) If manufacture Temperature	97.80 of hot wate 145.03 0.15 x (45) 21.75 (litres) incluses: er's declared factor from water seems water see	94.24 er used = 4.1 126.84)m 19.03 uding any so ed loss facto m Table 2b storage (kW	90.68 18 x Vd,m 130.89 19.63 olar or WV or is known	87.13 x nm x Tm/3 114.11 17.12 WHRS storag n (kWh/day)	83.57 8600 kWh/me 109.50 16.42 ge within sam	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	87.13	90.68 94.24 $\Sigma(44)112 = \square$ 118.49 129.3 $\Sigma(45)112 = \square$	97.80 1066.87 4	(45) (46) (47) (48) (49) (50)
Energy content of Distribution loss Storage volume (Nater storage loss) If manufacture Temperature Energy lost frenter (50) or (54)	97.80 of hot wate 145.03 0.15 x (45) 21.75 (litres) incluses: er's declared factor from water seems water see	94.24 er used = 4.1 126.84)m 19.03 uding any so ed loss facto m Table 2b storage (kW	90.68 18 x Vd,m 130.89 19.63 olar or WV or is known	87.13 x nm x Tm/3 114.11 17.12 WHRS storag n (kWh/day)	83.57 8600 kWh/me 109.50 16.42 ge within sam	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	87.13	90.68 94.24 $\Sigma(44)112 = \square$ 118.49 129.3 $\Sigma(45)112 = \square$	97.80 1066.87 4]
Energy content of Distribution loss Storage volume (Nater storage lost) If manufacture Temperature Energy lost frenter (50) or (54)	97.80 of hot wate 145.03 0.15 x (45) 21.75 (litres) incluses: er's declared factor from water sell) in (55) oss calculate 4.36	94.24 er used = 4.1 126.84)m 19.03 uding any so ed loss facto m Table 2b storage (kW ed for each 3.93	90.68 18 x Vd,m 130.89 19.63 polar or WV or is known /h/day) (4 month (5) 4.36	87.13 x nm x Tm/3 114.11 17.12 WHRS storag n (kWh/day) 18) x (49) 55) x (41)m 4.21	16.42 ge within sam	80.02 onth (see 94.49 14.17 ne vessel	80.02 Tables 1b 87.56 13.13	, 1c 1d) 100.47 15.07	87.13 101.67 15.25	90.68 94.24 Σ(44)112 = 118.49 129.3 Σ(45)112 = 17.77 19.40	97.80 1066.87 4	(45) (46) (47) (47) (48) (49) (50) (55)

Primary circuit	loss for each	n month fro	m Table 3										
	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 for	each month	from Table	3a, 3b or 3	С				•		•	•	•	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requ	uired for wat	er heating o	calculated f	or each mo	onth 0.85 >	(45)m + (4	.6)m + (57)	m + (59)m +	· (61)m				_
	172.65	151.79	158.51	140.84	137.11	121.21	115.17	128.09	128.40	146.11	156.07	168.07	(62)
Solar DHW inpu	ut calculated	using Appe	endix G or A	Appendix H	1			•					_
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from w	ater heater	for each mo	nth (kWh/ı	month) (6	2)m + (63)r	n					•		_
	172.65	151.79	158.51	140.84	137.11	121.21	115.17	128.09	128.40	146.11	156.07	168.07	7
					•	•	•	•		Σ(64)1	.12 = 1	1724.01	(64)
Heat gains fron	n water heat	ing (kWh/n	nonth) 0.25	5 × [0.85 ×	(45)m + (6:	1)m] + 0.8 ×	((46)m + (57)m + (59)	m]				
	70.32	62.13	65.62	59.32	58.50	52.80	51.21	55.50	55.19	61.49	64.39	68.79	(65)
		'									'		
5. Internal gai	ins												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains		1	Г	T									-
	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	(66)
Lighting gains (, also see T	able 5				,			_
	18.15	16.12	13.11	9.93	7.42	6.26	6.77	8.80	11.81	15.00	17.50	18.66	(67)
Appliance gains	s (calculated	in Appendi	x L, equatio	on L13 or L	13a), also s	ee Table 5							_
	202.88	204.98	199.68	188.38	174.13	160.73	151.78	149.67	154.98	166.27	180.53	193.93	(68)
Cooking gains (calculated ir	n Appendix	L, equation	L15 or L15	5a), also see	e Table 5							_
	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	34.52	(69)
Pump and fan g	gains (Table	5a)											_
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. eva		ble 5)								1			_
	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	(71)
Water heating	gains (Table	5)	•						•				_
	94.51	92.46	88.19	82.40	78.63	73.33	68.83	74.60	76.65	82.65	89.43	92.47	(72)
Total internal g	gains (66)m	+ (67)m + (6	58)m + (69)	m + (70)m	+ (71)m + (72)m							_
	376.09	374.12	361.53	341.26	320.73	300.87	287.92	293.62	303.99	324.47	348.01	365.60	(73)
6. Solar gains													
			Access f	actor	Area		ar flux		g	FF		Gains	
			Table	6d	m²	V	V/m²	-	ific data able 6b	specific o		W	
West			0.7	7 x	10.54	x 1	.9.64 x	0.9 x	0.63 x	0.70		63.26	(80)
South			0.7		4.48				0.63 x			64.01	_ (78)
Solar gains in w	vatts Σ(74)m	n(82)m	3.7		11.75	'	^^		^				_ (. •)
<i>5</i> :	127.27	228.59	337.35	448.18	521.57	524.27	502.91	448.58	376.54	259.92	154.76	107.34	(83)
Total gains - int		1				1,	, ======	1		1 =33.32	1 -2 0		_ (33)
	503.37	602.71	698.89	789.43	842.30	825.15	790.84	742.20	680.53	584.39	502.76	472.94	(84)
7. Mean inter	nal tempera	ture (beati	ng saason)										
				aroa frans	Table O. The	1/°C)						21.00	(05)
Temperature d	_		_				11	۸	Can.	0.00	No.	21.00 Doc	(85)
Litiliantino for	Jan	Feb	Mar	Apr	May \	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto		_		1									7 (2.5)
	1.00	0.99	0.97	0.93	0.82	0.64	0.48	0.53	0.78	0.96	0.99	1.00	(86)
	1.00	0.99	0.97	0.93	0.82	0.64	0.48	0.53	0.78	0.96	0.99	1.00	_] (8

	emp or non	ig area T1 (s	steps 3 to 7	7 in Table 9	c)								
	19.72	19.91	20.21	20.56	20.83	20.96	20.99	20.99	20.90	20.54	20.06	19.68	(87
emperature du	ıring heatin	g periods in	the rest o	f dwelling f	rom Table 9	9, Th2(°C)							
	19.88	19.88	19.89	19.90	19.90	19.91	19.91	19.91	19.91	19.90	19.90	19.89	(88
Jtilisation facto	r for gains t	for rest of d	welling n2	,m									
	0.99	0.99	0.97	0.90	0.76	0.55	0.37	0.41	0.69	0.93	0.99	1.00	(89
Mean internal to	emperature	e in the rest	of dwellin	g T2 (follow	steps 3 to	7 in Table 9	Эс)						
	18.19	18.47	18.90	19.40	19.74	19.89	19.91	19.91	19.83	19.38	18.69	18.15	(90
Living area fract	ion								Li	ving area ÷	(4) =	0.38	(9:
Mean internal to	emperature	e for the wh	ole dwellir	ng fLA x T1 +	+(1 - fLA) x	Т2							_
	18.76	19.01	19.39	19.84	20.15	20.29	20.32	20.31	20.23	19.81	19.21	18.72	(9:
Apply adjustme	nt to the m	ean interna	l temperat	ure from Ta	ble 4e whe	ere appropr	iate				•		
	18.76	19.01	19.39	19.84	20.15	20.29	20.32	20.31	20.23	19.81	19.21	18.72	(93
			1	1	1	1	1				1	1	
8. Space heating	ng requiren	nent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	r for gains,	ηm											
	0.99	0.98	0.96	0.90	0.77	0.58	0.41	0.46	0.72	0.93	0.99	0.99	(94
Useful gains, ηπ	nGm, W (94	4)m x (84)m	ı										
	499.89	593.24	672.02	710.75	652.75	480.35	323.00	337.92	490.30	545.16	495.59	470.45	(95
Monthly averag	e external t	emperature	e from Tab	le U1									
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96
Heat loss rate fo	or mean int	ernal tempe	erature, Lm	n, W [(39)m	x [(93)m -	(96)m]							
	1306.68	1271.87	1158.69	971.29	748.51	498.70	325.66	342.35	539.85	816.34	1077.48	1299.01	(97
Space heating re	equirement	, kWh/mon	th 0.024 x	: [(97)m - (9	5)m] x (41)	m							
	600.25	456.04	362.08	187.59	71.24	0.00	0.00	0.00	0.00	201.75	418.96	616.45	
	600.25	1		187.59	71.24	0.00	0.00	0.00		201.75 3)15, 10		616.45]] (98
Space heating re		456.04	362.08	187.59	71.24	0.00	0.00	0.00		8)15, 10		2914.36	╣ .
	equirement	456.04 kWh/m²/ye	362.08 ear				0.00	0.00		8)15, 10	.12 = 2	2914.36	╣ .
9a. Energy req	equirement	456.04 kWh/m²/ye	362.08 ear				0.00	0.00		8)15, 10	.12 = 2	2914.36	╣ .
9a. Energy req	equirement uirements	456.04 kWh/m²/ye	362.08 ear heating sy	rstems inclu	uding micro	э-СНР	0.00	0.00		8)15, 10	.12 = 2	2914.36 40.24	(99
9a. Energy req Space heating Fraction of space	equirement uirements e heat from	456.04 kWh/m²/ye individual	362.08 ear heating sy	rstems inclu	uding micro	э-СНР	0.00	0.00		(98)	.12 = ÷ (4)	2914.36	(99
9a. Energy req	equirement uirements e heat from	456.04 kWh/m²/ye individual	362.08 ear heating sy	rstems inclu	uding micro	э-СНР	0.00	0.00		(98)	.12 = 2	2914.36 40.24] (98] (99] (20
9a. Energy req Space heating Fraction of space	equirements uirements e heat from	456.04 kWh/m²/yo individual a secondary, a main syste	362.08 ear heating sy /suppleme	rstems inclu	uding micro	э-СНР	0.00	0.00		(98)	.12 = ÷ (4)	2914.36 40.24	(20)
9a. Energy req Space heating Fraction of space	equirements uirements e heat from e heat from	456.04 kWh/m²/ye individual a secondary a main system	362.08 ear heating sy /suppleme	rstems inclu	uding micro	э-СНР	0.00	0.00	∑(98	(98)	.12 =	0.00 1.00	(20)
9a. Energy req Space heating Fraction of spac Fraction of spac Fraction of spac	equirements e heat from e heat from e heat from	456.04 kWh/m²/ye individual a secondary, a main syste	a62.08 heating sy /suppleme em(s) em 2 system 1	rstems inclu	uding micro	э-СНР	0.00	0.00	∑(98	(98) 1 - (2	.12 = 2 ÷ (4) = 01) = 03)] = 03	0.00 1.00	(20) (20) (20) (20)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total	equirements e heat from e heat from e heat from l space head	456.04 kWh/m²/ye individual a secondary a main syste a main syste t from main	a62.08 heating sy /suppleme em(s) em 2 system 1	rstems inclu	iding micro	э-СНР	0.00	0.00	∑(98	1 - (2 02) x [1- (20	.12 = 2 ÷ (4) = 01) = 03)] = 03	0.00 1.00 1.00	(99)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total	equirements e heat from e heat from e heat from l space head	456.04 kWh/m²/ye individual a secondary a main syste a main syste t from main	a62.08 heating sy /suppleme em(s) em 2 system 1	rstems inclu	iding micro	э-СНР	0.00	0.00 Aug	∑(98	1 - (2 02) x [1- (20	.12 = 2 ÷ (4) = 01) = 03)] = 03	0.00 1.00 0.00 0.00	(20) (20) (20) (20) (20)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total	e heat from e heat from e heat from l space head in system 1 Jan	456.04 kWh/m²/ye individual a secondary, a main syste a main syste t from main t from main (%) Feb	362.08 ear heating sy /suppleme em(s) em 2 system 1 system 2 Mar	entary syste	nding micro	-снр			Σ(98	1 - (2 (202) x (2	.12 =	0.00 1.00 0.00 1.00 0.00 93.50	(20) (20) (20) (20) (20)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma	e heat from e heat from e heat from l space head in system 1 Jan	456.04 kWh/m²/ye individual a secondary, a main syste a main syste t from main t from main (%) Feb	362.08 ear heating sy /suppleme em(s) em 2 system 1 system 2 Mar	entary syste	nding micro	-снр			Σ(98	1 - (2 (202) x (2	.12 =	0.00 1.00 0.00 1.00 0.00 93.50	(20) (20) (20) (20) (20)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma	equirements e heat from e heat from l space head in system 1 Jan uel (main sy	456.04 kWh/m²/ye individual n secondary n main syste t from main t from main (%) Feb	a62.08 heating sy /suppleme em(s) em 2 system 1 system 2 Mar wh/month	entary syste	nding micro	-CHP .)	Jul	Aug	Σ(98 (20 Sep	1 - (2 (202) x [1- (20 (202) x (2	.12 =	0.00 1.00 0.00 1.00 0.00 93.50 Dec	(99) (20) (20) (20) (20) (20)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma	equirements e heat from e heat from l space head in system 1 Jan uel (main sy	456.04 kWh/m²/ye individual n secondary n main syste t from main t from main (%) Feb	a62.08 heating sy /suppleme em(s) em 2 system 1 system 2 Mar wh/month	entary syste	nding micro	-CHP .) Jun	Jul	Aug	Σ(98 (20 Sep	1 - (2 02) x [1- (20 (202) x (2	.12 =	0.00 1.00 0.00 1.00 0.00 93.50 Dec	(99) (20) (20) (20) (20) (20)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma Space heating for	equirements e heat from e heat from e heat from space head in system 1 Jan uel (main sy 641.98	456.04 kWh/m²/ye individual n secondary n main syste t from main t from main (%) Feb	a62.08 heating sy /suppleme em(s) em 2 system 1 system 2 Mar wh/month	entary syste	nding micro	-CHP .) Jun	Jul	Aug	Σ(98 (20 Sep	1 - (2 02) x [1- (20 (202) x (2	.12 =	0.00 1.00 0.00 1.00 0.00 93.50 Dec	(9! (2! (2! (2! (2!
9a. Energy req Space heating Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma Space heating for	equirements e heat from e heat from e heat from space head in system 1 Jan uel (main sy 641.98	456.04 kWh/m²/ye individual n secondary n main syste t from main t from main (%) Feb	a62.08 heating sy /suppleme em(s) em 2 system 1 system 2 Mar wh/month	entary syste	nding micro	-CHP .) Jun	Jul	Aug	Σ(98 (20 Sep	1 - (2 02) x [1- (20 (202) x (2	.12 =	0.00 1.00 0.00 1.00 0.00 93.50 Dec	(20) (20) (20) (20) (20) (20) (20)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma Space heating for	equirements e heat from e heat from e heat from space head in system 1 Jan uel (main sy 641.98	456.04 kWh/m²/ye individual a secondary, a main syste from main from main (%) Feb estem 1), kW 487.74	a62.08 heating sy /suppleme em(s) em 2 system 1 system 2 Mar /h/month 387.25	Apr 200.63	May 76.19	Jun 0.00	Jul 0.00	Aug 0.00	Σ(98 Sep 0.00 Σ(21:	1 - (2 02) x [1- (20 (202) x (2 Oct 215.78 1)15, 10	.12 =	0.00 1.00 0.00 1.00 0.00 93.50 Dec 659.30	(99) (20) (20) (20) (20) (20) (20)
9a. Energy req Space heating Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of ma Space heating for Water heating Efficiency of war	equirements e heat from e heat from e heat from space head in system 1 Jan uel (main sy 641.98	456.04 kWh/m²/ye individual a secondary, a main syste from main from main (%) Feb estem 1), kW 487.74	a62.08 heating sy /suppleme em(s) em 2 system 1 system 2 Mar /h/month 387.25	Apr 200.63	May 76.19	Jun 0.00	Jul 0.00	Aug 0.00	Σ(98 Sep 0.00 Σ(21:	1 - (2 02) x [1- (20 (202) x (2 Oct 215.78 1)15, 10	.12 =	0.00 1.00 0.00 1.00 0.00 93.50 Dec 659.30	(20) (20) (20) (20) (20)

Space heating fuel - main system 1			3116.96]
Water heating fuel			2039.51]
Electricity for pumps, fans and electric keep-hot (Table 4f)				
central heating pump or water pump within warm air heating unit		30.00		(230c)
boiler flue fan		45.00		(230e)
Total electricity for the above, kWh/year			75.00	(231)
Electricity for lighting (Appendix L)			320.59	(232)
Total delivered energy for all uses		(211)(221) + (231) + (232)(237b) =	5552.07	(238)
10a. Fuel costs - individual heating systems including micro-CHP				
	Euol	Fuel price	Euol	

10a. Fuel costs - individual heating systems including micro-	СНР					
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3116.96	x	3.48	x 0.01 =	108.47	(240)
Water heating	2039.51	x	3.48	x 0.01 =	70.98	(247)
Pumps and fans	75.00	х	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	320.59	x	13.19	x 0.01 =	42.29	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242) +	(245)(254) =	351.62	(255)
11a. SAP rating - individual heating systems including micro-	СНР					
Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					1.26	(257)
SAP value					82.45	

SAP rating (section 13)

SAP band

12a. CO ₂ emissions - individual heating systems including mi	icro-CHP					
	Energy kWh/year		Emission factor kg CO₂/kWh		Emissions kg CO₂/year	
Space heating - main system 1	3116.96	x	0.216	=	673.26	(261)
Water heating	2039.51	x	0.216	=	440.53	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	1113.80	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	320.59	x	0.519	=	166.39	(268)
Total CO₂, kg/year				(265)(271) =	1319.11	(272)
Dwelling CO₂ emission rate				(272) ÷ (4) =	18.21	(273)
El value					84.95]
El rating (section 14)					85	(274)
El band					В]

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3116.96	х	1.22	=	3802.69	(261
Water heating	2039.51	х	1.22	=	2488.21	(264
Space and water heating			(261) + (262) +	(263) + (264) =	6290.90	(265
Pumps and fans	75.00	х	3.07	=	230.25	(267
Electricity for lighting	320.59	х	3.07	=	984.22	(268
Primary energy kWh/year					7505.37	(272
Dwelling primary energy rate kWh/m2/year					103.64	(273

(258)

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	3B5P, Kingston upon Thames, KT1		

Client							La	ist modified	d	30/09	/2020	
Address	3B5P, Ki	ngston upo	n Thames,	KT1								
1. Overall dwelling dim	ensions											
				А	irea (m²)			rage storey eight (m)		Vo	olume (m³)	
owest occupied					104.07	(1a) x		2.50	(2a) =		260.18	(3a
otal floor area	(1a) + (1b) + (1	.c) + (1d)	(1n) =	104.07	(4)						
welling volume							(3a) + (3b) + (3	sc) + (3d)((3n) =	260.18	(5)
2. Ventilation rate												
										m	³ per hour	
lumber of chimneys								0	x 40	= [0	(6
lumber of open flues								0	x 20	=	0	(6
lumber of intermittent	ans							4	x 10	=	40	(7
lumber of passive vents								0	x 10	=	0	
lumber of flueless gas fi	res							0	x 40	=	0	(7
										Air	changes pe	•r
									7		hour	_
nfiltration due to chimn	•					(a) + (7b) + (40	÷ (5)	=	0.15	(8)
a pressurisation test ha								to (16)				_
ir permeability value, q							e area				5.00	(1
based on air permeabi				8), otherwi	se (18) = (1	.6)					0.40	(1
lumber of sides on whic	h the dwellin	g is shelter	ed								2	(19
helter factor								1 -	- [0.075 x (:		0.85	(20
nfiltration rate incorpor	_								(18) x ((20) =	0.34	(2:
nfiltration rate modified Jan	Feb	wind speed		May	lun	lul.	A~	San	Oct	Nov	Dec	
Jan Nonthly average wind sp			Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
5.10		4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(2:
Vind factor (22)m ÷ 4	3.00	4.30	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(2.
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(2:
djusted infiltration rate.		•		7		1 0.95	1 0.93	1.00	1.00	1.13	1.10	(2.
0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.40	(22
Calculate effective air ch		J. 12	0.00	1 0.07	0.00	1 0.00	1 0.02	1 0.0 .	1 0.07		3.10	'

Calculate effecti	ve air chan	ge rate for t	the applical	ole case:									
If mechanical	l ventilatior	n: air chang	e rate throu	ıgh system								N/A	(23a)
If balanced w	ith heat red	covery: effic	ciency in %	allowing fo	or in-use fac	ctor from T	able 4h					N/A	(23c)
d) natural vei	ntilation or	whole hou	se positive	input venti	lation from	loft							
	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)
Effective air cha	nge rate - e	nter (24a) d	or (24b) or ((24c) or (24	d) in (25)								
	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)



Element		ss paramet)	Cuesa	On!	B1	2425	II walee	Δ	/v	Α	
			i	Gross area, m²	Openings m ²		area m²	U-value W/m²K	AxUW	/K κ-value, kJ/m².K	Αxκ, kJ/K	
Window						18	.08 x	1.33	= 23.97			(27)
Door						1.	80 x	1.00	= 1.80			(26)
Ground floor						104	1.07 x	0.13	= 13.53			(28
External wall						65	.40 x	0.18	= 11.77			(29
Party wall						24	.13 x	0.00	= 0.00			(32)
Total area of ext	ernal eleme	ents ∑A, m²				189	9.35					(31)
Fabric heat loss,	W/K = ∑(A	× U)							(26	5)(30) + (32) = [51.07	(33)
Heat capacity Cn	n = ∑(A x κ)							(28)	(30) + (32) +	+ (32a)(32e) = [N/A	(34)
Thermal mass pa	arameter (T	MP) in kJ/n	n²K								250.00	(35)
Thermal bridges	: Σ(L x Ψ) ca	alculated us	ing Apper	ndix K							10.99	(36)
Total fabric heat	loss									(33) + (36) =	62.06	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct No	ov Dec	
Ventilation heat	loss calcula	ated month	ly 0.33 x (25)m x (5)	-							
	51.15	50.83	50.52	49.05	48.77	47.49	47.49	47.25	47.98	48.77 49.	33 49.91	(38)
Heat transfer co			ļ.	10.00	12							_ (,
	113.21	112.89	112.58	111.11	110.84	109.56	109.56	109.32	110.05	110.84 111	.39 111.97	7
	113.21	112.03		111.11	110.01	103.30	103.30	1		[(39)112/12 = [111.11	」 │(39)
Heat loss param	eter (HIP)	W/m²K (30	4)m ÷ (4)					· ·	Average - Z	(33)112/12 - [111.11	_ (33)
icat 1033 parami	1.09	1.08	1.08	1.07	1.07	1.05	1.05	1.05	1.06	1.07 1.0	07 1.08	٦
	1.09	1.08	1.08	1.07	1.07	1.03	1.03	•		(40)112/12 = [1.07	」 ີ (40)
Number of days	in month (Table 1a)						·	Hverage – Z	(40)112/12 - [1.07	(40)
Nulliber of days			24.00	20.00	24.00	20.00	24.00	24.00	20.00	24.00	00 34.00	7 (40)
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00 30.	00 31.00	(40)
4. Water heatir	ng energy r	equiremen	t									
Assumed occupa	ancy, N										2.77	(42)
Annual average l	hot water u	ısage in litre	es per day	Vd,average	= (25 x N) +	36				[100.09	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct No	ov Dec	
Hot water usage				Val f		la 1c v //2						
	e in litres pe	r day for ea	ich month	va,m = raci	tor from Tab	16 TC V (42	')					
								94.08	98.08	102.09 106	.09 110.09	1
_	110.09	106.09	102.09	98.08	94.08	90.08	90.08	94.08	98.08	102.09 106 Σ(44)112 = [(44)
Energy content o	110.09	106.09	102.09	98.08	94.08	90.08	90.08		98.08	102.09 106 ∑(44)112 = [1201.03	(44)
Energy content o	110.09	106.09 r used = 4.1	102.09	98.08 x nm x Tm/3	94.08 8600 kWh/m	90.08 onth (see	90.08 Tables 1b,	1c 1d)		Σ(44)112 = [1201.03]] (44)
Energy content o	110.09	106.09	102.09	98.08	94.08	90.08	90.08		98.08	Σ(44)112 = [133.39 145	1201.03	
Energy content o	110.09 of hot wate 163.27	106.09 r used = 4.1 142.79	102.09	98.08 x nm x Tm/3	94.08 8600 kWh/m	90.08 onth (see	90.08 Tables 1b,	1c 1d)		Σ(44)112 = [1201.03] (44)] (45)
	110.09 of hot wate 163.27	r used = 4.1 142.79	102.09 8 x Vd,m 147.35	98.08 x nm x Tm/3 128.46	94.08 3600 kWh/m 123.26	90.08 onth (see 106.37	90.08 Tables 1b,	1c 1d)	114.46	$\sum (44)112 = \begin{bmatrix} \\ 133.39 \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	1201.03 .60 158.12 1574.74]] (45)
Distribution loss	110.09 of hot wate 163.27 0.15 x (45) 24.49	r used = 4.1 142.79)m 21.42	102.09 18 x Vd,m 147.35	98.08 x nm x Tm/3 128.46	94.08 8600 kWh/m 123.26	90.08 onth (see 106.37	90.08 Tables 1b,	1c 1d)		Σ(44)112 = [133.39 145	1201.03 .60 158.12 1574.74 84 23.72	(45)
Distribution loss Storage volume	110.09 of hot wate 163.27 0.15 x (45) 24.49 (litres) inclu	r used = 4.1 142.79)m 21.42	102.09 18 x Vd,m 147.35	98.08 x nm x Tm/3 128.46	94.08 8600 kWh/m 123.26	90.08 onth (see 106.37	90.08 Tables 1b,	1c 1d)	114.46	$\sum (44)112 = \begin{bmatrix} \\ 133.39 \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	1201.03 .60 158.12 1574.74	(45)
Distribution loss Storage volume Water storage lo	110.09 of hot wate 163.27 0.15 x (45) 24.49 (litres) incluses:	106.09 r used = 4.1 142.79)m 21.42 uding any so	102.09 18 x Vd,m 147.35 22.10 plar or WV	98.08 x nm x Tm/3 128.46 19.27 VHRS storage	94.08 8600 kWh/m 123.26 18.49 ge within sam	90.08 onth (see 106.37	90.08 Tables 1b,	1c 1d)	114.46	$\sum (44)112 = \begin{bmatrix} \\ 133.39 \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	1201.03 .60 158.12 1574.74 84 23.72 3.00	(45) (46) (47)
Distribution loss Storage volume Water storage lo a) If manufacture	110.09 of hot wate 163.27 0.15 x (45) 24.49 (litres) incluses: er's declare	106.09 r used = 4.1 142.79)m 21.42 uding any so	102.09 18 x Vd,m 147.35 22.10 plar or WV	98.08 x nm x Tm/3 128.46 19.27 VHRS storage	94.08 8600 kWh/m 123.26 18.49 ge within sam	90.08 onth (see 106.37	90.08 Tables 1b,	1c 1d)	114.46	$\sum (44)112 = \begin{bmatrix} \\ 133.39 \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	1201.03 .60 158.12 1574.74 84 23.72 3.00 0.26	(45) (46) (47) (48)
Distribution loss Storage volume Water storage lo a) If manufacture Temperature	of hot wate 163.27 0.15 x (45) 24.49 (litres) incluses: er's declare	106.09 r used = 4.1 142.79)m 21.42 uding any solution and loss factors in Table 2b	102.09 18 x Vd,m 147.35 22.10 plar or WV	98.08 x nm x Tm/3 128.46 19.27 VHRS storagen (kWh/day)	94.08 8600 kWh/m 123.26 18.49 ge within sam	90.08 onth (see 106.37	90.08 Tables 1b,	1c 1d)	114.46	$\sum (44)112 = \begin{bmatrix} \\ 133.39 \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	1201.03 .60 158.12 1574.74 84 23.72 3.00 0.26 0.54	(45) (46) (47) (48) (49)
Distribution loss Storage volume Water storage lo a) If manufacture Temperature Energy lost fr	of hot wate 163.27 0.15 x (45) 24.49 (litres) incluses: er's declare	106.09 r used = 4.1 142.79)m 21.42 uding any solution and loss factors in Table 2b	102.09 18 x Vd,m 147.35 22.10 plar or WV	98.08 x nm x Tm/3 128.46 19.27 VHRS storagen (kWh/day)	94.08 8600 kWh/m 123.26 18.49 ge within sam	90.08 onth (see 106.37	90.08 Tables 1b,	1c 1d)	114.46	$\sum (44)112 = \begin{bmatrix} \\ 133.39 \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	1201.03 .60	(45) (46) (47) (48) (49) (50)
Distribution loss Storage volume Water storage lo a) If manufacture Temperature Energy lost fr	of hot wate 163.27 0.15 x (45) 24.49 (litres) incluses: er's declared factor from water some wa	r used = 4.1 142.79 m 21.42 uding any so ed loss factor n Table 2b storage (kW	102.09 18 x Vd,m 147.35 22.10 plar or WV or is known (h/day) (4	98.08 x nm x Tm/3 128.46 19.27 VHRS storage n (kWh/day) 8) x (49)	94.08 8600 kWh/m 123.26 18.49 ge within sam	90.08 onth (see 106.37	90.08 Tables 1b,	1c 1d)	114.46	$\sum (44)112 = \begin{bmatrix} \\ 133.39 \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	1201.03 .60 158.12 1574.74 84 23.72 3.00 0.26 0.54	(45) (46) (47) (48) (49) (50)
Distribution loss Storage volume Water storage lo a) If manufacture Temperature	of hot wate 163.27 0.15 x (45) 24.49 (litres) incluses: er's declare factor from water solution (55) oss calculate	r used = 4.1 142.79)m 21.42 uding any so n Table 2b storage (kW	102.09 18 x Vd,m 147.35 22.10 polar or WV or is known /h/day) (4	98.08 x nm x Tm/3 128.46 19.27 VHRS storage n (kWh/day) 8) x (49) 5) x (41)m	94.08 8600 kWh/m 123.26 18.49 ge within sam	90.08 onth (see 106.37 15.96 ne vessel	90.08 Tables 1b, 98.57	1c 1d) 113.11 16.97	17.17	$\sum (44)112 = \begin{bmatrix} \\ 133.39 \\ 145 \\ \sum (45)112 = \begin{bmatrix} \\ \\ \end{bmatrix} $ $20.01 $	1201.03 .60	(45) (46) (47) (48) (49) (50)
Distribution loss Storage volume Water storage lo a) If manufacture Temperature Energy lost fr Enter (50) or (54 Water storage lo	of hot wate 163.27 0.15 x (45) 24.49 (litres) incluses: er's declaree factor from water sell) in (55) poss calculate 4.36	r used = 4.1 142.79 m 21.42 uding any so red loss factor Table 2b storage (kW) ded for each 3.93	102.09 18 x Vd,m 147.35 22.10 plar or WV or is known /h/day) (4 month (5 4.36	98.08 x nm x Tm/3 128.46 19.27 VHRS storage (kWh/day) 8) x (49) 5) x (41)m 4.21	94.08 3600 kWh/m 123.26 18.49 ge within sam	90.08 onth (see 106.37 15.96 ne vessel	90.08 Tables 1b, 98.57 14.78	1c 1d) 113.11 16.97 4.36	114.46	$\sum (44)112 = \begin{bmatrix} \\ 133.39 \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	1201.03 .60	(45) (46) (47) (48) (49) (50)
Distribution loss Storage volume Water storage lo a) If manufacture Temperature Energy lost fr	of hot wate 163.27 0.15 x (45) 24.49 (litres) incluses: er's declaree factor from water sell) in (55) poss calculate 4.36	r used = 4.1 142.79 m 21.42 uding any so red loss factor Table 2b storage (kW) ded for each 3.93	102.09 18 x Vd,m 147.35 22.10 plar or WV or is known /h/day) (4 month (5 4.36	98.08 x nm x Tm/3 128.46 19.27 VHRS storage (kWh/day) 8) x (49) 5) x (41)m 4.21	94.08 3600 kWh/m 123.26 18.49 ge within sam	90.08 onth (see 106.37 15.96 ne vessel	90.08 Tables 1b, 98.57 14.78	1c 1d) 113.11 16.97 4.36	17.17	$\sum (44)112 = \begin{bmatrix} \\ 133.39 \\ 145 \\ \sum (45)112 = \begin{bmatrix} \\ \\ \end{bmatrix} $ $20.01 $	1201.03 .60	(45) (46) (47) (48) (49) (50)

Primary circuit lo	oss for each	month fro	m Table 3										
	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 for ea	ach month	from Table	3a, 3b or 3	3c	•			•					_
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requir	red for wate	er heating o	calculated	for each mo	onth 0.85 x	(45)m + (4	16)m + (57)	m + (59)m ·	+ (61)m		1	•	_ , ,
·	190.88	167.74	174.97	155.19	150.88	133.09	126.18	140.72	141.18	161.01	172.33	185.73	(62)
Solar DHW input		Į.				1 200.00	120.20	1 2 1011 2	1 - 1 - 1 - 1	102.02	1 2/2:00	1 200.70] (02)
30.a. 2pac	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from wat		!		1	1		0.00	0.00	0.00	0.00	0.00	0.00] (03)
output from wat	190.88	167.74	174.97	155.19	150.88	133.09	126.18	140.72	141.18	161.01	172.33	185.73	٦
	190.00	107.74	174.97	155.19	150.88	155.09	120.10	140.72	141.16		`]] (CA)
Heat gains from	water beat	ina /1/14/h /n	aanth\ 0.2	F v [0 0F v	/45\m + /61	\ml . 0 0 x	. [(46\m + /	F7\m + /F0	\mal	∑(64)1	.12 =	1899.92	(64)
Heat gains from				-	1	1						T =	7 ,,_,
	76.38	67.44	71.09	64.10	63.08	56.75	54.87	59.70	59.44	66.45	69.79	74.67	(65)
5. Internal gain	S												
0	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains				7.40.	····uy	54	Ju.	7.08	000	00.		200	
Wetabolic gairis	138.71	120 71	120 71	138.71	120 71	138.71	120.71	120.71	120.71	120 71	120.71	120 71	7 (66)
Lighting gains (or		138.71	138.71		138.71		138.71	138.71	138.71	138.71	138.71	138.71	(66)
Lighting gains (ca			-				0.6=	14155	45.00	40.00	22.55	24.72	7 (67)
	24.07	21.38	17.38	13.16	9.84	8.31	8.97	11.66	15.66	19.88	23.20	24.73	(67)
Appliance gains (1			1			I			7
	262.74	265.47	258.60	243.97	225.51	208.16	196.56	193.84	200.71	215.33	233.80	251.15	(68)
Cooking gains (ca	alculated in	Appendix	L, equatior	n L15 or L15	5a), also see	Table 5				_			_
	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	(69)
Pump and fan ga	ins (Table 5	5a)											
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evapo	oration (Tal	ole 5)											
	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	(71)
Water heating ga	ains (Table	5)											
	102.66	100.35	95.55	89.02	84.78	78.82	73.75	80.24	82.55	89.31	96.94	100.36	(72)
Total internal ga	ins (66)m +	+ (67)m + (6	58)m + (69)	m + (70)m	+ (71)m + (7	72)m		•	•		•	•	_
	457.08	454.81	439.14	413.77	387.74	362.89	346.90	353.36	366.53	392.14	421.55	443.86	(73)
						•			<u>'</u>		<u>'</u>	<u> </u>	_ , ,
6. Solar gains													
			Access		Area		lar flux		g	FF		Gains	
			Table	e 6d	m²	١	N/m²	-	cific data Fable 6b	specific of Table		W	
						–							7 (- 0)
North			0.7		6.86				0.63 x			22.29	
NorthEast			0.7		2.18				0.63 x			7.52	(75)
East			0.7		6.78	-			0.63 x			40.70	<u>(76)</u>
SouthEast			0.7	′7 x	2.26	x 3	36.79 x	0.9 x	0.63 x	0.70	=	25.41	(77)
Solar gains in wa	itts ∑(74)m	(82)m											_
	95.92	180.80	290.29	426.15	534.03	554.06	524.31	440.87	337.24	211.72	118.14	79.94	(83)
Total gains - inte	rnal and so	lar (73)m +	(83)m										
	553.00	635.61	729.44	839.92	921.78	916.95	871.21	794.23	703.77	603.85	539.69	523.80	(84)
7. Mean interna	·												
Temperature du	ring heating	g periods in	the living	area from ⁻	Table 9, Th1	.(°C)						21.00	(85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

		_	ea n1,m (se				T :		0.0=			T
L	1.00	1.00	0.99	0.97	0.89	0.71	0.54	0.61	0.87	0.98	1.00	1.00
Mean internal tem				1				1	1			
L	19.78	19.92	20.17	20.51	20.80	20.96	20.99	20.98	20.87	20.49	20.08	19.76
Temperature durii	ng heating	ş periods in	the rest of	dwelling f	rom Table 9	}, Th2(°C)						
L	20.01	20.01	20.02	20.03	20.03	20.04	20.04	20.04	20.04	20.03	20.03	20.02
Utilisation factor f	or gains fo	or rest of d	welling n2,	m								
L	1.00	1.00	0.99	0.96	0.84	0.63	0.43	0.50	0.81	0.98	1.00	1.00
Mean internal tem	nperature	in the rest	of dwelling	; T2 (follow	steps 3 to	7 in Table 9	9c)					
L	18.37	18.58	18.94	19.45	19.83	20.01	20.04	20.04	19.92	19.42	18.82	18.35
Living area fraction	n								Li	ving area ÷	(4) =	0.32
Mean internal tem	nperature	for the wh	ole dwellin	g fLA x T1 -	+(1 - fLA) x 7	Г2						
	18.82	19.01	19.34	19.79	20.14	20.31	20.34	20.34	20.23	19.76	19.22	18.80
Apply adjustment	to the me	an interna	l temperati	ure from Ta	able 4e whe	re appropr	riate					
	18.82	19.01	19.34	19.79	20.14	20.31	20.34	20.34	20.23	19.76	19.22	18.80
8. Space heating	requirem	ent										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor f	or gains, r	ηm										
Γ	1.00	1.00	0.99	0.95	0.85	0.65	0.47	0.53	0.82	0.97	1.00	1.00
ــ Useful gains, ŋmG	im, W (94)m x (84)m	l		-							_
Г	551.81	632.58	719.53	799.23	782.37	598.20	406.23	423.26	580.28	588.06	537.23	522.94
ــ Monthly average و												
Γ	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20
∟ Heat loss rate for ا			1				20.00	200		1 20.00	1 7.20	
_	1644.00	1592.61	1445.16	1209.64	935.87	625.90	409.97	430.60	674.14	1015.33	1349.90	1634.71
∟ Space heating req				-			103.37	130.00	07 1121	1013.33	1 13 13.30	100 1.71
					114.20		0.00	0.00	0.00	317.88	585.13	827.16
L	012.33	013.11	_ 333.67	233.13	111120	0.00	0.00	1 0.00		8)15, 10		4137.46
Space heating req	uirement	kWh/m²/v	ear						2(3)		÷ (4)	39.76
space ricuting req	direfficite	K V V I I I I I I I I I I I I I I I I I	Jui							(30)	. (-)	33.70
9a. Energy requi	rements -	individual	heating sy	stems inclu	uding micro	-СНР						
Space heating												
Fraction of space I	heat from	secondary	/suppleme	ntary syste	m (table 11)						0.00
Fraction of space I	heat from	main syste	em(s)							1 - (2	(01) =	1.00
Fraction of space I	heat from	main syste	em 2									0.00
Fraction of total sp	pace heat	from main	system 1						(20	02) x [1- (20)3)] =	1.00
Fraction of total sp	pace heat	from main	system 2							(202) x (2	.03) =	0.00
Efficiency of main	system 1	(%)										93.50
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fue	l (main sys	stem 1), kV	Vh/month									
	869.08	689.99	577.40	316.03	122.14	0.00	0.00	0.00	0.00	339.98	625.80	884.66
1					-			•	Σ(21	1)15 <i>,</i> 10		4425.09
L									_, _	,	L	<u> </u>
∟ Water heating												
· ·	r heater									1		
Water heating Efficiency of water		88 N6	87.62	86 51	84 08	79 <u>8</u> 0	79 RU	79 80	/	ጸհ հበ	87 82	88 33
Efficiency of water	88.25	88.06	87.62	86.51	84.08	79.80	79.80	79.80	79.80	86.60	87.82	88.33
•	88.25		87.62	86.51	84.08	79.80	79.80	79.80	176.92	185.93	196.23	210.28

	∑(219a)112 =	2235.91	(219)
Annual totals			
Space heating fuel - main system 1		4425.09]
Water heating fuel		2235.91]
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		425.01	(232)
Total delivered energy for all uses	(211)(221) + (231) + (232)(237b) =	7161.01	(238)

10a. Fuel costs - individual heating systems including micro-C	СНР					
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4425.09	x	3.48	x 0.01 =	153.99	(240)
Water heating	2235.91	x	3.48	x 0.01 =	77.81	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	425.01	x	13.19	x 0.01 =	56.06	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242)	- (245)(254) =	417.75	(255)

11a. SAP rating - individual heating systems including micro-CHP	
Energy cost deflator (Table 12)	0.42 (256)
Energy cost factor (ECF)	1.18 (257)
SAP value	83.58
SAP rating (section 13)	84 (258)
SAP band	В

	Energy kWh/year		Emission factor kg CO₂/kWh	Emissions kg CO₂/year	
Space heating - main system 1	4425.09	x	0.216 =	955.82	(261)
Water heating	2235.91	х	0.216 =	482.96	(264)
Space and water heating			(261) + (262) + (263) + (2	264) = 1438.78	(265)
Pumps and fans	75.00	х	0.519 =	38.93	(267)
Electricity for lighting	425.01	x	0.519 =	220.58	(268)
Total CO ₂ , kg/year			(265)(2	271) = 1698.28	(272)
Dwelling CO₂ emission rate			(272) ÷	- (4) = 16.32	(273)
El value				84.73	
El rating (section 14)				85	(274)
El band				В	

	Energy kWh/year		Primary factor	Primary Energy kWh/year	/	
Space heating - main system 1	4425.09	x	1.22	=	5398.61	(261)
Water heating	2235.91	x	1.22	=	2727.81	(264)
Space and water heating			(261) + (262) + (26	3) + (264) =	8126.42	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	425.01	х	3.07	=	1304.79	(268)

9661.46

92.84

284 (273

(272)

SAP version 9.92

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	3B6P, Kingston upon Thames, KT1		

Client							La	st modified	d	30/0	9/2020	
Address	3B6P, Kir	ngston upo	n Thames,	, KT1								
1. Overall dwelling dime	nsions											
				ı	Area (m²)			rage storey eight (m)	′	V	olume (m³)	
owest occupied					94.73	(1a) x		2.50	(2a) =		236.83	(3a
otal floor area	(1a)	+ (1b) + (1	c) + (1d)	(1n) =	94.73	(4)						
Owelling volume							(3a)) + (3b) + (3	3c) + (3d)((3n) =	236.83	(5)
2. Ventilation rate												
7										ņ	n³ per hour	
lumber of chimneys								0	x 40	=	0	(6a
lumber of open flues								0	x 20		0	(6k
lumber of intermittent fa	ns							3	x 10	=	30	(7a
lumber of passive vents								0	x 10	=	0	(7k
lumber of flueless gas fire	es							0	x 40	=	0	(70
										Air	changes pe	:r
									7	_	hour	_
nfiltration due to chimney				•		(a) + (7b) + (30	÷ (5)	=	0.13	(8)
f a pressurisation test has								o (16)				_
ir permeability value, q50), expressed	in cubic m	etres per l	hour per sq	uare metre	of envelope	e area				5.00	(17
f based on air permeabilit	y value, the	n (18) = [(1	7) ÷ 20] +	(8), otherw	ise (18) = (1	.6)					0.38	(18
lumber of sides on which	the dwelling	g is shelter	ed								2	(19
helter factor								1 -	- [0.075 x (19)] =	0.85	(20
nfiltration rate incorporat	ing shelter f	actor							(18) x	(20) =	0.32	(21
nfiltration rate modified f	or monthly v	wind speed	l:									
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Nonthly average wind spe	ed from Tab	ole U2							_			_
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22
Vind factor (22)m ÷ 4												
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22
			d wind for	tor\ (21) v /	22-1							
Adjusted infiltration rate (allowing for	sneiter and	a wind rac	tor) (21) x (22a)m							



If mechanical ventilation: air change rate through system

0.58

0.58

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

0.58

0.58

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h

0.56

0.56

0.56

0.56

0.58

0.58

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

N/A

N/A

0.57

0.57

0.56

0.56

(23a)

(23c)

(24d)

(25)

0.55

0.55

0.55

0.55

0.54

0.54

0.55

0.55

0.56

0.56

3. Heat losses a	and heat lo	ss paramet	er									
Element				Gross area, m²	Openings m ²		area m²	U-value W/m²K	AxUW	/К к-value, kJ/m².К	Αxκ, kJ/K	
Window						14	.86 x	1.33	= 19.70			(27)
Door						1.	80 x	1.00	= 1.80			(26)
External wall						70	.96 x	0.18	= 12.77			(29a)
Party wall						15	.15 x	0.00	= 0.00			(32)
Roof						94	.73 x	0.13	= 12.31			(30)
Total area of ext	ernal elem	ents ∑A, m²				182	2.35					(31)
Fabric heat loss,	W/K = ∑(A	× U)							(26	5)(30) + (32) =	46.59	(33)
Heat capacity Cn	n = ∑(A x к)							(28)	(30) + (32)	+ (32a)(32e) =	N/A	(34)
Thermal mass pa	arameter (T	MP) in kJ/m	n²K								250.00	(35)
Thermal bridges:	: ∑(L x Ѱ) ca	alculated us	ing Appei	ndix K							17.18	(36)
Total fabric heat	loss									(33) + (36) =	63.77	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct Nov	Dec	
Ventilation heat	loss calcula	ated month	ly 0.33 x	(25)m x (5)								
	45.59	45.34	45.09	43.92	43.71	42.69	42.69	42.50	43.08	43.71 44.1	44.61	(38)
Heat transfer co	efficient, W	//K (37)m +	(38)m									
	109.36	109.11	108.86	107.69	107.48	106.46	106.46	106.27	106.85	107.48 107.9	2 108.38	
									Average = ∑	(39)112/12 =	107.69	(39)
Heat loss parame	eter (HLP),	W/m²K (39)m ÷ (4)									
	1.15	1.15	1.15	1.14	1.13	1.12	1.12	1.12	1.13	1.13 1.14	1.14	
									Average = 2	(40)112/12 =	1.14	(40)
Number of days	in month (Table 1a)										
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00 30.00	31.00	(40)
4. Water heatir	ng energy r	equiremen ¹	t									
Assumed occupa											2.69	(42)
Annual average I	hot water u	ısage in litre	es per day	Vd,average	= (25 x N) +	36				Ē	97.97	(43)
_	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct Nov		
Hot water usage	in litres pe	r day for ea	ich month	Vd,m = fact	tor from Tab	le 1c x (43	3)					
	107.77	103.85	99.93	96.01	92.09	88.17	88.17	92.09	96.01	99.93 103.8	5 107.77	7
								•	•	Σ(44)112 =	1175.65	(44)
Energy content o	of hot wate	r used = 4.1	.8 x Vd,m	x nm x Tm/3	3600 kWh/m	onth (see	Tables 1b	, 1c 1d)		_		_
	159.82	139.78	144.24	125.75	120.66	104.12	96.48	110.72	112.04	130.57 142.5	3 154.77	
										∑(45)112 =	1541.46	(45)
Distribution loss	0.15 x (45)m										
	23.97	20.97	21.64	18.86	18.10	15.62	14.47	16.61	16.81	19.59 21.3	3 23.22	(46)
Storage volume	(litres) inclu	uding any so	olar or W\	WHRS storag	ge within san	ne vessel					3.00	(47)
Water storage lo	oss:											
a) If manufacture	er's declare	d loss facto	r is know	n (kWh/day))						0.26	(48)
Temperature	factor from	n Table 2b									0.54	(49)
Energy lost fr	om water s	storage (kW	'h/day) (4	l8) x (49)							0.14	(50)
Enter (50) or (54) in (55)									Γ	0.14	(55)
Water storage lo	ss calculate	ed for each	month (5	55) x (41)m								-
	4.36	3.93	4.36	4.21	4.36	4.21	4.36	4.36	4.21	4.36 4.21	4.36	(56)
If the vessel cont	tains dedica	ated solar st	torage or	dedicated W	/WHRS (56)r	m x [(47) -	Vs] ÷ (47)	, else (56)				
	4.36	3.93	4.36	4.21	4.36	4.21	4.36	4.36	4.21	4.36 4.21	4.36	(57)
										.		_ -

Primary circuit	loss for each	n month fro	m Table 3										
	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 for	each month	from Table	3a, 3b or 3	С									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requ	ired for wat	er heating (calculated f	or each mo	onth 0.85 x	: (45)m + (4	.6)m + (57)r	n + (59)m +	(61)m				
	187.43	164.72	171.85	152.48	148.28	130.85	124.10	138.33	138.76	158.19	169.25	182.39	(62)
Solar DHW inpu	ut calculated	l using App	endix G or A	Appendix H									_
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from w	ater heater f	for each mo	onth (kWh/	month) (62	- 2)m + (63)n	n	•	•			,	1	
	187.43	164.72	171.85	152.48	148.28	130.85	124.10	138.33	138.76	158.19	169.25	182.39	1
										∑(64)1		1866.64	(64)
Heat gains fron	n water heat	ting (kWh/n	nonth) 0.2	5 × [0.85 ×	(45)m + (61	L)m] + 0.8 >	((46)m + (57)m + (59)	m]	2. ,			. ,
· ·	75.23	66.43	70.05	63.19	62.21	56.00	54.17	58.91	58.63	65.51	68.77	73.56	(65)
												1	
5. Internal gai	ins												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	s (Table 5)												
	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	(66)
Lighting gains (calculated ir	Appendix	L, equation	L9 or L9a),	, also see Ta	able 5							
	23.11	20.53	16.69	12.64	9.45	7.98	8.62	11.20	15.04	19.09	22.28	23.75	(67)
Appliance gains	s (calculated	in Appendi	ix L, equatio	on L13 or L	13a), also s	ee Table 5							
	247.52	250.08	243.61	229.83	212.44	196.09	185.17	182.60	189.08	202.85	220.25	236.59	(68)
Cooking gains (calculated in	n Appendix	L, equation	L15 or L15	sa), also see	Table 5							_
	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	(69)
Pump and fan g	gains (Table	5a)	!	!							ļ.	1	_ ` '
,	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. eva		1		2.00		0.00	0.00			0.00	0.00	0.00	_ (/
	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	(71)
Water heating		ı	2071.0	2071.10	1 2071.0	207110	1071.10	2071.0	207110	1071.10	2071.10	1 20///	_ (, _,
	101.12	98.86	94.16	87.77	83.62	77.78	72.82	79.18	81.44	88.05	95.52	98.87	(72)
Total internal g		1				1	72.02	73.10	01.44	00.03	33.32	30.07] (72)
Total Internal 6	438.02	435.75	420.74	396.52	371.78	348.12	332.88	339.26	351.82	376.27	404.32	425.49	(73)
	436.02	433.73	420.74	390.32	3/1./8	346.12	332.88	339.20	331.82	370.27	404.32	423.43] (73)
6. Solar gains													
			Access		Area		ar flux		g	FF		Gains	
			Table	6d	m²	V	V/m²		ific data able 6b	specific of or Table		W	
													7
East			0.7		10.44).63 x		=	62.66	∫ (76)
South			0.7	7 x L	4.42	x 4	6.75 x	0.9 x C).63 x	0.70	=	63.15	(78)
Solar gains in w						1		, ,					7
	125.82	226.01	333.63	443.33	516.00	518.71	497.57	443.77	372.42	257.01	152.99	106.10	(83)
Total gains - int	ternal and so	olar (73)m +	· (83)m										7
	563.84	661.76	754.37	839.85	887.79	866.83	830.45	783.02	724.25	633.29	557.32	531.59	(84)
7. Mean inter	nal tempera	ture (beati	ng season)										
	·	•			T-bl- 0 T	1(°C)						24.00	(05)
Temperature d	_		_				s s		C	0		21.00	(85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	_		1			1	1	1			1		٦,
	1.00	1.00	0.99	0.96	0.88	0.72	0.55	0.60	0.84	0.98	1.00	1.00	(86)

Mean internal	temp of livir	ng area T1 (s	steps 3 to 7	7 in Table 90	c)								
	19.75	19.91	20.17	20.51	20.78	20.95	20.99	20.98	20.87	20.50	20.06	19.72	(87)
Temperature d	luring heatir	g periods ir	the rest o	f dwelling f			•	!					_ , ,
	19.96	19.96	19.96	19.97	19.97	19.98	19.98	19.98	19.98	19.97	19.97	19.97	(88)
Utilisation fact	or for gains	1	welling n2,	m						1	1		_ ` '
	1.00	0.99	0.98	0.94	0.84	0.63	0.43	0.48	0.77	0.96	0.99	1.00	(89)
Mean internal		ļ					Į.						
	18.29	18.53	18.91	19.39	19.76	19.94	19.98	19.98	19.88	19.39	18.75	18.25	(90)
Living area frac									1	ving area ÷		0.33	(91)
Mean internal		e for the wh	ole dwellir	ng fLA x T1 +	+(1 - fLA) x ⁻	Т2					()		(,
	18.77	18.98	19.33	19.76	20.10	20.27	20.31	20.31	20.21	19.76	19.18	18.74	(92)
Apply adjustme		1	-	1	1		!						
,,,,	18.77	18.98	19.33	19.76	20.10	20.27	20.31	20.31	20.21	19.76	19.18	18.74	(93)
	20	1 20.00	1 23.00	1 23.7 0							1 20.20		
8. Space heat	ing requirer	nent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation fact	or for gains,	ηm											
	1.00	0.99	0.98	0.94	0.84	0.66	0.47	0.52	0.79	0.96	0.99	1.00	(94)
Useful gains, η	mGm, W (9	4)m x (84)m	1										
	561.77	656.23	738.29	788.83	747.77	571.68	390.33	407.53	571.85	607.49	552.98	530.13	(95)
Monthly avera	ge external	temperatur	e from Tab	le U1									
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate f	for mean int	ernal tempe	erature, Lm	n, W [(39)m	ı x [(93)m -	(96)m]							
	1582.30	1536.62	1396.13	1169.14	902.40	604.04	395.00	415.24	652.35	984.33	1304.13	1575.32	(97)
Space heating	requirement	t, kWh/mon	th 0.024 x	[(97)m - (9	5)m] x (41)	m							
	759.27	591.62	489.44	273.82	115.04	0.00	0.00	0.00	0.00	280.37	540.82	777.63	
									∑(9	8)15, 10	.12 = 3	3828.02	(98)
Space heating	requirement	t kWh/m²/y	ear							(98)	÷ (4)	40.41	(99)
9a. Energy re	auiromonts	individual	hoating sy	estams inclu	ıdina micro	CHD							
	quirements	- iliuiviuuai	neating sy	stems mcit	iding micro	-СПР							
Space heating	b t		/		/+- - - 4.4	,						0.00	7 (204)
Fraction of spa		•		entary syste	m (table 11	-)				4 /2	04)	0.00	(201)
Fraction of spa		-								1 - (2	01) =	1.00	(202)
Fraction of spa									101	22) [4 (26	\	0.00	∫ (202) √ (204)
Fraction of tota	•								(20	02) x [1- (20		1.00	」(204) □ (205)
Fraction of tota			system 2							(202) x (2	03) = [0.00	(205)
Efficiency of m	-		84	A	D.d.o.	1	11	A	C	0	N. a	93.50	(206)
Coope beating	Jan fuel (main s	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating				202.05	422.04	0.00	0.00		0.00	1 200 00	F70.40	024.60	٦
	812.06	632.75	523.46	292.86	123.04	0.00	0.00	0.00	0.00	299.86	578.42	831.69]] (2)
14/-4 1 -1									∑(21	1)15, 10	.12 =	4094.13	(211)
Water heating													
Efficiency of w		07.55	l c=	00.55		70.55	70.00	70.55	72.55	0000	1 6===	1 60 5=	7 (2:=:
Makeshir	88.16	87.93	87.45	86.36	84.15	79.80	79.80	79.80	79.80	86.32	87.70	88.25	(217)
Water heating		•	400 = :	1-0	1-0	460 ==	1 455 5 5		4=0 ==	100 ==	100	1 222	٦
	212.61	187.33	196.51	176.56	176.21	163.97	155.51	173.35	173.89	183.25	193.00	206.67]
										∑(219a)1	.12 =2	2198.86	(219)
Annual totals													

			_
Space heating fuel - main system 1		4094.13]
Water heating fuel		2198.86]
Electricity for pumps, fans and electric keep-hot (Table 4f)			
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		408.17	(232)
Total delivered energy for all uses	(211)(221) + (231) + (232)(237b) =	6776.16	(238)
10a. Fuel costs - individual heating systems including micro-CHP			

Coa. Fuel costs - individual heating systems including micro-CHP Fuel kWh/ye coace heating - main system 1 4094.1 2198.8	(211)(221) + (2	(31) + (232)(237b) =	6776.16	(238)
Fuel kWh/ye bace heating - main system 1 4094.1 2198.8 2198.8 2198.9 2198.0 219				
kWh/yo pace heating - main system 1 dater heating umps and fans kWh/yo 2198.8 75.00				
Zater heating 2198.8 umps and fans 75.00	Fuel pri ar	ice	Fuel cost £/year	
umps and fans 75.00	3.48	x 0.01 =	142.48	(240)
·	3.48	x 0.01 =	76.52	(247)
ectricity for lighting 408.1	x 13.19	x 0.01 =	9.89	(249)
	x 13.19	x 0.01 =	53.84	(250)
dditional standing charges			120.00	(251)
otal energy cost	(240)((242) + (245)(254) =	402.73	(255)
.1a. SAP rating - individual heating systems including micro-CHP				
nergy cost deflator (Table 12)			0.42	(256)
nergy cost factor (ECF)			1.21	(257)
AP value			83.11	
AP rating (section 13)			83	(258)
AP band				_

12a. CO ₂ emissions - individual heating systems inc	luding micro-CHP					
	Energy kWh/year		Emission factor kg CO₂/kWh		Emissions kg CO₂/year	
Space heating - main system 1	4094.13	×	0.216	=	884.33	(261)
Water heating	2198.86	x	0.216	=	474.95	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	1359.29	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	408.17	x	0.519	=	211.84	(268)
Total CO ₂ , kg/year				(265)(271) =	1610.05	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	17.00	(273)
El value					84.56	
El rating (section 14)					85	(274)
El band					В	

	Energy kWh/year		Primary factor		Primary Energy kWh/year	1
Space heating - main system 1	4094.13	х	1.22	=	4994.84	(261
Water heating	2198.86	x	1.22	=	2682.61	(264
Space and water heating			(261) + (262) +	(263) + (264) =	7677.45	(265
Pumps and fans	75.00	х	3.07	=	230.25	(267
Electricity for lighting	408.17	x	3.07	=	1253.08	(268
Primary energy kWh/year					9160.78	(272
Dwelling primary energy rate kWh/m2/year					96.70	(273

Design - Draft



m³ per hour

5.00

0.37

2

Dec

Oct

Sep

Nov

(17)

(18)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	23/10/2020
Address	4B8P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions			
	Area (m²)	Average storey height (m)	Volume (m³)
Lowest occupied	72.24 (1a) x	(2.50) (2a) =	180.60 (3a)

143.00 57.20 (1b) 2.50 (2b) +1 Total floor area (1a) + (1b) + (1c) + (1d)...(1n) =129.44

323.60 (3a) + (3b) + (3c) + (3d)...(3n) =Dwelling volume (5)

2. Ventilation rate

Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	4	x 10 =	40	(7a)

Number of passive vents x 10 =0 Number of flueless gas fires 0 x 40 = 0

Air changes per hour

(6a) + (6b) + (7a) + (7b) + (7c) =40 \div (5) = 0.12 (8)Infiltration due to chimneys, flues, fans, PSVs

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

Apr

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

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

Number of sides on which the dwelling is sheltered (19)Shelter factor 1 - [0.075 x (19)] = 0.85 (20)

0.32 (21)

Infiltration rate incorporating shelter factor $(18) \times (20) =$

May

Infiltration rate modified for monthly wind speed:

Jul

Aug

Jan Feb

Monthly average	wind spee	d from Tab	le U2										
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)	m ÷ 4												
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltrat	ion rate (al	lowing for	shelter and	wind facto	or) (21) x (2	2a)m							

0.40 0.40 0.39 0.35 0.34 0.30 0.30 0.29 0.32 0.37 0.34 0.36 (22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system N/A (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h

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

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

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



N/A

(23c)

				Gross	Openings			U-value	A x U W		alue,	Ахк,	
			а	rea, m²	m²	A, m		W/m²K		kJ, —	/m².K	kJ/K	
Vindow						23.7	2 x	1.33	= 31.45				
Door						1.80) x [1.00	= 1.80				
Ground floor						72.2	4 x [0.13	= 9.39				
External wall						64.3	1 x [0.18	= 11.58				
Party wall						79.9	5 x	0.00	= 0.00				
Roof						17.6	2 x [0.13	= 2.29				
Total area of ex	ternal eleme	ents ∑A, m²	!			179.6	59						
Fabric heat loss,	, W/K = ∑(A	× U)							(26)(30) + (3	32) =	56.50	
Heat capacity C	m = ∑(A x к)							(28)	.(30) + (32) +	(32a)(32	2e) =	N/A	
Thermal mass p	arameter (T	MP) in kJ/n	n²K									250.00	
Thermal bridges	s: ∑(L x Ψ) ca	alculated us	sing Appen	dix K								9.46	
Total fabric hea	t loss									(33) + (3	36) =	65.96	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat	t loss calcula	ated month	ly 0.33 x (2	25)m x (5)									
	62.15	61.81	61.47	59.91	59.62	58.25	58.25	58.00	58.78	59.62	60.21	60.83	
Heat transfer co	efficient, W	//K (37)m +	- (38)m										
	128.11	127.77	127.44	125.87	125.58	124.22	124.22	123.96	124.74	125.58	126.17	126.79	
									Average = ∑	(39)112/	′12 = <u> </u>	125.87	
Heat loss param	neter (HLP),	W/m²K (39	9)m ÷ (4)										
	0.99	0.99	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.97	0.97	0.98	
									Average = ∑	(40)112/	′12 = <u> </u>	0.97	
Number of days	in month (Table 1a)											
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	
4. 10/-1													
4. Water heati		equiremen	t									2.00	
Assumed occup	ancy, N			(4)	(25 v. NV v.	26						2.89	
Assumed occup	ancy, N hot water u	ısage in litro	es per day '					Aug	Con	0.1		102.92	
Assumed occup Annual average	ancy, N hot water u Jan	ısage in litro Feb	es per day ' Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov		=
Assumed occup Annual average	ancy, N hot water u Jan e in litres pe	r day for ea	es per day ' Mar ach month	Apr Vd,m = fac	May tor from Tabl	Jun le 1c x (43)						102.92 Dec	
Assumed occup Annual average	ancy, N hot water u Jan	ısage in litro Feb	es per day ' Mar	Apr	May	Jun	Jul 92.63	Aug 96.75	Sep	104.98	109.10	102.92 Dec	
Assumed occup Annual average Hot water usage	ancy, N hot water u Jan e in litres pe 113.21	r day for ea	Mar ach month	Apr Vd,m = fac 100.86	May tor from Tabl	Jun le 1c x (43) 92.63	92.63	96.75			109.10	102.92 Dec	
Assumed occup Annual average Hot water usage	ancy, N hot water u Jan e in litres pe 113.21 of hot wate	r day for ea	Mar ch month 104.98	Apr Vd,m = fac 100.86	May tor from Tabl 96.75 3600 kWh/m	Jun le 1c x (43) 92.63 onth (see Ta	92.63 ables 1b,	96.75	100.86	104.98 ∑(44)1	109.10	102.92 Dec 113.21 1235.05	
Assumed occup Annual average Hot water usage	ancy, N hot water u Jan e in litres pe 113.21	r day for ea	Mar ach month	Apr Vd,m = fac 100.86	May tor from Tabl	Jun le 1c x (43) 92.63 onth (see Ta	92.63	96.75		104.98 Σ(44)1 137.17	109.10 12 = 149.73	102.92 Dec 113.21 1235.05	
Assumed occup Annual average Hot water usage Energy content	ancy, N hot water u Jan e in litres pe 113.21 of hot wate	r day for ea 109.10 r used = 4.1	Mar ch month 104.98	Apr Vd,m = fac 100.86	May tor from Tabl 96.75 3600 kWh/m	Jun le 1c x (43) 92.63 onth (see Ta	92.63 ables 1b,	96.75	100.86	104.98 ∑(44)1	109.10 12 = 149.73	102.92 Dec 113.21 1235.05	
Assumed occup Annual average Hot water usage Energy content	Jan e in litres pe 113.21 of hot wate 167.89	r day for ea 109.10 r used = 4.1 146.84	Mar Mar ach month 104.98 18 x Vd,m x 151.53	Apr Vd,m = fac 100.86 nm x Tm/ 132.10	May tor from Tabl 96.75 3600 kWh/m 126.76	Jun le 1c x (43) 92.63 onth (see Ta	92.63 ables 1b, 101.36	96.75 1c 1d) 116.31	100.86	104.98 Σ(44)1 137.17 Σ(45)1	109.10 12 = 149.73 12 =	102.92 Dec 113.21 1235.05 162.59 1619.35	
Assumed occup Annual average Hot water usage Energy content Distribution loss	ancy, N hot water u Jan e in litres pe 113.21 of hot wate 167.89 s 0.15 x (45) 25.18	r day for ea 109.10 r used = 4.1 146.84	Mar ach month 104.98 18 x Vd,m x 151.53	Apr Vd,m = fac 100.86 nm x Tm/ 132.10	May tor from Tabl 96.75 3600 kWh/m 126.76	Jun le 1c x (43) 92.63 onth (see Ta 109.38	92.63 ables 1b,	96.75	100.86	104.98 Σ(44)1 137.17	109.10 12 = 149.73	102.92 Dec 113.21 1235.05 162.59 1619.35	
Assumed occup Annual average Hot water usage Energy content Distribution loss	ancy, N hot water u Jan e in litres pe 113.21 of hot wate 167.89 s 0.15 x (45) 25.18 (litres) include	r day for ea 109.10 r used = 4.1 146.84	Mar ach month 104.98 18 x Vd,m x 151.53	Apr Vd,m = fac 100.86 nm x Tm/ 132.10	May tor from Tabl 96.75 3600 kWh/m 126.76	Jun le 1c x (43) 92.63 onth (see Ta 109.38	92.63 ables 1b, 101.36	96.75 1c 1d) 116.31	100.86	104.98 Σ(44)1 137.17 Σ(45)1	109.10 12 = 149.73 12 =	102.92 Dec 113.21 1235.05 162.59 1619.35	
Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage le	ancy, N hot water u Jan e in litres pe 113.21 of hot wate 167.89 s 0.15 x (45) 25.18 (litres) incluoss:	r day for ea 109.10 r used = 4.1 146.84)m 22.03 uding any so	Mar ach month 104.98 18 x Vd,m x 151.53	Apr Vd,m = fac 100.86 nm x Tm/ 132.10 19.82 /HRS storage	May tor from Table 96.75 3600 kWh/m 126.76 19.01 ge within sam	Jun le 1c x (43) 92.63 onth (see Ta 109.38	92.63 ables 1b, 101.36	96.75 1c 1d) 116.31	100.86	104.98 Σ(44)1 137.17 Σ(45)1	109.10 12 = 149.73 12 =	102.92	
Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage le	ancy, N hot water u Jan e in litres pe 113.21 of hot wate 167.89 s 0.15 x (45) 25.18 (litres) incluoss:	r day for ea 109.10 r used = 4.1 146.84)m 22.03 uding any so	Mar ach month 104.98 18 x Vd,m x 151.53	Apr Vd,m = fac 100.86 nm x Tm/ 132.10 19.82 /HRS storage	May tor from Table 96.75 3600 kWh/m 126.76 19.01 ge within sam	Jun le 1c x (43) 92.63 onth (see Ta 109.38	92.63 ables 1b, 101.36	96.75 1c 1d) 116.31	100.86	104.98 Σ(44)1 137.17 Σ(45)1	109.10 12 = 149.73 12 =	102.92 Dec 113.21 1235.05 162.59 1619.35	
Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage le	ancy, N hot water u Jan e in litres pe 113.21 of hot wate 167.89 s 0.15 x (45) 25.18 (litres) incluoss: rer's declare	r day for ea 109.10 r used = 4.3 146.84)m 22.03 uding any so	Mar ach month 104.98 18 x Vd,m x 151.53	Apr Vd,m = fac 100.86 nm x Tm/ 132.10 19.82 /HRS storage	May tor from Table 96.75 3600 kWh/m 126.76 19.01 ge within sam	Jun le 1c x (43) 92.63 onth (see Ta 109.38	92.63 ables 1b, 101.36	96.75 1c 1d) 116.31	100.86	104.98 Σ(44)1 137.17 Σ(45)1	109.10 12 = 149.73 12 =	102.92	
Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage le	ancy, N hot water u Jan e in litres pe 113.21 of hot wate 167.89 s 0.15 x (45) 25.18 (litres) incluoss: rer's declare	r day for ear 109.10 r used = 4.1 146.84 m 22.03 uding any so	Mar ach month 104.98 18 x Vd,m x 151.53 22.73 olar or WW	Apr Vd,m = fac 100.86 nm x Tm/ 132.10 19.82 /HRS storage (kWh/day)	May tor from Table 96.75 3600 kWh/m 126.76 19.01 ge within sam	Jun le 1c x (43) 92.63 onth (see Ta 109.38	92.63 ables 1b, 101.36	96.75 1c 1d) 116.31	100.86	104.98 Σ(44)1 137.17 Σ(45)1	109.10 12 = 149.73 12 =	102.92 Dec 113.21 1235.05 162.59 1619.35 24.39 3.00 0.26	
Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage la a) If manufacture Temperature	ancy, N hot water u Jan e in litres pe 113.21 of hot wate 167.89 s 0.15 x (45) 25.18 (litres) incluoss: rer's declared a factor from water s	r day for ear 109.10 r used = 4.1 146.84 m 22.03 uding any so	Mar ach month 104.98 18 x Vd,m x 151.53 22.73 olar or WW	Apr Vd,m = fac 100.86 nm x Tm/ 132.10 19.82 /HRS storage (kWh/day)	May tor from Table 96.75 3600 kWh/m 126.76 19.01 ge within sam	Jun le 1c x (43) 92.63 onth (see Ta 109.38	92.63 ables 1b, 101.36	96.75 1c 1d) 116.31	100.86	104.98 Σ(44)1 137.17 Σ(45)1	109.10 12 = 149.73 12 =	102.92 Dec 113.21 1235.05 162.59 1619.35 24.39 3.00 0.26 0.54	
Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage lea) If manufactur Temperature Energy lost f	ancy, N hot water u Jan e in litres pe 113.21 of hot wate 167.89 s 0.15 x (45) 25.18 (litres) incluoss: rer's declare e factor from water s 4) in (55)	r day for ear 109.10 r used = 4.1 146.84 m 22.03 uding any so ad loss factor Table 2b storage (kW	Mar ach month 104.98 18 x Vd,m x 151.53 22.73 blar or WW or is known	Apr Vd,m = fac 100.86 nm x Tm/ 132.10 19.82 /HRS storag (kWh/day) 8) x (49)	May tor from Table 96.75 3600 kWh/m 126.76 19.01 ge within sam	Jun le 1c x (43) 92.63 onth (see Ta 109.38	92.63 ables 1b, 101.36	96.75 1c 1d) 116.31	100.86	104.98 Σ(44)1 137.17 Σ(45)1	109.10 12 = 149.73 12 =	102.92 Dec 113.21 1235.05 162.59 1619.35 24.39 3.00 0.26 0.54 0.14	

0.58

0.58

0.58

0.56

0.56

0.55

0.55

0.54

0.55

0.56

0.56

0.57

(25)

If the vessel con	tains dedica	ated solar st	torage or de	edicated W	/WHRS (56)	m x [(47) -	Vs] ÷ (47),	else (56)					
	4.36	3.93	4.36	4.21	4.36	4.21	4.36	4.36	4.21	4.36	4.21	4.36	(57)
Primary circuit lo	oss for each	month fro	m Table 3						•			•	
	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 for ea	ach month		<u> </u>				•	•	•		1	•	_ ` `
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requi							l .	1	ļ.				
,	195.51	171.78	179.14	158.83	154.37	136.11	128.98	143.93	144.43	164.78	176.45	190.21	(62)
Solar DHW input			I			100.11		1 2 10.55		20 0	1 2700		
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from wa							0.00	0.00	0.00	0.00	0.00	0.00	(03)
	195.51	171.78	179.14	158.83	154.37	136.11	128.98	143.93	144.43	164.78	176.45	190.21	
	155.51	171.70	173.14	130.03	154.57	150.11	120.50	143.33	144.43	Σ(64)1	·	1944.53	」 【64】
Heat gains from	water heat	ing (k\N/h/m	onth) 0.25	v [0 85 v	(15)m ± (61	\m] + 0 8 v	[(46)m ± (57\m ± (50)	\ml	2(04)1	.12	1944.93	(04)
ricat gains nom	77.92	68.78	72.48	65.31	64.24	57.75	55.80	60.77	60.52	67.70	71.17	76.16	(65)
	77.92	00.76	72.40	05.51	04.24	37.73	33.80	60.77	00.52	67.70	/1.1/	76.16	(65)
5. Internal gain	ıs												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	(Table 5)												
	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	144.68	(66)
Lighting gains (ca	alculated in	Appendix l	., equation	L9 or L9a),	also see Ta	ıble 5						•	_
	26.97	23.96	19.48	14.75	11.03	9.31	10.06	13.07	17.55	22.28	26.00	27.72	(67)
Appliance gains	(calculated	in Appendi	x L, equatio	n L13 or L:	13a), also se	ee Table 5					1	1	
	297.04	300.13	292.36	275.82	254.95	235.33	222.22	219.14	226.91	243.45	264.32	283.94	(68)
Cooking gains (c	alculated in	Appendix I	_, equation	L15 or L15	a), also see	Table 5							_ ` '
00 (37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	37.47	(69)
Pump and fan ga			• • • • • • • • • • • • • • • • • • • •	07111	07	37111	0,,,,	07	1 07111	37	07117	07117	_ (00)
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evap			3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	_ (/0)
203363 6.8. 6444	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	-115.74	(71)
Water heating g			-115.74	-113.74	-115.74	-115.74	-113.74	-115.74	-113.74	-113.74	-113.74	-113.74	(/ 1)
water neating g	104.73	102.35	97.41	90.70	86.34	80.21	74.99	81.68	84.05	91.00	98.84	102.36	(72)
Total internal ga							74.99	01.00	64.03	91.00	90.04	102.30	(72)
TOtal Internal ga							276.60	202.20	207.04	426.42	450.57	402.42	7 (72)
	498.15	495.84	478.66	450.68	421.72	394.25	376.68	383.29	397.91	426.13	458.57	483.42	(73)
6. Solar gains													
			Access fa	actor	Area	Sol	ar flux		g	FF		Gains	
			Table	6d	m²	W	//m²	•	ific data	specific o		W	
									able 6b	or Table			_
South			0.77	' x	9.04	-			0.63 x			129.16	(78)
East			0.77	' x [10.68	x 1	9.64 x	0.9 x	0.63 x	0.70	=	64.10	(76)
SouthEast			0.77	' x	4.00	x 3	6.79 x	0.9 x	0.63 x	0.70	=	44.98	(77)
Solar gains in wa	atts ∑(74)m	ı(82)m											_
	238.25	413.56	580.81	735.63	831.97	827.72	797.40	726.43	635.18	461.64	286.91	202.82	(83)
Total gains - inte	ernal and so	lar (73)m +	(83)m										
	736.40	909.39	1059.47	1186.31	1253.69	1221.97	1174.08	1109.72	1033.09	887.77	745.48	686.24	(84)
7.00	-1.4												
7. Mean intern													
Temperature du	ring heatin	g periods in	the living a	rea from T	Table 9, Th1	.(°C)						21.00	(85)
											_		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor	for gains f	or living are	a n1,m (se	e Table 9a)									
	1.00	0.99	0.98	0.94	0.82	0.63	0.46	0.51	0.77	0.96	1.00	1.00	(86)
Mean internal te	emp of living	g area T1 (s	teps 3 to 7	in Table 9c)								
	19.95	20.14	20.40	20.69	20.90	20.98	21.00	21.00	20.95	20.66	20.24	19.92	(87)
Temperature du	ring heating	g periods in	the rest of	dwelling fr	om Table 9), Th2(°C)							
	20.09	20.09	20.10	20.11	20.11	20.12	20.12	20.12	20.11	20.11	20.10	20.10	(88)
Utilisation factor	for gains f	or rest of d	welling n2,r	m									
	1.00	0.99	0.98	0.91	0.77	0.55	0.37	0.41	0.69	0.95	0.99	1.00	(89)
Mean internal te	emperature	in the rest	of dwelling	T2 (follow	steps 3 to	7 in Table 9	9c)						
	18.68	18.96	19.33	19.75	20.01	20.11	20.12	20.12	20.07	19.72	19.12	18.64	(90)
Living area fracti	on								Li	ving area ÷	(4) =	0.30	(91)
Mean internal te	mperature	for the wh	ole dwellin	g fLA x T1 +	(1 - fLA) x T	72							_
	19.06	19.31	19.65	20.03	20.28	20.37	20.38	20.38	20.34	20.00	19.46	19.03	(92)
Apply adjustmer	nt to the me	ean internal	temperatu	ire from Tal	ble 4e whe	re appropr	riate						_
	19.06	19.31	19.65	20.03	20.28	20.37	20.38	20.38	20.34	20.00	19.46	19.03	(93)
8. Space heatin	g requirem	ent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor	for gains, i	ηm											
	1.00	0.99	0.97	0.91	0.78	0.58	0.40	0.44	0.71	0.94	0.99	1.00	(94)
Useful gains, ηm	Gm, W (94	l)m x (84)m											
	734.27	901.01	1029.58	1083.14	978.76	703.13	468.45	491.21	734.73	838.13	739.84	684.88	(95)
Monthly average	e external to	emperature	from Table	e U1									
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate fo	r mean inte	ernal tempe	rature, Lm,	W [(39)m	x [(93)m -	(96)m]							
	1891.51	1841.60	1676.03	1401.38	1077.08	716.73	469.81	493.65	778.09	1180.93	1559.03	1879.87	(97)
Space heating re	quirement,	, kWh/mon	th 0.024 x	[(97)m - (95	5)m] x (41)r	m							
	860.99	632.07	480.96	229.13	73.15	0.00	0.00	0.00	0.00	255.05	589.81	889.07	
									∑(9	8)15, 10	.12 = 4	4010.24	(98)
Space heating re	quirement	kWh/m²/ye	ear							(98)	÷ (4)	30.98	(99)
9a. Energy requ	uirements -	individual	heating sys	tems inclu	ding micro	CHD							
Space heating	arrements -	muividuai	neating sys	items inclu	unig inicio	-CHF							
Fraction of space	a heat from	secondary	/sunnlamer	ntary systen	n (table 11	,						0.00	(201)
Fraction of space				italy system	ii (table 11	,				1 - (2	01) =	1.00	(202)
Fraction of space										1 (2	01, - <u> </u>	0.00	(202)
Fraction of total									(20	02) x [1- (20	3)] =	1.00	(204)
Fraction of total									(2)	(202) x (20		0.00	(205)
Efficiency of mai			3,510							(202) // (2	-	93.50	(206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	_ (===)
Space heating fu	el (main sy	stem 1), kW	/h/month		•			Ü	•				
	920.84	676.02	514.39	245.06	78.24	0.00	0.00	0.00	0.00	272.78	630.82	950.88]
		0.0.0					0.00			1)15, 10		4289.02	(211)
Water heating									۷-1	,,			_ (- /
Efficiency of wat	er heater												
,	88.31	87.98	87.32	85.79	82.95	79.80	79.80	79.80	79.80	85.98	87.79	88.41	(217)
Water heating fu				-			-	-				1	. ,

	221.39 195.26 205.15 185.14	186.10 170.56 161	62 180	0.36 180.98	191.66 201	1.00 215.15	
					∑(219a)112 =	2294.37	(219)
Annual totals							
Space heating for	uel - main system 1					4289.02	
Water heating f	fuel					2294.37	
Electricity for pu	umps, fans and electric keep-hot (Table 4f)				'		_
central heati	ing pump or water pump within warm air hea	ting unit		30.00			(230c)
boiler flue fa		J		45.00			(230e)
Total electricity	for the above, kWh/year					75.00	(231)
•	ghting (Appendix L)					476.33	(232)
	energy for all uses		(211)	(221) + (231) + ((232)(237b) =	7134.73	(238)
	(,				, (,		
10a. Fuel costs	s - individual heating systems including micro	-СНР					
		Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating -	main system 1	4289.02	x	3.48	x 0.01 =	149.26	(240)
Water heating		2294.37	x	3.48	x 0.01 =	79.84	(247)
Pumps and fans	S	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lig	ghting	476.33	x	13.19	x 0.01 =	62.83	(250)
Additional stand	ding charges					120.00	(251)
Total energy cos	st			(240)(242) +	(245)(254) =	421.82	(255)
11a. SAP rating	g - individual heating systems including micro	o-CHP					
Energy cost defl	lator (Table 12)					0.42	(256)
Energy cost fact	tor (ECF)					1.02	(257)
CADvalue						85.83	
SAP value						65.65	_
SAP rating (sect	tion 13)					86	(258)
	tion 13)						(258)
SAP rating (sect	tion 13) sions - individual heating systems including n	nicro-CHP				86	(258)
SAP rating (sect		nicro-CHP Energy kWh/year		Emission factor kg CO ₂ /kWh		86	(258)
SAP rating (sect	sions - individual heating systems including n	Energy	x		=	86 B	(258)
SAP rating (sect SAP band 12a. CO ₂ emiss	sions - individual heating systems including n	Energy kWh/year	x x	kg CO₂/kWh	= =	B Emissions kg CO ₂ /year	
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating -	sions - individual heating systems including n main system 1	Energy kWh/year 4289.02		kg CO ₂ /kWh	=	B Emissions kg CO ₂ /year 926.43	(261)
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating - Water heating	sions - individual heating systems including n main system 1 er heating	Energy kWh/year 4289.02		kg CO ₂ /kWh 0.216 0.216	=	B Emissions kg CO ₂ /year 926.43 495.58	(261)
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating - Water heating Space and wate	sions - individual heating systems including n main system 1 er heating	Energy kWh/year 4289.02 2294.37	x	kg CO ₂ /kWh 0.216 0.216 (261) + (262) +	= (263) + (264) =	86 B Emissions kg CO ₂ /year 926.43 495.58 1422.01	(261) (264) (265)
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating - Water heating Space and wate Pumps and fans	sions - individual heating systems including n main system 1 er heating s ghting	Energy kWh/year 4289.02 2294.37	x x	kg CO ₂ /kWh 0.216 0.216 (261) + (262) + 0.519	= (263) + (264) = =	86 B Emissions kg CO ₂ /year 926.43 495.58 1422.01 38.93	(261) (264) (265) (267)
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating - Water heating Space and wate Pumps and fans Electricity for light	sions - individual heating systems including normal main system 1 er heating sighting ear	Energy kWh/year 4289.02 2294.37	x x	kg CO ₂ /kWh 0.216 0.216 (261) + (262) + 0.519	= (263) + (264) = = =	86 B Emissions kg CO ₂ /year 926.43 495.58 1422.01 38.93 247.22	(261) (264) (265) (267) (268)
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating - Water heating Space and wate Pumps and fans Electricity for lig Total CO ₂ , kg/ye	sions - individual heating systems including normal main system 1 er heating sighting ear	Energy kWh/year 4289.02 2294.37	x x	kg CO ₂ /kWh 0.216 0.216 (261) + (262) + 0.519	= (263) + (264) = = = (265)(271) =	86 B Emissions kg CO ₂ /year 926.43 495.58 1422.01 38.93 247.22 1708.16	(261) (264) (265) (267) (268) (272)
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating - Water heating Space and wate Pumps and fans Electricity for lig Total CO ₂ , kg/ye Dwelling CO ₂ en	sions - individual heating systems including name of the main system 1 er heating sighting the mission rate	Energy kWh/year 4289.02 2294.37	x x	kg CO ₂ /kWh 0.216 0.216 (261) + (262) + 0.519	= (263) + (264) = = = (265)(271) =	86 B Emissions kg CO ₂ /year 926.43 495.58 1422.01 38.93 247.22 1708.16 13.20	(261) (264) (265) (267) (268) (272)
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating - Water heating Space and wate Pumps and fans Electricity for lig Total CO ₂ , kg/ye Dwelling CO ₂ en	sions - individual heating systems including name of the main system 1 er heating sighting the mission rate	Energy kWh/year 4289.02 2294.37	x x	kg CO ₂ /kWh 0.216 0.216 (261) + (262) + 0.519	= (263) + (264) = = = (265)(271) =	86 B Emissions kg CO ₂ /year 926.43 495.58 1422.01 38.93 247.22 1708.16 13.20 86.88	(261) (264) (265) (267) (268) (272) (273)
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating - Water heating Space and wate Pumps and fans Electricity for lig Total CO ₂ , kg/ye Dwelling CO ₂ en El value El rating (section El band	sions - individual heating systems including n main system 1 er heating s ghting ear mission rate	Energy kWh/year 4289.02 2294.37 75.00 476.33	x x	kg CO ₂ /kWh 0.216 0.216 (261) + (262) + 0.519	= (263) + (264) = = = (265)(271) =	86 B Emissions kg CO ₂ /year 926.43 495.58 1422.01 38.93 247.22 1708.16 13.20 86.88 87	(261) (264) (265) (267) (268) (272) (273)
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating - Water heating Space and wate Pumps and fans Electricity for lig Total CO ₂ , kg/ye Dwelling CO ₂ en El value El rating (section El band	sions - individual heating systems including name of the main system 1 er heating sighting the mission rate	Energy kWh/year 4289.02 2294.37 75.00 476.33	x x	kg CO ₂ /kWh 0.216 0.216 (261) + (262) + 0.519 0.519	= (263) + (264) = = = (265)(271) = (272) ÷ (4) =	86 B Emissions kg CO ₂ /year 926.43 495.58 1422.01 38.93 247.22 1708.16 13.20 86.88 87 B	(261) (264) (265) (267) (268) (272) (273) (274)
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating - Water heating Space and wate Pumps and fans Electricity for lig Total CO ₂ , kg/ye Dwelling CO ₂ en El value El rating (section El band	sions - individual heating systems including n main system 1 er heating s ghting ear mission rate	Energy kWh/year 4289.02 2294.37 75.00 476.33	x x	kg CO ₂ /kWh 0.216 0.216 (261) + (262) + 0.519	= (263) + (264) = = = (265)(271) = (272) ÷ (4) =	86 B Emissions kg CO ₂ /year 926.43 495.58 1422.01 38.93 247.22 1708.16 13.20 86.88 87	(261) (264) (265) (267) (268) (272) (273) (274)
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating - Water heating Space and wate Pumps and fans Electricity for lig Total CO ₂ , kg/ye Dwelling CO ₂ en El value El rating (section El band	main system 1 er heating s ghting ear mission rate on 14) energy - individual heating systems including	Energy kWh/year 4289.02 2294.37 75.00 476.33	x x	kg CO ₂ /kWh 0.216 0.216 (261) + (262) + 0.519 0.519	= (263) + (264) = = = (265)(271) = (272) ÷ (4) =	86 B Emissions kg CO ₂ /year 926.43 495.58 1422.01 38.93 247.22 1708.16 13.20 86.88 87 B	(261) (264) (265) (267) (268) (272) (273) (274)
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating - Water heating Space and water Pumps and fanse Electricity for light Total CO ₂ , kg/ye Dwelling CO ₂ enter the section of th	main system 1 er heating s ghting ear mission rate on 14) energy - individual heating systems including	Energy kWh/year 4289.02 2294.37 75.00 476.33 micro-CHP Energy kWh/year	x x x	kg CO ₂ /kWh 0.216 0.216 (261) + (262) + 0.519 0.519 Primary factor	= (263) + (264) = = = (265)(271) = (272) ÷ (4) =	86 B Emissions kg CO ₂ /year 926.43 495.58 1422.01 38.93 247.22 1708.16 13.20 86.88 87 B Primary Energy kWh/year	(261) (264) (265) (267) (268) (272) (273)
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating - Water heating Space and wate Pumps and fans Electricity for lig Total CO ₂ , kg/ye Dwelling CO ₂ en El value El rating (section El band 13a. Primary e	main system 1 er heating s ghting ear mission rate en 14) energy - individual heating systems including main system 1	Energy kWh/year 4289.02 2294.37 75.00 476.33 micro-CHP Energy kWh/year 4289.02	x x x	kg CO ₂ /kWh 0.216 (261) + (262) + 0.519 0.519 Primary factor 1.22 1.22	= (263) + (264) = = = (265)(271) = (272) ÷ (4) =	86 B Emissions kg CO ₂ /year 926.43 495.58 1422.01 38.93 247.22 1708.16 13.20 86.88 87 B Primary Energy kWh/year 5232.61	(261) (264) (265) (267) (268) (272) (273) (274)
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating - Water heating Space and water Pumps and fans Electricity for light Total CO ₂ , kg/ye Dwelling CO ₂ emiss El value El rating (section El band 13a. Primary emiss Space heating - Water heating	main system 1 er heating sighting ear mission rate en 14) energy - individual heating systems including main system 1	Energy kWh/year 4289.02 2294.37 75.00 476.33 micro-CHP Energy kWh/year 4289.02	x x x	kg CO ₂ /kWh 0.216 (261) + (262) + 0.519 0.519 Primary factor 1.22 1.22	= (263) + (264) = = = (265)(271) = (272) ÷ (4) =	86 B Emissions kg CO ₂ /year 926.43 495.58 1422.01 38.93 247.22 1708.16 13.20 86.88 87 B Primary Energy kWh/year 5232.61 2799.13	(261) (264) (265) (267) (268) (272) (273) (274) (261) (264)
SAP rating (sect SAP band 12a. CO ₂ emiss Space heating - Water heating Space and wate Pumps and fans Electricity for lig Total CO ₂ , kg/ye Dwelling CO ₂ en El value El rating (section El band 13a. Primary e Space heating - Water heating Space and wate	main system 1 er heating sighting ear mission rate en 14) energy - individual heating systems including main system 1	Energy kWh/year 4289.02 2294.37 75.00 476.33 micro-CHP Energy kWh/year 4289.02 2294.37	x x x	Ng CO ₂ /kWh 0.216 0.216 (261) + (262) + 0.519 0.519 Primary factor 1.22 1.22 (261) + (262) +	= (263) + (264) = = = (265)(271) = (272) ÷ (4) = = = = (263) + (264) =	86 B Emissions kg CO ₂ /year 926.43 495.58 1422.01 38.93 247.22 1708.16 13.20 86.88 87 B Primary Energy kWh/year 5232.61 2799.13 8031.74	(261) (264) (265) (267) (268) (272) (273) (274) (261) (264) (265)

Electricity for lighting

Primary energy kWh/year

Dwelling primary energy rate kWh/m2/year

476.33

3.07

1462.34

9724.33 (27

(268)

75.13 (273)

SAP version 9.92

Appendix C DER Worksheets – Be Lean

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	1B2P, Kingston upon Thames, KT1		

Cheffe						2000 1110 011		30,0	3/2020	
Address	1B2P, Kingston upon	Thames, KT1	L							
1. Overall dwelling dimer	isions									
			Area (m²	²)		Average sto height (m	-	V	olume (m³)	
owest occupied			51.12	(1a)	x	2.50	(2a) =		127.80	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n)	= 51.12	(4)						
Owelling volume						(3a) + (3b) +	+ (3c) + (3d)(3	3n) =	127.80	(5)
2. Ventilation rate										
								n	n³ per hour	
Number of chimneys						0	x 40 =	=	0	(6a
lumber of open flues						0	x 20 =	=	0	(6b
Number of intermittent far	ıs					0	x 10 =	=	0	(7a
lumber of passive vents						0	x 10 =	=	0	(7b
lumber of flueless gas fire	S					0	x 40 =	=	0	(7c
								Air	changes pe hour	r
nfiltration due to chimney	s, flues, fans, PSVs		(6a) + (6b)	+ (7a) + (7	b) + (7c) =	0	÷ (5) =	=	0.00	(8)
f a pressurisation test has	been carried out or is in	tended, proce	eed to (17), oth	erwise co	ntinue froi	m (9) to (16)				
Air permeability value, q50	, expressed in cubic me	tres per hour	per square me	etre of env	elope are	a			3.00	(17
based on air permeability	y value, then (18) = [(17)) ÷ 20] + (8), d	otherwise (18)	= (16)					0.15	(18
lumber of sides on which	the dwelling is sheltered	d							1	(19
helter factor							1 - [0.075 x (1	.9)] =	0.93	(20
nfiltration rate incorporati	ng shelter factor						(18) x (20) =	0.14	(21
nfiltration rate modified fo	or monthly wind speed:									
Jan	Feb Mar	Apr	May Jur	n Ji	ul <i>A</i>	Aug Sep	Oct	Nov	Dec	
Monthly average wind spe	ed from Table U2									
5.10	5.00 4.90	4.40	4.30 3.8	0 3.	80 3	3.70 4.00	4.30	4.50	4.70	(22
Vind factor (22)m ÷ 4										
1.28	1.25 1.23	1.10	1.08 0.9	5 0.	95 0	0.93 1.00	1.08	1.13	1.18	(22
Adjusted infiltration rate (a	allowing for shelter and	wind factor)	(21) x (22a)m							

	• • • • • • • • • • • • • • • • • • • •					• • • • • • • • • • • • • • • • • • • •	• • • • •						
Monthly average	wind spee	d from Tab	le U2										
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)	m ÷ 4												
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltrat	ion rate (a	llowing for	shelter and	wind facto	or) (21) x (2	2a)m							
	0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16	(22b)
Calculate effective	ve air chang	ge rate for t	he applica	ble case:									
If mechanical	ventilation	ı: air change	e rate thro	ugh system								0.50	(23a)
If halanced w	ith heat red	overv effic	riency in %	allowing fo	or in-use fac	tor from Ta	ahle 4h					75.65	(23c)

If mechanical	If mechanical ventilation: air change rate through system											0.50	(23a)
If balanced w	If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h											75.65	(23c)
a) If balanced	l mechanica	al ventilatio	n with hea	t recovery ((MVHR) (22	2b)m + (23b) x [1 - (23c	c) ÷ 100]					
	0.30	0.30	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.28	(24a)
Effective air char	nge rate - e	nter (24a) (or (24b) or ((24c) or (24	d) in (25)								
	0.30	0.30	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.28	(25)



3. Heat losses a	ınd <u>heat lo</u>	ss para <u>met</u>	er										
Element				Gross area, m²	Openings m ²		area m²	U-value W/m²K	AxUW	/K κ-val	-	Αxκ, kJ/K	
Window						8.	18 x	1.24	= 10.11				(27)
Door						1.	.80 x	0.60	= 1.08				(26)
Ground floor						51	12 x	0.10	= 5.11				(28a
External wall						18	.25 x	0.17	= 3.10				(29a
Party wall						17	'.80 x	0.00	= 0.00				(32)
External wall						25	.45 x	0.15	= 3.82				(29a
External wall						2.	.70 x	0.20	= 0.54				(29a
Total area of ext	ernal elem	ents ∑A, m²				107	7.50						(31)
Fabric heat loss,	W/K = ∑(A	× U)							(26	5)(30) + (32)) =	23.76	(33)
Heat capacity Cn	n = Σ(A x κ))						(28)	(30) + (32) -	+ (32a)(32e)) =	N/A	(34)
Thermal mass pa	rameter (TMP) in kJ/n	n²K									250.00	(35)
Thermal bridges:	: Σ(L x Ψ) c	alculated us	ing Apper	ıdix K								8.51	(36)
Total fabric heat	loss									(33) + (36)) =	32.27	(37)
Ventilation heat	Jan loss calcul	Feb ated month	Mar ly 0.33 x (Apr 25)m x (5)	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	12.60	12.45	12.30	11.57	11.43	10.69	10.69	10.55	10.99	11.43	11.72	12.01	(38)
Heat transfer coe	efficient, V	V/K (37)m +	· (38)m										` ` ′
	44.86	44.72	44.57	43.84	43.69	42.96	42.96	42.82	43.26	43.69	43.99	44.28	7
		1		1	1				Average = 2	(39)112/12	2 =	43.80	
Heat loss parame	eter (HLP),	W/m ² K (39	9)m ÷ (4)										
	0.88	0.87	0.87	0.86	0.85	0.84	0.84	0.84	0.85	0.85	0.86	0.87	
									Average = \(\)	(40)112/12	2 =	0.86	(40)
Number of days	in month (31.00	Table 1a) 28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
4. Water heating	ng energy i	requiremen	t										_
Assumed occupa	-											1.72	(42)
Annual average h		-	es per day	Vd,average		36						75.12	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage								1					_
	82.64	79.63	76.63	73.62	70.62	67.61	67.61	70.62	73.62		79.63	82.64	
F	£ 1 1 1 -		0		2500 bank /		T-1-1 41-	. 4 - 4 - 1\		∑(44)112	! =	901.49	(44)
Energy content of									1 05 04	100.10		1 110 50	\neg
	122.55	107.18	110.60	96.42	92.52	79.84	73.98	84.90	85.91		109.29	118.68	=
Distribution loss	0 1E v /4E	lm.								∑(45)112	! =	1181.99	(45)
Distribution loss	-		16.50	14.46	12.00	11.00	11 10	12.72	12.00	15.02	16.20	17.00	140
Storage volume ((litres) incl	16.08	16.59	14.46	13.88	11.98	11.10	12.73	12.89	15.02	16.39	3.00	(46)
Water storage lo		uunig afiy so	יומו טו ۷۷۷	Storas	ge within sar	ne vessel						5.00	(47)
b) Manufacturer		l loss factor	is not kno	wn									
Hot water sto					nv)							0.02	(51)
Volume facto	_		1 avic 2 (K)	vii) iiti e/ud	· y <i>)</i>							3.42	(51)
Temperature												0.60	(52) (53)
Energy lost fr			/h/dav/\ /4	7) y (51) v (52) x (52)							0.60	(53) (54)
		storage (KW	11/udy) (4	,) У (ЭТ) X (JZJ X (33)								=
Enter (50) or (54)) III (55)											0.13	(55)

water storage I	oss calculat	ed for each	month (55	5) x (41)m									
	4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)
If the vessel cor	ntains dedic	ated solar st	torage or c	dedicated V	VWHRS (56)	m x [(47) -	Vs] ÷ (47),	else (56)					_
	4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)
Primary circuit l	oss for each	h month fro	m Table 3	•	•							•	-
	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 for e	each month	from Table	3a, 3b or 3	3c	'			1					
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requi	ired for wat	ter heating c	calculated f	for each mo	onth 0.85 x	(45)m + (4	6)m + (57)ı	m + (59)m	+ (61)m				
	149.85	131.84	137.90	122.85	119.83	106.26	101.29	112.20	112.33	127.42	135.71	145.98	(62)
Solar DHW inpu		1		1									, ,
·	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from wa		ļ			ļ.	<u> </u>			A] (/
	149.85	131.84	137.90	122.85	119.83	106.26	101.29	112.20	112.33	127.42	135.71	145.98	1
	2.5.65	1 202.01			1 223.00	200.20	102.23		111.55	∑(64)1		503.47	(64)
Heat gains from	ı water heat	ting (kWh/m	nonth) 0.2	5 × [0.85 ×	(45)m + (61	.)ml + 0.8 ×	: [(46)m + (57)m + (59))m]	2(01)1		.505.17] (0 .)
	62.59	55.37	58.62	53.20	52.61	47.68	46.44	50.07	49.70	55.13	57.48	61.30	(65)
	02.55	33.37	30.02	33.20	32.01	47.00	40.44	30.07	43.70	33.13	37.40	01.50] (03)
5. Internal gain	ns												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	(Table 5)												
	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	86.16	(66)
Lighting gains (d	calculated ir	ո Appendix I	L, equation	1 L9 or L9a),	, also see Ta	ble 5							
	13.96	12.40	10.09	7.64	5.71	4.82	5.21	6.77	9.08	11.54	13.46	14.35	(67)
Appliance gains	(calculated	in Appendi:	x L, equation	on L13 or L	13a), also se	ee Table 5							
	150.14	151.70	147.77	139.42	128.87	118.95	112.32	110.77	114.69	123.05	133.60	143.52	(68)
Cooking gains (d	calculated ir	n Appendix I	L, equation	າ L15 or L15	sa), also see	Table 5							-
	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	31.62	(69)
Pump and fan g	ains (Table	5a)							•				
	0.00	1 0 00											
Losses e.g. evap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
		-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
	ooration (Ta	ible 5)											1
Water heating g	ooration (Ta	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92] (70)] (71)
Water heating g	-68.92 gains (Table	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	(71)
	-68.92 gains (Table	-68.92 -5) 82.39	-68.92 78.79	-68.92 73.89	-68.92 70.71	-68.92 66.23							1
Water heating g	-68.92 gains (Table 84.13 ains (66)m	-68.92 -68.92 -5) 82.39 + (67)m + (6	-68.92 78.79 58)m + (69)	-68.92 73.89 m + (70)m	-68.92 70.71 + (71)m +	-68.92 66.23 72)m	-68.92 62.42	-68.92 67.30	-68.92 69.03	-68.92 74.10	-68.92 79.83	-68.92 82.40] (71)] (72)
	-68.92 gains (Table	-68.92 -5) 82.39	-68.92 78.79	-68.92 73.89	-68.92 70.71	-68.92 66.23	-68.92	-68.92	-68.92	-68.92	-68.92	-68.92	(71)
	-68.92 gains (Table 84.13 ains (66)m	-68.92 -68.92 -5) 82.39 + (67)m + (6	-68.92 78.79 58)m + (69)	-68.92 73.89 m + (70)m	-68.92 70.71 + (71)m +	-68.92 66.23 72)m	-68.92 62.42	-68.92 67.30	-68.92 69.03	-68.92 74.10	-68.92 79.83	-68.92 82.40] (71)] (72)
Total internal ga	-68.92 gains (Table 84.13 ains (66)m	-68.92 -68.92 -5) 82.39 + (67)m + (6	-68.92 78.79 68)m + (69) 285.49	-68.92 73.89 m + (70)m 269.79	-68.92 70.71 + (71)m +	-68.92 66.23 72)m 238.84	-68.92 62.42 228.80	-68.92 67.30 233.68	-68.92 69.03 241.66	-68.92 74.10 257.54	-68.92 79.83 275.74	-68.92 82.40 289.11] (71)] (72)
Total internal ga	-68.92 gains (Table 84.13 ains (66)m	-68.92 -68.92 -5) 82.39 + (67)m + (6	-68.92 78.79 68)m + (69) 285.49	-68.92 73.89 m + (70)m 269.79	-68.92 70.71 + (71)m +	-68.92 66.23 72)m 238.84	-68.92 62.42 228.80	-68.92 67.30 233.68	-68.92 69.03 241.66	-68.92 74.10 257.54	-68.92 79.83 275.74	-68.92 82.40 289.11] (71)] (72)
Total internal ga	-68.92 gains (Table 84.13 ains (66)m	-68.92 -68.92 -5) 82.39 + (67)m + (6	-68.92 78.79 68)m + (69) 285.49 Access f	-68.92 73.89 m + (70)m 269.79	-68.92 70.71 + (71)m +	-68.92 66.23 72)m 238.84	-68.92 62.42 228.80 ar flux V/m²	-68.92 67.30 233.68 spec	-68.92 69.03 241.66 g cific data Table 6b	-68.92 74.10 257.54 FF specific c or Table	-68.92 79.83 275.74	-68.92 82.40 289.11 Gains W] (71)] (72)] (73)
Total internal ga	eoration (Ta -68.92 gains (Table 84.13 ains (66)m 297.08	-68.92 -68.92 -5) -82.39 + (67)m + (6 	-68.92 78.79 68)m + (69) 285.49	-68.92 73.89 m + (70)m 269.79	-68.92 70.71 + (71)m +	-68.92 66.23 72)m 238.84	-68.92 62.42 228.80 ar flux V/m²	-68.92 67.30 233.68 spec	69.03 241.66 g cific data	-68.92 74.10 257.54 FF specific c or Table	-68.92 79.83 275.74	-68.92 82.40 289.11] (71)] (72)
Total internal ga	ooration (Ta -68.92 gains (Table 84.13 ains (66)m 297.08	-68.92 -68.92 -55) 82.39 + (67)m + (6 295.34	-68.92 78.79 68)m + (69) 285.49 Access 6 Table	-68.92 73.89 m + (70)m 269.79 factor e 6d	-68.92 70.71 + (71)m + (71)m	-68.92 66.23 72)m 238.84 Sol	-68.92 62.42 228.80 ar flux V/m²	-68.92 67.30 233.68 spec or 1	-68.92 69.03 241.66 g cific data Table 6b 0.45	-68.92 74.10 257.54 FF specific c or Table 0.70	-68.92 79.83 275.74 lata 6c =	-68.92 82.40 289.11 Gains W] (71)] (72)] (73)
Total internal ga 6. Solar gains West Solar gains in w	ooration (Ta -68.92 gains (Table 84.13 ains (66)m 297.08 atts Σ(74)m 35.07	-68.92 -68.92 -55 -82.39 -+ (67)m + (6 295.34	-68.92 78.79 68)m + (69) 285.49 Access f Table 0.7	-68.92 73.89 m + (70)m 269.79	-68.92 70.71 + (71)m +	-68.92 66.23 72)m 238.84	-68.92 62.42 228.80 ar flux V/m²	-68.92 67.30 233.68 spec	-68.92 69.03 241.66 g cific data Table 6b	-68.92 74.10 257.54 FF specific c or Table	-68.92 79.83 275.74	-68.92 82.40 289.11 Gains W] (71)] (72)] (73)
Total internal ga	atts Σ(74)m 35.07 ernal and sc	n:(82)m 68.61 65) -68.92 -75) 82.39 + (67)m + (6 295.34	-68.92 78.79 68)m + (69) 285.49 Access t Table 0.7 112.98	-68.92 73.89 m + (70)m 269.79 factor e 6d 7 x 164.78	-68.92 70.71 + (71)m + (72) 254.13 Area m ² 8.18	-68.92 66.23 72)m 238.84 Sol V	-68.92 62.42 228.80 ar flux V/m ² 9.64 x	-68.92 67.30 233.68 spec or 7 0.9 x	-68.92 69.03 241.66 g cific data Table 6b 0.45	-68.92 74.10 257.54 FF specific c or Table 0.70 81.41	-68.92 79.83 275.74 lata 6c = 43.73	-68.92 82.40 289.11 Gains W 35.07] (71)] (72)] (73)] (80)] (83)
Total internal ga 6. Solar gains West Solar gains in w	ooration (Ta -68.92 gains (Table 84.13 ains (66)m 297.08 atts Σ(74)m 35.07	-68.92 -68.92 -55 -82.39 -+ (67)m + (6 295.34	-68.92 78.79 68)m + (69) 285.49 Access f Table 0.7	-68.92 73.89 m + (70)m 269.79 factor e 6d	-68.92 70.71 + (71)m + (71)m	-68.92 66.23 72)m 238.84 Sol	-68.92 62.42 228.80 ar flux V/m²	-68.92 67.30 233.68 spec or 1	-68.92 69.03 241.66 g cific data Table 6b 0.45	-68.92 74.10 257.54 FF specific c or Table 0.70	-68.92 79.83 275.74 lata 6c =	-68.92 82.40 289.11 Gains W] (71)] (72)] (73)
Total internal ga 6. Solar gains West Solar gains in w	atts Σ(74)m 35.07 ernal and so	nible 5) -68.92 -68.92 -68.92 -68.92 -7.00 -68.39 + (67)m + (6 -7.00 -	-68.92 78.79 68)m + (69) 285.49 Access (Table 0.7 112.98 (83)m 398.48	-68.92 73.89 m + (70)m 269.79 factor 6d 7 x 164.78	-68.92 70.71 + (71)m + (72) 254.13 Area m ² 8.18	-68.92 66.23 72)m 238.84 Sol V	-68.92 62.42 228.80 ar flux V/m ² 9.64 x	-68.92 67.30 233.68 spec or 7 0.9 x	-68.92 69.03 241.66 g cific data Table 6b 0.45	-68.92 74.10 257.54 FF specific c or Table 0.70 81.41	-68.92 79.83 275.74 lata 6c = 43.73	-68.92 82.40 289.11 Gains W 35.07] (71)] (72)] (73)] (80)] (83)
Total internal ga 6. Solar gains West Solar gains in w Total gains - internal gains	atts Σ(74)m 35.07 all tempera	n(82)m 68.61 68.95 82.39 + (67)m + (6 295.34 68.61 colar (73)m + 363.95	-68.92 78.79 68)m + (69) 285.49 Access t Table 0.7 112.98 (83)m 398.48	-68.92 73.89 m + (70)m 269.79 factor 6d 7 x 164.78	-68.92 70.71 + (71)m + (72) 254.13 Area m² 8.18 201.94	-68.92 66.23 72)m 238.84 Sol V x 1 206.73	-68.92 62.42 228.80 ar flux V/m ² 9.64 x	-68.92 67.30 233.68 spec or 7 0.9 x	-68.92 69.03 241.66 g cific data Table 6b 0.45	-68.92 74.10 257.54 FF specific c or Table 0.70 81.41	-68.92 79.83 275.74 lata 6c = 43.73	-68.92 82.40 289.11 Gains W 35.07] (71)] (72)] (73)] (80)] (83)] (84)
Total internal ga 6. Solar gains West Solar gains in w Total gains - internal gains	atts Σ(74)m 35.07 all tempera	n(82)m 68.61 68.95 82.39 + (67)m + (6 295.34 68.61 colar (73)m + 363.95	-68.92 78.79 68)m + (69) 285.49 Access t Table 0.7 112.98 (83)m 398.48	-68.92 73.89 m + (70)m 269.79 factor 6d 7 x 164.78	-68.92 70.71 + (71)m + (72) 254.13 Area m² 8.18 201.94	-68.92 66.23 72)m 238.84 Sol V x 1 206.73	-68.92 62.42 228.80 ar flux V/m ² 9.64 x	-68.92 67.30 233.68 spec or 7 0.9 x	-68.92 69.03 241.66 g cific data Table 6b 0.45	-68.92 74.10 257.54 FF specific c or Table 0.70 81.41	-68.92 79.83 275.74 lata 6c = 43.73	-68.92 82.40 289.11 Gains W 35.07 28.84] (71)] (72)] (73)] (80)] (83)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains		1				I -	T			1		7
1.00	0.99	0.98	0.93	0.81	0.61	0.44	0.49	0.75	0.96	0.99	1.00	(86)
Mean internal temp of living 20.19	20.31	20.51	20.76	20.93	20.99	21.00	21.00	20.97	20.75	20.43	20.17	(87)
Temperature during heating	-					21.00	21.00	20.97	20.73	20.43	20.17	(07)
20.19	20.19	20.19	20.20	20.21	20.22	20.22	20.22	20.21	20.21	20.20	20.20	(88)
Utilisation factor for gains	-		1									_ (00)
1.00	0.99	0.98	0.91	0.76	0.54	0.36	0.41	0.68	0.94	0.99	1.00	(89)
Mean internal temperatur	e in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	Эс)	•			•		
19.10	19.27	19.56	19.92	20.14	20.21	20.22	20.22	20.19	19.92	19.46	19.09	(90)
Living area fraction								Liv	ving area ÷	(4) =	0.47	(91)
Mean internal temperatur	e for the wh	ole dwellin	g fLA x T1 +	(1 - fLA) x 1	Γ2							
19.62	19.76	20.01	20.32	20.51	20.58	20.59	20.59	20.55	20.31	19.92	19.60	(92)
Apply adjustment to the m	nean interna	l temperati	ure from Tal	ble 4e whe	ere appropr	iate						
19.62	19.76	20.01	20.32	20.51	20.58	20.59	20.59	20.55	20.31	19.92	19.60	(93)
8. Space heating requirer	ment											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains,	ηm		·	•								
0.99	0.99	0.97	0.92	0.78	0.57	0.40	0.44	0.72	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (9	4)m x (84)m	1								•		
330.35	360.17	388.00	398.81	356.69	253.79	170.95	178.73	267.01	319.02	315.72	316.61	(95)
Monthly average external	temperature	e from Tabl	e U1									
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean int	ternal tempe	erature, Lm	, W [(39)m	x [(93)m -	(96)m]							
687.15	664.50	602.02	500.53	384.96	256.86	171.22	179.23	279.17	424.16	563.78	681.78	(97)
Space heating requiremen	t, kWh/mon	th 0.024 x	[(97)m - (95	5)m] x (41)	m						_	_
265.46	204.51	159.24	73.24	21.03	0.00	0.00	0.00	0.00	78.23	178.60	271.69	
								∑(98	3)15, 10		1251.99	(98)
Space heating requiremen	t kWh/m²/ye	ear							(98)	÷ (4)	24.49	(99)
9b. Energy requirements	- communit	y heating s	scheme									
Fraction of space heat from	n secondary	/suppleme	ntary syster	n (table 11	.)				'0' if	none	0.00	(301)
Fraction of space heat fror									1 - (3	01) =	1.00	(302)
Fraction of community hea	at from boile	ers									1.00	(303a)
Fraction of total space hea	t from comr	nunity boil	ers						(302) x (30	3a) =	1.00	(304a)
Factor for control and char	ging method	d (Table 4c	(3)) for com	munity spa	ace heating						1.00	(305)
Factor for charging method	d (Table 4c(3	3)) for com	munity wate	er heating							1.00	(305a)
Distribution loss factor (Ta	ble 12c) for	community	heating sys	stem							1.05	(306)
Space heating								254.00	1			(00)
Annual space heating requ	iirement							1251.99	. (205) (2	06)	1214 50	(98)
Space heat from boilers							(98	8) x (304a) x	k (305) x (3	Ub) = [1314.59	(307a)
Water heating												
Annual water heating requ	iirement						1	1503.47]			(64)
Water heat from boilers) x (303a) x	(305a) x (3	06) =	1578.64	(310a)

mechanical ventilation fans - balanced, extract or positive input from outside

103.29 (330a) (331)

Total electricity for the above, kWh/year

103.29

Electricity for lighting (Appendix L)

246.61 (332)

Total delivered energy for all uses

(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =3243.14

10b. Fuel costs - community	y heating scheme
-----------------------------	------------------

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1314.59	x	4.24	x 0.01 =	55.74	(340a)
Water heating from boilers	1578.64	x	4.24	x 0.01 =	66.93	(342a)
Pumps and fans	103.29	x	13.19	x 0.01 =	13.62	(349)
Electricity for lighting	246.61] x	13.19	x 0.01 =	32.53	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)(342e) +	- (345)(354) =	288.83	(355)

11b. SAP rating - community heating scheme	
Energy cost deflator (Table 12)	0.42 (356)
Energy cost factor (ECF)	1.26 (357)
SAP value	82.39
SAP rating (section 13)	82 (358)
SAP band	В

12b. CO ₂ emissions - community heating s	scheme						
		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating	g)						
Efficiency of boilers		89.50					(367a)
CO2 emissions from boilers [(307a)+(3	10a)] x 100 ÷ (367a) =	3232.66	x	0.216	= [698.25	(367)
Electrical energy for community heat distrib	oution	28.93	x	0.519	= [15.02	(372)
Total CO2 associated with community syste	ms					713.27	(373)
Total CO2 associated with space and water	heating					713.27	(376)
Pumps and fans		103.29	x	0.519	= [53.61	(378)
Electricity for lighting		246.61	x	0.519	= [127.99	(379)
Total CO₂, kg/year					(376)(382) = [894.87	(383)
Dwelling CO₂ emission rate					(383) ÷ (4) = [17.51	(384)
El value						87.52	
El rating (section 14)						88	(385)
El band						В	

13b. Primary energy - commu	nity heating scheme						
		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sour	rces (space heating)						
Efficiency of boilers		89.50					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3232.66	x	1.22	=	3943.85	(367)
Electrical energy for community	y heat distribution	28.93	x	3.07	=	88.82	(372)
Total primary energy associated	d with community systems					4032.67	(373)

Pumps and fans

Electricity for lighting

103.29 246.61

3.07

3.07

4032.67

317.11 (378)

(376)

757.11 (379)

5106.89 (383)

99.90 (384)

Primary energy kWh/year

Dwelling primary energy rate kWh/m2/year

URN: 1B2P - Ground Floor version 12 NHER Plan Assessor version 6.3.9

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	1B2P, Kingston upon Thames, KT1		

Client								Last modified		30/09	/2020	
Address	1B2P, Kir	ngston upoi	n Thames,	KT1								
1. Overall dwelling dimen	sions											
				А	irea (m²)			erage storey height (m)		Vo	olume (m³)	
owest occupied					50.88	(1a) x		2.50	(2a) =		127.20	(3a)
otal floor area	(1a)	+ (1b) + (1c	c) + (1d)(1n) =	50.88	(4)						
welling volume							(3	sa) + (3b) + (3	c) + (3d)(3	3n) =	127.20	(5)
2. Ventilation rate												
										m	³ per hour	
lumber of chimneys								0	x 40 =	=	0	(6a
lumber of open flues								0	x 20 =	=	0	(6b
lumber of intermittent far	ıs							0	x 10 =		0	(7a
lumber of passive vents								0	x 10 =	=	0	(7b
lumber of flueless gas fire	s							0	x 40 =	-	0	(7c
										Air	changes pe	er
									1		hour	_
nfiltration due to chimney						a) + (7b) + (0	÷ (5) =	=	0.00	(8)
f a pressurisation test has) to (16)		_		_
ir permeability value, q50							e area				3.00	(17
f based on air permeability				3), otherwi	se (18) = (1	6)					0.15	(18
lumber of sides on which	the dwelling	g is sheltere	ed								3	(19
helter factor								1 -	· [0.075 x (1		0.78	(20
nfiltration rate incorporati	_								(18) x (20) =	0.12	(21
nfiltration rate modified fo								_			_	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spec		1			<u> </u>						1	_
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22
Vind factor (22)m ÷ 4					1	1			_		1	
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22
Adjusted infiltration rate (a				1	1		1			1	1	_
0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14	(22
Calculate effective air chan	ge rate for	the applical	ble case:									_

Calculate effective	ve air chang	ge rate for t	ne applicai	oie case:									
If mechanical	ventilation	: air change	e rate throu	ıgh system								0.50	(23a)
If balanced w	alanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h f balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]												(23c)
a) If balanced	l mechanica	al ventilatio	n with hea	t recovery (MVHR) (22	b)m + (23b) x [1 - (23c	:) ÷ 100]					
	0.27 0.27 0.26 0.25 0.25 0.23 0.23 0.23 0.24 0.25										0.25	0.26	(24a)
Effective air char	nge rate - e	nter (24a) c	or (24b) or ((24c) or (24	d) in (25)								
	0.27	0.27	0.26	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.25	0.26	(25)



Element			er									
			•	Gross area, m²	Openings m ²	Net A,		U-value W/m²K	AxUW	/К к-value, kJ/m².К	Αxκ, kJ/K	
Window						7.	76 x	1.24	= 9.59			(27)
Door						1.3	30 x	0.70	= 1.26			(26)
External wall						28	52 x	0.17	= 4.85			(29a)
Party wall						11	68 x	0.00	= 0.00			(32)
External wall						22	93 x	0.20	= 4.59			(29a)
Total area of ext	ernal elem	ents ∑A, m²				61	01					(31)
Fabric heat loss,	W/K = ∑(A	× U)							(26	5)(30) + (32) =	20.28	(33)
Heat capacity Cn	n = ∑(A x к)							(28)	.(30) + (32) -	+ (32a)(32e) =	N/A	(34)
Thermal mass pa	arameter (T	MP) in kJ/n	n²K								250.00	(35)
Thermal bridges	: Σ(L x Ψ) ca	alculated us	ing Apper	ndix K							7.20	(36)
Total fabric heat	loss									(33) + (36) =	27.48	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct Nov	Dec	
Ventilation heat	loss calcula	ated month	ly 0.33 x (25)m x (5)	-				·			
	11.33	11.21	11.09	10.48	10.36	9.75	9.75	9.62	9.99	10.36 10.6	0 10.84	(38)
Heat transfer co								7	1 0.00			_ (,
	38.81	38.69	38.57	37.96	37.84	37.23	37.23	37.11	37.47	37.84 38.0	8 38.33	7
	30.02	00.00	30.07	07.50	07.01	07.20	07.120	07.122		(39)112/12 =	37.93	_ (39)
Heat loss param	eter (HIP)	W/m²K (39	1)m ÷ (4)						Average - Z	.(33)112/12	37.33	_ (55)
ricut 1033 param	0.76	0.76	0.76	0.75	0.74	0.73	0.73	0.73	0.74	0.74 0.75	5 0.75	٦
	0.70	0.70	0.70	0.73	0.74	0.73	0.73	-		(40)112/12 =	0.75	」 │(40)
Number of days	in month /	Table 1a)							Average - 2	(40)112/12 -	0.73	(40)
Number of days			21.00	20.00	21.00	20.00	21.00	21.00	20.00	21.00 20.0	0 21.00	7 (40)
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00 30.0	0 31.00	(40)
4. Water heating	ng energy r	equiremen	t									
Assumed occupa	ancv. N										1.72	(42)
											1.72	
Annual average	•	usage in litre	es per day	Vd,average	= (25 x N) +	36					74.96	(43)
Annual average	•	usage in litre Feb	es per day Mar	Vd,average Apr	= (25 x N) + May	36 Jun	Jul	Aug	Sep	Oct Nov	74.96	_
Annual average	hot water u	Feb	Mar	Apr	May	Jun		Aug	Sep	Oct Nov	74.96	_
-	Jan in litres pe	Feb er day for ea	Mar ach month	Apr Vd,m = fact	May tor from Tab	Jun le 1c x (43)				74.96 Dec	_
-	hot water u	Feb	Mar	Apr	May	Jun		Aug 70.46	Sep 73.46	76.45 79.4	74.96 Dec 82.45	(43)
Hot water usage	Jan e in litres pe	Feb er day for ea 79.45	Mar ach month 76.45	Apr Vd,m = fact 73.46	May tor from Tab	Jun le 1c x (43 67.46	67.46	70.46			74.96 Dec	_
-	Jan in litres pe 82.45	Feb er day for ea 79.45 er used = 4.1	Mar ach month 76.45	Apr Vd,m = fact 73.46 x nm x Tm/3	May tor from Tab 70.46	Jun le 1c x (43 67.46 onth (see	67.46 Tables 1b	70.46	73.46	76.45 79.4 ∑(44)112 = [74.96 Dec 82.45 899.47	(43)
Hot water usage	Jan e in litres pe	Feb er day for ea 79.45	Mar ach month 76.45	Apr Vd,m = fact 73.46	May tor from Tab	Jun le 1c x (43 67.46	67.46	70.46		76.45 79.4 Σ(44)112 = 99.90 109.0	74.96 Dec 82.45 899.47	(43)
Hot water usage	Jan e in litres pe 82.45 of hot wate 122.27	Feb er day for ea 79.45 er used = 4.1 106.94	Mar ach month 76.45	Apr Vd,m = fact 73.46 x nm x Tm/3	May tor from Tab 70.46	Jun le 1c x (43 67.46 onth (see	67.46 Tables 1b	70.46	73.46	76.45 79.4 ∑(44)112 = [74.96 Dec 82.45 899.47	(43)
Hot water usage	hot water u Jan in litres pe 82.45 of hot wate 122.27	Feb er day for ea 79.45 er used = 4.1 106.94	Mar 16.45 76.45 8 x Vd,m 110.35	Apr Vd,m = fact 73.46 x nm x Tm/3 96.21	May tor from Tab 70.46 8600 kWh/m 92.31	Jun le 1c x (43 67.46 onth (see	67.46 Tables 1b 73.82	70.46 . 1c 1d) 84.71	73.46	76.45 79.4 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	74.96 Dec 82.45 899.47 1179.35	(43)
Hot water usage Energy content of Distribution loss	Jan e in litres pe 82.45 of hot wate 122.27 0.15 x (45	Feb er day for ea 79.45 er used = 4.1 106.94 er 16.04	Mar 76.45 .8 x Vd,m 110.35	Apr Vd,m = fact 73.46 x nm x Tm/3 96.21	May tor from Tab 70.46 8600 kWh/m 92.31	Jun le 1c x (43 67.46 onth (see 79.66	67.46 Tables 1b	70.46	73.46	76.45 79.4 Σ(44)112 = 99.90 109.0	74.96 Dec 82.45 899.47 1179.35 6 17.76	(43)
Hot water usage Energy content of Distribution loss Storage volume	hot water u Jan in litres pe 82.45 of hot wate 122.27 0.15 x (45) 18.34 (litres) include	Feb er day for ea 79.45 er used = 4.1 106.94 er 16.04	Mar 76.45 .8 x Vd,m 110.35	Apr Vd,m = fact 73.46 x nm x Tm/3 96.21	May tor from Tab 70.46 8600 kWh/m 92.31	Jun le 1c x (43 67.46 onth (see 79.66	67.46 Tables 1b 73.82	70.46 . 1c 1d) 84.71	73.46	76.45 79.4 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	74.96 Dec 82.45 899.47 1179.35	(43)
Energy content of Distribution loss Storage volume Water storage lo	Jan e in litres pe 82.45 of hot wate 122.27 0.15 x (45) 18.34 (litres) includes:	Feb er day for ea 79.45 er used = 4.1 106.94)m 16.04 uding any so	Mar 76.45 .8 x Vd,m 110.35 16.55 blar or WV	Apr Vd,m = fact 73.46 x nm x Tm/3 96.21 14.43 VHRS storage	May tor from Tab 70.46 8600 kWh/m 92.31	Jun le 1c x (43 67.46 onth (see 79.66	67.46 Tables 1b 73.82	70.46 . 1c 1d) 84.71	73.46	76.45 79.4 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	74.96 Dec 82.45 899.47 1179.35 6 17.76	(43)
Energy content of Distribution loss Storage volume Water storage lob) Manufacturer	hot water u Jan in litres pe 82.45 of hot wate 122.27 0.15 x (45 18.34 (litres) incluses:	Feb er day for ea 79.45 er used = 4.1 106.94)m 16.04 uding any so	Mar 76.45 18 x Vd,m 110.35 16.55 blar or WV	Apr Vd,m = fact 73.46 x nm x Tm/3 96.21 14.43 VHRS storag	May tor from Tab 70.46 8600 kWh/m 92.31 13.85 ge within sam	Jun le 1c x (43 67.46 onth (see 79.66	67.46 Tables 1b 73.82	70.46 . 1c 1d) 84.71	73.46	76.45 79.4 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	74.96 Dec 82.45 899.47 118.41 1179.35 17.76 3.00	(43) (44) (45) (46) (47)
Energy content of Distribution loss Storage volume Water storage lob) Manufacturer Hot water sto	hot water u Jan e in litres pe 82.45 of hot wate 122.27 0.15 x (45) 18.34 (litres) incluses: c's declared prage loss fa	r day for ear 79.45 r used = 4.1 106.94 uding any so loss factor actor from	Mar 76.45 18 x Vd,m 110.35 16.55 blar or WV	Apr Vd,m = fact 73.46 x nm x Tm/3 96.21 14.43 VHRS storag	May tor from Tab 70.46 8600 kWh/m 92.31 13.85 ge within sam	Jun le 1c x (43 67.46 onth (see 79.66	67.46 Tables 1b 73.82	70.46 . 1c 1d) 84.71	73.46	76.45 79.4 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	74.96 7 Dec 5 82.45 899.47 04 118.41 1179.35 6 17.76 3.00	(43) (44) (45) (45) (46) (47)
Energy content of Distribution loss Storage volume Water storage lo b) Manufacturer Hot water sto	Jan 2 in litres per 82.45 of hot wate 122.27 of 0.15 x (45) 18.34 (litres) incluses: It's declared prage loss for from Tab	r day for ear 79.45 r used = 4.1 106.94)m 16.04 uding any so loss factor actor from	Mar 76.45 18 x Vd,m 110.35 16.55 blar or WV	Apr Vd,m = fact 73.46 x nm x Tm/3 96.21 14.43 VHRS storag	May tor from Tab 70.46 8600 kWh/m 92.31 13.85 ge within sam	Jun le 1c x (43 67.46 onth (see 79.66	67.46 Tables 1b 73.82	70.46 . 1c 1d) 84.71	73.46	76.45 79.4 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	74.96 7 Dec 5 82.45 899.47 04 118.41 1179.35 6 17.76 3.00 0.02 3.42	(43) (44) (45) (46) (47) (51) (52)
Energy content of Distribution loss Storage volume Water storage lo b) Manufacturer Hot water sto Volume facto Temperature	hot water u Jan e in litres pe 82.45 of hot wate 122.27 0.15 x (45) 18.34 (litres) incluoss: e's declared orage loss for from Tab	r day for ear 79.45 r used = 4.1 106.94 uding any so loss factor actor from actor from ale 2a n Table 2b	Mar 76.45 18 x Vd,m 110.35 16.55 blar or WV is not kno	Apr Vd,m = fact 73.46 x nm x Tm/3 96.21 14.43 VHRS storag wn Wh/litre/day	May tor from Tab 70.46 3600 kWh/m 92.31 13.85 ge within sam	Jun le 1c x (43 67.46 onth (see 79.66	67.46 Tables 1b 73.82	70.46 . 1c 1d) 84.71	73.46	76.45 79.4 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	74.96 7 Dec 5 82.45 899.47 04 118.41 1179.35 6 17.76 3.00 0.02 3.42 0.60	(43) (44) (45) (46) (47) (51) (52) (53)
Energy content of Distribution loss Storage volume Water storage lob) Manufacturer Hot water storage location of the Content o	Jan e in litres per 82.45 of hot wate 122.27 c 0.15 x (45) 18.34 (litres) includes: c's declared prage loss from Table factor from water services.	r day for ear 79.45 r used = 4.1 106.94 uding any so loss factor actor from actor from ale 2a n Table 2b	Mar 76.45 18 x Vd,m 110.35 16.55 blar or WV is not kno	Apr Vd,m = fact 73.46 x nm x Tm/3 96.21 14.43 VHRS storag wn Wh/litre/day	May tor from Tab 70.46 3600 kWh/m 92.31 13.85 ge within sam	Jun le 1c x (43 67.46 onth (see 79.66	67.46 Tables 1b 73.82	70.46 . 1c 1d) 84.71	73.46	76.45 79.4 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	74.96 7 Dec 5 82.45 899.47 04 118.41 1179.35 6 17.76 3.00 0.02 3.42 0.60 0.13	(43) (44) (45) (46) (47) (51) (52) (53) (54)
Energy content of Distribution loss Storage volume Water storage lost of Temperature Energy lost free Enter (50) or (54)	hot water u Jan e in litres per 82.45 of hot water 122.27 10.15 x (45) 18.34 (litres) includes: c's declared orage loss for from Table factor from water services.	r day for ear 79.45 r used = 4.1 106.94 uding any so loss factor actor from actor from Table 2b storage (kW	Mar ach month 76.45 8 x Vd,m 110.35 16.55 blar or WV is not kno Table 2 (k)	Apr Vd,m = fact 73.46 x nm x Tm/3 96.21 14.43 VHRS storag wn Wh/litre/day	May tor from Tab 70.46 3600 kWh/m 92.31 13.85 ge within sam	Jun le 1c x (43 67.46 onth (see 79.66	67.46 Tables 1b 73.82	70.46 . 1c 1d) 84.71	73.46	76.45 79.4 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	74.96 7 Dec 5 82.45 899.47 04 118.41 1179.35 6 17.76 3.00 0.02 3.42 0.60	(43) (44) (45) (46) (47) (51) (52) (53)
Energy content of Distribution loss Storage volume Water storage lob) Manufacturer Hot water storage location of the Content o	hot water u Jan e in litres per 82.45 of hot water 122.27 10.15 x (45) 18.34 (litres) includes: c's declared orage loss for from Table factor from water services.	r day for ear 79.45 r used = 4.1 106.94 uding any so loss factor actor from actor from Table 2b storage (kW	Mar ach month 76.45 8 x Vd,m 110.35 16.55 blar or WV is not kno Table 2 (k)	Apr Vd,m = fact 73.46 x nm x Tm/3 96.21 14.43 VHRS storag wn Wh/litre/day	May tor from Tab 70.46 3600 kWh/m 92.31 13.85 ge within sam	Jun le 1c x (43 67.46 onth (see 79.66	67.46 Tables 1b 73.82	70.46 . 1c 1d) 84.71	73.46	76.45 79.4 $\Sigma(44)112 = \begin{bmatrix} \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\$	74.96 7 Dec 5 82.45 899.47 04 118.41 1179.35 6 17.76 3.00 0.02 3.42 0.60 0.13	(43) (44) (45) (46) (47) (51) (52) (53) (54)

4.04 3 or each mo 3.26 2 month from 0.00 (0 for water he 49.58 13 culated usir 0.00 (0 neater for e 49.58 13	3.65 21.01 3.65 21.01 3.65 3.65 3.60	4.04 Table 3 23.26 , 3b or 3c 0.00 culated fo dix G or Ap 0.00 h (kWh/m 137.66)	3.91 22.51 0.00 r each mo 122.63 opendix H 0.00 nonth) (62 122.63	0.00 onth 0.85 x 119.62 0.00 2)m + (63)m 119.62	3.91 22.51 0.00 (45)m + (40 106.08	23.26	4.04 23.26 0.00	3.91 22.51 0.00 (61)m 112.14	23.26 0.00	3.91 22.51 0.00	4.04 (5 23.26 (5 0.00 (6 145.72 (6
or each mo 3.26	eating calcomples of month from Table 3a, 0.00 and 1.60 a	Table 3 23.26 , 3b or 3c 0.00 culated fo 137.66 dix G or Ap 0.00 h (kWh/m 137.66	22.51 0.00 r each mo 122.63 ppendix H 0.00 nonth) (62	23.26 0.00 onth 0.85 x 119.62 0.00 2)m + (63)m	22.51 0.00 (45)m + (40 106.08	23.26 0.00 6)m + (57)n 101.12	23.26 0.00 n + (59)m + 112.01	22.51 0.00 (61)m	23.26	0.00	23.26 (5
23.26 2 month from 0.00 (0 for water he 49.58 13 culated usin 0.00 (0 neater for e 49.58 13 er heating (62.50 5	21.01 :: n Table 3a, 0.00 eating calc 31.60 1 ng Append 0.00 each month 31.60 1	23.26 , 3b or 3c 0.00 culated fo 137.66 h (kWh/m 137.66 nth) 0.25	0.00 r each mo 122.63 ppendix H 0.00 nonth) (62 122.63	0.00 onth 0.85 x 119.62 onth 0.00 onth 0.85 x 129.62 onth 0.00 ont	0.00 (45)m + (46 106.08	0.00 6)m + (57)n 101.12	0.00 n + (59)m + 112.01	0.00 (61)m	0.00	0.00	0.00 (6
month from 0.00 (1) for water he 49.58 13 culated usin 0.00 (1) neater for e 49.58 13 er heating (1) 52.50 5	n Table 3a, 0.00 eating calc 31.60 1 ng Append 0.00 each month 31.60 1	, 3b or 3c 0.00 culated fo 137.66 dix G or Ap 0.00 h (kWh/m 137.66	0.00 r each mo 122.63 ppendix H 0.00 nonth) (62 122.63	0.00 onth 0.85 x 119.62 onth 0.00 onth 0.85 x 129.62 onth 0.00 ont	0.00 (45)m + (46 106.08	0.00 6)m + (57)n 101.12	0.00 n + (59)m + 112.01	0.00 (61)m	0.00	0.00	0.00 (6
0.00 (for water he 49.58 13 culated usin 0.00 (neater for e 49.58 13 er heating (52.50 5	eating calcomples of the calco	0.00 culated fo	0.00 r each mo 122.63 opendix H 0.00 nonth) (62 122.63	0.00 0.00 0.00 0.00	(45)m + (46 106.08 0.00	6)m + (57)n 101.12	n + (59)m + 112.01	(61)m			
for water he 49.58 13 culated usin 0.00 (10 neater for e 49.58 13 er heating (12.50 5	eating calcomplete (a) 1.60	culated fo 137.66 dix G or Ap 0.00 h (kWh/m 137.66	122.63 ppendix H 0.00 ponth) (62	0.00 0.00 0.00 0.00	(45)m + (46 106.08 0.00	6)m + (57)n 101.12	n + (59)m + 112.01	(61)m			
49.58 13 culated usin 0.00 (0 neater for e 49.58 13 er heating (6 52.50 5	31.60 1 ng Append 0.00 each month 31.60 1	137.66 dix G or Ap 0.00 h (kWh/m 137.66 dix	122.63 opendix H 0.00 onth) (62 122.63	0.00 2)m + (63)m	0.00	101.12	112.01		127.20	135.47	145.72 (6
culated usin 0.00 (ng Append 0.00 each month 31.60 1	0.00 0.00 h (kWh/m 137.66 nth) 0.25	0.00 nonth) (62	0.00 2)m + (63)m	0.00			112.14	127.20	135.47	145.72 (6
0.00 (0.00 cach month 31.60 1 (kWh/mon	0.00 h (kWh/m 137.66 h	0.00 nonth) (62 122.63	0.00 2)m + (63)m	1	0.00	0.00				
er heating (52.50 5	ach month 31.60 1	h (kWh/m 137.66 http://doi.org/ nth) 0.25	nonth) (62 122.63	2)m + (63)m	1	0.00	0.00				
49.58 13 er heating (52.50 5	31.60 1	137.66 nth) 0.25	122.63				3.00	0.00	0.00	0.00	0.00 (6
er heating (2.50 5	(kWh/mon	nth) 0.25		119.62	106.00						
2.50 5	· · ·		× [0.85 × (106.08	101.12	112.01	112.14	127.20	135.47	145.72
2.50 5	· · ·		× [0.85 × (∑(64)1	12 = 1	1500.82 (6
2.50 5	· · ·			(45)m + (61)m] + 0.8 ×	: [(46)m + (5	57)m + (59)	m]			
Jan			53.13	52.54	47.63	46.39	50.01	49.64	55.06	57.40	61.22 (6
			33.12	02.01	.,,,,,,	10.00	30.02	.5.0	33.00	37.10	
ole 5)	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
,											
35.80 8	35.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80	85.80 (6
lated in App	pendix L, e	equation L	.9 or L9a),	also see Ta	ble 5	•					
						5.24	6.81	9.14	11.60	13.54	14.43 (6
I				l l	7	3121	0.01	3.2.			(
						111 96	110 21	11/1 22	122.54	122.05	142.92 (6
						111.80	110.51	114.22	122.54	133.03	142.32
						24.50	24.50	24.50	24.50	24.50	24.50 (6
	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58	31.58 (6
											
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (7
ion (Table 5	5)										
68.64 -6	68.64 -	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64 (7
(Table 5)											
84.00 8	32.27	78.68	73.79	70.61	66.15	62.35	67.21	68.94	74.00	79.72	82.28 (7
(66)m + (67	7)m + (68)r	m + (69)m	ı + (70)m -	+ (71)m + (7	⁷ 2)m						
96.31 29	94.56 2	284.72	269.05	253.43	238.19	228.18	233.07	241.04	256.88	275.04	288.37 (7
				Area				g :f: - d-t-	FF	lata	Gains
		i abie e	oa	m-	V	v/m-	-		•		W
		0.77	—, г	4.56] <u>, </u>	0.62	00 4 () 4F v	0.70	— ₋ _	10.50 /7
	l I										10.58 (7
C/74\ '-		0.77	x	3.20	_ x <u>1</u>	9.64 X	υ.9 X [().45 X	0.70	=	13.72 (7
						1		<u> </u>			
			119.67	153.37	160.49	151.33	125.11	92.73	55.92	30.16	20.11 (8
and solar ((73)m + (83	3)m									
20.61 34	41.62 3	363.29	388.72	406.80	398.68	379.51	358.18	333.77	312.81	305.21	308.48 (8
na na exaterra	/haating	coscoul									
			,	=:	(°C)						24.05
•		_				_			_		21.00 (8
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	ated in Ap 4.04	ated in Appendix L, 6 4.04	ated in Appendix L, equation L 4.04	ated in Appendix L, equation L9 or L9a), 4.04	Access factor Area Table 6d Access factor Tab	Access factor Table 5 Access factor Table 6 Access factor Table 5 Access factor Table 5	Access factor Access factor Table 5 Access factor Table 6 Access f	Access factor Table 6d Page 19. 28.4.72 269.05 253.43 238.19 228.18 233.07 Access factor Table 6d Page 29. 26.77 x 4.56 x 10.63 x 0.9 x (2.74)m(82)m Access factor Table 6d Page 29. 27. 78.57 119.67 153.37 160.49 151.33 125.11 and solar (73)m + (83)m Access factor Table 9, Th1(°C)	ated in Appendix L, equation L9 or L9a), also see Table 5 4.04	ated in Appendix L, equation L9 or L9a), also see Table 5 4.04 12.47 10.14 7.68 5.74 4.85 5.24 6.81 9.14 11.60 ulated in Appendix L, equation L13 or L13a), also see Table 5 19.52 151.07 147.16 138.84 128.33 118.46 111.86 110.31 114.22 122.54 ated in Appendix L, equation L15 or L15a), also see Table 5 1.58 31.58 31.58 31.58 31.58 31.58 31.58 31.58 31.58 31.58 31.58 Table 5a) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	ated in Appendix L, equation L9 or L9a), also see Table 5 4.04

otilisation race	or for gains f	or living are	a n1 m (se	e Table 9a)									
	1.00	0.99	0.98	0.94	0.81	0.59	0.43	0.48	0.74	0.95	0.99	1.00	(86)
Mean internal t	temp of livin	g area T1 (s	steps 3 to 7	in Table 9c)	1		'		Į.		-1	_ ` `
	20.35	20.44	20.60	20.81	20.95	21.00	21.00	21.00	20.98	20.81	20.55	20.33	(87)
Temperature d	luring heatin	g periods in	the rest of	dwelling fr	om Table 9	9, Th2(°C)		•			•		_
	20.29	20.29	20.29	20.30	20.30	20.31	20.31	20.32	20.31	20.30	20.30	20.29	(88)
Utilisation facto	or for gains f	or rest of d	welling n2,	m		•					•		_
	1.00	0.99	0.98	0.92	0.76	0.53	0.36	0.41	0.68	0.94	0.99	1.00	(89)
Mean internal t	temperature	in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	ŧc)						
	19.41	19.54	19.78	20.08	20.26	20.31	20.31	20.31	20.29	20.09	19.71	19.39	(90)
Living area frac	ction								Liv	ving area ÷	(4) =	0.45	(91)
Mean internal t	temperature	for the who	ole dwellin	g fLA x T1 +	(1 - fLA) x	Γ2							
	19.84	19.95	20.15	20.41	20.57	20.62	20.63	20.63	20.61	20.42	20.09	19.82	(92)
Apply adjustme	ent to the me	ean internal	l temperatı	ure from Ta	ble 4e whe	ere appropri	iate						
	19.84	19.95	20.15	20.41	20.57	20.62	20.63	20.63	20.61	20.42	20.09	19.82	(93)
8. Space heati	ing requires	nent											
or space fieati	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto			17101	, .p.	ay	54	7	7166	ССР	000		200	
otinisation racti	0.99	0.99	0.98	0.92	0.78	0.56	0.39	0.44	0.71	0.94	0.99	1.00	(94)
Useful gains, ηι		1		0.02	0.70	1 0.00		0	0.72	0.5	0.55		_ (0 .,
G , .	318.87	338.35	354.81	358.81	317.30	222.73	149.75	156.61	236.58	293.94	301.50	307.17	(95)
Monthly averag	ge external t									l .			_ ` `
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate f	for mean inte	ernal tempe	erature, Lm	, W [(39)m	x [(93)m -	(96)m]							_
	603.01	582.26	526.48	437.04	335.76	224.18	149.85	156.82	243.77	371.40	494.80	598.63	(97)
Space heating r	requirement	, kWh/mont	th 0.024 x	[(97)m - (95	5)m] x (41)	m							
	211.40	163.90	127.72	56.33	13.73	0.00	0.00	0.00	0.00	57.63	139.17	216.85	
									∑(98	3)15, 10	.12 =	986.74	(98)
Space heating r	requirement	kWh/m²/ye	ear							(98)	÷ (4)	19.39	(99)
9b. Energy red	quirements .	communit	y heating d	cheme									
				cheme									
•				ntary systar	n (table 11	\				'O' if	nono [0.00	7 (201
	co hoat trom	•		ntary syster	n (table 11	.)				'0' if		0.00	_
		n community	y system	ntary syster	n (table 11	.)				'0' if i		1.00	(302
Fraction of com	nmunity hea	community t from boile	y system ers		n (table 11	.)				1 - (3	01) =	1.00	(302
Fraction of com	nmunity hear	t from boile	y system ers munity boile	ers							01) =	1.00 1.00 1.00	(302 (303 (304
Fraction of com Fraction of tota Factor for conti	nmunity hear al space heat rol and charg	n community t from boile t from comm	y system ers munity boile d (Table 4c(ers (3)) for com	munity spa					1 - (3	01) =	1.00 1.00 1.00 1.00	(302 (303 (304) (305
Fraction of com Fraction of tota Factor for conti Factor for char	nmunity hear al space heat rol and charg ging method	t from boile t from comm t from comm ging methoo I (Table 4c(3	y system ers munity boile d (Table 4c(3)) for comr	ers (3)) for com munity wate	munity spa					1 - (3	01) =	1.00 1.00 1.00 1.00	(302 (303 (304) (305) (305
Fraction of com Fraction of tota Factor for conti Factor for char	nmunity hear al space heat rol and charg ging method	t from boile t from comm t from comm ging methoo I (Table 4c(3	y system ers munity boile d (Table 4c(3)) for comr	ers (3)) for com munity wate	munity spa					1 - (3	01) =	1.00 1.00 1.00 1.00	(302 (303 (304 (305 (305
Fraction of com Fraction of tota Factor for conti Factor for charg Distribution los	nmunity hear al space heat rol and charg ging method	t from boile t from comm t from comm ging methoo I (Table 4c(3	y system ers munity boile d (Table 4c(3)) for comr	ers (3)) for com munity wate	munity spa					1 - (3	01) =	1.00 1.00 1.00 1.00	(302 (303 (304 (305 (305
Fraction of com Fraction of tota Factor for conti Factor for charg Distribution los Space heating	nmunity hear al space heat rol and charg ging method as factor (Tab	t from boile t from comm ging method I (Table 4c(3	y system ers munity boile d (Table 4c(3)) for comr	ers (3)) for com munity wate	munity spa				986.74	1 - (3	01) =	1.00 1.00 1.00 1.00	(302 (303 (304 (305 (305 (306
Fraction of com Fraction of tota Factor for conti Factor for charg Distribution los Space heating Annual space h	nmunity hear al space heat rol and charg ging method as factor (Tab	t from boile t from comm ging method I (Table 4c(3	y system ers munity boile d (Table 4c(3)) for comr	ers (3)) for com munity wate	munity spa					1 - (3)	01) =	1.00 1.00 1.00 1.00	(302 (303 (304) (305) (305) (306
Fraction of com Fraction of total Factor for contr Factor for chargon Distribution los Space heating Annual space h Space heat from	nmunity hear al space heat rol and charg ging method as factor (Tab neating requi m boilers	t from boile t from comm ging method I (Table 4c(3	y system ers munity boile d (Table 4c(3)) for comr	ers (3)) for com munity wate	munity spa				986.74	1 - (3)	01) =	1.00 1.00 1.00 1.00 1.00 1.05	(302 (303 (304) (305) (306 (306
Fraction of com Fraction of total Factor for contractor for charge Distribution lose Space heating Annual space heating Space heat from	nmunity hear al space heat rol and charg ging method as factor (Tab neating requi m boilers	t from boile t from comm ging method I (Table 4c(3 ole 12c) for d	y system ers munity boile d (Table 4c(3)) for comr	ers (3)) for com munity wate	munity spa			(98	986.74 3) x (304a) x	1 - (3)	01) =	1.00 1.00 1.00 1.00 1.00 1.05	(302 (303 (304 (305 (305 (306 (98) (307
Fraction of com Fraction of total Factor for contribution los Distribution los Space heating Annual space h Space heat from Water heating Annual water h	nmunity hear al space heat rol and charg ging method as factor (Tab heating requi m boilers	t from boile t from comm ging method I (Table 4c(3 ole 12c) for d	y system ers munity boile d (Table 4c(3)) for comr	ers (3)) for com munity wate	munity spa			(98	986.74 3) x (304a) x	1 - (3) (302) x (30)	01) =	1.00 1.00 1.00 1.00 1.00 1.05	(302 (303 (304 (305 (305 (306 (98) (307
Fraction of com Fraction of total Factor for contribution los Distribution los Space heating Annual space h Space heat from Water heating	nmunity hear al space heat rol and charg ging method as factor (Tab heating requi m boilers heating requi m boilers	t from boiled t from comm ging method I (Table 4c(3 ble 12c) for d	y system ers munity boile d (Table 4c(3)) for comr	ers (3)) for com munity wate	munity spa			(98	986.74 3) x (304a) x 500.82 x (303a) x	1 - (36) (302) x (30) (305) x (36)	01) =	1.00 1.00 1.00 1.00 1.00 1.05	(307

mechanical ventilation fans - balanced, extract or positive input from outside

102.81 (330a)

Total electricity for the above, kWh/year

102.81 (331)

Electricity for lighting (Appendix L)

247.99 (332)

Total delivered energy for all uses

(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =

2962.74 (338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1036.08	x	4.24	x 0.01 =	43.93	(340a)
Water heating from boilers	1575.86] x	4.24	x 0.01 =	66.82	(342a)
Pumps and fans	102.81] x	13.19	x 0.01 =	13.56	(349)
Electricity for lighting	247.99	x	13.19	x 0.01 =	32.71	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)(342e) +	- (345)(354) =	277.02	(355)

11b. SAP rating - community heating scheme

(356) Energy cost deflator (Table 12) 0.42 Energy cost factor (ECF) 1.21 (357)SAP value 83.07 SAP rating (section 13) 83 (358)SAP band В

12b. CO ₂ emissions - communi	ity heating scheme						
		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (s	pace heating)						
Efficiency of boilers		89.50					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) = [2918.37	x	0.216	=	630.37	(367)
Electrical energy for community	heat distribution	26.12	x	0.519	=	13.56	(372)
Total CO2 associated with comm	munity systems					643.92	(373)
Total CO2 associated with space	e and water heating					643.92	(376)
Pumps and fans		102.81	x	0.519	=	53.36	(378)
Electricity for lighting		247.99	x	0.519	=	128.71	(379)
Total CO₂, kg/year					(376)(382) =	825.99	(383)
Dwelling CO₂ emission rate					(383) ÷ (4) =	16.23	(384)
El value						88.46	
El rating (section 14)						88	(385)
EI band						В	

13b. Primary energy - community heating scheme

Energy kWh/year		Primary factor		Primary energy (kWh/year)	•
89.50					(367a)
2918.37	x	1.22	=	3560.41	(367)
26.12	x	3.07	=	80.19	(372)
				3640.60	(373)
				3640.60	(376)
	89.50 2918.37	89.50 2918.37 x	kWh/year 89.50 2918.37 x 1.22	kWh/year 89.50 2918.37 x 1.22 =	kWh/year (kWh/year) 89.50 2918.37 x 1.22 = 3560.41 26.12 x 3.07 = 80.19 3640.60

Pumps and fans Electricity for lighting Primary energy kWh/year

Dwelling primary energy rate kWh/m2/year

102.81 247.99

3.07 3.07

315.62

761.32 (379) 4717.55 (383)

(378)

92.72

(384)

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	1B2P, Kingston upon Thames, KT1		

Cilcrit								LC	ist infodince	4	30,0	3/2020	
Address		1B2P, Ki	ngston upo	n Thames,	KT1								
1. Overall dwe	elling dimen	sions											
					A	rea (m²)			rage storey eight (m)		V	olume (m³)	
Lowest occupie	ed					50.32	(1a) x		2.50	(2a) =		125.80	(3a)
Total floor area		(1a) + (1b) + (1	c) + (1d)	(1n) =	50.32	(4)						
Dwelling volum	ie							(3a) + (3b) + (3	c) + (3d)(3n) =	125.80	(5)
2. Ventilation	rate												
											r	n³ per hour	
Number of chin	nneys								0	x 40 =	=	0	(6a)
Number of ope	n flues								0	x 20 =	=	0	(6b)
Number of inte	rmittent fan	s							0	x 10 =	=	0	(7a)
Number of pass	sive vents								0	x 10 =	=	0	(7b)
Number of flue	less gas fires								0	x 40 =	=	0	(7c)
											Aiı	changes pe hour	r
Infiltration due	to chimneys	, flues, fan	ıs, PSVs		(6a)	+ (6b) + (7	a) + (7b) + (7c) =	0	÷ (5) :	= [0.00	(8)
If a pressurisati	on test has b	een carrie	ed out or is i	ntended, p	proceed to (17), otherw	rise continue	e from (9)	to (16)				
Air permeability	y value, q50,	expressed	d in cubic m	etres per h	nour per squ	are metre	of envelope	e area				3.00	(17)
If based on air p	permeability	value, the	n (18) = [(1	7) ÷ 20] + (8), otherwis	se (18) = (1	6)					0.15	(18)
Number of side	s on which t	he dwellin	g is sheltere	ed								2	(19)
Shelter factor									1 -	- [0.075 x (1	L9)] =	0.85	(20)
Infiltration rate	incorporation	ng shelter i	factor							(18) x (20) =	0.13	(21)
Infiltration rate	modified fo	r monthly	wind speed	:									
	lan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	Jan												
Monthly averag		d from Ta	ble U2										
Monthly averag		d from Ta	ble U2 4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Monthly averag	ge wind spee			4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22	5.10 2)m ÷ 4	5.00	4.90	1.10	1.08	0.95	3.80	3.70 0.93	4.00	1.08	4.50	4.70	(22) (22a)
	5.10 2)m ÷ 4	5.00	4.90	1.10	1.08	0.95							_

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2													
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)	m ÷ 4												
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltrat	tion rate (al	llowing for	shelter and	wind facto	or) (21) x (2	2a)m							
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)
Calculate effective	ve air chang	ge rate for t	the applical	ole case:									
If mechanical	ventilation	ı: air chang	e rate throu	ugh system								0.50	(23a)

Calculate effective	e air chang	ge rate for t	the applical	ole case:									
If mechanical	If mechanical ventilation: air change rate through system												
If balanced wi	If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h												
a) If balanced	mechanica	al ventilatio	on with hea	t recovery	(MVHR) (22	2b)m + (23b) x [1 - (23d	c) ÷ 100]					
[0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(24a)
Effective air chan	Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)												
	0.28 0.28 0.28 0.26 0.26 0.24 0.24 0.24 0.25 0.26 0												
													(25)



Name	Mindow	Fl									
1.80	Cloop	Element						A x U W/I			
14.32 X 0.17 = 2.43 (29a) arty wall (34.3 X 0.00 = 0.00 (33) (33) (34.3 X 0.00 = 0.00 (33)	Party wail	Window			7.8	6 x [1.24	= 9.71			(27)
Section Sect	Party wail	Door			1.8	0 x [0.60	= 1.08			(26)
Section Sect	Referral wall	External wall			14.3	32 x	0.17	= 2.43			(29a)
Solidar Soli	Roof Signature	Party wall			34.4	13 x	0.00	= 0.00			(32)
Sear	Stationare of external elements SA, m San	External wall			16.5	50 x	0.20	= 3.30			(29a)
seric heat loss, W/K = \(\(\(\(\) \ \ \ \ \ \ \ \ \ \ \ \	Septice place Septice	Roof			50.3	32 x	0.13	= 6.54			(30)
teat capacity Cm = \(\(\(\) \) (A) \(\) (B) \(\) (A) \(\) (A	Fide capacity Cm = \(\(\int \) \(in the capacity Cm = \(\(\(\int \) \) \(\text{in the capacity Cm = \(\int \) \(\int \) \(\text{in the capacity Cm = \(\int \) \(\int \) \\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	Total area of external elements ΣA , m^2			90.8	30					(31)
Section Sect	The mean than sage show that	Fabric heat loss, W/K = Σ (A × U)						(26).	(30) + (32) =	23.07	(33)
hermal bridges: $\sum (1 \times V) \ calculated using Appendix K$ Sep Get Nov Dec	The mail bridges: \(\(\) \(\) \(\) \(Heat capacity Cm = $\sum (A \times \kappa)$					(28)	.(30) + (32) + ((32a)(32e) =	N/A	(34)
total fabric heat loss Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Total fabric heat loss	Thermal mass parameter (TMP) in kJ/m²K								250.00	(35)
Jan	May	Thermal bridges: $\Sigma(L \times \Psi)$ calculated using	Appendix K							6.77	(36)
The contribution heat loss calculated monthly 0.33 x (25)m x (5) 11.80	Note 1.80 1.67 1.54 10.88 10.74 10.08 10.08 9.95 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 11.01 11.27 3.89 10.35 10.74 10.35 10.35 10.74 10.35 10.35 10.74 10.35 10.35 10.35 10.74 10.35 10	Total fabric heat loss							(33) + (36) =	29.84	(37)
11.80 11.67 11.54 10.88 10.74 10.08 10.08 9.95 10.35 10.74 11.01 11.17 (38) leat transfer coefficient, W/K (37)m + (38)m 41.64 41.51 41.38 40.72 40.58 39.92 39.92 39.79 40.19 40.58 40.85 41.11 Average = ∑(39)112/12 = 40.68 (39) leat loss parameter (HLP), W/m²K (39)m ÷ (4) 0.83 0.82 0.82 0.81 0.81 0.79 0.79 0.79 0.79 0.80 0.81 0.81 0.81 0.82 Average = ∑(40)112/12 = 0.81 (40) lumber of days in month (Table 1a) 31.00 28.00 31.00 30.00 31.00 30.00 31.00 30.00 31.00 30.00 31.00 30.00 31.00 30.00 31.00 40) 4. Water heating energy requirement susumed occupancy, N unual average hot water usage in litres per day Vd, average = (25 x N) + 36 1.70 (42) 1.74.56 (43) 82.02 79.04 76.06 73.07 70.09 67.11 67.11 70.09 73.07 76.06 79.04 82.02 Eq. (44)112 = 894.76 (44) 121.63 106.38 109.78 95.71 91.83 79.24 73.43 84.26 85.27 99.37 108.47 117.80 182.5 15.96 16.47 14.36 13.77 11.89 11.01 12.64 12.79 14.91 16.27 17.67 (46) 182.5 15.96 16.47 14.36 13.77 11.89 11.01 12.64 12.79 14.91 16.27 17.67 (46) Vater storage loss: 1 3.00 (47) Vater storage loss: 1 0 Manufacturer's declared loss factor is not known	11.80	Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct Nov	Dec	
teat transfer coefficient, W/K (37)m + (38)m 41.64	Heat transfer coefficient, W/K (37)m + (38)m 41.64 41.51 41.38 40.72 40.58 39.92 39.92 39.79 40.19 40.58 40.85 41.11 Average = \(\frac{7}{2}(39)112/12 = 40.68 (39) (39) (11.1) Beat loss parameter (HLP), W/m²K (39)m ÷ (4) 0.83 0.82 0.82 0.81 0.81 0.79 0.79 0.79 0.80 0.81 0.81 0.81 0.82 Average = \(\frac{7}{2}(40)112/12 = 0.81 (40) (Ventilation heat loss calculated monthly (0.33 x (25)m x (5)								_
4.1.64 4.1.51 4.1.38 40.72 40.58 39.92 39.92 39.79 40.19 40.58 40.85 41.11 Average = Σ(39)112/12 = 40.68 (39) Average = Σ(39)112/12 = 40.68 (39) Average = Σ(39)112/12 = 40.68 (39) Average = Σ(40)112/12 = 40.68 (40) Average = Σ(40)112 Average = Σ(40)112 = 40.68 (40) Average = Σ(40)112 Average = Σ(40)1		11.80 11.67 1	11.54 10.88	10.74	10.08	10.08	9.95	10.35	10.74 11.03	11.27	(38)
Average = \(\sum{2}(39)\tau12/12 = \text{40.68} (39)\text{ leat loss parameter (HLP), W/m²K (39)m ÷ (4) \[\begin{array}{c ccccccccccccccccccccccccccccccccccc	Average \(\frac{1}{2} \)	Heat transfer coefficient, W/K (37)m + (38	8)m								_
Sear loss parameter (HLP), W/m²K (39)m ÷ (4)	Heat loss parameter (HLP), W/m³K (39) + (4) 0.83	41.64 41.51	41.38 40.72	40.58	39.92	39.92	39.79	40.19	40.58 40.85	41.11	
0.83	Number of days in month (Table 1a) 10,00							Average = ∑(3	39)112/12 =	40.68	(39)
Average = \(\Sigma(40) \) 112/12 = \(0.81 \) (40) Aumber of days in month (Table 1a) 31.00 28.00 31.00 30.00 31	Average = \(\(\(\(\) \) Average = \(\) \(\) \(\) Average = \(\)	Heat loss parameter (HLP), W/m²K (39)m	÷ (4)								_
A. Water heating energy requirement Susumed occupancy, N Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres per day Vd, average = (25 x N) + 36 Introduction of the water usage in litres	Number of days in month (Table 1a) 31.00 28.00 31.00 30.00 31.00 30.00 31.00 31.00 30.00 30	0.83 0.82	0.82 0.81	0.81	0.79	0.79	0.79	0.80	0.81 0.81	0.82	
31.00 28.00 31.00 30.00 31.00 31.00 30.00	Note 1.00							Average = ∑(4	40)112/12 =	0.81	(40)
4. Water heating energy requirement A. Sep out 1.70 (42) 74.56 (43) Aug Sep Oct Nov Dec Aug Sep Oc	A. Water heating energy requirement A. Water heating energy region in litres per day for each month \(\forall \) And An										7
1.70 (42) (43) (42) (43) (44) (45)	1.70 42 1.70	31.00 28.00 3	31.00 30.00	31.00	30.00	31.00	31.00	30.00	31.00 30.00	31.00	(40)
Innual average hot water usage in litres per day Vd,average = (25 x N) + 36 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Annual average hot water usage in litres per day Vd, average = (25 x N) + 36	4. Water heating energy requirement									
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Mar	Assumed occupancy, N								1.70	(42)
Not water usage in litres per day for each month Vd,m = factor from Table 1c x (43) 82.02 79.04 76.06 73.07 70.09 67.11 67.11 70.09 73.07 76.06 79.04 82.02	Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43) 82.02 79.04 76.06 73.07 70.09 67.11 67.11 70.09 73.07 76.06 79.04 82.02	Annual average hot water usage in litres p	er day Vd,average	= (25 x N) + 3	36				Ē	74.56	(43)
82.02 79.04 76.06 73.07 70.09 67.11 67.11 70.09 73.07 76.06 79.04 82.02 Σ(44)112 = 894.76 (44) nergy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d) 121.63 106.38 109.78 95.71 91.83 79.24 73.43 84.26 85.27 99.37 108.47 117.80 Σ(45)112 = 1173.18 (45) 18.25 15.96 16.47 14.36 13.77 11.89 11.01 12.64 12.79 14.91 16.27 17.67 (46) torage volume (litres) including any solar or WWHRS storage within same vessel Vater storage loss: () Manufacturer's declared loss factor is not known	82.02 79.04 76.06 73.07 70.09 67.11 67.11 70.09 73.07 76.06 79.04 82.02 \[\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct Nov	Dec	
	Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d) 121.63	Hot water usage in litres per day for each	month Vd,m = fact	or from Tabl	e 1c x (43)						
nergy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d) 121.63	Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d) 121.63 106.38 109.78 95.71 91.83 79.24 73.43 84.26 85.27 99.37 108.47 117.80 [245]112 = 1173.18 (45) Distribution loss 0.15 x (45)m 18.25 15.96 16.47 14.36 13.77 11.89 11.01 12.64 12.79 14.91 16.27 17.67 (46) Storage volume (litres) including any solar or WWHRS storage within same vessel 3.00 (47) Water storage loss: b) Manufacturer's declared loss factor is not known Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51) Volume factor from Table 2a 3.42 (52) Temperature factor from Table 2b 0.60 (53) Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	82.02 79.04	76.06 73.07	70.09	67.11	67.11	70.09	73.07	76.06 79.04	82.02	
	121.63 106.38 109.78 95.71 91.83 79.24 73.43 84.26 85.27 99.37 108.47 117.80 Σ(45)112 = 1173.18 (45) Σ(45)112 = 1173.18 (4								∑(44)112 =	894.76	(44)
Σ(45)112 = 1173.18 (45) Distribution loss 0.15 x (45)m 18.25 15.96 16.47 14.36 13.77 11.89 11.01 12.64 12.79 14.91 16.27 17.67 (46) torage volume (litres) including any solar or WWHRS storage within same vessel Vater storage loss: O) Manufacturer's declared loss factor is not known	Distribution loss 0.15 x (45)m 18.25	Energy content of hot water used = 4.18 x	Vd,m x nm x Tm/3	8600 kWh/m	onth (see T	ables 1b	4 4 1\				
18.25 15.96 16.47 14.36 13.77 11.89 11.01 12.64 12.79 14.91 16.27 17.67 (46)	Distribution loss 0.15 x (45)m 18.25			,000 100011, 1111	011011 (300 1	ables 10	, 1c 1a)				
18.25 15.96 16.47 14.36 13.77 11.89 11.01 12.64 12.79 14.91 16.27 17.67 (46) torage volume (litres) including any solar or WWHRS storage within same vessel Vater storage loss: O) Manufacturer's declared loss factor is not known	18.25 15.96 16.47 14.36 13.77 11.89 11.01 12.64 12.79 14.91 16.27 17.67 (46) Storage volume (litres) including any solar or WWHRS storage within same vessel 3.00 (47) Water storage loss: b) Manufacturer's declared loss factor is not known Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51) Volume factor from Table 2a 3.42 (52) Temperature factor from Table 2b 0.60 (53) Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53) 0.13 (54)	121.63 106.38 1	09.78 95.71					85.27	99.37 108.4	7 117.80	
torage volume (litres) including any solar or WWHRS storage within same vessel Vater storage loss: Manufacturer's declared loss factor is not known	Storage volume (litres) including any solar or WWHRS storage within same vessel Water storage loss: b) Manufacturer's declared loss factor is not known Hot water storage loss factor from Table 2 (kWh/litre/day) Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53) (47)	121.63 106.38 1	09.78 95.71					85.27		!]] (45)
Vater storage loss:) Manufacturer's declared loss factor is not known	Water storage loss: b) Manufacturer's declared loss factor is not known Hot water storage loss factor from Table 2 (kWh/litre/day) Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53) 0.13 (54)		09.78 95.71					85.27		!]] (45)
) Manufacturer's declared loss factor is not known	b) Manufacturer's declared loss factor is not known Hot water storage loss factor from Table 2 (kWh/litre/day) Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53) (54)	Distribution loss 0.15 x (45)m		91.83	79.24	73.43	84.26		∑(45)112 =	1173.18	7
	Hot water storage loss factor from Table 2 (kWh/litre/day) Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53) 0.02 (51) 3.42 (52) 0.60 (53) 0.13 (54)	Distribution loss 0.15 x (45)m 18.25 15.96 :	16.47 14.36	91.83	79.24	73.43	84.26		∑(45)112 =	1173.18	(46)
Hot water storage loss factor from Table 2 (kWh/litro/dov)	Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53) 0.13 (54)	Distribution loss 0.15 x (45)m 18.25 15.96 2 Storage volume (litres) including any solar	16.47 14.36	91.83	79.24	73.43	84.26		∑(45)112 =	1173.18	(46)
1101 water storage 1055 ractor from rable 2 (kwiffiltie/udy) 0.02 (51)	Temperature factor from Table 2b Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53) 0.60 (53) 0.13 (54)	Distribution loss 0.15 x (45)m 18.25 15.96 3 Storage volume (litres) including any solar Water storage loss:	16.47 14.36 or WWHRS storag	91.83	79.24	73.43	84.26		∑(45)112 =	1173.18	(46)
Volume factor from Table 2a 3.42 (52)	Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53) 0.13 (54)	Distribution loss 0.15 x (45)m 18.25 15.96 2 Storage volume (litres) including any solar Water storage loss: b) Manufacturer's declared loss factor is not solar to the storage loss.	16.47 14.36 or WWHRS storag	91.83 13.77 e within sam	79.24	73.43	84.26		∑(45)112 =	1173.18 7 17.67 3.00	(46) (47)
Temperature factor from Table 2b 0.60 (53)		Distribution loss 0.15 x (45)m 18.25	16.47 14.36 or WWHRS storag	91.83 13.77 e within sam	79.24	73.43	84.26		∑(45)112 =	1173.18 7 17.67 3.00	(46) (47) (51)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53) 0.13 (54)	Enter (50) or (54) in (55)	Distribution loss 0.15 x (45)m 18.25 15.96 2 Storage volume (litres) including any solar Water storage loss: b) Manufacturer's declared loss factor is not water storage loss factor from Table Volume factor from Table 2a	16.47 14.36 or WWHRS storag	91.83 13.77 e within sam	79.24	73.43	84.26		∑(45)112 =	1173.18 7	(46) (47) (51) (52)
	(55)	Distribution loss 0.15 x (45)m 18.25 15.96 2 Storage volume (litres) including any solar Water storage loss: b) Manufacturer's declared loss factor is not water storage loss factor from Table Volume factor from Table 2a Temperature factor from Table 2b	16.47 14.36 For WWHRS storag not known le 2 (kWh/litre/day	91.83 13.77 e within sam	79.24	73.43	84.26		∑(45)112 =	1173.18 7	(46) (47) (51) (52) (53)
nter (50) or (54) in (55) 0.13 (55)	Water storage loss calculated for each month (55) x (41)m	Distribution loss 0.15 x (45)m 18.25 15.96 2 Storage volume (litres) including any solar Water storage loss: b) Manufacturer's declared loss factor is not water storage loss factor from Table Volume factor from Table 2a Temperature factor from Table 2b	16.47 14.36 For WWHRS storag not known le 2 (kWh/litre/day	91.83 13.77 e within sam	79.24	73.43	84.26		∑(45)112 =	1173.18 7	(46) (47) (51) (52) (53) (54)

	4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)
f the vessel con	tains dedica	ated solar s	torage or d	edicated V	WHRS (56))m x [(47) -	Vs] ÷ (47),	else (56)					
	4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)
Primary circuit l	oss for each	month fro	m Table 3										
	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 for e	ach month	from Table	3a, 3b or 3	С									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requi	red for wat	er heating o	calculated f	or each mo	onth 0.85 x	(45)m + (4	6)m + (57)ı	n + (59)m -	+ (61)m			•	•
·	148.94	131.04	137.08	122.13	119.14	105.67	100.73	111.57	111.69	126.68	134.90	145.10	(62
Solar DHW inpu					ļ.	100.07	200.70	1 11107	111.05	220.00	2000	1 .5.12	, (02
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63
Output from wa		1		1			0.00	0.00	0.00	0.00	0.00	0.00	, (03
Julpul Holli wa		1		1		1	400.72	444.57	111.00	126.60	424.00	1.45.40	ı
	148.94	131.04	137.08	122.13	119.14	105.67	100.73	111.57	111.69	126.68	134.90	145.10	
				- 10.0-	(.=)		5 (10) (> (-0		∑(64)1	12 =1	1494.66	(64)
Heat gains from		1		1		1			1				ı
	62.29	55.10	58.34	52.96	52.38	47.49	46.26	49.86	49.49	54.88	57.21	61.01	(65)
5. Internal gair	ıs												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains				7 40.	····ay	,		7.008	ЭСР	001		200	
victabolic gairis	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	84.98	(66
ighting gains (s				!			04.90	04.30	04.90	04.90	04.30	04.90	(00)
ighting gains (c		1	-	1			F 46	674	0.00	44.40	42.24	44.22	l (c=
. !!	13.84	12.29	10.00	7.57	5.66	4.78	5.16	6.71	9.00	11.43	13.34	14.22	(67)
Appliance gains			-	1				,		Г			ı
	148.07	149.60	145.73	137.49	127.08	117.30	110.77	109.23	113.11	121.35	131.75	141.53	(68
Cooking gains (c	alculated ir	Appendix	L, equation	L15 or L15	ia), also see	Table 5							
	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	31.50	(69
Pump and fan g	ains (Table	5a) 										_	_
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evap	oration (Ta	ble 5)											
	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	(71
Water heating g	ains (Table	5)											
	83.72	82.00	78.42	73.56	70.40	65.95	62.18	67.02	68.74	73.77	79.45	82.00	(72)
Total internal ga	ins (66)m -	+ (67)m + (6	58)m + (69)	m + (70)m	+ (71)m + (72)m							
	294.11	292.38	282.64	267.10	251.63	236.53	226.60	231.45	239.34	255.04	273.04	286.25	(73)
								'	1				
6. Solar gains													
			Access		Area		ar flux		g	FF		Gains	
			Table	6d	m²	W	//m²	-	ific data able 6b	specific of or Table		W	
												22.70	۱ (۵۵
Most			0.7	, I	7.00	,, -	064 '	A A					
	otto 5/74\	. /02\	0.7	7 x	7.86	x 1	9.64 x	0.9 x	0.45 x	0.70	=	33.70	(80
		. ,											1
Solar gains in wa	33.70	65.92	108.56	7 x [7.86	x 1	9.64 x	0.9 x	126.26	78.22	42.02	27.71	1
Solar gains in wa	33.70 ernal and so	65.92 lar (73)m +	108.56	158.33	194.04	198.64	189.11	162.44	126.26	78.22	42.02	27.71	1
Solar gains in wa	33.70	65.92	108.56										(83
Solar gains in wa	33.70 ernal and so 327.81	65.92 slar (73)m + 358.30	108.56 (83)m 391.20	158.33	194.04	198.64	189.11	162.44	126.26	78.22	42.02	27.71	(83
West Solar gains in wa Total gains - inte	33.70 ernal and so 327.81	65.92 blar (73)m + 358.30 ture (heati	108.56 (83)m 391.20	158.33	194.04	198.64	189.11	162.44	126.26	78.22	42.02	27.71	(84)
Solar gains in wa	33.70 ernal and so 327.81	65.92 blar (73)m + 358.30 ture (heati	108.56 (83)m 391.20	158.33	194.04	198.64	189.11	162.44	126.26	78.22	42.02	27.71	(80) (83) (84) (85)

	JI IOI KAIIIS I	or living are	ea n1.m (se	e Table 9a)									
	1.00	0.99	0.98	0.92	0.79	0.58	0.42	0.46	0.73	0.95	0.99	1.00	(86)
Mean internal t	emp of livin	g area T1 (s	teps 3 to 7	in Table 9c	:)								
	20.27	20.38	20.57	20.80	20.95	20.99	21.00	21.00	20.98	20.79	20.49	20.25	(87)
emperature du	uring heating	g periods in	the rest of	f dwelling fr	rom Table S	 €, Th2(°C)							
	20.23	20.23	20.23	20.25	20.25	20.26	20.26	20.26	20.25	20.25	20.24	20.24	(88)
Jtilisation facto	or for gains f	or rest of d	welling n2,	m									
	1.00	0.99	0.97	0.90	0.74	0.52	0.35	0.39	0.66	0.93	0.99	1.00	(89
Mean internal t	emperature	in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	tc)						
	19.25	19.41	19.69	20.02	20.20	20.26	20.26	20.26	20.24	20.01	19.59	19.23	(90
iving area fract	tion								Li	ving area ÷	(4) =	0.55	(91
Mean internal t	emperature	for the wh	ole dwellin	g fLA x T1 +	-(1 - fLA) x 7	Γ2							
	19.81	19.94	20.17	20.45	20.61	20.66	20.66	20.66	20.64	20.43	20.08	19.79	(92
Apply adjustme	ent to the me	ean interna	l temperati	ure from Ta	ble 4e whe	re appropri	iate						
	19.81	19.94	20.17	20.45	20.61	20.66	20.66	20.66	20.64	20.43	20.08	19.79	(93)
8. Space heati	ng requirem	ent											
o. Space Heath	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto			IVIGI	Aþi	iviay	Juli	Jui	Aug	Зер	Oct	1404	Dec	
Julisation facto	0.99	0.99	0.97	0.91	0.76	0.55	0.39	0.43	0.70	0.93	0.99	1.00	(94)
Jseful gains, ηn			1	0.91	0.70	0.55	0.33	0.43	0.70	0.93	0.55	1.00] (34
oserai gams, ijn	325.95	354.36	380.06	386.99	340.74	239.90	162.03	169.34	254.35	311.59	311.08	312.58	(95
Monthly averag					340.74	239.90	102.03	103.54	254.55	311.55	311.08	312.38] (33
violitiny averag	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96
Heat loss rate fo							10.00	10.40	14.10	10.00	7.10	1.20] (30
	645.68	624.31	565.55	470.12	361.50	241.86	162.19	169.64	262.84	399.12	530.20	640.78	(97
Space heating re			1				101.13	1 200.0 .	1 202.0	1 000.11	1 300.20	1 0 10170] (0)
	237.88	181.41	138.01	59.85	15.45	0.00	0.00	0.00	0.00	65.12	157.77	244.18	1
			·						Σ(98	8)15, 10	.12 = 1	1099.65]] (98
Space heating re	equirement	kWh/m²/ye	ear									21.85	(99
9b. Energy req	quirements -	communit	y heating s	cheme									
raction of spac	ce heat from												,
				ntary systei	m (table 11	.)				'0' if ı		0.00	_
raction of spac				ntary systei	m (table 11	.)				'0' if r 1 - (30		0.00	(30
	ce heat from	communit	y system	ntary systei	m (table 11	.)				1 - (30	01) =		(30
raction of com	ce heat from	communit	y system ers		m (table 11	.)					01) =	1.00	(30 (30 (30
Fraction of com Fraction of total Factor for contr	ce heat from nmunity head of space heat of and charg	community t from boile from comn	y system ers munity boild d (Table 4c	ers (3)) for com	nmunity spa					1 - (30	01) =	1.00	(30 (30 (30 (30
Fraction of com Fraction of total Factor for contr Factor for charg	ce heat from nmunity head Il space heat rol and charg ging method	t from boile from comn from comn ging method (Table 4c(3	y system ers munity boild d (Table 4cd 3)) for comm	ers (3)) for com munity wate	nmunity spa er heating					1 - (30	01) =	1.00 1.00 1.00	(30) (30) (30) (30) (30)
Fraction of com Fraction of total Factor for contr Factor for charg	ce heat from nmunity head Il space heat rol and charg ging method	t from boile from comn from comn ging method (Table 4c(3	y system ers munity boild d (Table 4cd 3)) for comm	ers (3)) for com munity wate	nmunity spa er heating					1 - (30	01) =	1.00 1.00 1.00 1.00	(30) (30) (30) (30) (30) (30) (30)
Fraction of com Fraction of total Factor for contr Factor for charg Distribution loss	ce heat from nmunity head Il space heat rol and charg ging method	t from boile from comn from comn ging method (Table 4c(3	y system ers munity boild d (Table 4cd 3)) for comm	ers (3)) for com munity wate	nmunity spa er heating					1 - (30	01) =	1.00 1.00 1.00 1.00 1.00	(30) (30) (30) (30) (30)
Fraction of com Fraction of total Factor for contr Factor for charg Distribution loss	ce heat from nmunity head Il space heat rol and charg ging method s factor (Tab	t from boile from comn ging method (Table 4c(3	y system ers munity boild d (Table 4cd 3)) for comm	ers (3)) for com munity wate	nmunity spa er heating					1 - (30	01) =	1.00 1.00 1.00 1.00 1.00	(30) (30) (30) (30) (30) (30)
Fraction of com Fraction of total Factor for contr Factor for charg Distribution loss Space heating Annual space he	ce heat from nmunity head of space heat rol and charg ging method s factor (Tab	t from boile from comn ging method (Table 4c(3	y system ers munity boild d (Table 4cd 3)) for comm	ers (3)) for com munity wate	nmunity spa er heating				099.65	1 - (30 (302) x (303	O1) =	1.00 1.00 1.00 1.00 1.00 1.05	(30) (30) (30) (30) (30) (30) (98)
Fraction of com Fraction of total Factor for contr Factor for charg Distribution loss Space heating Annual space he	ce heat from nmunity head of space heat rol and charg ging method s factor (Tab	t from boile from comn ging method (Table 4c(3	y system ers munity boild d (Table 4cd 3)) for comm	ers (3)) for com munity wate	nmunity spa er heating				099.65	1 - (30	O1) =	1.00 1.00 1.00 1.00 1.00	(30) (30) (30) (30) (30) (30) (98)
Fraction of com Fraction of total Factor for contr Factor for charg Distribution loss Space heating Annual space he Space heat from	ce heat from nmunity head of space heat rol and charg ging method s factor (Tab	t from boile from comn ging method (Table 4c(3	y system ers munity boild d (Table 4cd 3)) for comm	ers (3)) for com munity wate	nmunity spa er heating				099.65	1 - (30 (302) x (303	O1) =	1.00 1.00 1.00 1.00 1.00 1.05	(30) (30) (30) (30) (30) (30) (98)
Fraction of com Fraction of total Fractor for contr Fractor for charg Distribution loss Space heating Annual space he Space heat from Water heating	ce heat from nmunity head of space heat rol and charg ging method s factor (Tab eating requi n boilers	t from boile from comn ging method (Table 4c(3 ole 12c) for o	y system ers munity boild d (Table 4cd 3)) for comm	ers (3)) for com munity wate	nmunity spa er heating			(98	.099.65 3) x (304a) :	1 - (30 (302) x (303	O1) =	1.00 1.00 1.00 1.00 1.00 1.05	(30) (30) (30) (30) (30) (30) (30) (30)
Fraction of com Fraction of total Fractor for contr Fractor for charg Distribution loss Space heating Annual space he Space heat from Water heating Annual water he	ce heat from nmunity head of space heat rol and charg ging method s factor (Tab eating requi n boilers	t from boile from comn ging method (Table 4c(3 ole 12c) for o	y system ers munity boild d (Table 4cd 3)) for comm	ers (3)) for com munity wate	nmunity spa er heating			(98	.099.65 3) x (304a) :	1 - (30 (302) x (303) x (305) x (305)	01) = 3a) =	1.00 1.00 1.00 1.00 1.00 1.05	(30) (30) (30) (30) (30) (30) (30) (30)
Fraction of space Fraction of com Fraction of total Factor for contr Factor for charg Distribution loss Space heating Annual space he Space heat from Water heating Annual water he Water heat from	ce heat from nmunity head Il space heat rol and charg ging method s factor (Tab eating requi n boilers eating requi	t from boile from community from community ging method (Table 4c(3) for other	y system ers munity boild d (Table 4cd 3)) for comm	ers (3)) for com munity wate	nmunity spa er heating			(98 1 (64)	.099.65 3) x (304a) : .494.66 x (303a) x	1 - (30 (302) x (303	01) =	1.00 1.00 1.00 1.00 1.00 1.05	(30) (30) (30) (30) (30)

mechanical ventilation fans - balanced, extract or positive input from outside

101.68 (330a)

Total electricity for the above, kWh/year

101.68 (331)

Electricity for lighting (Appendix L)

244.38 (332)

Total delivered energy for all uses

(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =

3070.08 (338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1154.64] x	4.24	x 0.01 =	48.96	(340a)
Water heating from boilers	1569.39] x	4.24	x 0.01 =	66.54	(342a)
Pumps and fans	101.68] x	13.19	x 0.01 =	13.41	(349)
Electricity for lighting	244.38] x	13.19	x 0.01 =	32.23	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)(342e)	+ (345)(354) =	281.14	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	56)
Energy cost factor (ECF)	1.24 (3	57)
SAP value	82.72	
SAP rating (section 13)	83 (3	58)
SAP band	В	

12b. CO₂ emissions - community heating	scheme							
		Energy kWh/year		Emission factor		Emissions (kg/year)		
Emissions from other sources (space heating	ng)							
Efficiency of boilers		89.50					(367a)	
CO2 emissions from boilers [(307a)+(3	310a)] x 100 ÷ (367a) = [3043.60	x	0.216	= [657.42	(367)	
Electrical energy for community heat distril	bution	27.24	x	0.519	= [14.14	(372)	
Total CO2 associated with community system	ems					671.56	(373)	
Total CO2 associated with space and water	heating					671.56	(376)	
Pumps and fans		101.68	x	0.519	= [52.77	(378)	
Electricity for lighting		244.38	x	0.519	= [126.83	(379)	
Total CO ₂ , kg/year					(376)(382) = [851.16	(383)	
Dwelling CO ₂ emission rate					(383) ÷ (4) = [16.91	(384)	
El value						88.03		
El rating (section 14)						88	(385)	
El band						В		

13b. Primary energy - community heating scheme

Energy kWh/year			Primary energy (kWh/year)				
89.50					(367a)		
'a) = 3043.60	х	1.22	=	3713.20	(367)		
27.24	х	3.07	=	83.63	(372)		
				3796.82	(373)		
g				3796.82	(376)		
	kWh/year 89.50 'a) = 3043.60	kWh/year 89.50 7a) = 3043.60 x 27.24 x	kWh/year 89.50 7a) = 3043.60	kWh/year 89.50 7a) = 3043.60	kWh/year (kWh/year) 89.50 7a) = 3043.60		

Pumps and fans Electricity for lighting Primary energy kWh/year

Dwelling primary energy rate kWh/m2/year

101.68 244.38

3.07 3.07

312.15 750.24

(379)

(378)

4859.22 (383)

96.57

(384)

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	2B3P, Kingston upon Thames, KT1		

Address		2B3P, Kir	ngston upoi	n Thames, I	KT1								
1. Overall dwelling	dimensi	ons											
					A	rea (m²)			rage storey eight (m)		Vo	olume (m³)	
Lowest occupied						64.62] (1a) x		2.50] (2a) =		161.55	(3
Total floor area		(1a)	+ (1b) + (1d	c) + (1d)(1	Ln) =	64.62	(4)						
Dwelling volume								(3a)) + (3b) + (3	c) + (3d)(3	3n) =	161.55	(5
2. Ventilation rate													
											m	³ per hour	
Number of chimney	S								0	x 40 =		0	(6
Number of open flue	es								0	x 20 =	: [0	(6
Number of intermitt	tent fans								0	x 10 =	:	0	(7
Number of passive v	ents								0	x 10 =	:	0	(7
Number of flueless g	gas fires								0	x 40 =	:	0	(7
											Air	changes pe hour	r
nfiltration due to ch	nimneys, i	flues, fans	s, PSVs		(6a)	+ (6b) + (7a	a) + (7b) + (7c) =	0	÷ (5) =		0.00	(8
f a pressurisation te	est has be	en carriec	d out or is ii	ntended, pr	oceed to (1	(7), otherw	ise continue	e from (9) t	o (16)				
Air permeability valu	ue, q50, e	xpressed	in cubic me	etres per ho	our per squ	are metre	of envelope	area				3.00	(1
f based on air perm	eability v	alue, ther	n (18) = [(17	7) ÷ 20] + (8), otherwis	se (18) = (16	5)					0.15	(1
Number of sides on	which the	e dwelling	g is sheltere	ed								2	(1
Shelter factor									1 -	[0.075 x (1	9)] =	0.85	(2
Infiltration rate inco	rporating	shelter f	actor							(18) x (2	20) =	0.13	(2
Infiltration rate mod	lified for	monthly v	wind speed	:									
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wi	nd speed	from Tab	le U2										
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(2
Wind factor (22)m ÷	4												
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2													
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)	m ÷ 4												
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltrat	ion rate (a	llowing for	shelter and	wind facto	or) (21) x (2	2a)m							
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)
Calculate effective	ve air chan	ge rate for t	he applicat	ble case:									
If mechanical	ventilation	n: air chang	e rate throu	ugh system								0.50	(23a)

Calculate effecti	ve air chang	ge rate for t	the applical	ble case:									
If mechanica	If mechanical ventilation: air change rate through system												
If balanced w	If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h												
a) If balanced	l mechanica	al ventilatio	n with hea	t recovery ((MVHR) (22	!b)m + (23b) x [1 - (23d	c) ÷ 100]					
	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)
Effective air cha	Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)												
	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(25)



	and heat lo	ss paramet	EI										
Element				Gross area, m²	Openings m ²	Net a		U-value W/m²K	A x U W		alue, /m².K	Αxκ, kJ/K	
Window						15.	.04 x	1.24	= 18.59				(27)
Door						1.8	80 x	0.60	= 1.08				(26)
External wall						31.	.51 x	0.17	= 5.36				(29a)
Party wall						14.	.88 x	0.00	= 0.00				(32)
External wall						22.	.05 x	0.20	= 4.41				(29a)
Roof						64.	.62 x	0.13	= 8.40				(30)
Total area of ex	ternal elem	ents ∑A, m²				135	.02						(31)
Fabric heat loss	, W/K = ∑(A	× U)							(26)(30) + (3	32) =	37.83	(33)
Heat capacity C	m = ∑(A x κ)							(28)	.(30) + (32) +	· (32a)(32	2e) =	N/A	(34)
Thermal mass p	arameter (٦	MP) in kJ/n	n²K									250.00	(35)
Thermal bridge	s: ∑(L x Ψ) c	alculated us	sing Appe	ndix K								15.57	(36)
Total fabric hea	t loss									(33) + (3	36) =	53.41	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation hea	t loss calcula	ated month	ly 0.33 x	(25)m x (5)									
	15.38	15.21	15.04	14.19	14.02	13.17	13.17	13.00	13.51	14.02	14.36	14.70	(38)
Heat transfer co	oefficient, W	//K (37)m +	- (38)m										
	68.79	68.62	68.45	67.60	67.43	66.58	66.58	66.41	66.92	67.43	67.77	68.11	
									Average = ∑	(39)112/	12 =	67.56	(39)
Heat loss param	neter (HLP),	W/m²K (39	9)m ÷ (4)										
	1.06	1.06	1.06	1.05	1.04	1.03	1.03	1.03	1.04	1.04	1.05	1.05	
									Average = ∑	(40)112/	12 =	1.05	(40)
Number of days	s in month (Table 1a)											
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
4. Water heat	ing energy r	equiremen	†										
Assumed occup		equiremen										2.11	(42)
Annual average	-	ısago in litra	as nar dav	. Vd. average	= (25 × N) ±	36						84.28	(43)
Ailliual average	Jan	_	zs pei uay	vu,average	- (23 x N) 1	30						04.20	(43)
Hot water usag	Jan	Foh			May	lun	Ind	Διισ	San	Oct	Nov	Dec	_
TIOL Water usage	a in litras na	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
		er day for ea	Mar ach month	Apr Vd,m = fac	tor from Tab	le 1c x (43)						_ _
	e in litres pe		Mar	Apr				Aug 79.23	Sep	85.97	89.34	92.71	
Energy content	92.71	er day for ea	Mar ach month 85.97	Apr 1 Vd,m = fac 82.60	tor from Tab	le 1c x (43 75.86	75.86	79.23			89.34		
Energy content	92.71 of hot wate	89.34 89.34 er used = 4.1	Mar ach month 85.97	Apr 1 Vd,m = fact 82.60 x nm x Tm/3	79.23 79.23 8600 kWh/m	le 1c x (43 75.86 onth (see	75.86 Tables 1b	79.23	82.60	85.97 ∑(44)1	89.34 12 =	92.71	
Energy content	92.71	er day for ea	Mar ach month 85.97	Apr 1 Vd,m = fac 82.60	tor from Tab	le 1c x (43 75.86	75.86	79.23		85.97 Σ(44)1 112.33	89.34 12 =	92.71 1011.41 133.15	
	92.71 of hot wate	89.34 er used = 4.1	Mar ach month 85.97	Apr 1 Vd,m = fact 82.60 x nm x Tm/3	79.23 79.23 8600 kWh/m	le 1c x (43 75.86 onth (see	75.86 Tables 1b	79.23	82.60	85.97 ∑(44)1	89.34 12 =	92.71	(44)
Energy content Distribution loss	92.71 of hot wate 137.49 s 0.15 x (45	er day for ea 89.34 er used = 4.1 120.25	Mar ach month 85.97 18 x Vd,m 124.09	Apr 1 Vd,m = fact 82.60 x nm x Tm/3 108.18	79.23 8600 kWh/m	75.86 onth (see	75.86 Tables 1b 83.00	79.23 , 1c 1d) 95.25	96.39	85.97 Σ(44)1 112.33 Σ(45)1	89.34 12 = 122.61 12 =	92.71 1011.41 133.15 1326.12	(45)
Distribution los	92.71 of hot wate 137.49 s 0.15 x (45) 20.62	er day for ea 89.34 er used = 4.1 120.25)m	Mar ach month 85.97 18 x Vd,m 124.09	Apr 1 Vd,m = fact 82.60 x nm x Tm/3 108.18	79.23 3600 kWh/m 103.80	75.86 onth (see 89.57	75.86 Tables 1b	79.23	82.60	85.97 Σ(44)1 112.33	89.34 12 =	92.71 1011.41 133.15 1326.12	(45)
Distribution loss	92.71 of hot wate 137.49 s 0.15 x (45) 20.62 e (litres) include	er day for ea 89.34 er used = 4.1 120.25)m	Mar ach month 85.97 18 x Vd,m 124.09	Apr 1 Vd,m = fact 82.60 x nm x Tm/3 108.18	79.23 3600 kWh/m 103.80	75.86 onth (see 89.57	75.86 Tables 1b 83.00	79.23 , 1c 1d) 95.25	96.39	85.97 Σ(44)1 112.33 Σ(45)1	89.34 12 = 122.61 12 =	92.71 1011.41 133.15 1326.12	(45)
Distribution los Storage volume Water storage I	92.71 of hot wate 137.49 s 0.15 x (45) 20.62 e (litres) inclusions:	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so	Mar ach month 85.97 18 x Vd,m 124.09 18.61 olar or WV	Apr 1 Vd,m = fact 82.60 x nm x Tm/3 108.18 16.23 WHRS storage	79.23 3600 kWh/m 103.80	75.86 onth (see 89.57	75.86 Tables 1b 83.00	79.23 , 1c 1d) 95.25	96.39	85.97 Σ(44)1 112.33 Σ(45)1	89.34 12 = 122.61 12 =	92.71 1011.41 133.15 1326.12	(45)
Distribution loss Storage volume Water storage I b) Manufacture	92.71 of hot wate 137.49 s 0.15 x (45) 20.62 e (litres) incluoss: er's declared	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so	Mar ach month 85.97 18 x Vd,m 124.09	Apr 1 Vd,m = fact 82.60 x nm x Tm/3 108.18 16.23 WHRS storage	15.57 tor from Tab	75.86 onth (see 89.57	75.86 Tables 1b 83.00	79.23 , 1c 1d) 95.25	96.39	85.97 Σ(44)1 112.33 Σ(45)1	89.34 12 = 122.61 12 =	92.71 1011.41 133.15 1326.12 19.97 3.00	(45) (46) (47)
Distribution loss Storage volume Water storage I b) Manufacture Hot water st	92.71 of hot wate 137.49 s 0.15 x (45) 20.62 e (litres) incluoss: er's declared corage loss f	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so loss factor actor from	Mar ach month 85.97 18 x Vd,m 124.09	Apr 1 Vd,m = fact 82.60 x nm x Tm/3 108.18 16.23 WHRS storage	15.57 tor from Tab	75.86 onth (see 89.57	75.86 Tables 1b 83.00	79.23 , 1c 1d) 95.25	96.39	85.97 Σ(44)1 112.33 Σ(45)1	89.34 12 = 122.61 12 =	92.71 1011.41 133.15 1326.12 19.97 3.00	(45) (46) (47) (51)
Distribution loss Storage volume Water storage I b) Manufacture Hot water st	92.71 of hot wate 137.49 s 0.15 x (45) 20.62 e (litres) incluoss: er's declared corage loss for from Tab	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so loss factor actor from	Mar ach month 85.97 18 x Vd,m 124.09	Apr 1 Vd,m = fact 82.60 x nm x Tm/3 108.18 16.23 WHRS storage	15.57 tor from Tab	75.86 onth (see 89.57	75.86 Tables 1b 83.00	79.23 , 1c 1d) 95.25	96.39	85.97 Σ(44)1 112.33 Σ(45)1	89.34 12 = 122.61 12 =	92.71 1011.41 133.15 1326.12 19.97 3.00 0.02 3.42	(45) (46) (47) (51) (52)
Distribution loss Storage volume Water storage I b) Manufacture Hot water st Volume fact Temperature	92.71 of hot wate 137.49 s 0.15 x (45) 20.62 e (litres) incluoss: er's declared corage loss for from Table e factor from	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so loss factor actor from le 2a m Table 2b	Mar ach month 85.97 18 x Vd,m 124.09 18.61 olar or WV is not knot	Apr NVd,m = fact 82.60 x nm x Tm/3 108.18 16.23 WHRS storage own Wh/litre/da	15.57 ge within sam	75.86 onth (see 89.57	75.86 Tables 1b 83.00	79.23 , 1c 1d) 95.25	96.39	85.97 Σ(44)1 112.33 Σ(45)1	89.34 12 = 122.61 12 =	92.71 1011.41 133.15 1326.12 19.97 3.00 0.02 3.42 0.60	(45) (46) (47) (51) (52) (53)
Distribution loss Storage volume Water storage I b) Manufacture Hot water st Volume fact Temperature Energy lost f	92.71 of hot water 137.49 s 0.15 x (45) 20.62 e (litres) inclusions: er's declared corage loss from Table e factor from water strom water strong wate	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so loss factor actor from le 2a m Table 2b	Mar ach month 85.97 18 x Vd,m 124.09 18.61 olar or WV is not knot	Apr NVd,m = fact 82.60 x nm x Tm/3 108.18 16.23 WHRS storage own Wh/litre/da	15.57 ge within sam	75.86 onth (see 89.57	75.86 Tables 1b 83.00	79.23 , 1c 1d) 95.25	96.39	85.97 Σ(44)1 112.33 Σ(45)1	89.34 12 = 122.61 12 =	92.71 1011.41 133.15 1326.12 19.97 3.00 0.02 3.42 0.60 0.13	(45) (46) (47) (51) (52) (53) (54)
Distribution loss Storage volume Water storage I b) Manufacture Hot water st Volume fact Temperature	92.71 of hot water 137.49 s 0.15 x (45) 20.62 e (litres) inclusions: er's declared corage loss from Table factor from water states (4) in (55)	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so loss factor actor from actor from le 2a m Table 2b storage (kW	Mar ach month 85.97 18 x Vd,m 124.09 18.61 olar or WV is not kno Table 2 (k	Apr 1 Vd,m = fact 82.60 x nm x Tm/3 108.18 16.23 WHRS storage wwn Wh/litre/da	15.57 ge within sam	75.86 onth (see 89.57	75.86 Tables 1b 83.00	79.23 , 1c 1d) 95.25	96.39	85.97 Σ(44)1 112.33 Σ(45)1	89.34 12 = 122.61 12 =	92.71 1011.41 133.15 1326.12 19.97 3.00 0.02 3.42 0.60	(45) (46) (47) (51) (52) (53)

											1		1
	4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	[56]
If the vessel con				1			1		1				1
	4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	[57]
Primary circuit lo				T					T				1 (= 5)
	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 for e			3a, 3b or 3	1	ı		1	Γ	1	Γ	1		1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requi		er heating c		or each mo	onth 0.85 x		1		1	r	ı		1
	164.79	144.91	151.39	134.60	131.11	116.00	110.31	122.55	122.81	139.63	149.04	160.46	(62)
Solar DHW input			endix G or A	Appendix H									1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from wa		for each mo	nth (kWh/	month) (62	2)m + (63)m -								1
	164.79	144.91	151.39	134.60	131.11	116.00	110.31	122.55	122.81	139.63	149.04	160.46	
										∑(64)1	.12 =1	1647.59	(64)
Heat gains from	water heat	ing (kWh/m	nonth) 0.2!	5 × [0.85 × ((45)m + (61 	.)m] + 0.8 ×	[(46)m + (5	57)m + (59))m]				-
	67.56	59.71	63.10	57.11	56.36	50.92	49.44	53.51	53.19	59.19	61.91	66.12	(65)
5. Internal gain	ıs												
51 meerinal Ban	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains		165	IVIGI	Aþi	iviay	Juli	Jui	Aug	Зер	Oct	1404	Dec	
Wietabolic gairis	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	105.44	166)
Lighting gains (s		105.44			105.44		105.44	105.44	105.44	105.44	105.44	105.44	(66)
Lighting gains (ca			-				6.42	7.07	10.70	42.50	45.05	16.00	1 (67)
Appliance gains	16.44	14.60	11.88	8.99	6.72	5.67	6.13	7.97	10.70	13.58	15.85	16.90	(67)
Appliance gains			-	1						l .==		17000	1 (60)
	184.43	186.34	181.52	171.25	158.29	146.11	137.98	136.06	140.88	151.15	164.11	176.29	(68)
o 1				145 145	\ I	- 11 -							
Cooking gains (c			•						1		I	T	1
	33.54	33.54	L, equation 33.54	L15 or L15 33.54	a), also see 33.54	Table 5 33.54	33.54	33.54	33.54	33.54	33.54	33.54	(69)
Cooking gains (c	33.54 ains (Table !	33.54 5a)	33.54	33.54	33.54	33.54					1		1
Pump and fan ga	33.54 ains (Table !	33.54 5a) 0.00	•				33.54	33.54	33.54	33.54	33.54	33.54] (69)] (70)
	33.54 ains (Table !	33.54 5a) 0.00 ble 5)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00] (70)
Pump and fan ga Losses e.g. evap	33.54 ains (Table 9 0.00 oration (Tal -84.35	33.54 5a) 0.00 ble 5)	33.54	33.54	33.54	33.54					1		1
Pump and fan ga	33.54 ains (Table 9 0.00 oration (Tal -84.35	33.54 5a) 0.00 ble 5)	0.00	0.00	33.54 0.00 -84.35	0.00	0.00	-84.35	0.00	0.00	0.00 -84.35	0.00] (70)
Pump and fan ga Losses e.g. evap Water heating g	33.54 ains (Table 9 0.00 oration (Tal -84.35 ains (Table 90.80	33.54 5a) 0.00 ble 5) -84.35 5) 88.86	33.54 0.00 -84.35	33.54 0.00 -84.35	33.54 0.00 -84.35	33.54 0.00 -84.35	0.00	0.00	0.00	0.00	0.00	0.00] (70)
Pump and fan ga Losses e.g. evap	33.54 ains (Table 9 0.00 oration (Tal -84.35 ains (Table 90.80 ins (66)m -	33.54 5a) 0.00 ble 5) -84.35 5) 88.86	33.54 0.00 -84.35	33.54 0.00 -84.35	33.54 0.00 -84.35	33.54 0.00 -84.35	0.00	-84.35	0.00	0.00 -84.35	0.00 -84.35	0.00] (70)] (71)
Pump and fan ga Losses e.g. evap Water heating g	33.54 ains (Table 9 0.00 oration (Tal -84.35 ains (Table 90.80	33.54 5a) 0.00 ble 5) -84.35 5) 88.86	33.54 0.00 -84.35	33.54 0.00 -84.35	33.54 0.00 -84.35	33.54 0.00 -84.35	0.00	-84.35	0.00	0.00 -84.35	0.00 -84.35	0.00] (70)] (71)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga	33.54 ains (Table 9 0.00 oration (Tal -84.35 ains (Table 90.80 ins (66)m -	33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6	33.54 0.00 -84.35 84.81 8)m + (69)	33.54 0.00 -84.35 79.32 m+(70)m-	33.54 0.00 -84.35 75.75 + (71)m + (7	33.54 0.00 -84.35 70.72 72)m	-84.35 66.45	0.00 -84.35 71.93	-84.35 73.87	-84.35 79.56	-84.35 85.98	0.00 -84.35 88.87] (70)] (71)] (72)
Pump and fan ga Losses e.g. evap Water heating g	33.54 ains (Table 9 0.00 oration (Tal -84.35 ains (Table 90.80 ins (66)m -	33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6	33.54 0.00 -84.35 84.81 8)m + (69) 332.84	33.54 0.00 -84.35 79.32 m+(70)m- 314.20	33.54 0.00 -84.35 75.75 + (71)m + (72)	33.54 0.00 -84.35 70.72 72)m 277.14	0.00 -84.35 66.45 265.19	0.00 -84.35 71.93	73.87 280.08	-84.35 79.56 298.93	-84.35 85.98	0.00 -84.35 88.87] (70)] (71)] (72)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga	33.54 ains (Table 9 0.00 oration (Tal -84.35 ains (Table 90.80 ins (66)m -	33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6	33.54 0.00 -84.35 84.81 8)m + (69)	33.54 0.00 -84.35 79.32 m+(70)m- 314.20	33.54 0.00 -84.35 75.75 + (71)m + (7	33.54 0.00 -84.35 70.72 72)m 277.14	-84.35 66.45	0.00 -84.35 71.93 270.59	0.00 -84.35 73.87 280.08	0.00 -84.35 79.56 298.93	0.00 -84.35 85.98 320.58	0.00 -84.35 88.87] (70)] (71)] (72)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga	33.54 ains (Table 9 0.00 oration (Tal -84.35 ains (Table 90.80 ins (66)m -	33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6	33.54 0.00 -84.35 84.81 8)m + (69) 332.84	33.54 0.00 -84.35 79.32 m+(70)m- 314.20	33.54 0.00 -84.35 75.75 + (71)m + (72) 295.40 Area	33.54 0.00 -84.35 70.72 72)m 277.14	0.00 -84.35 66.45 265.19	0.00 -84.35 71.93 270.59	0.00 -84.35 73.87 280.08	0.00 -84.35 79.56 298.93	0.00 -84.35 85.98 320.58	0.00 -84.35 88.87 336.69] (70)] (71)] (72)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga	33.54 ains (Table 9 0.00 oration (Tal -84.35 ains (Table 90.80 ins (66)m -	33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6	33.54 0.00 -84.35 84.81 8)m + (69) 332.84	33.54 0.00 -84.35 79.32 m+(70)m- 314.20 Factor 6d	33.54 0.00 -84.35 75.75 + (71)m + (72) 295.40 Area	33.54 0.00 -84.35 70.72 72)m 277.14 Sol	0.00 -84.35 66.45 265.19	0.00 -84.35 71.93 270.59 spec	0.00 -84.35 73.87 280.08	0.00 -84.35 79.56 298.93 FF specific cor Table	0.00 -84.35 85.98 320.58	0.00 -84.35 88.87 336.69] (70)] (71)] (72)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains	33.54 ains (Table 9 0.00 oration (Tal -84.35 ains (Table 90.80 ins (66)m -	33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6	33.54 0.00 -84.35 84.81 8)m + (69) 332.84 Access f	33.54 0.00 -84.35 79.32 m+(70)m- 314.20 factor 6d	33.54 0.00 -84.35 75.75 + (71)m + (72) 295.40 Area m²	33.54 0.00 -84.35 70.72 72)m 277.14 Sol	0.00 -84.35 66.45 265.19 ar flux J/m² 0.63 x	0.00 -84.35 71.93 270.59 spec or T	73.87 280.08 g ific data able 6b	0.00 -84.35 79.56 298.93 FF specific c or Table 0.70	0.00 -84.35 85.98 320.58	0.00 -84.35 88.87 336.69] (70)] (71)] (72)] (73)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains	33.54 ains (Table 9 0.00 oration (Tal -84.35 ains (Table 90.80 ins (66)m - 346.31	33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6 344.44	33.54 0.00 -84.35 84.81 8)m + (69) 332.84 Access f Table	33.54 0.00 -84.35 79.32 m+(70)m- 314.20 factor 6d	33.54 0.00 -84.35 75.75 + (71)m + (33.54 0.00 -84.35 70.72 72)m 277.14 Sol	0.00 -84.35 66.45 265.19 ar flux J/m² 0.63 x	0.00 -84.35 71.93 270.59 spec or T	0.00 -84.35 73.87 280.08 g ific data able 6b 0.45 x	0.00 -84.35 79.56 298.93 FF specific c or Table 0.70	0.00 -84.35 85.98 320.58	0.00 -84.35 88.87 336.69 Gains W] (70)] (71)] (72)] (73)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains North East	33.54 ains (Table 9 0.00 oration (Tal -84.35 ains (Table 90.80 ins (66)m - 346.31	33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6 344.44	33.54 0.00 -84.35 84.81 8)m + (69) 332.84 Access f Table	33.54 0.00 -84.35 79.32 m+(70)m- 314.20 factor 6d	33.54 0.00 -84.35 75.75 + (71)m + (33.54 0.00 -84.35 70.72 72)m 277.14 Sol	0.00 -84.35 66.45 265.19 ar flux J/m² 0.63 x	0.00 -84.35 71.93 270.59 spec or T	0.00 -84.35 73.87 280.08 g ific data able 6b 0.45 x	0.00 -84.35 79.56 298.93 FF specific c or Table 0.70	0.00 -84.35 85.98 320.58	0.00 -84.35 88.87 336.69 Gains W] (70)] (71)] (72)] (73)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains North East	33.54 ains (Table 9 0.00 oration (Tal -84.35 ains (Table 90.80 ins (66)m - 346.31	33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6 344.44	33.54 0.00 -84.35 84.81 8)m + (69) 332.84 Access f Table 0.7 0.7	33.54 0.00 -84.35 79.32 m+(70)m- 314.20 factor 6d 7 x 7 x	33.54 0.00 -84.35 75.75 + (71)m + (33.54 0.00 -84.35 70.72 72)m 277.14 Sol W	0.00 -84.35 66.45 265.19 ar flux //m² 0.63 x 9.64 x	0.00 -84.35 71.93 270.59 spec or T 0.9 x 0.9 x	0.00 -84.35 73.87 280.08 gific data able 6b 0.45 x x x	0.00 -84.35 79.56 298.93 FF specific c or Table 0.70 0.70	0.00 -84.35 85.98 320.58	0.00 -84.35 88.87 336.69 Gains W 19.03 29.33] (70)] (71)] (72)] (73)] (74)] (76)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains North East Solar gains in wa	33.54 ains (Table 9 0.00 oration (Tal -84.35 ains (Table 90.80 ins (66)m - 346.31	33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6 344.44	33.54 0.00 -84.35 84.81 8)m + (69) 332.84 Access f Table 0.7 0.7	33.54 0.00 -84.35 79.32 m+(70)m- 314.20 factor 6d 7 x 7 x	33.54 0.00 -84.35 75.75 + (71)m + (33.54 0.00 -84.35 70.72 72)m 277.14 Sol W	0.00 -84.35 66.45 265.19 ar flux //m² 0.63 x 9.64 x	0.00 -84.35 71.93 270.59 spec or T 0.9 x 0.9 x	0.00 -84.35 73.87 280.08 gific data able 6b 0.45 x x x	0.00 -84.35 79.56 298.93 FF specific c or Table 0.70 0.70	0.00 -84.35 85.98 320.58	0.00 -84.35 88.87 336.69 Gains W 19.03 29.33] (70)] (71)] (72)] (73)] (74)] (76)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains North East Solar gains in wa Total gains - inter	33.54 ains (Table 9 0.00 oration (Tale 9 -84.35 ains (Table 90.80 ins (66)m - 346.31 atts Σ(74)m 48.36 ernal and so 394.67	33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6 344.44 1(82)m 93.74 plar (73)m + 438.18	33.54 0.00 -84.35 84.81 8)m + (69) 332.84 Access f Table 0.7 0.7 156.29 (83)m 489.13	33.54 0.00 -84.35 79.32 m+(70)m 314.20 factor 6d 7 x 237.07	33.54 0.00 -84.35 75.75 + (71)m + (33.54 0.00 -84.35 70.72 72)m 277.14 Sol W x 1 x 1 316.04	0.00 -84.35 66.45 265.19 ar flux //m² 0.63 x 9.64 x	0.00 -84.35 71.93 270.59 spec or T 0.9 x 0.9 x 247.42	0.00 -84.35 73.87 280.08 gific data able 6b 0.45 x 184.19	0.00 -84.35 79.56 298.93 FF specific c or Table 0.70 0.70 111.37	0.00 -84.35 85.98 320.58 data 6c = 60.05	0.00 -84.35 88.87 336.69 Gains W 19.03 29.33] (70)] (71)] (72)] (73)] (74)] (76)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains North East Solar gains in wa Total gains - internal gains - internal gains - internal gains	33.54 ains (Table 9 0.00 oration (Tal -84.35 ains (Table 90.80 ins (66)m - 346.31 atts Σ(74)m 48.36 ernal and so 394.67 al tempera	33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6 344.44 n(82)m 93.74 blar (73)m + 438.18	33.54 0.00 -84.35 84.81 8)m + (69) 332.84 Access f Table 0.7 0.7 156.29 (83)m 489.13	33.54 0.00 -84.35 79.32 m+(70)m 314.20 factor 6d 7 x 237.07	33.54 0.00 -84.35 75.75 + (71)m + (33.54 0.00 -84.35 70.72 72)m 277.14 Sol W x 1 x 1 316.04	0.00 -84.35 66.45 265.19 ar flux //m² 0.63 x 9.64 x	0.00 -84.35 71.93 270.59 spec or T 0.9 x 0.9 x 247.42	0.00 -84.35 73.87 280.08 gific data able 6b 0.45 x 184.19	0.00 -84.35 79.56 298.93 FF specific c or Table 0.70 0.70 111.37	0.00 -84.35 85.98 320.58 data 6c = 60.05	0.00 -84.35 88.87 336.69 Gains W 19.03 29.33 39.98] (70)] (71)] (72)] (73)] (74)] (76)] (83)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains North East Solar gains in wa Total gains - inter	33.54 ains (Table 9 0.00 oration (Tal -84.35 ains (Table 90.80 ins (66)m - 346.31 atts Σ(74)m 48.36 ernal and so 394.67 al tempera	33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6 344.44 n(82)m 93.74 blar (73)m + 438.18	33.54 0.00 -84.35 84.81 8)m + (69) 332.84 Access f Table 0.7 0.7 156.29 (83)m 489.13	33.54 0.00 -84.35 79.32 m+(70)m 314.20 factor 6d 7 x 237.07	33.54 0.00 -84.35 75.75 + (71)m + (33.54 0.00 -84.35 70.72 72)m 277.14 Sol W x 1 x 1 316.04	0.00 -84.35 66.45 265.19 ar flux //m² 0.63 x 9.64 x	0.00 -84.35 71.93 270.59 spec or T 0.9 x 0.9 x 247.42	0.00 -84.35 73.87 280.08 gific data able 6b 0.45 x 184.19	0.00 -84.35 79.56 298.93 FF specific c or Table 0.70 0.70 111.37	0.00 -84.35 85.98 320.58 data 6c = 60.05	0.00 -84.35 88.87 336.69 Gains W 19.03 29.33] (70)] (71)] (72)] (73)] (74)] (76)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation fact	or for gains f	or living are	ea n1,m (se	e Table 9a)									
	1.00	1.00	0.99	0.96	0.86	0.68	0.51	0.58	0.84	0.98	1.00	1.00	(86)
Mean internal	temp of livin	g area T1 (s	steps 3 to 7	in Table 9c	:)								
	19.89	20.01	20.25	20.57	20.84	20.97	20.99	20.99	20.90	20.55	20.17	19.86	(87)
Temperature d	during heatin	g periods in	the rest of	f dwelling fr	rom Table	9, Th2(°C)							
	20.03	20.03	20.03	20.05	20.05	20.06	20.06	20.06	20.05	20.05	20.04	20.04	(88)
Utilisation fact	or for gains f	or rest of d	welling n2,	m									
	1.00	0.99	0.98	0.94	0.82	0.60	0.41	0.47	0.77	0.97	0.99	1.00	(89)
Mean internal	temperature	e in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	Эс)						
	18.54	18.73	19.07	19.54	19.89	20.04	20.06	20.06	19.97	19.52	18.96	18.52	(90)
Living area frac	ction								Liv	ving area ÷	(4) =	0.42	(91)
Mean internal	temperature	for the wh	ole dwellin	g fLA x T1 +	-(1 - fLA) x	T2							
	19.10	19.26	19.56	19.97	20.28	20.42	20.45	20.44	20.36	19.95	19.46	19.08	(92)
Apply adjustme	ent to the m	ean interna	l temperati	ure from Ta	ble 4e whe	ere appropr	riate						
	19.10	19.26	19.56	19.97	20.28	20.42	20.45	20.44	20.36	19.95	19.46	19.08	(93)
8. Space heat	ing roquiron	aont											
o. Space fleat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation fact			IVIGI	Aþi	iviay	Juli	Jui	Aug	Зер	Oct	NOV	Dec	
Othisation fact		0.99	0.98	0.94	0.83	0.63	0.45	0.51	0.80	0.96	0.99	1.00	7 (04)
Usoful gains in	1.00		l .	0.94	0.83	0.63	0.45	0.51	0.80	0.96	0.99	1.00	(94)
Useful gains, η		1		F40.00	406.63	272.00	25427	265.00	270.74	205.52	277.74	275.52	7 (05)
Monthly avera	393.15	435.00	480.26	519.08	496.62	373.90	254.27	265.09	370.74	395.52	377.71	375.53	(95)
Monthly avera	_				44.70	11.50	45.50	16.10	1110	10.00	7.10	1 4 2 2	7 (0.5)
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate f		,							110.50		T 00= 0.	1,0,0,00	٦ (٥=١
	1018.15	985.60	894.04	748.23	578.72	387.77	256.12	268.62	418.59	630.70	837.84	1013.28	<u>(97)</u>
Space heating			1			_					1		7
	465.01	370.00	307.86	164.98	61.08	0.00	0.00	0.00	0.00	174.97	331.30	474.48] 7
									∑(98	3)15, 10		2349.68	<u> </u> (98)
Space heating	requirement	kWh/m²/ye	ear							(98)	÷ (4)	36.36	(99)
9b. Energy re	quirements -	- communit	y heating s	cheme									
Fraction of spa	ice heat from	n secondary	/suppleme	ntarv svstei	m (table 11	1)				'0' if	none	0.00	(301)
Fraction of spa				,.,	,,,,,					1 - (3		1.00	(302)
Fraction of con			•							- (0	-,	1.00	(303a)
Fraction of total	-			ers						(302) x (30	3a) =	1.00	(304a)
Factor for cont	•		· ·		nmunity sp	ace heating	,			(, (1.00	(305)
Factor for char												1.00	(305a)
Distribution los												1.05	(306)
		, 101											_ (550)
Space heating													
Annual space h		rement							2349.68]			(98)
Space heat from									8) x (304a) x) ((305) x (3	06) =	2467.16	(307a)
Space neat IIO	III DOILEIS							(9)	o, n (304a))	, (202) y (2	oo,	<u>∠</u> +∪/.1U	_ (30/a)
Water heating	:												
Annual water h		irement							1647.59]			(64)
Water heat fro) x (303a) x	(305a) x (3	06) =	1729.97	(310a)
								(0.	, , , , , , , , , , , , , , , , , , , ,	, , , , , , , , , , , , , , , , , , , ,	-,		_ , • •)

mechanical ventilation fans - balanced, extract or positive input from outside

147.82 (330a)

Total electricity for the above, kWh/year

147.82 (331)

Electricity for lighting (Appendix L)

290.37 (332)

Total delivered energy for all uses

(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =4635.33

10b. Fue	l costs -	communit	ty I	heat	ing sc	heme
----------	-----------	----------	------	------	--------	------

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	2467.16	x	4.24	x 0.01 =	104.61	(340a)
Water heating from boilers	1729.97	x	4.24	x 0.01 =	73.35	(342a)
Pumps and fans	147.82	x	13.19	x 0.01 =	19.50	(349)
Electricity for lighting	290.37] x	13.19	x 0.01 =	38.30	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)(342e) +	(345)(354) =	355.76	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.36	(357)
SAP value	80.99]
SAP rating (section 13)	81	(358)
SAP hand	В	1

12b. CO₂ emissions - community heating scheme						
	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 \div (367a) =	4689.54	x	0.216	= [1012.94	(367)
Electrical energy for community heat distribution	41.97	x	0.519	= [21.78	(372)
Total CO2 associated with community systems					1034.72	(373)
Total CO2 associated with space and water heating					1034.72	(376)
Pumps and fans	147.82	x	0.519	= [76.72	(378)
Electricity for lighting	290.37	x	0.519	= [150.70	(379)
Total CO₂, kg/year				(376)(382) = [1262.14	(383)
Dwelling CO₂ emission rate				(383) ÷ (4) = [19.53	(384)
El value					84.57]
El rating (section 14)					85	(385)
EI band					В]

13b. Primary energy - community heating scheme						
	Energy kWh/year		Primary factor		Primary energy (kWh/year)	′
Primary energy from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
Primary energy from boilers $[(307a)+(310a)] \times 100 \div (367a) =$	4689.54] x	1.22	=	5721.23	(367)
Electrical energy for community heat distribution	41.97] x	3.07	=	128.85	(372)
Total primary energy associated with community systems					5850.08	(373)

Pumps and fans

Electricity for lighting

147.82 290.37 3.07

3.07

(376)

5850.08

453.80 (378)

(379) 891.45

7195.33 (383)

Primary energy kWh/year

Dwelling primary energy rate kWh/m2/year

111.35 (384)

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	2B4P, Kingston upon Thames, KT1		

Client							L	ast modified	d	30/0	9/2020	
Address	2B4P, Kir	ngston upoi	n Thames, k	KT1								
1. Overall dwelling dimen	sions											
				Aı	rea (m²)			erage storey eight (m)	,	V	olume (m³)	
Lowest occupied					73.74	(1a) x		2.50	(2a) =		184.35	(3a)
Total floor area	(1a)	+ (1b) + (1c	c) + (1d)(1	Ln) =	73.74	(4)						
Dwelling volume							(3a	a) + (3b) + (3	sc) + (3d)(3n) =	184.35	(5)
2. Ventilation rate												
										n	n³ per hour	
Number of chimneys								0	x 40 :	=	0	(6a)
Number of open flues								0	x 20 :	= [0	(6b)
Number of intermittent far	ıs							0	x 10 :	=	0	(7a)
Number of passive vents								0	x 10 :	=	0	(7b)
Number of flueless gas fire	5							0	x 40 =	=	0	(7c)
										Air	changes pe	er
Infiltration due to chimney	s, flues, fan:	s, PSVs		(6a)	+ (6b) + (7a	a) + (7b) + (7c) =	0	÷ (5)	= _	0.00	(8)
f a pressurisation test has	been carrie	d out or is ii	ntended, pr	oceed to (1	17), otherw	ise continue	e from (9)	to (16)				
Air permeability value, q50	, expressed	in cubic me	etres per ho	our per squ	are metre	of envelope	area				3.00	(17)
f based on air permeability	value, the	n (18) = [(17	7) ÷ 20] + (8	s), otherwis	se (18) = (10	6)					0.15	(18)
Number of sides on which t	:he dwelling	g is sheltere	ed								2	(19)
Shelter factor								1	- [0.075 x (1	L9)] =	0.85	(20)
Infiltration rate incorporati	ng shelter f	actor							(18) x (20) =	0.13	(21)
Infiltration rate modified fo	or monthly v	wind speed	:									
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spee	ed from Tab	ole U2										
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4												
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a
Adjusted infiltration rate (a	llowing for	shelter and	wind facto	or) (21) x (2	2a)m							
0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22k
Calculate effective air chan	ge rate for	the applical	ble case:									

Calculate effective	ve air chang	ge rate for t	he applical	ole case:									
If mechanical	ventilation	ı: air change	e rate throu	ıgh system								0.50	(23a)
If balanced w	ith heat red	covery: effic	ciency in %	allowing fo	or in-use fac	ctor from Ta	able 4h					75.65	(23c)
a) If balanced	l mechanica	al ventilatio	n with hea	t recovery ((MVHR) (22	!b)m + (23b) x [1 - (23c	:) ÷ 100]					
	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(24a)
Effective air char	nge rate - e	nter (24a) c	or (24b) or ((24c) or (24	d) in (25)								
	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(25)



				Gross area, m²	Openings m ²		area m²	U-value W/m²K	AxUW		/alue, /m².K	Ахк, kJ/K	
Window				,			.42 x	1.24	= 19.06		,	•	(27)
Door						1.	80 x	0.70	= 1.26				(26)
External wall							.58 x	0.17	= 5.03				(29
Party wall							.83 x	0.00	= 0.00				(32)
External wall							.63 x	0.20	= 5.93				(29
Total area of exte	rnal elem	ents ΣA. m²					.43	0.20					(31)
Fabric heat loss, \		_							(26	5)(30) + (32) =	31.27	(33
Heat capacity Cm		•						(28)	(30) + (32)			N/A] (34
Thermal mass par			n²K					(=0)	(55) (52)	(0_0)(0		250.00	(35
hermal bridges:	•			ndix K								9.45] (36
Fotal fabric heat I		aiculateu us	iiig Appei	IUIX K						(33) + (36) - 🗀	40.72] (30] (37
Total labile fleat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec] (3)
/entilation heat l				•	iviay	Juli	Jui	Aug	Зер	Oct	NOV	Dec	
/entiliation neat i]	17.30	17.10	16.91	15.94	15.74	14.78	14.78	14.58	15.16	15.74	16.12	16.52	7 /20
ا Heat transfer coe				15.94	15.74	14.78	14.78	14.58	15.16	15.74	16.13	16.52	(38
eat transfer coe				FC CC	FC 47	55.50	55.50	FF 20		56.47	FC 05	F7.24	7
	58.02	57.82	57.63	56.66	56.47	55.50	55.50	55.30	55.88	56.47	56.85	!]]
1	t (III D)	M. / 217 (20							Average = 2	(39)112	/12 =	56.61	[39
leat loss parame آ							_						7
L	0.79	0.78	0.78	0.77	0.77	0.75	0.75	0.75	0.76	0.77	0.77	0.78] 7
									Average = 2	(40)112	/12 =	0.77	(40
ا Number of days ا	•												7
L	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40
4. Water heating	g energy r	equirement	t										
Assumed occupar	ncy, N											2.33	(42
Annual average h	ot water u	ısage in litre	es per day	Vd,average	= (25 x N) +	36						89.62	」(43
		Ū		Apr	May	Jun	Jul	Aug	Sep	Oct			٠,
-	Jan	Feb	Mar	Api	ividy				Jeb	OCL	Nov	Dec	
									Зер	Oct	Nov	Dec	
	in litres pe	r day for ea	ich month	Vd,m = fact	or from Tab	le 1c x (43)						7
-								84.24	87.83	91.41	95.00	98.58]
Hot water usage	in litres pe 98.58	95.00	91.41	Vd,m = fact 87.83	sor from Tab	le 1c x (43 80.66	80.66	84.24			95.00] (44
Hot water usage	98.58 f hot wate	r day for ea 95.00 r used = 4.1	91.41 8 x Vd,m	x nm x Tm/3	or from Tab 84.24 8600 kWh/m	le 1c x (43 80.66 onth (see	80.66 Tables 1b,	1c 1d)	87.83	91.41 Σ(44)1	95.00	98.58]] (44
Hot water usage	in litres pe 98.58	95.00	91.41	Vd,m = fact 87.83	sor from Tab	le 1c x (43 80.66	80.66	84.24		91.41 Σ(44)1	95.00 .12 =	98.58 1075.42 7 141.58]
Hot water usage [[Energy content o	98.58 98.68 f hot wate 146.19	95.00 r used = 4.1	91.41 8 x Vd,m	x nm x Tm/3	or from Tab 84.24 8600 kWh/m	le 1c x (43 80.66 onth (see	80.66 Tables 1b,	1c 1d)	87.83	91.41 Σ(44)1	95.00 .12 =	98.58]
Hot water usage [[Energy content o	98.58 f hot wate 146.19 0.15 x (45	r day for ea 95.00 r used = 4.1 127.86	91.41 8 x Vd,m 131.94	x nm x Tm/3	84.24 8600 kWh/m	80.66 onth (see	80.66 Tables 1b,	1c 1d) 101.28	87.83	91.41 Σ(44)1 119.44 Σ(45)1	95.00 .12 =	98.58 1075.42 ' 141.58 1410.04] (45
Hot water usage [Energy content of [Distribution loss	98.58 f hot wate 146.19 0.15 x (45	r day for ea 95.00 r used = 4.1 127.86)m	91.41 8 x Vd,m 131.94	x nm x Tm/3 115.03	84.24 8600 kWh/m 110.37	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d)	87.83	91.41 Σ(44)1	95.00 .12 =	98.58 1075.42 7 141.58 1410.04 21.24]] (45] (46
Hot water usage Energy content o Distribution loss Storage volume (98.58 f hot wate 146.19 0.15 x (45) 21.93	r day for ea 95.00 r used = 4.1 127.86)m	91.41 8 x Vd,m 131.94	x nm x Tm/3 115.03	84.24 8600 kWh/m 110.37	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d) 101.28	87.83	91.41 Σ(44)1 119.44 Σ(45)1	95.00 .12 =	98.58 1075.42 ' 141.58 1410.04]] (4!] (4!
Hot water usage in the content of th	98.58 f hot wate 146.19 0.15 x (45 21.93 litres) incluses:	r day for ea 95.00 r used = 4.1 127.86)m 19.18 uding any so	91.41 .8 x Vd,m 131.94 19.79	x nm x Tm/3 17.25 17.25 17.25	84.24 8600 kWh/m 110.37	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d) 101.28	87.83	91.41 Σ(44)1 119.44 Σ(45)1	95.00 .12 =	98.58 1075.42 7 141.58 1410.04 21.24]] (45] (46
Hot water usage Energy content o Distribution loss Storage volume (I) Water storage los b) Manufacturer'	f hot wate 146.19 0.15 x (45 21.93 litres) incluses:	95.00 r used = 4.1 127.86 m 19.18 uding any so	91.41 8 x Vd,m 131.94 19.79 plar or WV	x nm x Tm/3 115.03 17.25 WHRS storag	84.24 8600 kWh/m 110.37 16.56 e within sam	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d) 101.28	87.83	91.41 Σ(44)1 119.44 Σ(45)1	95.00 .12 =	98.58 1075.42 7 141.58 1410.04 21.24 3.00] (45] (46] (47
Hot water usage Energy content of Distribution loss Storage volume (I) Water storage lose Manufacturer's Hot water storage	f hot wate 146.19 0.15 x (45) 21.93 litres) incluses: s declared rage loss face	r day for ea 95.00 r used = 4.1 127.86)m 19.18 uding any so	91.41 8 x Vd,m 131.94 19.79 plar or WV	x nm x Tm/3 115.03 17.25 WHRS storag	84.24 8600 kWh/m 110.37 16.56 e within sam	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d) 101.28	87.83	91.41 Σ(44)1 119.44 Σ(45)1	95.00 .12 =	98.58 1075.42 141.58 1410.04 21.24 3.00	(45)
Hot water usage Energy content or Distribution loss Storage volume (I Water storage los O) Manufacturer's Hot water stor	98.58 f hot wate 146.19 0.15 x (45 21.93 litres) incluses: s declared rage loss for from Tab	r day for ea 95.00 r used = 4.1 127.86 m 19.18 uding any so loss factor actor from	91.41 8 x Vd,m 131.94 19.79 plar or WV	x nm x Tm/3 115.03 17.25 WHRS storag	84.24 8600 kWh/m 110.37 16.56 e within sam	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d) 101.28	87.83	91.41 Σ(44)1 119.44 Σ(45)1	95.00 .12 =	98.58 1075.42 7 141.58 1410.04 21.24 3.00 0.02 3.42	(49) (49) (49) (49) (49) (49) (49) (49)
Hot water usage Energy content or Distribution loss Storage volume (I) Water storage lose O) Manufacturer's Hot water storage volume factorage remperature storage removes the stora	f hot wate 146.19 0.15 x (45) 21.93 litres) incluses: s declared rage loss for from Tab	r day for ea 95.00 r used = 4.1 127.86)m 19.18 Iding any so loss factor actor from actor from le 2a n Table 2b	91.41 8 x Vd,m 131.94 19.79 blar or WV	17.25 WHRS storag Wh/litre/day	84.24 8600 kWh/m 110.37 16.56 e within sam	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d) 101.28	87.83	91.41 Σ(44)1 119.44 Σ(45)1	95.00 .12 =	98.58 1075.42 141.58 1410.04 21.24 3.00 0.02 3.42 0.60	(45) (46) (47) (51) (52) (53)
Energy content or Distribution loss Storage volume (I) Water storage lose b) Manufacturer's Hot water storage lose Volume factor Temperature storage lose from	f hot wate 146.19 0.15 x (45) 21.93 litres) incluses: s declared rage loss factor from Tab factor from water s	r day for ea 95.00 r used = 4.1 127.86)m 19.18 Iding any so loss factor actor from actor from le 2a n Table 2b	91.41 8 x Vd,m 131.94 19.79 blar or WV	17.25 WHRS storag Wh/litre/day	84.24 8600 kWh/m 110.37 16.56 e within sam	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d) 101.28	87.83	91.41 Σ(44)1 119.44 Σ(45)1	95.00 .12 =	98.58 1075.42 7 141.58 1410.04 21.24 3.00 0.02 3.42 0.60 0.13	(444) (445) (466) (477) (51) (52) (53) (53) (543)
Energy content or Distribution loss Storage volume (I) Water storage los O) Manufacturer' Hot water story Volume factory Temperature in Energy lost from Enter (50) or (54)	98.58 f hot wate 146.19 0.15 x (45) 21.93 litres) incluses: s declared rage loss for from Tab factor from water sin (55)	r day for ea 95.00 r used = 4.1 127.86)m 19.18 uding any so loss factor actor from actor from the 2a n Table 2b storage (kW	19.79 Diar or WV is not kno Table 2 (k	17.25 WHRS storag Wh/litre/day	84.24 8600 kWh/m 110.37 16.56 e within sam	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d) 101.28	87.83	91.41 Σ(44)1 119.44 Σ(45)1	95.00 .12 =	98.58 1075.42 141.58 1410.04 21.24 3.00 0.02 3.42 0.60	(45) (45) (46) (47) (51) (52) (53)
Energy content or Distribution loss Storage volume (I Water storage lose) Hot water stor Volume factor Temperature is	98.58 f hot wate 146.19 0.15 x (45) 21.93 litres) incluses: s declared rage loss for from Tab factor from water sin (55)	r day for ea 95.00 r used = 4.1 127.86)m 19.18 uding any so loss factor actor from actor from the 2a n Table 2b storage (kW	19.79 Diar or WV is not kno Table 2 (k	17.25 WHRS storag Wh/litre/day	84.24 8600 kWh/m 110.37 16.56 e within sam	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d) 101.28	87.83	91.41 Σ(44)1 119.44 Σ(45)1	95.00 .12 =	98.58 1075.42 7 141.58 1410.04 21.24 3.00 0.02 3.42 0.60 0.13	(4!) (4!) (4!) (5:) (5:) (5:

If the vessel con	tains dedica	ated solar st	torage or de	edicated W	/WHRS (56)	m x [(47) -	Vs] ÷ (47),	else (56)					
	4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)
Primary circuit le	oss for each	month fro	m Table 3						1			1	
	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 for e	ach month						1	•	-		1	1	_ ` `
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Гotal heat requi			ļ			l .	1	1	1	0.00	1 0.00	1 0.00	(01)
rotarricat requi	173.49	152.52	159.24	141.45	137.68	121.67	115.56	128.58	128.91	146.74	156.80	168.88	(62)
Color DUW innu						121.07	113.30	128.38	120.91	140.74	130.80	100.88	(02)
Solar DHW inpu						0.00	0.00	1 0 00	1 0 00	0.00	0.00		7 (60)
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from wa			· · · · · · · · · · · · · · · · · · ·				1	1		Г	1		_
	173.49	152.52	159.24	141.45	137.68	121.67	115.56	128.58	128.91	146.74	156.80	168.88	_
										∑(64)1	.12 =1	1731.52	(64)
Heat gains from	water heat	ing (kWh/m	nonth) 0.25	× [0.85 ×	(45)m + (61)m] + 0.8 ×	: [(46)m + (57)m + (59)m]				
	70.45	62.24	65.71	59.39	58.54	52.81	51.19	55.52	55.21	61.56	64.49	68.92	(65)
E lateral sale													
5. Internal gair				_									
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains													_
	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	(66)
ighting gains (c	alculated in	Appendix l	., equation I	_9 or L9a),	also see Ta	ble 5							
	18.41	16.35	13.30	10.07	7.53	6.35	6.86	8.92	11.98	15.21	17.75	18.92	(67)
Appliance gains	(calculated	in Appendi	x L, equatio	n L13 or L:	13a), also se	ee Table 5							
	205.86	208.00	202.62	191.16	176.69	163.09	154.01	151.87	157.26	168.72	183.18	196.78	(68)
Cooking gains (c	alculated in	Appendix I	_, equation	L15 or L15	a), also see	Table 5							
	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	34.67	(69)
Pump and fan ga	ains (Table !	5a)											_ ` `
P 6.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evap			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(, 0)
LOSSES C.B. CVap			-93.34	02.24	02.24	02.24	02.24	02.24	02.24	02.24	02.24	02.24	7 (71)
Mataula ation	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	-93.34	(71)
Water heating g									1			T	٦,
	94.69	92.62	88.32	82.48	78.69	73.34	68.80	74.62	76.69	82.74	89.57	92.63	(72)
Total internal ga		+ (67)m + (6		n + (70)m	+ (71)m + (7	72)m	1		1			•	_
	376.97	374.97	362.24	341.70	320.90	300.79	287.68	293.42	303.92	324.66	348.50	366.33	(73)
6. Solar gains													
o. Solai gailis			Access fa	at a u	A 400	Cal	ar flux		_	FF		Coinc	
			Table		Area m²		ar nux V/m²	spec	g ific data	specific (data	Gains W	
								or T	able 6b	or Table	e 6c		
East			0.77	х	10.90	x 1	9.64 x	0.9 x	0.45 x	0.70	=	46.73	(76)
South			0.77	×	2.22	x 4			0.45 x	0.70	<u> </u>	22.66	(78)
West			0.77		2.30	-			0.45 x			9.86	(80)
Solar gains in wa	atts 5(74)m	ı(82)m	5.77	^ L			^		^				(50)
· · · · · · · · · · · · · · · · · ·	79.25	147.81	229.59	319.33	381.54	387.17	369.94	323.64	261.42	171.39	97.42	66.12	(83)
Fotal gains lints		-		313.33	301.34	307.17	303.34	323.04	201.42	1/1.33	37.42	1 00.12	(05)
Total gains - inte					700 :=	607.55	l c==	1 61=	T =====	400		100	٠ ٦
	456.22	522.79	591.83	661.03	702.45	687.96	657.61	617.06	565.34	496.05	445.92	432.45	(84)
7. Mean intern	al tempera	ture (heatir	ng season)										
		•	,	raa fram T	Table 0 Th1	(°C)						21.00	(85)
Temperature du	ung neatin	e herions in	trie livilig a	ı ca 110ff1 l	avie 3, INI	()						21.00	رده) ل

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for	or living are	a n1,m (se	e Table 9a)									
1.00	0.99	0.97	0.89	0.72	0.51	0.37	0.41	0.67	0.94	0.99	1.00	(86)
Mean internal temp of living	g area T1 (s	teps 3 to 7	in Table 9c)								
20.30	20.44	20.64	20.87	20.97	21.00	21.00	21.00	20.99	20.83	20.52	20.28	(87)
Temperature during heating	g periods in	the rest of	dwelling fr	om Table 9	9, Th2(°C)							
20.26	20.27	20.27	20.28	20.28	20.29	20.29	20.30	20.29	20.28	20.28	20.27	(88)
Utilisation factor for gains for	or rest of d	welling n2,	m									
1.00	0.99	0.96	0.86	0.67	0.46	0.31	0.35	0.60	0.91	0.99	1.00	(89)
Mean internal temperature	in the rest	of dwelling	T2 (follow	steps 3 to	7 in Table 9	9c)					_	_
19.32	19.52	19.82	20.13	20.26	20.29	20.29	20.30	20.28	20.10	19.66	19.30	(90)
Living area fraction								Liv	ving area ÷	(4) =	0.41	(91)
Mean internal temperature	for the wh	ole dwellin	g fLA x T1 +	(1 - fLA) x ⁻		·				,		7
19.72	19.90	20.16	20.43	20.55	20.58	20.58	20.58	20.57	20.40	20.01	19.69	(92)
Apply adjustment to the me								1			1	7
19.72	19.90	20.16	20.43	20.55	20.58	20.58	20.58	20.57	20.40	20.01	19.69	(93)
8. Space heating requirem	ent											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, I	ηm											
1.00	0.99	0.96	0.87	0.69	0.48	0.34	0.37	0.63	0.92	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m											
454.04	516.36	569.05	575.27	485.76	330.94	220.90	231.19	355.95	455.33	440.49	430.96	(95)
Monthly average external to	emperature	from Table	e U1									
4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean inte	rnal tempe	rature, Lm	, W [(39)m	x [(93)m -	(96)m]							
894.62	867.13	787.03	653.42	499.76	331.87	220.96	231.32	361.53	553.11	734.12	886.92	(97)
Space heating requirement,	kWh/mont	th 0.024 x	[(97)m - (95	5)m] x (41)	m							_
327.79	235.72	162.18	56.27	10.42	0.00	0.00	0.00	0.00	72.75	211.41	339.24	
								∑(98	3)15, 10		1415.77	(98)
Space heating requirement	kWh/m²/ye	ear							(98)	÷ (4)	19.20	(99)
9b. Energy requirements -	communit	y heating s	cheme									
Fraction of space heat from				n (table 11	L)				'0' if r	none	0.00	(301)
Fraction of space heat from									1 - (30		1.00	(302)
Fraction of community heat											1.00	(303a)
Fraction of total space heat	from comn	nunity boile	ers						(302) x (303	3a) =	1.00	(304a)
Factor for control and charg	ging method	d (Table 4c((3)) for com	munity spa	ace heating						1.00	(305)
Factor for charging method	(Table 4c(3)) for comr	nunity wate	er heating							1.00	(305a)
Distribution loss factor (Tab	le 12c) for o	community	heating sys	stem							1.05	(306)
Space heating												
Annual space heating require	rement						1	.415.77]			(98)
Space heat from boilers							(98	3) x (304a) >	(305) x (30	06) = 1	1486.56	(307a)
Water heating									1			
Annual water heating requi	rement							731.52				(64)
Water heat from boilers							(64)	x (303a) x	(305a) x (30	06) =1	1818.10	(310a)

mechanical ventilation fans - balanced, extract or positive input from outside

149.00 (330a) 149.00 (331)

Total electricity for the above, kWh/year

Electricity for lighting (Appendix L)

325.11 (332)

Total delivered energy for all uses

3778.76 (307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =

10b. Fuel costs - community heating scheme	10b. Fue	costs -	community	heating sc	heme
--	----------	---------	-----------	------------	------

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1486.56] x	4.24	x 0.01 =	63.03	(340a)
Water heating from boilers	1818.10] x	4.24	x 0.01 =	77.09	(342a)
Pumps and fans	149.00	x	13.19	x 0.01 =	19.65	(349)
Electricity for lighting	325.11] x	13.19	x 0.01 =	42.88	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)(342e) +	(345)(354) =	322.65	(355)

11b. SAP rating - community heating scheme

1101 57 it rating community nearing sentence			
Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)		1.14	(357)
SAP value		84.08]
SAP rating (section 13)		84	(358)
SAP band		В	

12b. CO₂ emissions - commur	nity heating scheme						
		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers		89.50					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3692.35	x	0.216	= [797.55	(367)
Electrical energy for communit	y heat distribution	33.05	x	0.519	= [17.15	(372)
Total CO2 associated with com	munity systems				[814.70	(373)
Total CO2 associated with space	ce and water heating					814.70	(376)
Pumps and fans		149.00	х	0.519	= [77.33	(378)
Electricity for lighting		325.11	х	0.519	= [168.73	(379)
Total CO₂, kg/year					(376)(382) = [1060.76	(383)
Dwelling CO₂ emission rate					(383) ÷ (4) = [14.39	(384)
El value						88.03	
El rating (section 14)						88	(385)
EI band					[В	

13b. Primary energy - commit	ility Heating Scheme						
		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sou	rces (space heating)						
Efficiency of boilers		89.50					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3692.35] x	1.22	=	4504.67	(367)
Electrical energy for communit	y heat distribution	33.05	x	3.07	=	101.45	(372)
Total primary energy associate	d with community systems					4606.12	(373)

Pumps and fans

Electricity for lighting

149.00 325.11

3.07

3.07

4606.12 (376)

457.43 (378)

998.08 (379)

6061.63 (383)

82.20 (384)

Primary energy kWh/year

Dwelling primary energy rate kWh/m2/year

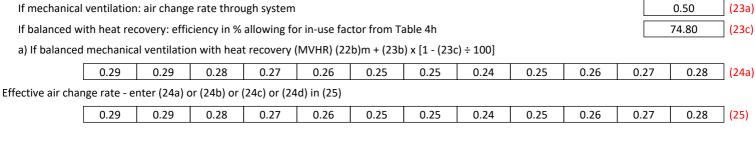
Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	2B3P, Kingston upon Thames, KT1		

							Lu	st modified		30/09	/2020	
Address	2B3P, Kingst	ton upon	Thames, k	(T1								
1. Overall dwelling dimens	sions											
				Aı	rea (m²)			rage storey eight (m)		Vo	olume (m³)	
owest occupied					74.00	(1a) x		2.50	(2a) =		185.00	(3a
otal floor area	(1a) + ((1b) + (1c	:) + (1d)(1	ln) =	74.00	(4)						
Dwelling volume							(3a)	+ (3b) + (3	c) + (3d)(3	3n) =	185.00	(5)
2. Ventilation rate												
										m	³ per hour	
Number of chimneys								0	x 40 =		0	(6
Number of open flues								0	x 20 =	:	0	(6l
Number of intermittent fans	5							0] x 10 =	:	0	(7a
Number of passive vents								0	x 10 =	:	0	(71
Number of flueless gas fires								0	x 40 =	:	0	(70
										Air	changes pe hour	r
nfiltration due to chimneys,	, flues, fans, P	'SVs		(6a)	+ (6b) + (7a	a) + (7b) + (7c) =	0	÷ (5) =		0.00	(8)
f a pressurisation test has b	een carried o	ut or is in	itended, pr	oceed to (1	17), otherwi	ise continue	e from (9) t	o (16)				
Air permeability value, q50,	expressed in	cubic me	tres per ho	our per squ	are metre	of envelope	area				3.00	(1
		18) = [(17) ÷ 201 + (8), otherwis	se (18) = (16	5)						
	value, then (1	10) [(1)	,, (-	••	. , .	- /					0.15	(18
f based on air permeability											0.15	(18 (19
f based on air permeability Number of sides on which th								1 -	[0.075 x (1	9)] =		=
f based on air permeability Number of sides on which the Shelter factor	he dwelling is	sheltere						1 -	[0.075 x (1 (18) x (2		2	(19
f based on air permeability Number of sides on which the Shelter factor nfiltration rate incorporation	he dwelling is	sheltere	d					1 -			2 0.85	(19
f based on air permeability Number of sides on which the Shelter factor nfiltration rate incorporation	he dwelling is	sheltere	d	May	Jun	Jul	Aug	1 - Sep			2 0.85	(19
f based on air permeability Number of sides on which the Shelter factor Infiltration rate incorporation Infiltration rate modified for	he dwelling is ng shelter factor r monthly win Feb	sheltered for ad speed:	d				Aug		(18) x (2	20) =	2 0.85 0.13	(19
f based on air permeability Number of sides on which the Shelter factor Infiltration rate incorporation Infiltration rate modified for	he dwelling is ng shelter factor r monthly win Feb d from Table I	sheltered for ad speed:	d				Aug 3.70		(18) x (2	20) =	2 0.85 0.13	(19
f based on air permeability Number of sides on which the shelter factor Infiltration rate incorporation in the shelter factor Jan Monthly average wind spectors.	he dwelling is ng shelter factor r monthly win Feb d from Table I	sheltered for ad speed: Mar U2	d Apr	May	Jun	Jul	-	Sep	(18) x (2	20) = Nov	2 0.85 0.13	(19 (20 (20
f based on air permeability Number of sides on which the shelter factor Infiltration rate incorporation in the shelter factor Jan Monthly average wind spectors.	he dwelling is ng shelter factor r monthly win Feb d from Table I	sheltered for ad speed: Mar U2	d Apr	May	Jun	Jul	-	Sep	(18) x (2	20) = Nov	2 0.85 0.13	(19 (20 (20
f based on air permeability Number of sides on which the Shelter factor Infiltration rate incorporation in the filtration rate modified for Jan Monthly average wind speed 5.10 Wind factor (22)m ÷ 4	he dwelling is ng shelter factor r monthly win Feb d from Table 0 5.00	sheltered or d speed: Mar U2 4.90	Apr 4.40	May 4.30	Jun 3.80	Jul 3.80	3.70	Sep 4.00	(18) x (2 Oct	Nov 4.50	2 0.85 0.13 Dec	(19 (20 (21 (21





Element	anu neat io	ss paramet	Ci									
Liement			;	Gross area, m²	Openings m ²		area m²	U-value W/m²K	A x U W	/K κ-value, kJ/m².K	Ахк, kJ/K	
Window						17.	.96 x	1.24	= 22.19			(27)
Door						1.3	80 x	0.70	= 1.26			(26)
External wall						30	.44 x	0.17	= 5.17			(29a)
Party wall						32	.15 x	0.00	= 0.00			(32)
External wall						2.	65 x	0.20	= 0.53			(29a)
Total area of ext	ternal eleme	ents ∑A, m²				52	.85					(31)
Fabric heat loss,	W/K = ∑(A	× U)							(26	5)(30) + (32) =	29.16	(33)
Heat capacity Cr	m = ∑(A x к)							(28)	(30) + (32) +	- (32a)(32e) =	N/A	(34)
Thermal mass pa	arameter (T	MP) in kJ/n	n²K								250.00	(35)
Thermal bridges	s: Σ(L x Ψ) ca	alculated us	sing Apper	ndix K							7.34	(36)
Total fabric heat			0							(33) + (36) =	36.49	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct Nov	Dec	
Ventilation heat				•	,			7.5.8	ССР			
vermination	17.62	17.42	17.23	16.25	16.06	15.09	15.09	14.89	15.48	16.06 16.45	16.84	(38)
Heat transfer co				10.23	10.00	13.03	15.05	14.83	13.48	10.00 10.43	10.84] (36)
rieat transfer co	54.11			52.75	52.55	51.58	51.58	51.39	51.97	52.55 52.94	F2 22	7
	54.11	53.92	53.72	52.75	52.55	51.58	51.58	-1]] (20)
	-t (III D)	M. / 21/ . /20)\						Average = >	(39)112/12 =	52.70	(39)
Heat loss param				1 -								7
	0.73	0.73	0.73	0.71	0.71	0.70	0.70	0.69	0.70	0.71 0.72] 7 ,
									Average = ∑	(40)112/12 =	0.71	(40)
Number of days		Table 1a)										_
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00 30.00	31.00	(40)
4. Water heati	ng energy r	eauiremen	t									
Assumed occupa		- 4									2.34	(42)
Annual average	•	sage in litre	es ner dav	Vd average	= (25 × N) +	36					89.76	(43)
7 mindar a verage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct Nov	Dec	(43)
Hot water usage					•			Aug	ЗСР	000	Dec	
TIOL Water usage								04.27	97.06	01.55	00.72	7
	98.73	95.14	91.55	87.96	84.37	80.78	80.78	84.37	87.96	91.55 95.14	-	_ □
		ا م	0. 1/1	- 10			- 11 41	4.41)		∑(44)112 =	1077.07	(44)
Energy content							1		T I		_	7
		128.06	132.14	115.21	110.54	95.39	88.39	101.43	102.64	119.62 130.5	7 141.80	
	146.42		102.12.									7.
			102.12.							∑(45)112 =	1412.21	(45)
Distribution loss	0.15 x (45)	m									_	_
Distribution loss			19.82	17.28	16.58	14.31	13.26	15.21	15.40	Σ(45)112 = 17.94 19.59	_	(45)
Distribution loss Storage volume	0.15 x (45)	m 19.21	19.82				13.26	15.21	15.40		_	_
	21.96 (litres) inclu	m 19.21	19.82				13.26	15.21	15.40		21.27	(46)
Storage volume	21.96 (litres) inclu	Im 19.21 uding any so	19.82 blar or WV	VHRS storag			13.26	15.21	15.40		21.27	(46)
Storage volume Water storage lo	21.96 (litres) incluoss: r's declared	19.21 Iding any so	19.82 blar or WV is not kno	VHRS storag	e within sam		13.26	15.21	15.40		21.27	(46)
Storage volume Water storage lo b) Manufacturer	21.96 (litres) incluoss: r's declared orage loss fa	19.21 Iding any so	19.82 blar or WV is not kno	VHRS storag	e within sam		13.26	15.21	15.40		3.00	(46) (47)
Storage volume Water storage lo b) Manufacturer Hot water sto	21.96 (litres) incluoss: r's declared orage loss for from Table	19.21 Iding any solutions factor from Tector from Tect	19.82 blar or WV is not kno	VHRS storag	e within sam		13.26	15.21	15.40		3.00	(46) (47) (51)
Storage volume Water storage lo b) Manufacturer Hot water sto Volume facto	21.96 (litres) incluoss: r's declared orage loss for from Table factor from	19.21 Iding any solutions factor from actor from 2 2 an Table 2b	19.82 blar or WV is not kno Table 2 (k	VHRS storag wn Wh/litre/day	re within sam		13.26	15.21	15.40		3.00 3.00 0.02 3.42	(46) (47) (51) (52)
Storage volume Water storage lo b) Manufacturer Hot water sto Volume facto Temperature	21.96 (litres) incluoss: r's declared orage loss factor from Table factor from water s	19.21 Iding any solutions factor from actor from 2 2 an Table 2b	19.82 blar or WV is not kno Table 2 (k	VHRS storag wn Wh/litre/day	re within sam		13.26	15.21	15.40		3.00 3.00 0.02 3.42 0.60	(46) (47) (51) (52) (53)
Storage volume Water storage lo b) Manufacturer Hot water sto Volume facto Temperature Energy lost fr	21.96 (litres) incluoss: r's declared orage loss for from Table factor from water states in (55)	19.21 Iding any solutions factor from Te 2a In Table 2b Itorage (kW	19.82 blar or WV is not kno Table 2 (k ^o 'h/day) (4	WHRS storag	re within sam		13.26	15.21	15.40		0.02 3.42 0.60 0.13	(46) (47) (51) (52) (53) (54)
Storage volume Water storage lo b) Manufacturer Hot water sto Volume facto Temperature Energy lost fi Enter (50) or (54	21.96 (litres) incluoss: r's declared orage loss for from Table factor from water states in (55)	19.21 Iding any solutions factor from Te 2a In Table 2b Itorage (kW	19.82 blar or WV is not kno Table 2 (k ^o 'h/day) (4	WHRS storag	re within sam		13.26	4.04	3.91		0.02 3.42 0.60 0.13	(46) (47) (51) (52) (53) (54)

If the vessel con	tains dedica	ated solar st	orage or d	edicated V	VWHRS (56)	m x [(47) -	Vs] ÷ (47).	else (56)					
ii tiic vessei coii	4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)
Primary circuit lo				3.51	4.04	3.31	4.04	1.04	3.31	4.04	3.51	4.04	(37)
,	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 for e		1			23.20	22.31	23.20	23.20	22.31	23.20	22.31	23.20	(33)
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requi		1		ļ.				!		0.00	0.00	0.00	(01)
rotal ficat requi	173.72	152.72	159.45	141.63	137.85	121.81	115.70	128.74	129.07	146.92	157.00	169.10	(62)
Solar DHW input						121.01	113.70	120.74	123.07	140.32	137.00	103.10	(02)
Join Bill input	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from wa		1					0.00	0.00	0.00	0.00	0.00	0.00	(03)
Output from wa	173.72	152.72	159.45	141.63	137.85	121.81	115.70	128.74	129.07	146.92	157.00	169.10	1
	173.72	132.72	133.43	141.03	137.83	121.61	113.70	120.74	123.07	Σ(64)1		1733.69] (64)
Heat gains from	water heat	ing (k\Mh/m	onth) 0.25	5 v [N 95 v	(45)m ± (61	\m] + 0 8 v	[(46)m + (57\m ± /50	2)m1	2(64)1	12	1755.09	(04)
rieat gains nom	70.53	62.31	65.78	59.44	58.60	52.86	51.23	55.57	55.27	61.62	64.55	68.99	(65)
	70.55	02.51	05.76	39.44	36.00	32.80	31.23	33.37	33.27	01.02	04.55	06.99	(65)
5. Internal gain	S												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	(Table 5)												
	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	116.96	(66)
Lighting gains (ca	alculated in	Appendix L	., equation	L9 or L9a)	, also see Ta	ble 5							
	18.40	16.35	13.29	10.06	7.52	6.35	6.86	8.92	11.97	15.20	17.74	18.92	(67)
Appliance gains	(calculated	in Appendix	x L, equatio	on L13 or L	13a), also se	ee Table 5							
	206.45	208.59	203.19	191.70	177.19	163.56	154.45	152.30	157.70	169.20	183.70	197.34	(68)
Cooking gains (c	alculated in	Appendix L	_, equation	L15 or L15	sa), also see	Table 5							
	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	34.70	(69)
Pump and fan ga	ains (Table 5	5a)											
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evap	oration (Tal	ble 5)							·				
	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71)
Water heating g	ains (Table	5)						!	•			,	
	94.79	92.72	88.41	82.56	78.76	73.41	68.86	74.69	76.76	82.82	89.66	92.73	(72)
Total internal ga		1	8)m + (69)				•		<u>'</u>			'	
	377.73	375.74	362.99	342.41	321.56	301.41	288.26	294.00	304.52	325.31	349.19	367.07	(73)
								!	'			'	
6. Solar gains													
			Access f		Area m²		ar flux //m²	cno	g cific data	FF specific o	lata	Gains W	
			Table	ou		v	,,,,,	-	Table 6b	or Table		vv	
North			0.7	7 x	6.10	x 1	0.63 x	0.9 x	0.45 x	0.70		14.16	(74)
NorthEast			0.7		3.20	7 -		0.9 x	0.45 x			7.88	(75)
West			0.7		8.66			0.9 x	0.45 x			37.13	(80)
Solar gains in wa	ntts Σ(74)m	ı(82)m	<u> </u>		0.00	_ ^	<u> </u>	0.0 /	<u> </u>	0.70		07.120	(00)
	59.17	115.73	194.50	295.78	377.09	393.39	371.44	308.60	229.62	138.00	73.68	48.77	(83)
Total gains - inte					303		1 2.2.17	, 555.00				,	, (55)
	436.90	491.48	557.49	638.19	698.66	694.80	659.70	602.61	534.14	463.31	422.87	415.84	(84)
	-30.30	-J1. 1 0	557. 4 5	030.13	050.00	00,4.00	033.70		JJ7.14	-00.01	722.07	713.04	, (U+)
7. Mean intern	al tempera	ture (heatir	ng season)										
Temperature du	ring heating	g periods in	the living a	area from ⁻	Table 9, Th1	(°C)						21.00	(85)

Mean internal temporal tempo		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temp of libring area T1 (isteps 3 to 7 in Table 9c) 20.36 20.68 20.69 20.90 20.90 20.90 20.0	Utilisation fact	or for gains f	for living are	ea n1,m (se	e Table 9a)									
The present of the proper periods in the rest of welling from Table 9, The City 100 21,00 20,09 20,09 20,00		1.00	0.99	0.97	0.88	0.68	0.47	0.34	0.39	0.66	0.94	0.99	1.00	(86)
The prevanting during heating periods in the rest of welling from Trable 9, This Properties of the Welling Annual Scale 1933 2033 2	Mean internal	temp of livin	ig area T1 (s	teps 3 to 7	in Table 9c	:)	_					_		_
Second		20.36	20.48	20.68	20.90	20.99	21.00	21.00	21.00	20.99	20.85	20.56	20.34	(87)
Unliastion factor for gains for rest of veelling n2, we will no 0.99	Temperature of	during heatin	g periods in	the rest of	dwelling fr	rom Table !	9, Th2(°C)							_
1.00 0.99 0.97 0.86 0.64 0.43 0.29 0.34 0.69 0.92 0.99 1.00 (89)		20.31	20.32	20.32	20.33	20.33	20.34	20.34	20.35	20.34	20.33	20.33	20.32	(88)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) 19-45 19-50 19-91 20-21 20-32 20-34 20-34 20-35 20-33 20-16 19-76 19-33 99) Uting area fraction 19-89 20-04 20-28 20-54 20-64 20-66 20-66 20-66 20-65 20-69 20-55 20-49 20-15 19-87 19-20 Apply adjustment to the mean internal temperature from Table 4e where appropriate 19-89 20-04 20-28 20-54 20-64 20-66 20-66 20-66 20-66 20-65 20-49 20-15 19-87 19-20 Apply adjustment to the mean internal temperature from Table 4e where appropriate 19-89 20-04 20-28 20-54 20-64 20-66 20-66 20-66 20-66 20-65 20-49 20-15 19-87 19-30 Apply adjustment to the mean internal temperature from Table 4e where appropriate 19-89 20-04 20-28 20-54 20-64 20-66 20-66 20-66 20-66 20-65 20-49 20-15 19-87 19-30 B-Space heating requirement to be mean internal temperature from Table U1 Useful galins, myGM, W (24)m 4-35-20 48-672 538-75 551.86 461.84 312-23 209-46 218-96 336-37 429-41 418-62 414-67 19-51	Utilisation fact	or for gains 1	for rest of d	welling n2,	m		,							_
19.45 19.62 19.91 20.21 20.32 20.34 20.34 20.35 20.33 20.36 19.76 19.43 19.35 19.3			!						0.34	0.60	0.92	0.99	1.00	(89)
Living area fraction	Mean internal	temperature	in the rest	of dwelling	T2 (follow	steps 3 to	7 in Table 9	9c)						_
Mean internal temperature for the whole diwight flax x1 + (1 - 14.) x12 19.89 20.04 20.28 20.54 20.66 20.66 20.66 20.65 20.49 20.15 19.87 92) Apply adjustment to the mean internal temperature from Table 4e whole appropriate 19.89 20.04 20.28 20.54 20.66 20.66 20.66 20.65 20.49 20.15 19.87 93) Apply adjustment to the mean internal temperature from Table 4e whole appropriate with the mean internal temperature from Table 4e (18.18 19.89 20.04 20.66 20.66 20.66 20.65 20.49 20.15 19.87 93) Apply adjustment to the mean internal temperature from Table 4e (18.18 19.24 20.66 20.66 20.66 20.65 20.49 20.15 19.87 93) Apply adjustment to the mean internal temperature from Table 4e (18.18 19.24 20.66 20.66 20.66 20.65 20.49 20.15 19.87 93) Apply adjustment flow flower flow		19.45	19.62	19.91	20.21	20.32	20.34	20.34	20.35	20.33	20.16	19.76	19.43	(90)
19.89 20.04 20.28 20.54 20.66 20.66 20.66 20.65 20.49 20.15 19.87 19.87 19.89 20.04 20.28 20.54 20.64 20.66 20.66 20.65 20.49 20.15 19.87 19.80 20.04 20.28 20.54 20.64 20.66 20.66 20.66 20.65 20.49 20.15 19.87 19.80 20.04 20.28 20.54 20.64 20.66 20.66 20.65 20.65 20.49 20.15 19.87 19.80 20.05 20.0	Living area fra	ction								Liv	ving area ÷	(4) =	0.48	(91)
Apply adjustment to the man internal temperature from Table 4e where appropriate 19.89 20.04 20.28 20.54 20.64 20.66 20.66 20.65 20.65 20.49 20.15 19.87 (33) 8. Space heating requirement Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, mm 1.00 0.99 0.97 0.86 0.66 0.45 0.32 0.36 0.63 0.93 0.99 1.00 (34) Useful gains, mmGm, W (94)m x (84)m 435.20 486.72 538.75 551.86 461.84 312.23 209.46 218.96 336.37 429.41 418.62 414.67 (35) Monthly average external temperature from Table U1 430 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 (36) Heat loss rate for mean internal temperature, Im, W (193)m x (193)m - (96)m 843.43 816.12 740.27 614.24 469.92 312.61 209.48 219.02 340.50 519.94 690.86 835.56 (37) Space heating requirement, kWh/month 0.024 x (197)m - (95)m) x (41)m 303.72 221.36 149.93 44.92 6.01 0.00 0.00 0.00 0.00 67.35 196.02 313.15 \$\$\$\$\$ Space heating requirement kWh/m²/year \$	Mean internal	temperature	for the wh	ole dwellin	g fLA x T1 +	-(1 - fLA) x	T2							_
19.89 20.04 20.28 20.54 20.66 20.66 20.66 20.65 20.49 20.15 19.87 (93)		19.89	20.04	20.28	20.54	20.64	20.66	20.66	20.66	20.65	20.49	20.15	19.87	(92)
Substitute Sub	Apply adjustm	ent to the m	ean interna	l temperati	ure from Ta	ble 4e whe	ere appropr	iate						_
Utilisation factor for gains, nm Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec		19.89	20.04	20.28	20.54	20.64	20.66	20.66	20.66	20.65	20.49	20.15	19.87	(93)
Utilisation factor for gains, η 1.00 0.99 0.97 0.86 0.66 0.45 0.32 0.36 0.63 0.93 0.99 1.00 (34) Useful gains, ημαση, W (94)m × (84)m 435,20 486,72 538,75 551,86 461,84 312,23 209,46 218,96 336,37 429,41 418,62 414,67 (95) Monthly average external temperature from Table U1 4.30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 (96) Heat loss rate for mean internal temperature, Lm, W (139)m × (193)m · (196)m) 843,43 816,12 740,27 614,24 469,92 312,61 209,48 219,02 340,50 519,94 690,86 835,56 (97) Space heating requirement, kWh/month 0.024 × (197)m · (95)m x (41)m 303,72 221,36 149,93 44,92 6.01 0.00 0.00 0.00 0.00 67,35 196,02 313,15 Space heating requirement kWh/m²/year (98) + (4) 17,66 (99) 9b. Energy requirements - community heating scheme Fraction of space heat from secondary/supplementary system (table 11) 0.00 (302) (302) × (303a) = 1.00 (303a) Fraction of total space heat from community boilers 1.00 (303a) Fraction of conducting method (Table 4c(3)) for community system 1.00 (305a) Distribution loss factor (Table 12c) for community water heating system 1.302.45 (98) × (304a) × (305) × (306) = 1367.57 (307a) × (307a) Water heating Annual water heating requirement 1.733.69 (64) × (6	8. Space heat	ting requiren	nent											
1.00 0.99 0.97 0.86 0.66 0.45 0.32 0.36 0.63 0.93 0.99 1.00 94		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains, nmGm, W (94)m x (84)m 435.20	Utilisation fact	or for gains,	ηm											
Monthly average external temperature from Table U1		1.00	0.99	0.97	0.86	0.66	0.45	0.32	0.36	0.63	0.93	0.99	1.00	(94)
Monthly average external temperature from Table U1 4.30	Useful gains, η	mGm, W (94	4)m x (84)m									•		
Monthly average external temperature from Table U1 4.30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 (96) Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m · (96)m) 843.43 816.12 740.27 614.24 469.92 312.61 209.48 219.02 340.50 519.94 690.86 835.56 (97) Space heating requirement, kWh/month 0.024 x [(97)m · (95)m] x (41)m 303.72 221.36 149.93 44.92 6.01 0.00 0.00 0.00 0.00 67.35 196.02 313.15 Space heating requirement kWh/m²/year		435.20	486.72	538.75	551.86	461.84	312.23	209.46	218.96	336.37	429.41	418.62	414.67	(95)
Heat loss rate for mean intermal temperature, Lm, W [(39)m x (96)m) 843.43 816.12 740.27 614.24 469.92 312.61 209.48 219.02 340.50 519.94 690.86 835.56 97) Space heating requirement, kWh/month 0.024 x [(97)m - (95)m) x (41)m 303.72 221.36 149.93 44.92 6.01 0.00 0.00 0.00 0.00 67.35 196.02 313.15 Space heating requirement kWh/m²/year (98) ÷ (4) 17.60 (99) 9b. Energy requirements - community heating scheme Fraction of space heat from secondary/supplementary system (table 11) '0' if none 0.00 (301) Fraction of space heat from community system Fraction of community heat from boilers (302) x (303a) = 1.00 (303a) Fraction of total space heat from community boilers (302) x (303a) = 1.00 (303a) Fractor for control and charging method (Table 4c(3)) for community space heating Bactor for control and charging method (Table 4c(3)) for community space heating Bactor for control and charging method (Table 4c(3)) for community space heating Bactor for control and charging method (Table 4c(3)) for community space heating Bactor for control and charging method (Table 4c(3)) for community space heating Bactor for control and charging method (Table 4c(3)) for community space heating Bactor for control and charging method (Table 4c(3)) for community space heating Bactor for control and charging method (Table 4c(3)) for community space heating Bactor for control and charging method (Table 4c(3)) for community space heating Bactor for control and charging method (Table 4c(3)) for community space heating Bactor for control and charging method (Table 4c(3)) for community space heating Bactor for control and charging method (Table 4c(3)) for community space heating Bactor for control and charging method (Table 4c(3)) for community space heating Bactor for control and charging method (Table 4c(3)) for community space heating Bactor for control and charging method (Table 4c(3)) for community space heating Bactor for control and charging method (Table 4c(3)) for community space heating Bactor for control and char	Monthly avera	ge external t	emperature	from Tabl	e U1								•	_
843.43 816.12 740.27 614.24 469.92 312.61 209.48 219.02 340.50 519.94 690.86 835.56 97) Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m 303.72 221.36 149.93 44.92 6.01 0.00 0.00 0.00 0.00 67.35 196.02 313.15 Space heating requirement kWh/m²/year 56.01 0.00 0.00 0.00 0.00 67.35 196.02 313.15 Space heating requirements - community heating scheme Fraction of space heat from secondary/supplementary system (table 11) 0' if none 0.00 (301) Fraction of space heat from community system 1 - (301) = 1.00 (302) Fraction of total space heat from community boilers (302) x (303a) = 1.00 (304a) Fractor for control and charging method (Table 4c(3)) for community space heating system (1.00 (305)) Factor for control and charging method (Table 4c(3)) for community water heating 5 (302) x (303a) = 1.00 (305) Bysich beating 6 (7able 12c) for community heating system (1.00 (305)) Space heating 7 (98) x (304a) x (305) x (306) = 1.367.57 (307a) Water heating Annual water heating requirement 1733.69 (64)		4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Space heating requirement, kWh/month 0.024 x [[97]m - (95)m] x (41)m 303.72 221.36 149.93 44.92 6.01 0.00 0.00 0.00 0.00 67.35 196.02 313.15 \$\sum{\text{\$[98]15, 1012}} = 1302.45 98\text{}\$ \$\sum{\text{\$[98] 15, 1012}} = 1302.45 98\text{}\$ \$\sum{\text{\$[98] 15, 1012}} = 1302.45 99\text{}\$ \$\sum{\text{\$[98] 15, 1012}} = 1302.45 99\text{\text{\$[98] 15, 1012}} = 17.60 99\text{\$[98] 15, 1012}} = 17.60 301\text{\$[98] 15, 1012}} = 17.60 302\text{\$[98] 15, 1012}} = 17.60 302\$	Heat loss rate	for mean int	ernal tempe	rature, Lm	, W [(39)m	x [(93)m -	(96)m]							
303.72 221.36 149.93 44.92 6.01 0.00 0.00 0.00 67.35 196.02 313.15		843.43	816.12	740.27	614.24	469.92	312.61	209.48	219.02	340.50	519.94	690.86	835.56	(97)
Space heating requirement kWh/m²/year $(98) \pm5$, $1012 = 1302.45$ (98) Space heating requirement kWh/m²/year $(98) \pm5$ $(98) \pm .$	Space heating	requirement	, kWh/mon	th 0.024 x	[(97)m - (9!	5)m] x (41)	m							_
Space heating requirement kWh/m²/year 9b. Energy requirements - community heating scheme Fraction of space heat from secondary/supplementary system (table 11) Fraction of space heat from community system 1 - (301) = 1.00 (302) Fraction of community heat from boilers 1.00 (303a) Fraction of total space heat from community boilers Fraction for control and charging method (Table 4c(3)) for community space heating Fraction for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system Space heating Annual space heating requirement 1302.45 (98) (98) Water heating Annual water heating requirement 1733.69 (64)		303.72	221.36	149.93	44.92	6.01	0.00	0.00	0.00	0.00	67.35	196.02	313.15	7
9b. Energy requirements - community heating scheme Fraction of space heat from secondary/supplementary system (table 11) '0' if none 0.00 (301) Fraction of space heat from community system 1 - (301) = 1.00 (302) Fraction of community heat from boilers 1.00 (303a) Fraction of total space heat from community boilers (302) x (303a) = 1.00 (304a) Factor for control and charging method (Table 4c(3)) for community space heating Factor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system Space heating Annual space heating requirement 1302.45 (98) Space heat from boilers (98) x (304a) x (305) x (306) = 1367.57 (307a) Water heating Annual water heating requirement 1733.69 (64)									•	Σ(98	3)15 <i>,</i> 10	.12 =	1302.45	(98)
Fraction of space heat from secondary/supplementary system (table 11) Fraction of space heat from community system 1 - (301) = 1.00 (302) Fraction of community heat from boilers 1.00 (303a) Fraction of total space heat from community boilers Fraction of total space heat from community boilers Fractor for control and charging method (Table 4c(3)) for community space heating Fractor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system Space heating Annual space heating requirement Mater heating Annual water heating requirement 1733.69 (64)	Space heating	requirement	: kWh/m²/ye	ear							(98)	÷ (4)	17.60	(99)
Fraction of space heat from secondary/supplementary system (table 11) Fraction of space heat from community system 1 - (301) = 1.00 (302) Fraction of community heat from boilers 1.00 (303a) Fraction of total space heat from community boilers Fraction of total space heat from community boilers Fraction of total space heat from community boilers Fractor for control and charging method (Table 4c(3)) for community space heating Fractor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system Space heating Annual space heating requirement Mater heating Annual water heating requirement 1733.69 (64)														_
Fraction of space heat from community system Fraction of community heat from boilers Fraction of total space heat from community boilers Fraction of total space heat from community boilers Fraction of total space heat from community boilers Factor for control and charging method (Table 4c(3)) for community space heating Factor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system Space heating Annual space heating requirement 1302.45 (98) x (304a) x (305) x (306) = 1367.57 (307a) Water heating Annual water heating requirement 1733.69 (64)														
Fraction of community heat from boilers Fraction of total space heat from community boilers Factor for control and charging method (Table 4c(3)) for community space heating Factor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system Space heating Annual space heating requirement Mater heating Annual water heating requirement Mater heating Annual water heating requirement 1.00 (303a) 1.00 (304a) 1.00 (305a) 1.05 (306) 1.05 (306)	•			• •	ntary systei	m (table 11	1)							= -
Fraction of total space heat from community boilers Factor for control and charging method (Table 4c(3)) for community space heating Factor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system Space heating Annual space heating requirement Mater heating Annual water heating requirement Mater heating requirement 100 (305a) 1.00 (305a) 1.05 (306) 1.05 (306) 1.05 (306) 1.05 (306)	•										1 - (3	01) = [= -
Factor for control and charging method (Table 4c(3)) for community space heating Factor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system Space heating Annual space heating requirement Space heat from boilers (98) x (304a) x (305) x (306) = 1367.57 (307a) Water heating Annual water heating requirement 1733.69 (64)		-												=
Factor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system Space heating Annual space heating requirement Space heat from boilers (98) x (304a) x (305) x (306) = 1367.57 (307a) Water heating Annual water heating requirement 1733.69 (64)											(302) x (30	3a) = [<u> </u>
Distribution loss factor (Table 12c) for community heating system Space heating Annual space heating requirement Space heat from boilers (98) x (304a) x (305) x (306) = 1367.57 (307a) Water heating Annual water heating requirement 1733.69 (64)							ace heating							=
Space heating Annual space heating requirement Space heat from boilers (98) x (304a) x (305) x (306) = 1367.57 (307a) Water heating Annual water heating requirement 1733.69 (64)														
Annual space heating requirement Space heat from boilers (98) x (304a) x (305) x (306) = 1367.57 (307a) Water heating Annual water heating requirement 1733.69 (64)	Distribution lo	ss tactor (Tal	ole 12c) for	community	neating sy	stem							1.05	<u> </u> (306)
Annual space heating requirement Space heat from boilers (98) x (304a) x (305) x (306) = 1367.57 (307a) Water heating Annual water heating requirement 1733.69 (64)	Snaco hostina													
Space heat from boilers (98) x (304a) x (305) x (306) = 1367.57 (307a) Water heating 1733.69 (64)			iromont							1202 4F	1			(00)
Water heating Annual water heating requirement 1733.69 (64)			ii eiii eiit								/ (30E) v /2	06) - [1267 57	_
Annual water heating requirement 1733.69 (64)	space neat fro	iii bollers							(98	5) x (3U4a))	k (305) X (3	ub) = [130/.5/	(3∪/a)
	Water heating	;												
Water heat from boilers (64) x (303a) x (305a) x (306) = 1820.37 (310a)	Annual water l	heating requ	irement						1	1733.69]			(64)
	Water heat fro	om boilers							(64)	x (303a) x	(305a) x (3	06) = [1820.37	(310a)

mechanical ventilation fans - balanced, extract or positive input from outside

169.28 (330a) 169.28 (331)

Total electricity for the above, kWh/year

Electricity for lighting (Appendix L)

325.04 (332)

Total delivered energy for all uses

(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =3682.26

10b. Fuel costs - community heating scheme	10b. Fue	costs -	community	heating so	cheme
--	----------	---------	-----------	------------	-------

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1367.57	x	4.24	x 0.01 =	57.99	(340a)
Water heating from boilers	1820.37	х	4.24	x 0.01 =	77.18	(342a)
Pumps and fans	169.28	х	13.19	x 0.01 =	22.33	(349)
Electricity for lighting	325.04	х	13.19	x 0.01 =	42.87	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)(342e) +	(345)(354) =	320.37	(355)

11b. SAP rating - community heating scheme

11b. SAF facing - Continuity heating scheme		
Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.13	(357)
SAP value	84.23]
SAP rating (section 13)	84	(358)
SAP band	В]

12b. CO₂ emissions - community heating scheme							
		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		89.50					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) = [3561.95	x	0.216	= [769.38	(367)
Electrical energy for communit	y heat distribution	31.88	x	0.519	= [16.55	(372)
Total CO2 associated with com	munity systems				[785.93	(373)
Total CO2 associated with space	e and water heating					785.93	(376)
Pumps and fans		169.28	х	0.519	= [87.85	(378)
Electricity for lighting		325.04	х	0.519	= [168.69	(379)
Total CO₂, kg/year					(376)(382) = [1042.47	(383)
Dwelling CO₂ emission rate					(383) ÷ (4) = [14.09	(384)
EI value						88.26	
El rating (section 14)					[88	(385)
EI band					[В	

13b. Primary energy - community heating scheme								
	Energy kWh/year		Primary factor		Primary energy (kWh/year)	,		
Primary energy from other sources (space heating)								
Efficiency of boilers	89.50					(367a)		
Primary energy from boilers $[(307a)+(310a)] \times 100 \div (367a) =$	3561.95] x	1.22	=	4345.58	(367)		
Electrical energy for community heat distribution	31.88] x	3.07	=	97.87	(372)		
Total primary energy associated with community systems					4443.45	(373)		

Pumps and fans

Electricity for lighting

169.28 325.04

3.07

3.07

4443.45

519.67 (378)

(376)

(379) 997.86

5960.98 (383)

80.55 (384)

Primary energy kWh/year

Dwelling primary energy rate kWh/m2/year

URN: 2B4P - Mid Floor BC version 1 NHER Plan Assessor version 6.3.9

DER Worksheet

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	3B4P, Kingston upon Thames, KT1		

Address 1. Overall dwelling owest occupied Total floor area Owelling volume 2. Ventilation rate		ons	ngston upor	n Thames,	A	rea (m²)		Ave				June (3)	
owest occupied Fotal floor area Dwelling volume			+ (1b) + (1			rea (m²)		Avei				al	
owest occupied Fotal floor area Dwelling volume			+ (1b) + (1			rea (m²)		Avei					
Otal floor area		(1a)	+ (1b) + (1			rea (m-)		AVPI					
Otal floor area		(1a)	+ (1b) + (1a						age storey eight (m)		V	olume (m³)	
Owelling volume		(1a)	+ (1b) + (1a			72.42	(1a) x		2.50] (2a) =		181.05	(3a)
			(1~) (1	c) + (1d)(1n) =	72.42	(4)						
2. Ventilation rate								(3a)	+ (3b) + (3	c) + (3d)(3	3n) =	181.05	(5)
v	9												
											m	³ per hour	
Number of chimney	ys								0	x 40 =	-	0	(6a)
Number of open flu	ıes								0	x 20 =		0	(6b)
Number of intermit	ttent 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	r
nfiltration due to c	himneys,	flues, fans	s, PSVs		(6a)	+ (6b) + (7a	a) + (7b) +	(7c) =	0	÷ (5) =	=	0.00	(8)
f a pressurisation t	est has be	en carried	d out or is i	ntended, p	roceed to (1	17), otherw	rise continu	e from (9) t	o (16)				_
Air permeability val	lue, q50, e	xpressed	in cubic m	etres per h	our per squ	are metre	of envelop	e area				3.00	(17)
f based on air pern	neability v	alue, ther	n (18) = [(17	7) ÷ 20] + (8), otherwis	se (18) = (1	6)					0.15	(18)
Number of sides on	which the	e dwelling	g is sheltere	ed								2	(19)
Shelter factor									1 -	[0.075 x (1	9)] =	0.85	(20)
nfiltration rate inco	orporating	shelter fa	actor							(18) x (20) =	0.13	(21)
nfiltration rate mo	dified for	monthly v	wind speed	:									_
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average w	ind speed	from Tab	le U2										
	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m	÷ 4												
	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration	n rate (allo	owing for	shelter and	wind fact	or) (21) x (2	2a)m							
	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:
--

ı£	machanical	vontilation	. air abana	e rate throug	h system
IΤ	mechanicai	ventilation	: air change	e rate throug	n system

0.28

0.50 (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h

0.28

75.65 (23

0.27

(25)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x $[1 - (23c) \div 100]$

0.26

0.26

	0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(24a)
Effective air char	ige rate - e	nter (24a) c	or (24b) or (24c) or (24	d) in (25)								

0.24

0.24

0.25

0.26

0.27



0.28

0.24

		ss paramet	er										
Element			•	Gross area, m²	Openings m ²	Net A,	area m²	U-value W/m²K	AxUW		alue, /m².K	Αxκ, kJ/K	
Window						15	.02 x	1.24	= 18.56				(27)
Door						1.3	80 x	0.70	= 1.26				(26)
External wall						30	.08 x	0.17	= 5.11				(29a
Party wall						32	.93 x	0.00	= 0.00				(32)
External wall						10	.38 x	0.20	= 2.08				(29a
Roof						72	.42 x	0.13	= 9.41				(30)
Total area of ex	ternal elem	ents ∑A, m²	!			129	0.70						(31)
Fabric heat loss,	, W/K = ∑(A	× U)							(26)(30) + (3	32) =	36.43	(33)
Heat capacity C	m = ∑(A x κ))						(28)	.(30) + (32) +	(32a)(32	2e) =	N/A	(34)
Thermal mass p	arameter (1	ΓMP) in kJ/n	n²K									250.00	(35)
Thermal bridges	s: ∑(L x Ψ) c	alculated us	sing Apper	ndix K								12.44	(36)
Total fabric hear	t loss									(33) + (3	36) =	48.87	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat	t loss calcula	ated month	ly 0.33 x (25)m x (5)									
	16.99	16.80	16.61	15.65	15.46	14.51	14.51	14.32	14.89	15.46	15.84	16.22	(38)
Heat transfer co	oefficient, W	V/K (37)m +	- (38)m										
	65.85	65.66	65.47	64.52	64.33	63.38	63.38	63.19	63.76	64.33	64.71	65.09	
									Average = ∑	(39)112/	12 =	64.47	(39)
Heat loss param	neter (HLP),	W/m ² K (39	9)m ÷ (4)										
	0.91	0.91	0.90	0.89	0.89	0.88	0.88	0.87	0.88	0.89	0.89	0.90	
									Average = ∑	(40)112/	12 =	0.89	(40)
Number of days	s in month (Table 1a)							Average = ∑	(40)112/	12 =	0.89	(40)
Number of days	31.00	Table 1a)	31.00	30.00	31.00	30.00	31.00	31.00	Average = ∑ 30.00	31.00	30.00	0.89	_ ` <i>'</i>
Number of days 4. Water heati	31.00	28.00		30.00	31.00	30.00	31.00						_ ` <i>'</i>
4. Water heati	31.00	28.00		30.00	31.00	30.00	31.00						(40)
4. Water heati	31.00 ing energy r	28.00 requiremen	t				31.00					31.00	(40)
4. Water heati	31.00 ing energy r	28.00 requiremen	t				31.00 Jul					31.00	(40)
4. Water heati	ing energy reancy, N hot water to	28.00 requirementusage in litro	t es per day Mar	Vd,average Apr	= (25 x N) + May	36 Jun	Jul	31.00	30.00	31.00	30.00	2.30 88.91	(40)
4. Water heati Assumed occup Annual average	31.00 ing energy reancy, N hot water to Jan e in litres pe	28.00 requirementusage in litro	t es per day Mar ach month	Vd,average Apr Vd,m = fact	= (25 x N) + May tor from Tab	36 Jun le 1c x (43	Jul)	31.00 Aug	30.00 Sep	31.00 Oct	30.00	2.30 88.91 Dec	(40)
4. Water heati Assumed occup Annual average	ing energy reancy, N hot water to	28.00 requirementusage in litro Feb er day for ea	t es per day Mar	Vd,average Apr	= (25 x N) + May	36 Jun	Jul	31.00	30.00	31.00 Oct	30.00 Nov	2.30 88.91 Dec	(40) (42) (43)
4. Water heati Assumed occup Annual average	31.00 ing energy reancy, N hot water to Jan e in litres per series of the series of	28.00 requirementusage in litro Feb er day for ea	es per day Mar ach month 90.68	Vd,average Apr Vd,m = fact 87.13	= (25 x N) +	36 Jun le 1c x (43 80.02	Jul) 80.02	Aug 83.57	30.00 Sep	31.00 Oct	30.00 Nov	2.30 88.91 Dec	(40) (42) (43)
4. Water heati Assumed occup Annual average Hot water usage	31.00 ing energy reancy, N hot water to Jan e in litres per series of the series of	28.00 requirementusage in litro Feb er day for ea	es per day Mar ach month 90.68	Vd,average Apr Vd,m = fact 87.13	= (25 x N) +	36 Jun le 1c x (43 80.02	Jul) 80.02	Aug 83.57	30.00 Sep	31.00 Oct	30.00 Nov	2.30 88.91 Dec 97.80	(40) (42) (43)
4. Water heati Assumed occup Annual average Hot water usage	31.00 ing energy reancy, N hot water to Jan e in litres per 97.80 of hot water	28.00 requirement usage in litro Feb er day for ea 94.24 er used = 4.1	es per day Mar ach month 90.68	Vd,average Apr Vd,m = fact 87.13 x nm x Tm/3	= (25 x N) +	36 Jun le 1c x (43 80.02	Jul) 80.02 Tables 1b	Aug 83.57	\$ep 87.13	31.00 Oct 90.68 Σ(44)1	30.00 Nov 94.24 12 =	2.30 88.91 Dec 97.80 1066.87	(42) (42) (43)
4. Water heati Assumed occup. Annual average Hot water usage Energy content	31.00 ing energy reancy, N hot water to Jan e in litres per 97.80 of hot water	28.00 requirementusage in litre Feb er day for ea 94.24 er used = 4.1 126.84	es per day Mar ach month 90.68	Vd,average Apr Vd,m = fact 87.13 x nm x Tm/3	= (25 x N) +	36 Jun le 1c x (43 80.02	Jul) 80.02 Tables 1b	Aug 83.57	\$ep 87.13	31.00 Oct 90.68 Σ(44)1	30.00 Nov 94.24 12 =	2.30 88.91 Dec 97.80	(40) (42) (43) (44)
4. Water heati Assumed occup Annual average Hot water usage	31.00 ing energy reancy, N hot water to Jan e in litres per 97.80 of hot water 145.03	28.00 requirement usage in litro Feb er day for eat 94.24 er used = 4.1 126.84	es per day Mar ach month 90.68 18 x Vd,m 130.89	Vd,average	= (25 x N) +	36 Jun le 1c x (43 80.02 nonth (see	Jul) 80.02 Tables 1b 87.56	Aug 83.57 , 1c 1d) 100.47	\$ep 87.13	31.00 Oct 90.68 Σ(44)1 118.49 Σ(45)1	30.00 Nov 94.24 12 = 129.34 12 =	2.30 88.91 Dec 97.80 1066.87 140.45 1398.84	(42) (42) (43) (44)
4. Water heati Assumed occup Annual average Hot water usage Energy content Distribution loss	31.00 ing energy reancy, N hot water to Jan e in litres per 97.80 of hot water 145.03 s 0.15 x (45) 21.75	28.00 requirement usage in litro Feb er day for eat 94.24 er used = 4.1 126.84 o)m 19.03	es per day Mar ach month 90.68 18 x Vd,m 130.89	Vd,average	= (25 x N) + May tor from Tab 83.57 3600 kWh/m 109.50	36 Jun le 1c x (43 80.02 nonth (see 94.49	Jul) 80.02 Tables 1b	Aug 83.57	\$ep 87.13	31.00 Oct 90.68 Σ(44)1	30.00 Nov 94.24 12 =	2.30 88.91 Dec 97.80 1066.87 140.45 1398.84	(40) (42) (43) (44) (45)
4. Water heati Assumed occup. Annual average Hot water usage Energy content	31.00 ing energy reancy, N hot water to Jan e in litres per 97.80 of hot water 145.03 s 0.15 x (45) 21.75 e (litres) inclin	28.00 requirement usage in litro Feb er day for eat 94.24 er used = 4.1 126.84 o)m 19.03	es per day Mar ach month 90.68 18 x Vd,m 130.89	Vd,average	= (25 x N) + May tor from Tab 83.57 3600 kWh/m 109.50	36 Jun le 1c x (43 80.02 nonth (see 94.49	Jul) 80.02 Tables 1b 87.56	Aug 83.57 , 1c 1d) 100.47	\$ep 87.13	31.00 Oct 90.68 Σ(44)1 118.49 Σ(45)1	30.00 Nov 94.24 12 = 129.34 12 =	2.30 88.91 Dec 97.80 1066.87 140.45 1398.84	(40) (42) (43) (44) (45)
4. Water heati Assumed occup. Annual average Hot water usage Energy content Distribution loss Storage volume	31.00 ing energy reancy, N hot water to Jan e in litres per 97.80 of hot water 145.03 s 0.15 x (45) 21.75 e (litres) inclusions:	28.00 requirement usage in litro Feb er day for eat 94.24 er used = 4.1 126.84)m 19.03 uding any so	es per day Mar ach month 90.68 18 x Vd,m 130.89 19.63 blar or WV	Vd,average	= (25 x N) + May tor from Tab 83.57 3600 kWh/m 109.50	36 Jun le 1c x (43 80.02 nonth (see 94.49	Jul) 80.02 Tables 1b 87.56	Aug 83.57 , 1c 1d) 100.47	\$ep 87.13	31.00 Oct 90.68 Σ(44)1 118.49 Σ(45)1	30.00 Nov 94.24 12 = 129.34 12 =	2.30 88.91 Dec 97.80 1066.87 140.45 1398.84	(40) (42) (43) (44) (45)
4. Water heati Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage le b) Manufacture	31.00 ing energy reancy, N hot water to Jan e in litres per 97.80 of hot water 145.03 s 0.15 x (45 21.75 e (litres) incluoss: er's declared	28.00 requirement usage in litro Feb er day for ea 94.24 er used = 4.1 126.84)m 19.03 uding any so	es per day Mar ach month 90.68 18 x Vd,m 130.89 19.63 plar or WV	Vd,average	= (25 x N) + May tor from Tab 83.57 3600 kWh/m 109.50 16.42 ge within san	36 Jun le 1c x (43 80.02 nonth (see 94.49	Jul) 80.02 Tables 1b 87.56	Aug 83.57 , 1c 1d) 100.47	\$ep 87.13	31.00 Oct 90.68 Σ(44)1 118.49 Σ(45)1	30.00 Nov 94.24 12 = 129.34 12 =	2.30 88.91 Dec 97.80 1066.87 140.45 1398.84	(40) (42) (43) (44) (45) (46)
4. Water heati Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage lo	31.00 ing energy reancy, N hot water to Jan e in litres per 97.80 of hot water 145.03 s 0.15 x (45) 21.75 e (litres) inclusions: er's declared corage loss for	28.00 requirement usage in litro Feb er day for ea 94.24 er used = 4.1 126.84 19.03 uding any so	es per day Mar ach month 90.68 18 x Vd,m 130.89 19.63 plar or WV	Vd,average	= (25 x N) + May tor from Tab 83.57 3600 kWh/m 109.50 16.42 ge within san	36 Jun le 1c x (43 80.02 bonth (see 94.49	Jul) 80.02 Tables 1b 87.56	Aug 83.57 , 1c 1d) 100.47	\$ep 87.13	31.00 Oct 90.68 Σ(44)1 118.49 Σ(45)1	30.00 Nov 94.24 12 = 129.34 12 =	2.30 88.91 Dec 97.80 1066.87 140.45 1398.84 21.07 3.00	(40) (42) (42) (43) (44) (45) (46) (47)
4. Water heati Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage le b) Manufacture Hot water st Volume factor	31.00 ing energy reancy, N hot water to Jan e in litres per 97.80 of hot water 145.03 s 0.15 x (45) 21.75 e (litres) incluoss: er's declared corage loss for from Tab	28.00 requirement usage in litro Feb er day for ea 94.24 er used = 4.1 126.84)m 19.03 uding any so loss factor from factor f	es per day Mar ach month 90.68 18 x Vd,m 130.89 19.63 plar or WV	Vd,average	= (25 x N) + May tor from Tab 83.57 3600 kWh/m 109.50 16.42 ge within san	36 Jun le 1c x (43 80.02 bonth (see 94.49	Jul) 80.02 Tables 1b 87.56	Aug 83.57 , 1c 1d) 100.47	\$ep 87.13	31.00 Oct 90.68 Σ(44)1 118.49 Σ(45)1	30.00 Nov 94.24 12 = 129.34 12 =	2.30 88.91 Dec 97.80 1066.87 140.45 1398.84 21.07 3.00 0.02 3.42	(40) (42) (43) (44) (44) (45) (46) (47)
4. Water heati Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage le b) Manufacture Hot water st Volume factor Temperature	31.00 ing energy reancy, N hot water to Jan e in litres per 97.80 of hot water 145.03 s 0.15 x (45) 21.75 e (litres) incluoss: er's declared corage loss for from Table e factor from	28.00 requirement usage in litro Feb er day for ea 94.24 er used = 4.1 126.84 In 19.03 I loss factor factor from factor from factor from Table 2b	es per day Mar ach month 90.68 18 x Vd,m 130.89 19.63 blar or WV is not kno	Vd,average Apr Vd,m = fact 87.13 x nm x Tm/3 114.11 17.12 VHRS storage wn Wh/litre/da	= (25 x N) + May tor from Tab 83.57 3600 kWh/m 109.50 16.42 ge within san	36 Jun le 1c x (43 80.02 bonth (see 94.49	Jul) 80.02 Tables 1b 87.56	Aug 83.57 , 1c 1d) 100.47	\$ep 87.13	31.00 Oct 90.68 Σ(44)1 118.49 Σ(45)1	30.00 Nov 94.24 12 = 129.34 12 =	2.30 88.91 Dec 97.80 1066.87 140.45 1398.84 21.07 3.00 0.02 3.42 0.60	(40) (42) (43) (44) (45) (46) (47) (51) (52) (53)
4. Water heati Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage le b) Manufacture Hot water st Volume factor	31.00 ing energy reancy, N hot water to Jan e in litres per 97.80 of hot water 145.03 s 0.15 x (45) 21.75 e (litres) includes corage loss from Table e factor from Table e factor from water s	28.00 requirement usage in litro Feb er day for ea 94.24 er used = 4.1 126.84 In 19.03 I loss factor factor from factor from factor from Table 2b	es per day Mar ach month 90.68 18 x Vd,m 130.89 19.63 blar or WV is not kno	Vd,average Apr Vd,m = fact 87.13 x nm x Tm/3 114.11 17.12 VHRS storage wn Wh/litre/da	= (25 x N) + May tor from Tab 83.57 3600 kWh/m 109.50 16.42 ge within san	36 Jun le 1c x (43 80.02 bonth (see 94.49	Jul) 80.02 Tables 1b 87.56	Aug 83.57 , 1c 1d) 100.47	\$ep 87.13	31.00 Oct 90.68 Σ(44)1 118.49 Σ(45)1	30.00 Nov 94.24 12 = 129.34 12 =	2.30 88.91 Dec 97.80 1066.87 140.45 1398.84 21.07 3.00 0.02 3.42	(40) (42) (43) (44) (44) (45) (46) (47)

Company Comp				1		1								
Marka See Marka See Marka See			1	I.	3.91	1	3.91	1		3.91	4.04	3.91	4.04	(56)
Primary circuit loss for each month from Table 3 23.26	If the vessel con	tains dedic	ated solar s	torage or d	dedicated W	/WHRS (56))m x [(47) -	Vs] ÷ (47),	else (56)					
23.26 21.01 23.26 22.51 23.26 22.51 23.26 22.51 23.26 23.26 22.51 23.26 23.2			1		3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)
Combine Comb	Primary circuit le	oss for each	n month fro	m Table 3	_									
Total heat required for water meating calculated for each month 0.85 x x m + x x x x x x x x x x		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)
Total heat required for water heating calculated for each month 0.85 x (45)m + (16)m + (57)m + (59)m + (61)m 172.33 315.15 188.08 130.91 114.86 127.77 128.09 145.79 155.76 167.76 (62) Solar DHW input calculated wing Appendix G or Appendix G or Color 0.00	Combi loss for e	ach month	from Table	3a, 3b or 3	3c									
172.33 151.51 158.20 140.54 136.80 120.91 114.86 127.77 128.09 145.79 155.76 167.76 162.78		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Solar DHW input calculated using Appendix G or Appendix	Total heat requi	red for wat	er heating o	calculated f	for each mo	onth 0.85 x	(45)m + (4	6)m + (57)r	n + (59)m +	+ (61)m				
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0		172.33	151.51	158.20	140.54	136.80	120.91	114.86	127.77	128.09	145.79	155.76	167.76	(62)
Output from water heater for each month (kWh/month) (62)m + (63)m 114.86 127.77 128.09 145.79 155.76 167.76 167.76 167.76 167.76 167.76 167.76 167.76 167.76 167.76 167.76 167.76 167.76 167.76 167.76 167.76 167.70 167.07	Solar DHW inpu	t calculated	l using Appe	endix G or A	Appendix H									
172.33 151.51 158.20 140.54 136.80 120.91 114.86 127.77 128.09 145.79 155.76 167.76 2(64)112 1720.32 (64) 140.65 140.6		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m] 70.07 61.90 65.36 59.08 58.25 52.55 50.96 55.25 54.94 61.24 64.14 68.54 (65) S. Internal gains In Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Metabolic gains (Table 5) 115.17 115.1	Output from wa	ter heater f	for each mo	onth (kWh/	month) (62	2)m + (63)m	า							
Real gains from water heating (kWh/morth) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m] 70.07		172.33	151.51	158.20	140.54	136.80	120.91	114.86	127.77	128.09	145.79	155.76	167.76	
Total Tota											∑(64)1	.12 = 1	720.32	(64)
S. Internal gains	Heat gains from	water heat	ting (kWh/n	nonth) 0.2	5 × [0.85 ×	(45)m + (61	L)m] + 0.8 ×	: [(46)m + (5	57)m + (59)	m]				
Matabolic gains (Table 5) Mar May May Jun Jul May Sep Oct Nov Dec		70.07	61.90	65.36	59.08	58.25	52.55	50.96	55.25	54.94	61.24	64.14	68.54	(65)
Matabolic gains (Table 5) Mar May May Jun Jul May Sep Oct Nov Dec			•			•								'
Metabolic gains (Table 5) 115.17	5. Internal gair	ıs												
115.17 115.17		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 18.15	Metabolic gains	(Table 5)												
18.15 16.12 13.11 9.93 7.42 6.26 6.77 8.80 11.81 15.00 17.50 18.66 (67)		115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	115.17	(66)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 202.88 204.98 199.68 188.38 174.13 160.73 151.78 149.67 154.98 166.27 180.53 193.93 (68) Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 (69) Pump and fan gains (Table 5a) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	Lighting gains (c	alculated in	n Appendix I	L, equation	1 L9 or L9a),	also see Ta	able 5							
202.88 204.98 199.68 188.38 174.13 160.73 151.78 149.67 154.98 166.27 180.53 193.93 (68) Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 (69) Pump and fan gains (Table 5a) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.		18.15	16.12	13.11	9.93	7.42	6.26	6.77	8.80	11.81	15.00	17.50	18.66	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 (69) Pump and fan gains (Table 5a) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	Appliance gains	(calculated	in Appendi	x L, equation	on L13 or L1	13a), also s	ee Table 5							
34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 34.52 (69) Pump and fan gains (Table 5a) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.		202.88	204.98	199.68	188.38	174.13	160.73	151.78	149.67	154.98	166.27	180.53	193.93	(68)
Pump and fan gains (Table Sa) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	Cooking gains (c													
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	• • • • • • • • • • • • • • • • • • • •	alculated ir	n Appendix	L, equation	n L15 or L15	a), also see	Table 5							
Losses e.g. evaporation (Table 5) -92.14 -92.14 -92.14 -92.14 -92.14 -92.14 -92.14 -92.14 -92.14 -92.14 -92.14 -92.14 -92.14 -92.14 -92.14 -92.14 -92.14 -92.14 (71) Water heating gains (Table 5) -94.17 92.12 87.86 82.06 78.29 72.99 68.49 74.26 76.31 82.31 89.09 92.13 (72) Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m								34.52	34.52	34.52	34.52	34.52	34.52	(69)
-92.14 -92.14		34.52	34.52					34.52	34.52	34.52	34.52	34.52	34.52	(69)
Water heating gains (Table 5) 94.17 92.12 87.86 82.06 78.29 72.99 68.49 74.26 76.31 82.31 89.09 92.13 (72) Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m 372.76 370.78 358.20 337.92 317.39 297.54 284.59 290.28 300.65 321.13 344.67 362.26 (73) 6. Solar gains Access factor Table 6d m² Solar flux W/m² specific data or Table 6b or Table 6c West 0.77 x 10.54 x 19.64 x 0.9 x 0.45 x 0.70 = 45.19 (80) South 0.77 x 4.48 x 46.75 x 0.9 x 0.45 x 0.70 = 45.72 (78) Solar gains in watts Σ(74)m(82)m 90.91 163.28 240.97 320.13 372.55 374.48 359.22 320.42 268.96 185.66 110.54 76.67 (83) Total gains - internal and solar (73)m + (83)m 463.67 534.06 599.16 658.05 689.94 672.02 643.81 610.70 569.61 506.79 455.21 438.93 (84)		34.52 ains (Table	34.52 5a)	34.52	34.52	34.52	34.52					1		
94.17 92.12 87.86 82.06 78.29 72.99 68.49 74.26 76.31 82.31 89.09 92.13 (72) Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m 372.76 370.78 358.20 337.92 317.39 297.54 284.59 290.28 300.65 321.13 344.67 362.26 (73) 6. Solar gains Access factor Table 6d m² Solar flux W/m² specific data or Table 6b or Table 6c West 0.77 x 10.54 x 19.64 x 0.9 x 0.45 x 0.70 = 45.19 (80) South 0.77 x 4.48 x 46.75 x 0.9 x 0.45 x 0.70 = 45.72 (78) Solar gains in watts ∑(74)m(82)m 90.91 163.28 240.97 320.13 372.55 374.48 359.22 320.42 268.96 185.66 110.54 76.67 (83) Total gains - internal and solar (73)m + (83)m 463.67 534.06 599.16 658.05 689.94 672.02 643.81 610.70 569.61 506.79 455.21 438.93 (84)	Pump and fan ga	34.52 ains (Table 0.00	34.52 5a) 0.00	34.52	34.52	34.52	34.52					1		
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m 372.76 370.78 358.20 337.92 317.39 297.54 284.59 290.28 300.65 321.13 344.67 362.26 (73) 6. Solar gains Access factor Table 6d My Specific data or Table 6b On Table 6c West 0.77	Pump and fan ga	34.52 ains (Table 0.00 oration (Ta	34.52 5a) 0.00 ble 5)	0.00	0.00	34.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m 372.76 370.78 358.20 337.92 317.39 297.54 284.59 290.28 300.65 321.13 344.67 362.26 (73) 6. Solar gains Access factor Table 6d My Specific data or Table 6b 0.77 x 10.54 x 19.64 x 0.9 x 0.45 x 0.70 = 45.19 (80) South	Pump and fan ga Losses e.g. evap	34.52 ains (Table 0.00 oration (Ta	34.52 5a) 0.00 ble 5) -92.14	0.00	0.00	34.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
372.76 370.78 358.20 337.92 317.39 297.54 284.59 290.28 300.65 321.13 344.67 362.26 (73) 6. Solar gains Access factor Table 6d M² Solar flux W/m² specific data or Table 6b or Table 6c West 0.77 x 10.54 x 19.64 x 0.9 x 0.45 x 0.70 = 45.19 (80) South 0.77 x 4.48 x 46.75 x 0.9 x 0.45 x 0.70 = 45.72 (78) Solar gains in watts ∑(74)m(82)m 90.91 163.28 240.97 320.13 372.55 374.48 359.22 320.42 268.96 185.66 110.54 76.67 (83) Total gains - internal and solar (73)m + (83)m 463.67 534.06 599.16 658.05 689.94 672.02 643.81 610.70 569.61 506.79 455.21 438.93 (84) 7. Mean internal temperature (heating season)	Pump and fan ga Losses e.g. evap	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table	34.52 5a) 0.00 ble 5) -92.14	34.52 0.00 -92.14	34.52	34.52 0.00 -92.14	34.52 0.00 -92.14	0.00	-92.14	0.00	0.00 -92.14	0.00	-92.14	(70)
6. Solar gains Access factor Table 6d	Pump and fan ga Losses e.g. evap Water heating g	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table 94.17	34.52 5a) 0.00 ble 5) -92.14 5)	34.52 0.00 -92.14 87.86	34.52 0.00 -92.14 82.06	34.52 0.00 -92.14 78.29	34.52 0.00 -92.14 72.99	0.00	-92.14	0.00	0.00 -92.14	0.00	-92.14	(70)
Access factor Table 6d Area m² Solar flux W/m² g specific data or Table 6b FF specific data or Table 6c Gains W West 0.77 x 10.54 x 19.64 x 0.9 x 0.45 x 0.70 = 45.19 (80) South 0.77 x 4.48 x 46.75 x 0.9 x 0.45 x 0.70 = 45.72 (78) Solar gains in watts Σ(74)m(82)m 90.91 163.28 240.97 320.13 372.55 374.48 359.22 320.42 268.96 185.66 110.54 76.67 (83) Total gains - internal and solar (73)m + (83)m 463.67 534.06 599.16 658.05 689.94 672.02 643.81 610.70 569.61 506.79 455.21 438.93 (84) 7. Mean internal temperature (heating season)	Pump and fan ga Losses e.g. evap Water heating g	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table 94.17 ains (66)m	34.52 5a) 0.00 ble 5) -92.14 5) 92.12 + (67)m + (6	34.52 0.00 -92.14 87.86 68)m + (69)	34.52 0.00 -92.14 82.06 m + (70)m	34.52 0.00 -92.14 78.29 + (71)m + (**	34.52 0.00 -92.14 72.99 72)m	0.00 -92.14 68.49	-92.14 74.26	-92.14 76.31	0.00 -92.14 82.31	-92.14 89.09	92.13	(70) (71) (72)
West 0.77 x 10.54 x 19.64 x 0.9 x 0.45 x 0.70 = 45.19 (80) South 0.77 x 4.48 x 46.75 x 0.9 x 0.45 x 0.70 = 45.19 (80) Solar gains in watts ∑(74)m(82)m 90.91 163.28 240.97 320.13 372.55 374.48 359.22 320.42 268.96 185.66 110.54 76.67 (83) Total gains - internal and solar (73)m + (83)m 463.67 534.06 599.16 658.05 689.94 672.02 643.81 610.70 569.61 506.79 455.21 438.93 (84) 7. Mean internal temperature (heating season)	Pump and fan ga Losses e.g. evap Water heating g	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table 94.17 ains (66)m	34.52 5a) 0.00 ble 5) -92.14 5) 92.12 + (67)m + (6	34.52 0.00 -92.14 87.86 68)m + (69)	34.52 0.00 -92.14 82.06 m + (70)m	34.52 0.00 -92.14 78.29 + (71)m + (**	34.52 0.00 -92.14 72.99 72)m	0.00 -92.14 68.49	-92.14 74.26	-92.14 76.31	0.00 -92.14 82.31	-92.14 89.09	92.13	(70) (71) (72)
or Table 6b or Table 6c West 0.77 x 10.54 x 19.64 x 0.9 x 0.45 x 0.70 = 45.19 (80) South 0.77 x 4.48 x 46.75 x 0.9 x 0.45 x 0.70 = 45.72 (78) Solar gains in watts Σ(74)m(82)m 90.91 163.28 240.97 320.13 372.55 374.48 359.22 320.42 268.96 185.66 110.54 76.67 (83) Total gains - internal and solar (73)m + (83)m 463.67 534.06 599.16 658.05 689.94 672.02 643.81 610.70 569.61 506.79 455.21 438.93 (84) 7. Mean internal temperature (heating season)	Pump and fan ga Losses e.g. evap Water heating g Total internal ga	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table 94.17 ains (66)m	34.52 5a) 0.00 ble 5) -92.14 5) 92.12 + (67)m + (6	34.52 0.00 -92.14 87.86 68)m + (69)	34.52 0.00 -92.14 82.06 m + (70)m	34.52 0.00 -92.14 78.29 + (71)m + (**	34.52 0.00 -92.14 72.99 72)m	0.00 -92.14 68.49	-92.14 74.26	-92.14 76.31	0.00 -92.14 82.31	-92.14 89.09	92.13	(70) (71) (72)
West	Pump and fan ga Losses e.g. evap Water heating g Total internal ga	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table 94.17 ains (66)m	34.52 5a) 0.00 ble 5) -92.14 5) 92.12 + (67)m + (6	34.52 0.00 -92.14 87.86 68)m + (69) 358.20 Access	34.52 0.00 -92.14 82.06 m + (70)m - 337.92	34.52 0.00 -92.14 78.29 + (71)m + (1317.39)	34.52 0.00 -92.14 72.99 72)m 297.54	0.00 -92.14 68.49 284.59	74.26 290.28	76.31 300.65	0.00 -92.14 82.31 321.13	0.00 -92.14 89.09 344.67	92.14 92.13 362.26	(70) (71) (72)
South	Pump and fan ga Losses e.g. evap Water heating g Total internal ga	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table 94.17 ains (66)m	34.52 5a) 0.00 ble 5) -92.14 5) 92.12 + (67)m + (6	34.52 0.00 -92.14 87.86 68)m + (69) 358.20 Access	34.52 0.00 -92.14 82.06 m + (70)m - 337.92	34.52 0.00 -92.14 78.29 + (71)m + (1317.39)	34.52 0.00 -92.14 72.99 72)m 297.54	0.00 -92.14 68.49 284.59	74.26 290.28	76.31 300.65	0.00 -92.14 82.31 321.13	0.00 -92.14 89.09 344.67	92.14 92.13 362.26	(70) (71) (72)
Solar gains in watts ∑(74)m(82)m 90.91 163.28 240.97 320.13 372.55 374.48 359.22 320.42 268.96 185.66 110.54 76.67 (83) Total gains - internal and solar (73)m + (83)m 463.67 534.06 599.16 658.05 689.94 672.02 643.81 610.70 569.61 506.79 455.21 438.93 (84) 7. Mean internal temperature (heating season)	Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table 94.17 ains (66)m	34.52 5a) 0.00 ble 5) -92.14 5) 92.12 + (67)m + (6	34.52 0.00 -92.14 87.86 68)m + (69) 358.20 Access Table	34.52 0.00 -92.14 82.06 m + (70)m - 337.92 factor	34.52 0.00 -92.14 78.29 + (71)m + (1317.39) Area m ²	34.52 0.00 -92.14 72.99 72)m 297.54	0.00 -92.14 68.49 284.59 ar flux J/m²	0.00 -92.14 74.26 290.28 spec	76.31 300.65 g ific data able 6b	92.14 82.31 321.13 FF specific c or Table	0.00 -92.14 89.09 344.67	0.00 -92.14 92.13 362.26 Gains W	(70) (71) (72) (73)
90.91 163.28 240.97 320.13 372.55 374.48 359.22 320.42 268.96 185.66 110.54 76.67 (83) Total gains - internal and solar (73)m + (83)m 463.67 534.06 599.16 658.05 689.94 672.02 643.81 610.70 569.61 506.79 455.21 438.93 (84) 7. Mean internal temperature (heating season)	Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains West	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table 94.17 ains (66)m	34.52 5a) 0.00 ble 5) -92.14 5) 92.12 + (67)m + (6	34.52 0.00 -92.14 87.86 68)m + (69) 358.20 Access Table	34.52 0.00 -92.14 82.06 m + (70)m - 337.92 factor e 6d	34.52 0.00 -92.14 78.29 + (71)m + (317.39 Area m²	34.52 0.00 -92.14 72.99 72)m 297.54 Sol	0.00 -92.14 68.49 284.59 ar flux y/m²	0.00 -92.14 74.26 290.28 spec or T	0.00 -92.14 76.31 300.65 gific data able 6b 0.45 x	0.00 -92.14 82.31 321.13 FF specific c or Table 0.70	0.00 -92.14 89.09 344.67	0.00 -92.14 92.13 362.26 Gains W	(70) (71) (72) (73)
Total gains - internal and solar (73)m + (83)m 463.67 534.06 599.16 658.05 689.94 672.02 643.81 610.70 569.61 506.79 455.21 438.93 (84) 7. Mean internal temperature (heating season)	Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains West South	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table 94.17 ains (66)m 372.76	34.52 5a) 0.00 ble 5) -92.14 5) 92.12 + (67)m + (6 370.78	34.52 0.00 -92.14 87.86 68)m + (69) 358.20 Access Table	34.52 0.00 -92.14 82.06 m + (70)m - 337.92 factor e 6d	34.52 0.00 -92.14 78.29 + (71)m + (317.39 Area m²	34.52 0.00 -92.14 72.99 72)m 297.54 Sol	0.00 -92.14 68.49 284.59 ar flux y/m²	0.00 -92.14 74.26 290.28 spec or T	0.00 -92.14 76.31 300.65 gific data able 6b 0.45 x	0.00 -92.14 82.31 321.13 FF specific c or Table 0.70	0.00 -92.14 89.09 344.67	0.00 -92.14 92.13 362.26 Gains W	(70) (71) (72) (73)
463.67 534.06 599.16 658.05 689.94 672.02 643.81 610.70 569.61 506.79 455.21 438.93 (84) 7. Mean internal temperature (heating season)	Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains West South	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table 94.17 ains (66)m 372.76	34.52 5a) 0.00 ble 5) -92.14 5) 92.12 + (67)m + (6 370.78	34.52 0.00 -92.14 87.86 68)m + (69) 358.20 Access Table 0.7 0.7	34.52 0.00 -92.14 82.06 m + (70)m - 337.92 factor e 6d 7 x	34.52 0.00 -92.14 78.29 + (71)m + (317.39 Area m² 10.54 4.48	34.52 0.00 -92.14 72.99 72)m 297.54 Sol W x 1 x 4	0.00 -92.14 68.49 284.59 ar flux J/m² 9.64 x 6.75 x	0.00 -92.14 74.26 290.28 spec or T 0.9 x	0.00 -92.14 76.31 300.65 gific data able 6b 0.45 x x	0.00 -92.14 82.31 321.13 FF specific c or Table 0.70 0.70	0.00 -92.14 89.09 344.67	0.00 -92.14 92.13 362.26 Gains W 45.19 45.72	(70) (71) (72) (73) (80) (78)
7. Mean internal temperature (heating season)	Pump and fan ga Losses e.g. evap Water heating ga Total internal ga 6. Solar gains West South Solar gains in wa	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table 94.17 ains (66)m 372.76 atts ∑(74)m 90.91	34.52 5a) 0.00 ble 5) -92.14 5) 92.12 + (67)m + (6 370.78	34.52 0.00 -92.14 87.86 68)m + (69) 358.20 Access 1 Table 0.7 0.7	34.52 0.00 -92.14 82.06 m + (70)m - 337.92 factor e 6d 7 x	34.52 0.00 -92.14 78.29 + (71)m + (317.39 Area m² 10.54 4.48	34.52 0.00 -92.14 72.99 72)m 297.54 Sol W x 1 x 4	0.00 -92.14 68.49 284.59 ar flux J/m² 9.64 x 6.75 x	0.00 -92.14 74.26 290.28 spec or T 0.9 x	0.00 -92.14 76.31 300.65 gific data able 6b 0.45 x x	0.00 -92.14 82.31 321.13 FF specific c or Table 0.70 0.70	0.00 -92.14 89.09 344.67	0.00 -92.14 92.13 362.26 Gains W 45.19 45.72	(70) (71) (72) (73) (80) (78)
	Pump and fan ga Losses e.g. evap Water heating ga Total internal ga 6. Solar gains West South Solar gains in wa	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table 94.17 ains (66)m 372.76 atts ∑(74)m 90.91 ernal and so	34.52 5a) 0.00 ble 5) -92.14 5) 92.12 + (67)m + (6 370.78 1(82)m 163.28 blar (73)m +	34.52 0.00 -92.14 87.86 88)m + (69) 358.20 Access Table 0.7 0.7 240.97 (83)m	34.52 0.00 -92.14 82.06 m + (70)m + (30)m + (6d) 77 x	34.52 0.00 -92.14 78.29 + (71)m + (317.39 Area m ² 10.54 4.48	34.52 0.00 -92.14 72.99 72)m 297.54 Sol V x 1 x 4	0.00 -92.14 68.49 284.59 ar flux y/m² 9.64 x 6.75 x	0.00 -92.14 74.26 290.28 spec or T 0.9 x 0.9 x 320.42	0.00 -92.14 76.31 300.65 gific data able 6b 0.45 x 268.96	0.00 -92.14 82.31 321.13 FF specific c or Table 0.70 0.70 185.66	0.00 -92.14 89.09 344.67	0.00 -92.14 92.13 362.26 Gains W 45.19 45.72	(70) (71) (72) (73) (80) (78) (83)
	Pump and fan ga Losses e.g. evap Water heating ga Total internal ga 6. Solar gains West South Solar gains in wa	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table 94.17 ains (66)m 372.76 atts ∑(74)m 90.91 ernal and so	34.52 5a) 0.00 ble 5) -92.14 5) 92.12 + (67)m + (6 370.78 1(82)m 163.28 blar (73)m +	34.52 0.00 -92.14 87.86 88)m + (69) 358.20 Access Table 0.7 0.7 240.97 (83)m	34.52 0.00 -92.14 82.06 m + (70)m + (30)m + (6d) 77 x	34.52 0.00 -92.14 78.29 + (71)m + (317.39 Area m ² 10.54 4.48	34.52 0.00 -92.14 72.99 72)m 297.54 Sol V x 1 x 4	0.00 -92.14 68.49 284.59 ar flux y/m² 9.64 x 6.75 x	0.00 -92.14 74.26 290.28 spec or T 0.9 x 0.9 x 320.42	0.00 -92.14 76.31 300.65 gific data able 6b 0.45 x 268.96	0.00 -92.14 82.31 321.13 FF specific c or Table 0.70 0.70 185.66	0.00 -92.14 89.09 344.67	0.00 -92.14 92.13 362.26 Gains W 45.19 45.72	(70) (71) (72) (73) (80) (78) (83)
100)	Pump and fan ga Losses e.g. evap Water heating ga Total internal ga 6. Solar gains West South Solar gains in wa Total gains - internal	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table 94.17 ains (66)m 372.76 atts ∑(74)m 90.91 ernal and sc 463.67	34.52 5a) 0.00 ble 5) -92.14 5) 92.12 + (67)m + (6 370.78 163.28 blar (73)m + 534.06	34.52 0.00 -92.14 87.86 68)m + (69) 358.20 Access Table 0.7 0.7 (83)m 599.16	34.52 0.00 -92.14 82.06 m + (70)m - 337.92 factor e 6d 77 x [77 x [320.13]	34.52 0.00 -92.14 78.29 + (71)m + (317.39 Area m ² 10.54 4.48	34.52 0.00 -92.14 72.99 72)m 297.54 Sol V x 1 x 4	0.00 -92.14 68.49 284.59 ar flux y/m² 9.64 x 6.75 x	0.00 -92.14 74.26 290.28 spec or T 0.9 x 0.9 x 320.42	0.00 -92.14 76.31 300.65 gific data able 6b 0.45 x 268.96	0.00 -92.14 82.31 321.13 FF specific c or Table 0.70 0.70 185.66	0.00 -92.14 89.09 344.67	0.00 -92.14 92.13 362.26 Gains W 45.19 45.72	(70) (71) (72) (73) (80) (78) (83)
	Pump and fan ga Losses e.g. evap Water heating ga Total internal ga 6. Solar gains West South Solar gains in wa Total gains - internal	34.52 ains (Table 0.00 oration (Ta -92.14 ains (Table 94.17 ains (66)m 372.76 atts Σ(74)m 90.91 ernal and so 463.67	34.52 5a) 0.00 ble 5) -92.14 5) 92.12 + (67)m + (6 370.78 163.28 blar (73)m + 534.06	34.52 0.00 -92.14 87.86 88)m + (69) 358.20 Access Table 0.7 0.7 240.97 (83)m 599.16	34.52 0.00 -92.14 82.06 m + (70)m + (30)m + (70)m	34.52 0.00 -92.14 78.29 + (71)m + (1) 317.39 Area m² 10.54 4.48 372.55	34.52 0.00 -92.14 72.99 72)m 297.54 Sol V x 1 x 4 374.48	0.00 -92.14 68.49 284.59 ar flux y/m² 9.64 x 6.75 x	0.00 -92.14 74.26 290.28 spec or T 0.9 x 0.9 x 320.42	0.00 -92.14 76.31 300.65 gific data able 6b 0.45 x 268.96	0.00 -92.14 82.31 321.13 FF specific c or Table 0.70 0.70 185.66	0.00 -92.14 89.09 344.67 data 6c = [110.54]	0.00 -92.14 92.13 362.26 Gains W 45.19 45.72 76.67	(70) (71) (72) (73) (80) (78) (83) (84)

Mean internal temperature for the whole developed in the part of the whole developed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temp of living part of 12 (steps 3 to 7 in Table 9-1 Temperature during betang periods in the rest of dwelling FLOT 13 to 10 to	Utilisation factor for gains	for living are	ea n1,m (se	e Table 9a)									
Table 10.14 20.28 20.51 20.76 20.93 20.99 21.00 21.00 20.97 20.74 20.39 20.10 19.75 19.7	1.00	0.99	0.98	0.92	0.79	0.59	0.43	0.47	0.73	0.95	0.99	1.00	(86)
The presentation of the proper of the prope	Mean internal temp of liv	ing area T1 (s	steps 3 to 7	in Table 9c)							_	_
The content of the		-					21.00	21.00	20.97	20.74	20.39	20.11	(87)
Unitialization factor for gains for test of testiling n2 1.00 0.99 0.97 0.90 0.97 1.00 0.99 0.97 0.90 0.74 0.52 0.35 0.39 0.66 0.93 0.99 1.00 (89) Mean internal temperature in the resid of welling r12 (follow steps 3 to 7 in Table 9x) 1.00 0.922 0.95 0.99 1.91 0.91 0.91 0.01 0.01 0.01 0.01									1	1			٦
Mean internal temperature inter rest of swellings T2 (follow steps 3 to 7 in Table 9.00			1	1	20.18	20.19	20.19	20.19	20.18	20.18	20.17	20.17	[88]
Mean internal temperature the rest of dwelling 12 (follow steps 3 to 7 in Table 50 (190 19.00 19.00 19.20 19.34 19.91 20.11 20.18 20.19 20.19 20.16 19.89 19.39 18.97 90)	_				0.74	0.52	0.35	0.20	0.66	0.02	0.00	1.00	7 (00)
19.00 19.22 19.54 19.91 20.11 20.18 20.19 20.19 20.16 19.89 19.39 18.97 18.97 19.90 19.9			1				Į	0.39	0.00	0.93	0.99	1.00] (89)
Living area fraction				T T		1		20.19	20.16	19.89	19.39	18.97	(90)
Mean internal temperature for the whole liming fix a XT1+(1-fix) x12 Apply adjustment to the west-internal temperature from Table 4e were appropriate to the west-internal temperature from Table 4e were appropriate to the west-internal temperature from Table 4e were appropriate to the west-internal temperature from Table 4e were appropriate to the west-internal temperature from Table 4e were appropriate to the west-internal temperature from Table 4e were appropriate to the west-internal temperature from Table 4e were appropriate to the west-internal temperature from Table 4e was also as a fine for grains, and the west-internal temperature from Table 4e were appropriate to the west-internal temperature from Table 4e was also as a fine for grains, and the west-internal temperature from Table 4e was also as a fine for grain temperature from Table 4e was also as a fine for grains, and the west-internal temperature from Table 4e was also as a fine for grains, and the west-internal temperature from Table 4e was a fine for grains, and the west-internal temperature from Table 4e was a fine for grains from Table 4e was a fine for grains from Table 4e was a fine for grains from Table 4e was a fine for grain from Table 4e was a fine												1	J ` '
Apply a djustment to the mean internal temperature from Table 4e where appropriate 19.43 19.62 19.90 20.23 20.42 20.49 20.49 20.49 20.46 20.21 19.76 19.40 [93] 2. Space heating requirements 3. Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 1. Clisisation factor for gains, mm Gm, yel mix (84) mm Gu Sep Oct Nov Dec 2. Utilisation factor for gains, mm Gm, yel mix (84) mm Gu Sep Oct Nov Dec 2. Utilisation factor for gains, mm Gm, yel mix (84) mm Gu Sep Oct Nov Dec 2. Utilisation factor for gains, mm Gm, yel mix (84) mm Gu Sep Oct Nov Dec 3. Space deating requirement temperature from Table U1 4. 30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 (96) 4. 30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 (96) 4. 30 4.90 6.53 877.50 730.87 860.91 373.02 246.69 258.64 405.71 618.19 819.39 989.23 (97) 5. Space heating requirement twh/mm/mm 0.024 x (97)m - (95)m x (41) mm	-	re for the wh	ole dwellin	g fLA x T1 +	(1 - fLA) x	Т2					. ,		_ , ,
19.43 19.62 19.90 20.23 20.42 20.49 20.49 20.49 20.46 20.21 19.76 19.40 93	19.43	19.62	19.90	20.23	20.42	20.49	20.49	20.49	20.46	20.21	19.76	19.40	(92)
Same Peating requirement Feb. Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Apply adjustment to the	nean interna	l temperati	ure from Tal	ble 4e whe	ere appropr	iate						
San	19.43	19.62	19.90	20.23	20.42	20.49	20.49	20.49	20.46	20.21	19.76	19.40	(93)
Utilisation factor for gains, npm 0.99 0.99 0.97 0.90 0.76 0.55 0.38 0.42 0.69 0.93 0.99 1.00 (94)	8. Space heating require	ment											
0.99 0.97 0.90 0.76 0.55 0.38 0.42 0.69 0.93 0.99 1.00 94	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains, nmGm, W (94)m x (84)m 461.31 527.58 579.47 593.51 523.53 368.87 246.32 257.97 390.45 471.88 449.78 437.28 (95) Monthly average external temperature from Table U1 4.30 4.90 6.50 8.90 11.70 14.60 16.60 16.40 14.10 10.60 7.10 4.20 (96) Heat loss rate for mean intermal temperature, ltm, W (193)m x (193)	Utilisation factor for gains	s, ηm											
Monthly average external temperature from Table U1 Mathia Ma	0.99	0.99	0.97	0.90	0.76	0.55	0.38	0.42	0.69	0.93	0.99	1.00	(94)
Monthly average external temperature from Table U1 4.30	Useful gains, ηmGm, W (94)m x (84)m	1										
A 30	461.31	527.58	579.47	593.51	523.53	368.87	246.32	257.97	390.45	471.88	449.78	437.28	(95)
Heat loss rate for mean internal temperature, Lm, W [(39)m × ((93)m - (96)m) 996.17 966.53 877.50 730.87 560.91 373.02 246.69 258.64 405.71 618.19 819.39 989.23 (97) 582.00 2397.94 294.98 221.73 98.90 27.82 0.00 0.00 0.00 0.00 108.86 266.12 410.65 25(98) × (4) 25.23 (99) 258.00 258	Monthly average externa	temperature	e from Tabl	e U1							_	_	_
996.17 966.53 877.50 730.87 560.91 373.02 246.69 258.64 405.71 618.19 819.39 989.23 97) Space heating requirement, kWh/month 0.024 x [97)m - (95)m] x (41)m 397.94 294.98 221.73 98.90 27.82 0.00 0.00 0.00 0.00 108.86 266.12 410.65 5(98) ± (4) 25.23 (99) 5(98) ± (4) 25.23 (99) 5(98) ± (4) 25.23 (99) 6(10) ± (10)			1	1			16.60	16.40	14.10	10.60	7.10	4.20	(96)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m 397.94 294.98 221.73 98.90 27.82 0.00 0.00 0.00 108.86 266.12 410.65 Space heating requirement kWh/m²/year \$\subseteq\$ (98) ± (4) 25.23 (99) 9b. Energy requirements - community heating scheme Fraction of space heat from secondary/supplementary system (table 11) '0' if none 0.00 (301) Fraction of space heat from community system 1 - (301) = 1.00 (302) Fraction of todal space heat from community boilers (302) x (303a) = 1.00 (304a) Factor for control and charging method (Table 4c(3)) for community space heating 1.00 (305a) Factor for charging method (Table 4c(3)) for community water heating 1.00 (305a) Distribution loss factor (Table 12c) for community heating system 1827.00 (98) Space heating (98) x (304a) x (305) x (306) = 1918.35 (307a) Water heating (98) x (304a) x (305) x (306) = 1918.35 (307a)			_										7
397.94 294.98 221.73 98.90 27.82 0.00 0.00 0.00 108.86 266.12 410.65		-					246.69	258.64	405.71	618.19	819.39	989.23	(97)
Space heating requirement kWh/m²/year $(98) \pm5$, $1012 = 1827.00$ (98) Space heating requirement kWh/m²/year $(98) \pm (4)$ 25.23 (99) Phone		_				_	0.00	0.00	0.00	100.00	266.42	140.65	7
Space heating requirement kWh/m²/year (98) ÷ (4) 25.23 (99) Phone	397.94	294.98	221./3	98.90	27.82	0.00	0.00	0.00]] (00)
9b. Energy requirements - community heating scheme Fraction of space heat from secondary/supplementary system (table 11) '0' if none 0.00 (301) Fraction of space heat from community system 1 - (301) = 1.00 (302) Fraction of community heat from boilers 1.00 (303a) Fraction of total space heat from community boilers (302) x (303a) = 1.00 (304a) Factor for control and charging method (Table 4c(3)) for community space heating 1.00 (305) Factor for charging method (Table 4c(3)) for community water heating 1.00 (305a) Distribution loss factor (Table 12c) for community heating system 1.05 (306) Space heating Annual space heating requirement 1827.00 (98) Space heat from boilers (98) x (304a) x (305) x (306) = 1918.35 (307a) Water heating Annual water heating requirement 1720.32 (64)	Snace heating requiremen	nt k\\/h/m²/w	ear						2(98				J ' '
Fraction of space heat from secondary/supplementary system (table 11) Fraction of space heat from community system 1 - (301) = 1.00 (302) Fraction of community heat from boilers Fraction of total space heat from community boilers 1.00 (303a) 1.00 (305b) Fraction of total space heat from community boilers 1.00 (305c) 1.00 (30		10 KVV11/111 / y	cai							(56)	· (-)	23.23	
Fraction of space heat from community system Fraction of community heat from boilers Fraction of total space heat from community boilers Fraction of total space heating method (Table 4c(3)) for community space heating Fraction of total space heating method (Table 4c(3)) for community space heating Fraction of total space heating Fraction of total space heating method (Table 4c(3)) for community space heating Fraction of total space heating Fraction of total space heating method (Table 4c(3)) for community space heating Fraction of total space heating Fraction of total space heating method (Table 4c(3)) for community space heating Fraction of total space heating method (Table 4c(3)) for community space heating Fraction of total space heating method (Table 4c(3)) for community space heating Fraction of total space heating method (Table 4c(3)) for community space heating Fraction of total space heating method (Table 4c(3)) for community space heating Fraction of total space heating method (Table 4c(3)) for community space heating Fraction of total space heating method (Table 4c(3)) for community space heating Fraction of total space heating method (Table 4c(3)) for community space heating Fraction of total space heating Fra	9b. Energy requirement	s - communit	ty heating s	cheme									
Fraction of community heat from boilers Fraction of total space heat from community boilers Factor for control and charging method (Table 4c(3)) for community space heating Factor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system Space heating Annual space heating requirement Mater heating Annual water heating requirement Mater heating Annual water heating requirement 1.00 (303a) 1.00 (304a) 1.00 (305) 1.00 (305a) 1.05 (306) (306)	Fraction of space heat fro	m secondary	/suppleme	ntary syster	n (table 11	-)				'0' if ı	none	0.00	(301)
Fraction of total space heat from community boilers Factor for control and charging method (Table 4c(3)) for community space heating Factor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system Space heating Annual space heating requirement 1827.00 (98) Space heat from boilers (98) x (304a) x (305) x (306) = 1918.35 (307a) Water heating Annual water heating requirement 1720.32 (64)	Fraction of space heat fro	m communit	y system							1 - (30	01) =	1.00	(302)
Factor for control and charging method (Table 4c(3)) for community space heating Factor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system Space heating Annual space heating requirement Space heat from boilers (98) x (304a) x (305) x (306) = 1918.35 (307a) Water heating Annual water heating requirement 1720.32 (64)	-												_
Factor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system Space heating Annual space heating requirement Space heat from boilers (98) x (304a) x (305) x (306) = 1918.35 (307a) Water heating Annual water heating requirement 1720.32 (64)										(302) x (30	3a) = [
Space heating Annual space heating requirement Space heat from boilers Water heating Annual water heating requirement 1.05 (306) 1.05 (306) 1.05 (98) (98) (98) (98) x (304a) x (305) x (306) = 1918.35 (307a)						ace heating							_ ` ′
Space heating Annual space heating requirement Space heat from boilers (98) x (304a) x (305) x (306) = 1918.35 (307a) Water heating Annual water heating requirement 1720.32 (64)					_								_
Annual space heating requirement	istribution loss factor (T	able 12c) for	community	neating sys	stem							1.05] (306)
Annual space heating requirement	Snace heating												
Space heat from boilers (98) x (304a) x (305) x (306) = 1918.35 (307a) Water heating 1720.32 (64)		uirement						1	.827.00]			(98)
Water heating Annual water heating requirement 1720.32 (64)										ı k (305) x (30	06) = 1	1918.35	7
Annual water heating requirement 1720.32 (64)	,							(3.	, (=	, -, (0	, <u> </u>		_, ,/
	Water heating												
Water heat from hoilers $(64) \times (303a) \times (305a) \times (306) = \begin{bmatrix} 1806.33 & (310a) \\ 1806.33 &$	Annual water heating req	uirement						1	.720.32]			(64)
(04) A (3534) A (3534) A (3534) A (3534)	Water heat from boilers							(64)	x (303a) x	(305a) x (30	06) = 1	1806.33	(310a)

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside

146.33 (330a) 146.33 (331)

Total electricity for the above, kWh/year

Electricity for lighting (Appendix L)

320.59 (332)

Total delivered energy for all uses

(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =4191.61

10b. Fuel costs - community heating scheme	10b.	Fuel c	costs - c	ommunit	ty hea	ting sc	heme
--	------	--------	-----------	---------	--------	---------	------

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1918.35] x	4.24	x 0.01 =	81.34	(340a)
Water heating from boilers	1806.33	x	4.24	x 0.01 =	76.59	(342a)
Pumps and fans	146.33	x	13.19	x 0.01 =	19.30	(349)
Electricity for lighting	320.59	x	13.19	x 0.01 =	42.29	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)(342e) +	- (345)(354) =	339.51	(355)

11b. SAP rating - community heating scheme		
Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.21	(357)
SAP value	83.06]
SAP rating (section 13)	83	(358)
SAP band	В	

12b. CO₂ emissions - commu	nity heating scheme						
		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers		89.50					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) = [4161.65	x	0.216	= [898.92	(367)
Electrical energy for communit	y heat distribution	37.25	x	0.519	= [19.33	(372)
Total CO2 associated with com	munity systems					918.25	(373)
Total CO2 associated with space	ce and water heating					918.25	(376)
Pumps and fans		146.33	x	0.519	= [75.95	(378)
Electricity for lighting		320.59	x	0.519	= [166.39	(379)
Total CO ₂ , kg/year					(376)(382) = [1160.58	(383)
Dwelling CO₂ emission rate					(383) ÷ (4) = [16.03	(384)
EI value						86.76	
El rating (section 14)						87	(385)
EI band					[В	

13b. Primary energy - commu	inity neating scheme						
		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sou	rces (space heating)						
Efficiency of boilers		89.50					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	4161.65	x	1.22	=	5077.22	(367)
Electrical energy for community	y heat distribution	37.25	x	3.07	=	114.35	(372)
Total primary energy associated	d with community systems					5191.56	(373)

Total primary energy associated with space and water heating

Pumps and fans

Electricity for lighting
Primary energy kWh/year

146.33 320.59 x

3.07

3.07

5191.56

449.24 (378)

(376)

(384)

984.22 (379)

(379)

6625.03 (383)

91.48

Dwelling primary energy rate kWh/m2/year

URN: 3B4P - Top Floor version 1 NHER Plan Assessor version 6.3.9 SAP version 9.92

DER Worksheet

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	3B5P, Kingston upon Thames, KT1		

Client							La	st modified		30/09/	2020	
Address	3B5P, Kir	ngston upor	Thames,	KT1								
1. Overall dwelling dimer	nsions											
1. Overall dwelling diffici	1310113			А	rea (m²)			rage storey eight (m)		Vol	ume (m³)	
Lowest occupied					104.07	(1a) x		2.50	(2a) =		260.18	(3a)
Total floor area	(1a)	+ (1b) + (1c	:) + (1d)(1n) =	104.07	(4)						
Dwelling volume							(3a)	+ (3b) + (3d	c) + (3d)(3n)) =	260.18	(5)
2. Ventilation rate												
										m³	per hour	
Number of chimneys								0	x 40 =		0	(6a)
Number of open flues								0	x 20 =		0	(6b)
Number of intermittent far	ns							0	x 10 =		0	(7a)
Number of passive vents								0	x 10 =		0	(7b)
Number of flueless gas fire	S							0	x 40 =		0	(7c)
										Air c	hanges pe hour	r
Infiltration due to chimney	s, flues, fans	s, PSVs		(6a)	+ (6b) + (7a	a) + (7b) + (7	7c) =	0	÷ (5) =		0.00	(8)
If a pressurisation test has	been carried	d out or is ir	ntended, pi	roceed to (17), otherw	ise continue	e from (9) t	o (16)				
Air permeability value, q50	, expressed	in cubic me	etres per h	our per squ	are metre	of envelope	area				3.00	(17)
If based on air permeability	y value, ther	n (18) = [(17) ÷ 20] + (8	3), otherwis	se (18) = (16	5)					0.15	(18)
Number of sides on which	the dwelling	g is sheltere	d								2	(19)
Shelter factor								1 -	[0.075 x (19)] =	0.85	(20)
Infiltration rate incorporati	ing shelter fa	actor							(18) x (20) =	0.13	(21)
Infiltration rate modified for	or monthly v	wind speed:										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spe	ed from Tab	ole U2										
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4												
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (a	allowing for	shelter and	wind facto	or) (21) x (2	2a)m							
0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)
Calculate effective air char	ige rate for t	the applicat	ole case:									
If mechanical ventilatio	n: air chang	e rate throu	ıgh system	ı							0.50	(23a)
If balanced with heat re	covery: effic	ciency in %	allowing fo	or in-use fa	ctor from T	able 4h					74.80	(23c)
a) If balanced mechanic	al ventilatio	n with heat	recovery	(MVHR) (22	2b)m + (23b	o) x [1 - (23c	:) ÷ 100]					



0.29

0.29

0.29

0.29

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

0.28

0.28

0.27

0.27

0.26

0.26

0.28

0.28

(24a)

(25)

0.25

0.25

0.25

0.25

0.24

0.24

0.25

0.25

0.26

0.26

0.27

0.27

3. Heat losses	and heat lo	ss paramet	er										
Element			;	Gross area, m²	Openings m ²		area m²	U-value W/m²K	A x U W,		alue, 'm².K	Αxκ, kJ/K	
Window						18	.08 x	1.24	= 22.34				(27)
Door						1.	80 x	1.30	= 2.34				(26)
Ground floor						104	1.07 x	0.10	= 10.41				(28a)
External wall						38	.90 x	0.17	= 6.61				(29a)
Party wall						24	.13 x	0.00	= 0.00				(32)
External wall						26	.50 x	0.20	= 5.30				(29a)
Total area of ex	ternal elem	ents ∑A, m²				189	9.35						(31)
Fabric heat loss	, W/K = ∑(A	× U)							(26	5)(30) + (3	32) =	47.00	(33)
Heat capacity C	m = ∑(A x κ))						(28)	.(30) + (32) +	· (32a)(32	e) =	N/A	(34)
Thermal mass p	arameter (٦	TMP) in kJ/n	n²K									250.00	(35)
Thermal bridge	s: ∑(L x Ψ) c	alculated us	sing Apper	ndix K								13.64	(36)
Total fabric hea	t loss									(33) + (3	36) =	60.64	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation hea	t loss calcula	ated month	ly 0.33 x	(25)m x (5)									
	24.78	24.50	24.23	22.86	22.59	21.22	21.22	20.94	21.76	22.59	23.13	23.68	(38)
Heat transfer co	oefficient, W	//K (37)m +	· (38)m										
	85.42	85.14	84.87	83.50	83.23	81.86	81.86	81.58	82.41	83.23	83.77	84.32	
									Average = ∑	(39)112/	12 =	83.43	(39)
Heat loss param	neter (HLP),	W/m²K (39	9)m ÷ (4)										
	0.82	0.82	0.82	0.80	0.80	0.79	0.79	0.78	0.79	0.80	0.80	0.81	
									Average = ∑	(40)112/	12 =	0.80	(40)
Number of days	s in month (Table 1a)											
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
4. Water heat	ing energy r	eguiremen	t										
Assumed occup												2.77	(42)
Annual average	•	ısage in litre	es ner dav	Vd average	e = (25 x N) +	36						100.09	(43)
7 mindar average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(43)
Hot water usag					•			,	оср	001		200	
not water asag	110.09	106.09	102.09	98.08	94.08	90.08	90.08	94.08	98.08	102.09	106.09	110.09	7
	110.03	100.03	102.03	38.08	34.08	30.00	30.08	34.08	98.08	Σ(44)1		1201.03	(44)
Energy content	of hot wate	er used = 4.1	8 v Vd m	x nm x Tm/	3600 kWh/m	onth (see	Tahles 1h	1c 1d)		2(44)1	12	1201.03	(44)
LiferBy content	163.27	142.79	147.35	128.46	123.26	106.37	98.57	113.11	114.46	133.39	145.60	158.12	7
	103.27	142.79	147.33	120.40	123.20	100.57	36.37	113.11	114.40	Σ(45)1		1574.74	 (45)
Distribution los	c N 15 v //15)m								2(43)1	12	1374.74	(43)
Distribution los	24.49	21.42	22.10	19.27	18.49	15.96	14.78	16.97	17.17	20.01	21.84	23.72	(46)
Storage volume							14./0	10.97	1/.1/	20.01	21.04	3.00	(47)
Water storage I		uunig ally SC	oiai Oi WV	wiins stuid	5c withill Sdf	iic vessei						3.00	(47)
b) Manufacture		loss factor	is not kno	own									
•					w)							0.02	(51)
Hot water st Volume fact	_		iable 2 (K	vvii/iitie/da	iy <i>)</i>								= ' '
												3.42	(52)
Temperatur			ا الماحدة الما	17\ v /E4\ · · /	E2) v /E2\							0.60	(53)
Energy lost f		storage (kW	m/day) (4	1/) X (51) X (52) X (53)							0.13	(54)
Enter (50) or (5	4) IN (55)											0.13	(55)
Water storage I	ann calculat	od fo = = -!	ma:=+!- /=	T\ v//44\									

							_					_
4.	04 3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(56)
If the vessel contains	dedicated solar	storage or ded	icated W	/WHRS (56)	m x [(47) -	Vs] ÷ (47),	else (56)					
4.	04 3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)
Primary circuit loss fo	each month fr	om Table 3										_
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 for each m	onth from Table	e 3a, 3b or 3c										
0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat required fo	r water heating	calculated for	each mo	onth 0.85 x	(45)m + (4	6)m + (57)ı	m + (59)m	n + (61)m				
190).57 167.46	174.65	154.89	150.57	132.79	125.87	140.41	140.88	160.69	172.03	185.42	(62)
Solar DHW input calcu	lated using App	oendix G or App	oendix H									
0.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from water he	ater for each m	onth (kWh/mo	onth) (62	?)m + (63)m								
190).57 167.46	174.65	154.89	150.57	132.79	125.87	140.41	140.88	160.69	172.03	185.42]
									∑(64)1	12 =	1896.22	(64)
Heat gains from wate	heating (kWh/	month) 0.25 ×	[0.85 × ((45)m + (61))m] + 0.8 ×	[(46)m + (57)m + (5	9)m]				
76	.13 67.21	70.84	63.85	62.83	56.51	54.62	59.45	59.19	66.19	69.55	74.42	(65)
5. Internal gains												
	in Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table	= 5)											,
138	3.71 138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	138.71	(66)
Lighting gains (calcula	ted in Appendix	L, equation L9	or L9a),	also see Ta	ble 5							,
24	.07 21.38	17.38	13.16	9.84	8.31	8.97	11.66	15.66	19.88	23.20	24.73	(67)
Appliance gains (calcu	lated in Append	dix L, equation	L13 or L1	L3a), also se	ee Table 5							-
262	2.74 265.47	258.60	243.97	225.51	208.16	196.56	193.84	200.71	215.33	233.80	251.15	(68)
Cooking gains (calcula	ted in Appendix	L, equation L1	.5 or L15	a), also see	Table 5							
							<u> </u>					_
36	.87 36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	(69)
Pump and fan gains (1		36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	(69)
Pump and fan gains (1		0.00	0.00	0.00	0.00	0.00	36.87	0.00	0.00	0.00	0.00] (69)] (70)
Pump and fan gains (1	able 5a)										-	, , ,
Pump and fan gains (1 0. Losses e.g. evaporation	able 5a)	0.00						0.00			0.00	, , ,
Pump and fan gains (1 0. Losses e.g. evaporation	Table 5a) 00 0.00 n (Table 5) 0.97 -110.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00] (70)
Pump and fan gains (1 0. Losses e.g. evaporatio -11 Water heating gains (1)	Table 5a) 00 0.00 n (Table 5) 0.97 -110.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00] (70)
Pump and fan gains (1 0. Losses e.g. evaporatio -11 Water heating gains (1)	Table 5a) 00 0.00 n (Table 5) 0.97 -110.97 Table 5) 2.32 100.01	0.00 -110.97 -	0.00 110.97 88.68	0.00 -110.97 84.45	0.00 -110.97 78.48	0.00	0.00	0.00	0.00	0.00	0.00] (70)] (71)
Pump and fan gains (10 Losses e.g. evaporation -11 Water heating gains (10 Total internal gains (6	Table 5a) 00 0.00 n (Table 5) 0.97 -110.97 Table 5) 2.32 100.01	0.00 -110.97 - 95.21 (68)m + (69)m -	0.00 110.97 88.68	0.00 -110.97 84.45	0.00 -110.97 78.48	0.00	0.00	0.00 7 -110.97 82.22	0.00	0.00	0.00 7 -110.97 100.02] (70)] (71)
Pump and fan gains (1 0. Losses e.g. evaporation -11 Water heating gains (1 10. Total internal gains (6 45.	Table 5a) 00 0.00 n (Table 5) 0.97 -110.97 Table 5) 2.32 100.01 66)m + (67)m + (0.00 -110.97 - 95.21 (68)m + (69)m -	0.00 110.97 88.68 + (70)m +	0.00 -110.97 84.45 + (71)m + (7	0.00 -110.97 78.48 72)m	0.00 -110.97 73.41	0.00 -110.97 79.91	0.00 7 -110.97 82.22	0.00 -110.97 88.97	0.00 -110.97 96.60	0.00 7 -110.97 100.02] (70)] (71)] (72)
Pump and fan gains (10 Losses e.g. evaporation -11 Water heating gains (10 Total internal gains (6	Table 5a) 00 0.00 n (Table 5) 0.97 -110.97 Table 5) 2.32 100.01 66)m + (67)m + (0.00 -110.97 - 95.21 (68)m + (69)m -	0.00 110.97 88.68 + (70)m +	0.00 -110.97 84.45 + (71)m + (7 384.41	0.00 -110.97 78.48 72)m 359.55	0.00 -110.97 73.41 343.56	0.00 -110.97 79.91	0.00 7 -110.97 82.22	0.00 -110.97 88.97 388.80	0.00 -110.97 96.60	0.00 7 -110.97 100.02 440.52] (70)] (71)] (72)
Pump and fan gains (1 0. Losses e.g. evaporation -11 Water heating gains (1 10. Total internal gains (6 45.	Table 5a) 00 0.00 n (Table 5) 0.97 -110.97 Table 5) 2.32 100.01 66)m + (67)m + (0.00 -110.97 - 95.21 (68)m + (69)m -	0.00 110.97 88.68 + (70)m +	0.00 -110.97 84.45 + (71)m + (7	0.00 -110.97 78.48 72)m 359.55	0.00 -110.97 73.41	79.91 350.02	0.00 7 -110.97 82.22	0.00 -110.97 88.97	0.00 -110.97 96.60 418.21	0.00 7 -110.97 100.02] (70)] (71)] (72)
Pump and fan gains (1 0. Losses e.g. evaporation -11 Water heating gains (1 10. Total internal gains (6 45.	Table 5a) 00 0.00 n (Table 5) 0.97 -110.97 Table 5) 2.32 100.01 66)m + (67)m + (0.00 -110.97 - 95.21 (68)m + (69)m - 435.81 4	0.00 110.97 88.68 + (70)m +	0.00 -110.97 84.45 + (71)m + (7 384.41	0.00 -110.97 78.48 72)m 359.55	0.00 -110.97 73.41 343.56	79.91 350.02	0.00 7 -110.97 82.22 363.19	0.00 -110.97 88.97 388.80	0.00 -110.97 96.60 418.21	0.00 7 -110.97 100.02 440.52] (70)] (71)] (72)
Pump and fan gains (1 0. Losses e.g. evaporation -11 Water heating gains (1 10. Total internal gains (6 45.	Table 5a) 00 0.00 n (Table 5) 0.97 -110.97 Table 5) 2.32 100.01 66)m + (67)m + (0.00 -110.97 - 95.21 (68)m + (69)m - 435.81 4	0.00 110.97 88.68 + (70)m +	0.00 -110.97 84.45 + (71)m + (7 384.41	0.00 -110.97 78.48 72)m 359.55	0.00 -110.97 73.41 343.56 ar flux	79.91 350.02	0.00 7 -110.97 82.22 363.19 g gecific data	0.00 -110.97 88.97 388.80 FF specific d or Table	0.00 -110.97 96.60 418.21	0.00 7 -110.97 100.02 440.52] (70)] (71)] (72)
Pump and fan gains (10 Losses e.g. evaporation -11 Water heating gains (10 Total internal gains (6 45 6. Solar gains	Table 5a) 00 0.00 n (Table 5) 0.97 -110.97 Table 5) 2.32 100.01 66)m + (67)m + (0.00 -110.97 - 95.21 (68)m + (69)m - 435.81 4 Access fact Table 6c	0.00 110.97 88.68 + (70)m +	0.00 -110.97 84.45 + (71)m + (7 384.41 Area m²	0.00 -110.97 78.48 72)m 359.55 Sol	0.00 -110.97 73.41 343.56 ar flux //m²	79.91 350.02	0.00 7 -110.97 82.22 363.19 g ecific data Table 6b	0.00 -110.97 88.97 388.80 FF specific d or Table 0.70	0.00 -110.97 96.60 418.21 ata 6c	0.00 7 -110.97 100.02 440.52 Gains W] (70)] (71)] (72)] (73)
Pump and fan gains (1 0. Losses e.g. evaporation -11 Water heating gains (1 10. Total internal gains (6 45.) 6. Solar gains	Table 5a) 00 0.00 n (Table 5) 0.97 -110.97 Table 5) 2.32 100.01 66)m + (67)m + (0.00 -110.97 - 95.21 (68)m + (69)m - 435.81 4 Access fact Table 6c	0.00 110.97 88.68 + (70)m + 410.43	0.00 -110.97 84.45 + (71)m + (7 384.41 Area m² 6.86	0.00 -110.97 78.48 72)m 359.55 Sol W	0.00 -110.97 73.41 343.56 ar flux //m² 0.63 x 1.28 x	0.00 -110.97 79.91 350.02 spe or	0.00 7 -110.97 82.22 363.19 g ecific data Table 6b 0.45 x	0.00 -110.97 88.97 388.80 FF specific d or Table 0.70 0.70	0.00 -110.97 96.60 418.21 ata 6c = [0.00 7 -110.97 100.02 440.52 Gains W] (70)] (71)] (72)] (73)
Pump and fan gains (10 Losses e.g. evaporation -11 Water heating gains (10 Total internal gains (6 45: 6. Solar gains North NorthEast	Table 5a) 00 0.00 n (Table 5) 0.97 -110.97 Table 5) 2.32 100.01 66)m + (67)m + (0.00 -110.97 - 95.21 (68)m + (69)m - 435.81 4 Access fact Table 6c	0.00 110.97 88.68 + (70)m + 410.43	0.00 -110.97 84.45 + (71)m + (7 384.41 Area m² 6.86 2.18	0.00 -110.97 78.48 72)m 359.55 Sol W x 1 x 1 x 1	0.00 -110.97 73.41 343.56 ar flux //m² 0.63 x 1.28 x 9.64 x	0.00 -110.97 79.91 350.02 spe or 0.9 x	0.00 7 -110.97 82.22 363.19 g ecific data Table 6b 0.45 x 0.45 x	0.00 -110.97 88.97 388.80 FF specific d or Table 0.70 0.70 0.70	0.00 -110.97 96.60 418.21	0.00 7 -110.97 100.02 440.52 Gains W 15.92 5.37] (70)] (71)] (72)] (73)] (74)] (75)
Pump and fan gains (1 0. Losses e.g. evaporation -11 Water heating gains (1 10. Total internal gains (6 45. 6. Solar gains North NorthEast East	Fable 5a) 00	0.00 -110.97 - 95.21 (68)m + (69)m - 435.81 4 Access fact Table 6c 0.77 0.77	0.00 110.97 88.68 + (70)m + 410.43 tor x x x	0.00 -110.97 84.45 + (71)m + (7 384.41 Area m² 6.86 2.18 6.78	0.00 -110.97 78.48 72)m 359.55 Sol W x 1 x 1 x 1	0.00 -110.97 73.41 343.56 ar flux //m² 0.63 x 1.28 x 9.64 x	0.00 -110.97 79.91 350.02 spe or 0.9 x 0.9 x 0.9 x	0.00 7 -110.97 82.22 363.19 g ecific data Table 6b 0.45 x 0.45 x	0.00 -110.97 88.97 388.80 FF specific d or Table 0.70 0.70	0.00 -110.97 96.60 418.21 ata 6c = [= [= = [0.00 7 -110.97 100.02 440.52 Gains W 15.92 5.37 29.07] (70)] (71)] (72)] (73)] (74)] (75)] (76)
Pump and fan gains (10. Losses e.g. evaporation —11 Water heating gains (10. Total internal gains (6. 45: 6. Solar gains North NorthEast East SouthEast Solar gains in watts \(\Sigma\)	(74)m(82)m	0.00 -110.97 - 95.21 (68)m + (69)m - 435.81 4 Access fact Table 6c 0.77 0.77 0.77 0.77	0.00 110.97 88.68 + (70)m + 410.43 tor x x x x	0.00 -110.97 84.45 + (71)m + (7 384.41 Area m² 6.86 2.18 6.78 2.26	0.00 -110.97 78.48 72)m 359.55 Sol W x 1 x 1 x 1 x 3	0.00 -110.97 73.41 343.56 ar flux //m² 0.63 x 1.28 x 9.64 x 6.79 x	0.00 -110.97 79.91 350.02 spe or 0.9 x 0.9 x 0.9 x 0.9 x	0.00 7 -110.97 82.22 363.19 g ecific data Table 6b 0.45 x 0.45 x 0.45 x	0.00 -110.97 88.97 388.80 FF specific do or Table 0.70 0.70 0.70	0.00 -110.97 96.60 418.21 ata 6c = [= [= = [0.00 7 -110.97 100.02 440.52 Gains W 15.92 5.37 29.07 18.15] (70)] (71)] (72)] (73)] (74)] (75)] (76)
Pump and fan gains (10. Losses e.g. evaporation —11 Water heating gains (10. Total internal gains (6. 45: 6. Solar gains North NorthEast East SouthEast Solar gains in watts \(\Sigma\)	(74)m(82)m	0.00 -110.97 - 95.21 (68)m + (69)m - 435.81 4 Access fact Table 6c 0.77 0.77 0.77 0.77 207.35	0.00 110.97 88.68 + (70)m + 410.43 tor x x x	0.00 -110.97 84.45 + (71)m + (7 384.41 Area m² 6.86 2.18 6.78	0.00 -110.97 78.48 72)m 359.55 Sol W x 1 x 1 x 1	0.00 -110.97 73.41 343.56 ar flux //m² 0.63 x 1.28 x 9.64 x	0.00 -110.97 79.91 350.02 spe or 0.9 x 0.9 x 0.9 x	0.00 7 -110.97 82.22 363.19 g ecific data Table 6b 0.45 x 0.45 x 0.45 x	0.00 -110.97 88.97 388.80 FF specific d or Table 0.70 0.70	0.00 -110.97 96.60 418.21 ata 6c = [= [= = [0.00 7 -110.97 100.02 440.52 Gains W 15.92 5.37 29.07] (70)] (71)] (72)] (73)] (74)] (75)] (76)
Pump and fan gains (10. Losses e.g. evaporation —11. Water heating gains (10. Total internal gains (6. 45. 6. Solar gains North NorthEast East SouthEast Solar gains in watts \(\sigma\)	(74)m(82)m	0.00 -110.97 - 95.21 (68)m + (69)m - 435.81 Access fact Table 6c 0.77 0.77 0.77 207.35 + (83)m	0.00 110.97 88.68 + (70)m + 410.43 tor x x x x	0.00 -110.97 84.45 + (71)m + (7 384.41 Area m² 6.86 2.18 6.78 2.26	0.00 -110.97 78.48 72)m 359.55 Sol W x 1 x 1 x 1 x 3	0.00 -110.97 73.41 343.56 ar flux //m² 0.63 x 1.28 x 9.64 x 6.79 x	0.00 -110.97 79.91 350.02 spe or 0.9 x 0.9 x 0.9 x 0.9 x	0.00 82.22 363.19 g ecific data Table 6b 0.45 x 0.45 x 0.45 x	0.00 -110.97 88.97 388.80 FF specific do or Table 0.70 0.70 0.70	0.00 -110.97 96.60 418.21 ata 6c = [= [= = [Gains W 15.92 5.37 29.07 18.15] (70)] (71)] (72)] (73)] (74)] (75)] (76)

7. Mean internal te	nperature (he	eating season)										
Temperature during	neating period	ls in the living	area from ⁻	Table 9, Th	1(°C)						21.00	(85
	an Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for	gains for living	g area n1,m (se	ee Table 9a)								
1	00 1.00	0.99	0.97	0.88	0.68	0.50	0.56	0.84	0.98	1.00	1.00	(86
Mean internal temp	of living area T	1 (steps 3 to 7	in Table 9	c)	•							
20	0.13 20.24	4 20.43	20.69	20.90	20.99	21.00	21.00	20.94	20.68	20.36	20.12	(87
Temperature during	neating period	ls in the rest o	f dwelling f	from Table	9, Th2(°C)							
20	20.24	4 20.24	20.25	20.25	20.26	20.26	20.27	20.26	20.25	20.25	20.24	(88
Utilisation factor for	gains for rest o	of dwelling n2,	,m									
1	.00 1.00	0.99	0.96	0.84	0.61	0.42	0.47	0.79	0.98	1.00	1.00	(89
Mean internal tempe	rature in the r	est of dwellin	g T2 (follow	v steps 3 to	7 in Table 9	9c)						
1	.06 19.23	2 19.50	19.88	20.15	20.26	20.26	20.27	20.21	19.86	19.40	19.04	(90
iving area fraction								Li	ving area ÷	(4) =	0.32	(91
Mean internal tempe	rature for the	whole dwellir	ng fLA x T1	+(1 - fLA) x	T2							
1	.40 19.5	4 19.80	20.14	20.39	20.49	20.50	20.50	20.45	20.12	19.71	19.38	(92
Apply adjustment to	he mean inte	rnal temperat	ure from Ta	able 4e wh	ere appropr	riate						
1	.40 19.5	4 19.80	20.14	20.39	20.49	20.50	20.50	20.45	20.12	19.71	19.38	(93
O Cuasa haating up	ivove out											
8. Space heating red		Max	Анан	Mari	l	11	Aa	Can	Oct	Nov	Dec	
Itilisation factor for	an Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	· · ·	0.99	0.06	0.05	0.63	0.44	0.50	0.80	0.98	1.00	1.00	٦ (٥.
<u>د </u>	.00 1.00		0.96	0.85	0.63	0.44	0.50	0.80	0.98	1.00	1.00	<u>(</u> 94
_	1.49 578.7		684.18	647.54	473.96	318.52	333.02	484.39	526.64	500.84	497.08	(9!
<u>عدا</u> Monthly average ext		I	1	047.54	473.90	318.32	333.02	404.33	320.04	300.84	437.08	(೨.
	30 4.90		8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96
۔ Heat loss rate for me	l			•		10.00	10.40	14.10	10.00	7.10	4.20	(50
	9.74 1246.		938.66	723.49	482.13	319.18	334.48	523.04	792.69	1056.33	1280.28	(97
Space heating require	ļ.					013.10	000	020.0	732.03	1 2000.00	1 2200.20	(5,
	1.57 448.9		183.23	56.51	0.00	0.00	0.00	0.00	197.94	399.95	582.70	7
									8)15 <i>,</i> 10		2806.71	_ (98
Space heating require	ment kWh/m	ı²/year								÷ (4)	26.97	_ · (99
	·								. ,	. ,		
9b. Energy requiren	ents - commi	unity heating	scheme									_
raction of space hea	t from second	lary/suppleme	ntary syste	em (table 1	1)				'0' if	none	0.00	(30
raction of space hea									1 - (3	01) =	1.00	(30
raction of communi											1.00	(30
raction of total space	e heat from co	ommunity boil	ers						(302) x (30	3a) =	1.00	(30
actor for control and	charging met	thod (Table 4c	(3)) for con	nmunity sp	ace heating						1.00	(30
Factor for charging m	ethod (Table	4c(3)) for com	munity wat	ter heating							1.00	(30
Distribution loss facto	r (Table 12c)	for communit	y heating sy	ystem							1.05	(30
Space heating									٦			
Annual space heating								806.71	(205) (5	06)	20.47.25	(9)
Space heat from boil	ers						(98	s) x (304a)	x (305) x (3	06) = [2947.05	(30

Annual water heating requirement		1896.22			(64)
Water heat from boilers		(64) x (303a)	x (305a) x (306) = [1991.03	(310a)
Electricity used for heat distribution		0.01 × [(307a)(307e) +	(310a)(310e)] = [49.38	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)					
mechanical ventilation fans - balanced, extract or positive inpu	t from outside	238.06			(330a)
Total electricity for the above, kWh/year				238.06	(331)
Electricity for lighting (Appendix L)				425.01	(332)
Total delivered energy for all uses	(307) + (309) + (3	10) + (312) + (315) + (331)	+ (332)(337b) = [5601.15	(338)
10b. Fuel costs - community heating scheme					
	Fuel	Fuel price		Fuel	
	kWh/year			cost £/year	
Space heating from boilers	2947.05	x 4.24	x 0.01 =	124.95	(340a)
Water heating from boilers	1991.03	x 4.24	x 0.01 =	84.42	(342a)
Pumps and fans	238.06	x 13.19	x 0.01 =	31.40	(349)
Electricity for lighting	425.01	x 13.19	x 0.01 =	56.06	(350)
Additional standing charges				120.00	(351)
Total energy cost		(340a)(342e)	+ (345)(354) = [416.83	(355)
11b. SAP rating - community heating scheme					
			Γ	0.42	(356)
Energy cost deflator (Table 12)			Ĺ		1
Energy cost factor (ECF)			L	1.17] (357)]
SAP value			L	83.62]] (250)
SAP rating (section 13) SAP band				84 B	(358)]
5.1. 56.15			L	ь	J
12b. CO ₂ emissions - community heating scheme				Б	
	Energy kWh/year	Emission facto	r	Emissions (kg/year)	
		Emission facto	r	Emissions	
12b. CO ₂ emissions - community heating scheme		Emission facto	r	Emissions	(367a)
12b. CO ₂ emissions - community heating scheme Emissions from other sources (space heating)	kWh/year	Emission factor	r =[Emissions	(367a) (367)
12b. CO ₂ emissions - community heating scheme Emissions from other sources (space heating) Efficiency of boilers	kWh/year		¬ .	Emissions (kg/year)	1
12b. CO ₂ emissions - community heating scheme Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	89.50 5517.40	x 0.216] = [Emissions (kg/year)	(367)
12b. CO ₂ emissions - community heating scheme Emissions from other sources (space heating) Efficiency of boilers CO ₂ emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution	89.50 5517.40	x 0.216] = [Emissions (kg/year) 1191.76 25.63	(367) (372)
12b. CO ₂ emissions - community heating scheme Emissions from other sources (space heating) Efficiency of boilers CO ₂ emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO ₂ associated with community systems	89.50 5517.40	x 0.216] = [Emissions (kg/year) 1191.76 25.63 1217.39	(367) (372) (373)
12b. CO ₂ emissions - community heating scheme Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating	89.50 5517.40 49.38	x 0.216 x 0.519] = [] = [[Emissions (kg/year) 1191.76 25.63 1217.39 1217.39	(367) (372) (373) (376)
12b. CO ₂ emissions - community heating scheme Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans	89.50 5517.40 49.38	x 0.216 x 0.519] = [] = [[] = [Emissions (kg/year) 1191.76 25.63 1217.39 123.55	(367) (372) (373) (376) (378)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting	89.50 5517.40 49.38	x 0.216 x 0.519] = [] = [[] = [Emissions (kg/year) 1191.76 25.63 1217.39 1217.39 123.55 220.58] (367)] (372)] (373)] (376)] (378)] (379)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year	89.50 5517.40 49.38	x 0.216 x 0.519	= [] = [[] = [] = [(376)(382) = [Emissions (kg/year) 1191.76 25.63 1217.39 123.55 220.58 1561.52] (367)] (372)] (373)] (376)] (378)] (379)] (383)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate	89.50 5517.40 49.38	x 0.216 x 0.519	= [] = [[] = [] = [(376)(382) = [Emissions (kg/year) 1191.76 25.63 1217.39 1217.39 123.55 220.58 1561.52 15.00] (367)] (372)] (373)] (376)] (378)] (379)] (383)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value	89.50 5517.40 49.38	x 0.216 x 0.519	= [] = [[] = [] = [(376)(382) = [Emissions (kg/year) 1191.76 25.63 1217.39 1217.39 123.55 220.58 1561.52 15.00 85.96] (367)] (372)] (373)] (376)] (378)] (379)] (383)] (384)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14)	89.50 5517.40 49.38	x 0.216 x 0.519	= [] = [[] = [] = [(376)(382) = [Emissions (kg/year) 1191.76 25.63 1217.39 123.55 220.58 1561.52 15.00 85.96 86] (367)] (372)] (373)] (376)] (378)] (379)] (383)] (384)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band	89.50 5517.40 49.38 238.06 425.01	x 0.216 x 0.519	= [= [= [(376)(382) = [(383) ÷ (4) = [Emissions (kg/year) 1191.76 25.63 1217.39 123.55 220.58 1561.52 15.00 85.96 86 B	[(367)] (372)] (373)] (376)] (378)] (379)] (383)] (384)] (385)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO2, kg/year Dwelling CO2 emission rate El value El rating (section 14) El band 13b. Primary energy - community heating scheme	89.50 5517.40 49.38 238.06 425.01	x 0.216 x 0.519 x 0.519 x 0.519	= [= [= [(376)(382) = [(383) ÷ (4) = [Emissions (kg/year) 1191.76 25.63 1217.39 123.55 220.58 1561.52 15.00 85.96 86 B	[(367)] (372)] (373)] (376)] (378)] (379)] (383)] (384)] (385)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band	89.50 5517.40 49.38 238.06 425.01	x 0.216 x 0.519 x 0.519 x 0.519	= [= [= [(376)(382) = [(383) ÷ (4) = [Emissions (kg/year) 1191.76 25.63 1217.39 123.55 220.58 1561.52 15.00 85.96 86 B	[(367)] (372)] (373)] (376)] (378)] (379)] (383)] (384)] (385)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO2, kg/year Dwelling CO2 emission rate El value El rating (section 14) El band 13b. Primary energy - community heating scheme	89.50 5517.40 49.38 238.06 425.01	x 0.216 x 0.519 x 0.519 x 0.519	= [= [= [(376)(382) = [(383) ÷ (4) = [Emissions (kg/year) 1191.76 25.63 1217.39 123.55 220.58 1561.52 15.00 85.96 86 B	[(367)] (372)] (373)] (376)] (378)] (379)] (383)] (384)] (385)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO2, kg/year Dwelling CO2 emission rate El value El rating (section 14) El band 13b. Primary energy - community heating scheme	89.50 5517.40 49.38 238.06 425.01 Energy kWh/year	x 0.216 x 0.519 x 0.519 x 0.519	= [= [= [(376)(382) = [(383) ÷ (4) = [Emissions (kg/year) 1191.76 25.63 1217.39 123.55 220.58 1561.52 15.00 85.96 86 B] (367)] (372)] (373)] (376)] (378)] (379)] (383)] (384)]] (385)

Electrical energy for community heat distribution	49.38	х	3.07	=	151.60	(372)
Total primary energy associated with community systems					6882.83	(373)
Total primary energy associated with space and water heating					6882.83	(376)
Pumps and fans	238.06	х	3.07	=	730.84	(378)
Electricity for lighting	425.01	х	3.07	=	1304.79	(379)
Primary energy kWh/year					8918.46	(383)
Dwelling primary energy rate kWh/m2/year					85.70	(384)

DER Worksheet

Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	30/09/2020
Address	3B6P, Kingston upon Thames, KT1		

Client							La	st modified		30/0	9/2020	
Address	3B6P, Kir	ngston upo	n Thames,	KT1								
1. Overall dwelling dimer	nsions											
				А	rea (m²)			rage storey eight (m)		V	olume (m³)	
Lowest occupied					94.73	(1a) x		2.50] (2a) =		236.83	(3a)
Total floor area	(1a)	+ (1b) + (1	c) + (1d)(1n) =	94.73	(4)						
Dwelling volume							(3a)	+ (3b) + (3	c) + (3d)(3n) =	236.83	(5)
2. Ventilation rate												
										n	n³ per hour	
Number of chimneys								0	x 40	=	0	(6a
Number of open flues								0	x 20	=	0	(6b
Number of intermittent far	ns							0	x 10	=	0	(7a
Number of passive vents								0	x 10	=	0	(7b
lumber of flueless gas fire	es							0	x 40	=	0	(70
										Air	changes pe	r
									1		hour	7
nfiltration due to chimney						a) + (7b) + (0	÷ (5)	=	0.00	(8)
f a pressurisation test has								o (16)				_
Air permeability value, q50), expressed	in cubic m	etres per h	our per squ	are metre	of envelope	e area				3.00	(17
f based on air permeabilit	y value, ther	n (18) = [(1	7) ÷ 20] + (8), otherwi	se (18) = (10	6)					0.15	(18
Number of sides on which	the dwelling	g is sheltere	ed								2	(19
helter factor								1 -	[0.075 x (2	19)] =	0.85	(20
nfiltration rate incorporat	ing shelter f	actor							(18) x (20) =	0.13	(21
nfiltration rate modified for	or monthly v	wind speed	l:									
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spe	ad from Tab	ile U2										
, •	eu iroin rab											
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22
5.10	_		4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	_ (22 _
5.10 Wind factor (22)m ÷ 4	5.00	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	_
5.10 Wind factor (22)m ÷ 4	5.00	1.23	1.10	1.08	0.95							_
5.10 Nind factor (22)m ÷ 4	5.00	1.23	1.10	1.08	0.95							(22 (22 (22

Calculate effecti	ve air chan	ge rate for	the applical	ble case:									
If mechanical	ventilation	n: air chang	e rate throu	ugh system								0.50	(23a)
If balanced w	ith heat re	covery: effi	ciency in %	allowing fo	or in-use fac	ctor from Ta	able 4h					74.80	(23c)
a) If balanced	l mechanica	al ventilatio	n with hea	t recovery	(MVHR) (22	.b)m + (23b) x [1 - (23d	c) ÷ 100]					
	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)
Effective air cha	nge rate - e	nter (24a) (or (24b) or	(24c) or (24	ld) in (25)								
	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(25)



3. Heat losses	and heat lo	ss paramet	er									
Element			;	Gross area, m²	Openings m ²	Net a	_	U-value W/m²K	A x U W,	′К к-valı kJ/m [:]		
Window						14.	86 x	1.24	= 18.36			(27)
Door						1.8	30 x	0.60	= 1.08			(26)
External wall						36.	28 x	0.17	= 6.17			(29a)
Party wall						15.	15 x	0.00	= 0.00			(32)
External wall						34.	68 x	0.20	= 6.94			(29a)
Roof						94.	73 x	0.13	= 12.31			(30)
Total area of ex	ternal elem	ents ∑A, m²				182	.35					(31)
Fabric heat loss	, W/K = ∑(A	× U)							(26)(30) + (32)	= 44.86	(33)
Heat capacity C	m = ∑(A x к)							(28)	(30) + (32) +	(32a)(32e)	= N/A	(34)
Thermal mass p	arameter (T	MP) in kJ/n	n²K								250.00	(35)
Thermal bridge	s: ∑(L x Ψ) ca	alculated us	sing Apper	ndix K							14.02	(36)
Total fabric hea	t loss									(33) + (36)	= 58.88	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov Dec	
Ventilation hea	t loss calcula	ated month	ly 0.33 x ((25)m x (5)								
	22.55	22.30	22.05	20.81	20.56	19.31	19.31	19.06	19.81	20.56	21.06 21.56	(38)
Heat transfer co	oefficient, W	//K (37)m +	- (38)m									
	81.44	81.19	80.94	79.69	79.44	78.20	78.20	77.95	78.70	79.44	79.94 80.44	ļ
									Average = ∑	(39)112/12	= 79.63	(39)
Heat loss paran	neter (HLP),	W/m²K (39	9)m ÷ (4)									
	0.86	0.86	0.85	0.84	0.84	0.83	0.83	0.82	0.83	0.84	0.84 0.85	
									Average = ∑	(40)112/12	= 0.84	(40)
Number of days	s in month (Table 1a)										
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00 31.00	(40)
4. Water heat	ing energy r	eauiremen [.]	t									
Assumed occup											2.69	(42)
Annual average	•	ısage in litre	es per dav	Vd.average	e = (25 x N) +	36					97.97	(43)
,aa. ar c. ag c	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov Dec	(/
Hot water usag								• 0				
	107.77	103.85	99.93	96.01	92.09	88.17	88.17	92.09	96.01	99.93 1	103.85	7
	207	200.00	30.00	30.02	32.00	00.12.	00.17	32.03	30.02	Σ(44)112		(44)
Energy content	of hot wate	r used = 4.1	L8 x Vd.m	x nm x Tm/3	3600 kWh/m	onth (see	Tables 1b	. 1c 1d)		2(11)222	1175.05	
5 67 55 55	159.82	139.78	144.24	125.75	120.66	104.12	96.48	110.72	112.04	130.57 1	142.53 154.7	7
	100.01	200.70		1 223.73	120.00	20 1122	301.0	1 -1-0		Σ(45)112		(45)
Distribution los	s 0.15 x (45)m								2(10)22	20 121 10	()
	23.97	20.97	21.64	18.86	18.10	15.62	14.47	16.61	16.81	19.59	21.38 23.22	(46)
Storage volume							1 11.17	10.01	10.01	13.33	3.00	(47)
Water storage I		aung uny se	Jiai 01 111	viino storag	50 111111111111111111111111111111111111	10 103301					3.00	(. , ,
b) Manufacture		loss factor	is not kno	own								
Hot water st					v)						0.02	(51)
Volume fact	_		. abic Z (K	, ncie, ua	11						3.42	(52)
v Jiuiiic iact	or montrial	.c 2u									3.42	
	e factor from	n Tahle 2h									0.60	(52)
Temperatur			/h/day) //	[7] y (51) v (52) y /52)						0.60	(53)
Temperatur Energy lost f	from water s		/h/day) (4	17) x (51) x (52) x (53)						0.13	(54)
Temperatur	from water s 4) in (55)	storage (kW			52) x (53)							= '

	4.04	2.05	4.04	2.01	4.04	2.01	4.04	4.04	2.01	4.04	2.01	4.04	(FC)
If the vessel con	4.04	3.65	4.04	3.91	4.04 (WHRS (56)	3.91 m x [(47) -	4.04 Vsl ÷ (47)	4.04 else (56)	3.91	4.04	3.91	4.04	(56)
ii tiic vesser con	4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(57)
Primary circuit le		1		3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04	(37)
rimary circuit is	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 for e		-			23.20	22.31	23.20	23.20	22.31	23.20	22.31	23.20	(39)
Combinoss for e			,		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total boot rocui	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requi						1				457.07	460.05	102.00	(62)
Cala a DUNA da a ca	187.12	164.44	171.54	152.17	147.96	130.54	123.79	138.02	138.46	157.87	168.95	182.08	(62)
Solar DHW inpu			1			0.00	0.00		0.00	2.22	0.00	1 000	(60)
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from wa		1				1						1	l
	187.12	164.44	171.54	152.17	147.96	130.54	123.79	138.02	138.46	157.87	168.95	182.08	
				- 10.0-	(.=) (6.		5(46) (5	> (-0)		∑(64)1	.12 =1	1862.94	(64)
Heat gains from						1							1
	74.98	66.20	69.80	62.95	61.96	55.76	53.92	58.66	58.39	65.26	68.53	73.31	(65)
5. Internal gair	ıs												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains				•							-		
caacc gac	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	134.25	(66)
Lighting gains (c				1	!		154.25	154.25	154.25	154.25	154.25	134.23	(00)
righting gams (c	23.11	20.53	16.69	12.64	9.45	7.98	8.62	11.20	15.04	19.09	22.28	23.75	(67)
Appliance gains	_	1					8.02	11.20	13.04	19.09	22.20	23.73	(07)
Appliance gains					212.44		105 17	192.60	100.00	202.05	220.25	226 50	(60)
Caalina asino (a	247.52	250.08	243.61	229.83	l	196.09	185.17	182.60	189.08	202.85	220.25	236.59	(68)
Cooking gains (c			· ·				20.00			20.10	00.10	1 00 10	l (60)
- 16	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	36.43	(69)
Pump and fan ga	-							1	1		Г	_	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Losses e.g. evap								•				0.00	(70)
			4								1		
	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	-107.40	(70)
Water heating g	-107.40	-107.40 5)	-107.40					-107.40	-107.40		-107.40	-107.40	(71)
	-107.40 ains (Table 100.78	-107.40 5) 98.52	93.82	87.43	83.28	-107.40 77.44		-107.40 78.84	-107.40	-107.40 87.71	-107.40 95.18		
Water heating g	-107.40 ains (Table 100.78	-107.40 5) 98.52	93.82	87.43	83.28	-107.40 77.44	-107.40					-107.40	(71)
	-107.40 ains (Table 100.78	-107.40 5) 98.52	93.82	87.43	83.28	-107.40 77.44	-107.40					-107.40	(71)
Total internal ga	-107.40 ains (Table 100.78 ins (66)m	-107.40 5) 98.52 + (67)m + (6	93.82 68)m + (69)	87.43 m + (70)m	83.28 + (71)m + (7	-107.40 77.44 72)m	-107.40 72.48	78.84	81.10	87.71	95.18	98.53	(71)
	-107.40 ains (Table 100.78 ins (66)m	-107.40 5) 98.52 + (67)m + (6	93.82 68)m + (69) 417.40	87.43 m + (70)m · 393.18	83.28 + (71)m + (7 368.45	-107.40 77.44 72)m 344.79	-107.40 72.48 329.54	78.84	81.10	87.71 372.93	95.18	98.53	(71)
Total internal ga	-107.40 ains (Table 100.78 ins (66)m	-107.40 5) 98.52 + (67)m + (6	93.82 68)m + (69)	87.43 m + (70)m - 393.18	83.28 + (71)m + (7	-107.40 77.44 72)m 344.79	-107.40 72.48	78.84 335.92	81.10 348.49 g ific data	87.71 372.93 FF specific c	95.18 400.98	98.53	(71)
Total internal ga	-107.40 ains (Table 100.78 ins (66)m	-107.40 5) 98.52 + (67)m + (6	93.82 68)m + (69) 417.40 Access 6 Table	87.43 m + (70)m - 393.18	83.28 + (71)m + (7 368.45 Area m²	-107.40 77.44 72)m 344.79 Sol.	-107.40 72.48 329.54 ar flux //m²	78.84 335.92 spec or T	81.10 348.49 g ific data able 6b	87.71 372.93 FF specific c or Table	95.18 400.98	98.53 422.15 Gains W	(71) (72) (73)
Total internal ga 6. Solar gains East	-107.40 ains (Table 100.78 ins (66)m	-107.40 5) 98.52 + (67)m + (6	93.82 68)m + (69) 417.40 Access i Table	87.43 m + (70)m - 393.18 factor 6 dd	83.28 + (71)m + (7 368.45 Area m ²	-107.40 77.44 72)m 344.79 Sol. W	-107.40 72.48 329.54 ar flux //m²	78.84 335.92 spec or T	81.10 g ific data able 6b 0.45 x	87.71 372.93 FF specific c or Table 0.70	95.18 400.98	-107.40 98.53 422.15 Gains W	(71) (72) (73)
Total internal ga 6. Solar gains East South	-107.40 ains (Table 100.78 ins (66)m 434.69	-107.40 5) 98.52 + (67)m + (6 432.41	93.82 68)m + (69) 417.40 Access 6 Table	87.43 m + (70)m - 393.18 factor 6 dd	83.28 + (71)m + (7 368.45 Area m²	-107.40 77.44 72)m 344.79 Sol. W	-107.40 72.48 329.54 ar flux //m²	78.84 335.92 spec or T	81.10 348.49 g ific data able 6b	87.71 372.93 FF specific cor Table 0.70	95.18 400.98	98.53 422.15 Gains W	(71) (72) (73)
Total internal ga 6. Solar gains East	-107.40 ains (Table 100.78 ins (66)m 434.69	-107.40 5) 98.52 + (67)m + (6 432.41	93.82 68)m + (69) 417.40 Access t Table	87.43 m + (70)m - 393.18 factor 6 dd	83.28 + (71)m + (7 368.45 Area m ² 10.44 4.42	-107.40 77.44 72)m 344.79 Sol. X 1 X 4	-107.40 72.48 329.54 ar flux //m² 9.64 x 6.75 x	78.84 335.92 spec or T 0.9 x 0.9 x	81.10 g ific data able 6b 0.45 x 0.45 x	87.71 372.93 FF specific c or Table 0.70 0.70	95.18 400.98 data 6c = = =	-107.40 98.53 422.15 Gains W 44.76 45.11	(71) (72) (73) (76) (78)
Total internal ga 6. Solar gains East South	-107.40 ains (Table 100.78 ins (66)m 434.69	-107.40 5) 98.52 + (67)m + (6 432.41	93.82 68)m + (69) 417.40 Access i Table	87.43 m + (70)m - 393.18 factor 6 dd	83.28 + (71)m + (7 368.45 Area m ²	-107.40 77.44 72)m 344.79 Sol. W	-107.40 72.48 329.54 ar flux //m²	78.84 335.92 spec or T	81.10 g ific data able 6b 0.45 x	87.71 372.93 FF specific c or Table 0.70	95.18 400.98 data 6c =	-107.40 98.53 422.15 Gains W	(71) (72) (73)
Total internal ga 6. Solar gains East South	-107.40 ains (Table 100.78 ins (66)m 434.69 atts ∑(74)m 89.87	-107.40 5) 98.52 + (67)m + (6 432.41 (82)m 161.44	93.82 68)m + (69) 417.40 Access Table 0.7 0.7	87.43 m + (70)m - 393.18 factor 6 dd	83.28 + (71)m + (7 368.45 Area m ² 10.44 4.42	-107.40 77.44 72)m 344.79 Sol. X 1 X 4	-107.40 72.48 329.54 ar flux //m² 9.64 x 6.75 x	78.84 335.92 spec or T 0.9 x 0.9 x	81.10 g ific data able 6b 0.45 x 0.45 x	87.71 372.93 FF specific c or Table 0.70 0.70	95.18 400.98 data 6c = = =	-107.40 98.53 422.15 Gains W 44.76 45.11	(71) (72) (73) (76) (78)
6. Solar gains East South Solar gains in wa	-107.40 ains (Table 100.78 ins (66)m 434.69 atts ∑(74)m 89.87	-107.40 5) 98.52 + (67)m + (6 432.41 (82)m 161.44	93.82 68)m + (69) 417.40 Access Table 0.7 0.7	87.43 m + (70)m - 393.18 factor 6 dd	83.28 + (71)m + (7 368.45 Area m ² 10.44 4.42	-107.40 77.44 72)m 344.79 Sol. X 1 X 4	-107.40 72.48 329.54 ar flux //m² 9.64 x 6.75 x	78.84 335.92 spec or T 0.9 x 0.9 x	81.10 g ific data able 6b 0.45 x 0.45 x	87.71 372.93 FF specific c or Table 0.70 0.70	95.18 400.98 data 6c = = =	-107.40 98.53 422.15 Gains W 44.76 45.11	(71) (72) (73) (76) (78)
Total internal ga 6. Solar gains East South Solar gains in wa Total gains - internal gains	-107.40 ains (Table 100.78 ins (66)m 434.69 atts Σ(74)m 89.87 ernal and so 524.56	-107.40 5) 98.52 + (67)m + (6 432.41 	93.82 68)m + (69) 417.40 Access to Table 0.7 0.7 238.31 (83)m 655.71	87.43 m + (70)m - 393.18 factor - 6d 7 x 7 x 7 x 7 316.67	83.28 + (71)m + (7 368.45 Area m ² 10.44 4.42	-107.40 77.44 72)m 344.79 Sol. X 1 X 4	-107.40 72.48 329.54 ar flux //m² 9.64 x 6.75 x	78.84 335.92 spec or T 0.9 x 0.9 x 316.98	81.10 g ific data able 6b 0.45 x 0.45 x	87.71 372.93 FF specific cor Table 0.70 0.70 183.58	95.18 400.98 data 6c = [109.28	-107.40 98.53 422.15 Gains W 44.76 45.11	(71) (72) (73) (76) (78) (83)
6. Solar gains East South Solar gains in wa	-107.40 ains (Table 100.78 ins (66)m - 434.69 atts Σ(74)m 89.87 ernal and so 524.56 al tempera	-107.40 5) 98.52 + (67)m + (6 432.41 1(82)m 161.44 olar (73)m + 593.85 ture (heating	93.82 68)m + (69) 417.40 Access Table 0.7 0.7 238.31 (83)m 655.71	87.43 m + (70)m - 393.18 factor - 6d 7 x 7 x 7 x 7 316.67	83.28 + (71)m + (7 368.45 Area m ² 10.44 4.42 368.57	-107.40 77.44 72)m 344.79 Sol. X 1 X 4 370.50	-107.40 72.48 329.54 ar flux //m² 9.64 x 6.75 x	78.84 335.92 spec or T 0.9 x 0.9 x 316.98	81.10 g ific data able 6b 0.45 x 0.45 x	87.71 372.93 FF specific cor Table 0.70 0.70 183.58	95.18 400.98 data 6c = [109.28	-107.40 98.53 422.15 Gains W 44.76 45.11	(71) (72) (73) (76) (78) (83)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor	for gains f	or living are	ea n1,m (se	e Table 9a)									
	1.00	1.00	0.99	0.96	0.87	0.68	0.50	0.54	0.81	0.97	1.00	1.00	(86)
Mean internal te	mp of livin	g area T1 (s	teps 3 to 7	in Table 9c	:)								
[20.12	20.25	20.45	20.70	20.90	20.98	21.00	21.00	20.95	20.70	20.37	20.10	(87)
Temperature dur	ing heating	g periods in	the rest of	dwelling fr	om Table 9	9, Th2(°C)							
	20.20	20.20	20.21	20.22	20.22	20.23	20.23	20.23	20.23	20.22	20.22	20.21	(88)
Utilisation factor	for gains f	or rest of d	welling n2,	m									
	1.00	1.00	0.99	0.95	0.83	0.61	0.41	0.46	0.74	0.96	1.00	1.00	(89)
Mean internal te	mperature	in the rest	of dwelling	T2 (follow	steps 3 to	7 in Table 9	Эс)						
[19.02	19.20	19.50	19.86	20.12	20.22	20.23	20.23	20.19	19.87	19.38	19.00	(90)
Living area fraction	on								Liv	ving area ÷	(4) =	0.33	(91)
Mean internal te	mperature	for the wh	ole dwellin	g fLA x T1 +	(1 - fLA) x	Т2							
[19.38	19.55	19.81	20.14	20.37	20.47	20.48	20.48	20.44	20.14	19.71	19.36	(92)
Apply adjustmen	t to the me	ean interna	temperatu	ure from Ta	ble 4e whe	ere appropr	iate						
	19.38	19.55	19.81	20.14	20.37	20.47	20.48	20.48	20.44	20.14	19.71	19.36	(93)
8. Space heating	a roquirom	ont											
8. Space Heating	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor			IVIGI	Дрі	iviay	Juli	Jui	Aug	Зер	Ott	1404	Dec	
		0.99	0.98	0.94	0.84	0.63	0.44	0.49	0.76	0.96	0.99	1.00	7 (04)
Usoful gains nm	1.00			0.94	0.84	0.63	0.44	0.49	0.76	0.96	0.99	1.00	(94)
Useful gains, ηm				670.52	646 22	450.00	202.07	246.02	460.02	F24.66	F07.20	407.03	7 (05)
Monthly average	523.24	590.34	644.84	670.52	616.23	450.06	302.87	316.93	468.83	534.66	507.20	497.03	(95)
Monthly average					14 70	11.50	45.50	16.40	1110	10.00	7.40	4.20	7 (0.5)
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for							202.55	240.00	100.00	750.06	1007.00	1240 55	7 (07)
Constanting of	1228.32	1189.33	1077.28	895.73	689.03	459.16	303.66	318.33	498.88	758.06	1007.88	1219.55	<u>(97)</u>
Space heating red											1 000 10	T =====	7
	524.58	402.52	321.74	162.15	54.16	0.00	0.00	0.00	0.00	166.21	360.49	537.56]] (00)
									∑(98	3)15, 10		2529.40	∫ (98)
Space heating red	quirement	kWh/m²/ye	ear							(98)	÷ (4)	26.70	(99)
9b. Energy requ	irements -	- communit	y heating s	cheme									
Fraction of space	heat from	secondary	/supplemei	ntary syster	m (table 11	L)				'0' if	none	0.00	(301)
Fraction of space	heat from	communit	y system							1 - (3	01) =	1.00	(302)
Fraction of comm	nunity heat	t from boile	rs									1.00	(303a)
Fraction of total	-			ers						(302) x (30	3a) =	1.00	(304a)
Factor for contro			·		munity spa	ace heating				. , .	·	1.00	(305)
Factor for charging						S						1.00] (305a)
Distribution loss	_											1.05] (306)
	- 1.51%	-,,	,	.8-7									,===,
Space heating													
Annual space hea	ating requi	rement						7	2529.40]			(98)
Space heat from									8) x (304a) x	ı ((305) x (3	06) = 7	2655.87	(307a)
Space neat Holli	~UIICI 3							(50	o, x (304a) /	. (202) A (3		_555.07	_ (307a)
Water heating													
Annual water hea	ating requi	rement							1862.94]			(64)
Water heat from) x (303a) x	(305a) x (3	06) = 1	1956.09	(310a)
								(01)	, , , , , , , , , ,	, , (5	-,		_ ,00/

Electricity for pumps, fans and electric keep-hot (Table 4f)

mechanical ventilation fans - balanced, extract or positive input from outside

216.69 (330a)

Total electricity for the above, kWh/year

216.69 (331)

Electricity for lighting (Appendix L)

408.17 (332)

Total delivered energy for all uses

(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =5236.83

10b. Fuel costs - community heating scheme	10b.	Fuel c	costs - c	ommunit	ty hea	ting sc	heme
--	------	--------	-----------	---------	--------	---------	------

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	2655.87	х	4.24	x 0.01 =	112.61	(340a)
Water heating from boilers	1956.09	х	4.24	x 0.01 =	82.94	(342a)
Pumps and fans	216.69	х	13.19	x 0.01 =	28.58	(349)
Electricity for lighting	408.17	x	13.19	x 0.01 =	53.84	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)(342e) +	- (345)(354) =	397.97	(355)

11b. SAP rating - community neating scheme		
Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.20	(357)
SAP value	83.31	
SAP rating (section 13)	83	(358)
SAP band	В	

12b. CO₂ emissions - community heating scheme					
	Energy kWh/year	Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)					
Efficiency of boilers	89.50				(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷	(367a) = 5153.03	x 0.216	=	1113.05	(367)
Electrical energy for community heat distribution	46.12	x 0.519	=	23.94	(372)
Total CO2 associated with community systems				1136.99	(373)
Total CO2 associated with space and water heating				1136.99	(376)
Pumps and fans	216.69	x 0.519	=	112.46	(378)
Electricity for lighting	408.17	x 0.519	=	211.84	(379)
Total CO₂, kg/year			(376)(382) =	1461.30	(383)
Dwelling CO₂ emission rate			(383) ÷ (4) =	15.43	(384)
El value				85.99	
El rating (section 14)				86	(385)
El band				В	

13b. Primary energy - commit	inity neating scheme						
		Energy kWh/year		Primary factor		Primary energy (kWh/year)	
Primary energy from other sou	rces (space heating)						
Efficiency of boilers		89.50					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	5153.03] x	1.22	=	6286.70	(367)
Electrical energy for communit	y heat distribution	46.12	x	3.07	=	141.59	(372)
Total primary energy associate	d with community systems					6428.28	(373)

Total primary energy associated with space and water heating

Pumps and fans

216.69 408.17

3.07

3.07

6428.28 (376)

665.25 (378)

1253.08 (379)

8346.62 (383)

(384)

88.11

Primary energy kWh/year

Electricity for lighting

Dwelling primary energy rate kWh/m2/year

URN: 3B6P - Top Floor version 1 NHER Plan Assessor version 6.3.9

DER Worksheet

Design - Draft

+1



143.00

m³ per hour

0.15

(18)

(3b)

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Miss Nimco Ali	Assessor number	9526
Client		Last modified	23/10/2020
Address	4B8P, Kingston upon Thames, KT1		

1. Overall dwelling dimensions						
	Area (m²)	Average storey height (m)	Volume (m³)			
Lowest occupied	72.24 (1a) x	2.50 (2a) =	180.60 (3a)			

(1b)

2.50

(2b) =

Total floor area (1a) + (1b) + (1c) + (1d)...(1n) = 129.44 (4) Dwelling volume (3a) + (3b) + (3c) + (3d)...(3n) = 323.60 (5)

57.20

2. Ventilation rate

Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
		Г		

Air changes per hour

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3.00 (17)

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

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

Number of sides on which the dwelling is sheltered 2 (19)

Shelter factor $1 - [0.075 \times (19)] = 0.85$ (20)

Infiltration rate incorporating shelter factor $(18) \times (20) = 0.13$

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 U2

5.10 5.00 4.90 4.40 4.30 3.80 3.80 3.70 4.00 4.30 4.50 4.70 (22)

Wind factor (22)m ÷ 4

1.28 1.25 1.23 1.10 1.08 0.95 0.95 0.93 1.00 1.08 1.13 1.18 (22a)

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

Calculate effective air change rate for the applicable case:

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h 73.10 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

0.30 0.29 0.29 0.27 0.27 0.26 0.26 0.25 0.26 0.27 0.28 0.28 (24a)

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

If mechanical ventilation: air change rate through system



0.50

(23a)

Element				Gross	Openings m ²		area m²	U-value	AxUW		•	Ахк,
A.C. alan			а	irea, m²	m²		m²	W/m²K	20.24	kJ/m² □	.К	kJ/K
Window							.72 x	1.24	= 29.31			(
Door Ground floor							80 x .24 x	0.10	= 2.34			(
External wall							.24 x .31 x	0.10	= 7.22 = 10.93			(
Party wall							.95 x	0.00	= 0.00			(
Roof							.04 x	0.13	= 1.96			(
Roof							58 x	0.16	= 0.41			(
Total area of ext	ernal elem	ents $\Sigma A m^2$	1				9.69	0.10	0.12			(
abric heat loss,		_				1/3	7.05		(26	5)(30) + (32)	= 52.	
leat capacity Cr								(28)		· (32a)(32e)		
hermal mass pa			n²K					(20)	.(50) - (52)	(324)(326)	250	
Thermal bridges	•	•		dix K							14.	
Fotal fabric heat			8							(33) + (36)		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep		Nov	Dec
Ventilation heat	loss calcul	ated month	ly 0.33 x (•	•				·			
	31.72	31.38	31.04	29.34	29.00	27.30	27.30	26.96	27.98	29.00	29.68	30.36 (
Heat transfer co	efficient, W	√/K (37)m +	- (38)m	1	1					,		
	98.86	98.52	98.18	96.48	96.14	94.43	94.43	94.09	95.11	96.14	96.82	97.50
				•					Average = ∑	(39)112/12	= 96.	39 (
Heat loss param	eter (HLP),	W/m²K (39	9)m ÷ (4)									
	0.76	0.76	0.76	0.75	0.74	0.73	0.73	0.73	0.73	0.74	0.75	0.75
									Average = ∑	(40)112/12	= 0.7	74 (
Number of days	in month (Table 1a)										
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00 (
4 Mateu besti												
4. Water heating		equiremen	t									20 /
Assumed occupa	•			\	(25 · AI) ·	26					2.8	
Annual average	Jan	usage in litre Feb	es per day Mar	_			Jul	Διισ	Son	Oct	102 Nov	,
lot water usage				Apr	May	Jun		Aug	Sep	Oct	NOV	Dec
iot water usage	113.21	109.10	104.98	100.86	96.75	92.63	92.63	96.75	100.86	104.98 1	09.10 1	.13.21
	113.21	109.10	104.98	100.86	96.75	92.03	92.03	90.75	100.86	Σ(44)112		
Energy content (of hot wate	er used = 4 1	I 8 x Vd m s	nm x Tm/	3600 kWh/m	onth (see	Tahles 1h	1c 1d)		2(44)112	- 123	.05 (
inergy content	167.89	146.84	151.53	132.10	126.76	109.38	101.36	116.31	117.70	137.17 1	49.73 1	.62.59
	107.83	140.04	131.33	132.10	120.70	109.56	101.50	110.51	117.70	Σ(45)112		
Distribution loss	: 0 15 x (45	Jm								2(43)112	_ 1013	7.55 (
	25.18	22.03	22.73	19.82	19.01	16.41	15.20	17.45	17.65	20.57	22.46	24.39 (
Storage volume							13.20	17.43	17.03	20.37	3.0	
Vater storage lo		waning uliy 30	,.a. O. VV VI	5101 8	,	•					5.0	(
		l loss factor	is not kno	wn								
o) Manufacturer					v)						0.0)2 (
	orage loss f		. ~~. ~ LINV	, c, ua	11							(
Hot water sto	_		,								2 /	12 /
Volume facto	or from Tab	ole 2a									3.4	
Hot water sto	or from Tab	ole 2a m Table 2b		7) v /E4) //	E2) v /E2)						0.6	50 (

0.30

0.29

0.29

0.27

0.27

0.26

0.26

0.25

0.26

0.27

0.28

0.28

(25)

		Access f Table		Area m²		lar flux W/m²		g specific data or Table 6b		FF specific d or Table		Gains W	
South 0.77 x 9.04 x 46.75 x 0.9 x 0.50 x 0.70 = 102.51 (78)													
East		0.77	7 x	10.68	_ x	19.64	x 0.9 x	0.45] x	0.70	=	45.79	(76)
SouthEast		0.77	7 x	4.00	x	36.79	x 0.9 x	0.50] x	0.70	=	35.70	(77)
Solar gains in watts ∑(74)m(82	2)m												
184.00 318.27 444.57 559.93 631.00 626.93 604.31 552.00 485.05 354.57 221.36 156.78 (83)													
Total gains - internal and solar (7	73)m + ((83)m											
678.81 81	0.77	919.89	1007.27	1049.38	1017.84	977.65	931.	96 879.6	2	777.36	676.5	636.87	(84)

. Mean interna	i tempera	ture (heatir	ng season)										
emperature duri	ing heatin	g periods in	the living a	area from ⁻	Table 9, Th	l(°C)						21.00	(8
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tilisation factor f	for gains f	or living are	a n1,m (se	e Table 9a)								
	1.00	1.00	0.98	0.93	0.80	0.59	0.42	0.46	0.72	0.96	1.00	1.00	(8
lean internal ten	np of livin	g area T1 (s	teps 3 to 7	in Table 9	c)								
	20.24	20.39	20.59	20.82	20.96	21.00	21.00	21.00	20.98	20.80	20.47	20.22	(8
emperature duri	ing heating	g periods in	the rest of	dwelling f	rom Table	9, Th2(°C)							
	20.28	20.29	20.29	20.30	20.30	20.31	20.31	20.32	20.31	20.30	20.30	20.29	(8
tilisation factor f	for gains f	or rest of dv	welling n2,	m									
	1.00	0.99	0.98	0.91	0.75	0.53	0.36	0.40	0.66	0.94	1.00	1.00	(8
lean internal ten	nperature	in the rest	of dwelling	T2 (follow	steps 3 to	7 in Table 9	e)						
	19.25	19.48	19.77	20.09	20.26	20.31	20.31	20.32	20.30	20.07	19.61	19.23	(9
ving area fractio	n								Li	ving area ÷	(4) =	0.30	(9
lean internal ten	nperature	for the who	ole dwellin	g fLA x T1	+(1 - fLA) x	T2							
	19.55	19.75	20.02	20.31	20.47	20.52	20.52	20.52	20.50	20.29	19.87	19.52	(9
pply adjustment	to the me	ean internal	temperati	re from Ta	able 4e whe	ere appropr	iate						_
	19.55	19.75	20.02	20.31	20.47	20.52	20.52	20.52	20.50	20.29	19.87	19.52	(9
3. Space heating	requirem	nent .											
. Space meaning	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
ilisation factor f			IVIGI	Aþi	iviay	Juli	Jui	Aug	Зер	Oct	NOV	Dec	
	1.00	0.99	0.98	0.91	0.76	0.55	0.38	0.42	0.68	0.94	0.99	1.00	(9
ــ seful gains, ŋmG		1		0.51	0.70	0.55	0.56	0.42	0.00	0.54	0.55	1.00	()
	677.47	805.20	897.89	920.24	802.43	555.80	370.14	387.58	595.71	732.56	672.54	636.04	(9
ے • Ionthly average					002.13	333.00	370.11	307.30	7 333.71	732.30	0,2.31	030.01	(5
Γ	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(9
∟ eat loss rate for							10.00	10.10	1 1.110	10.00	7.20	1.20	()
_	1507.74	1463.21	1327.29	1101.17	843.21	558.90	370.32	387.94	609.16	931.85	1236.13	1494.12	(9
ے pace heating req							3,0,0					1 - 12 11-	
Γ	617.72	442.19	319.47	130.26	30.34	0.00	0.00	0.00	0.00	148.28	405.78	638.41	
L									1	8)15, 10		2732.45	 (9
pace heating req	uirement	kWh/m²/ve	ear						2,0		÷ (4)	21.11	(9
	,	4 / 10								(33)	. 7		(3
b. Energy requi	irements -	- community	y heating s	cheme									
raction of space	heat from	secondary/	suppleme	ntary syste	em (table 11	L)				'0' if	none	0.00	(3
raction of space	heat from	community	y system							1 - (3	01) =	1.00	(3
action of comm	unity heat	t from boile	rs									1.00	(3
action of total s	pace heat	from comm	nunity boile	ers						(302) x (30	3a) =	1.00	(3
actor for control	and charg	ging method	(Table 4c	(3)) for con	nmunity sp	ace heating						1.00	(3
actor for chargin	g method	(Table 4c(3)) for comr	nunity wat	er heating							1.00	(3
istribution loss f	actor (Tab	ole 12c) for o	community	heating sy	ystem							1.05	(3
pace heating										-			
nnual space hea	ting requi	rement						2	2732.45]			(9
									8) x (304a) :			2869.07	(3

Water heating

Annual water heating requirement			1940.83			(64)
Water heat from boilers			(64) x (303a) x (3	305a) x (306) =	2037.87	(310a)
Electricity used for heat distribution		0.01 × [(3	307a)(307e) + (31	.0a)(310e)] =	49.07	(313)
Electricity for pumps, fans and electric keep-hot (Table 4f)						
mechanical ventilation fans - balanced, extract or positive input	from outside		350.38			(330a)
Total electricity for the above, kWh/year					350.38	(331)
Electricity for lighting (Appendix L)					476.33	(332)
Total delivered energy for all uses	(307) + (309) + (32	10) + (312)	+ (315) + (331) + (3	332)(337b) =	5733.65	(338)
10b. Fuel costs - community heating scheme						
100. Faci costs community ficating sentence	Fuel		Fuel price		Fuel	
	kWh/year		r dei price		cost £/year	
Space heating from boilers	2869.07	x	4.24	x 0.01 =	121.65	(340a)
Water heating from boilers	2037.87	x	4.24	x 0.01 =	86.41	(342a)
Pumps and fans	350.38	x	13.19	x 0.01 =	46.21	(349)
Electricity for lighting	476.33	x	13.19	x 0.01 =	62.83	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)(342e) +	(345)(354) =	437.10	(355)
11b. SAP rating - community heating scheme						1 (0.5.6)
Energy cost deflator (Table 12)					0.42	(356)
Energy cost factor (ECF)					1.05] (357)]
SAP value					85.32] (0=0)
SAP rating (section 13)					85	(358)
SAP band					В	
12b. CO₂ emissions - community heating scheme					В	
	Energy kWh/year		Emission factor		Emissions (kg/year)	
			Emission factor		Emissions	
12b. CO₂ emissions - community heating scheme			Emission factor		Emissions	(367a)
12b. CO ₂ emissions - community heating scheme Emissions from other sources (space heating)	kWh/year	X	Emission factor	=	Emissions	(367a)] (367)
12b. CO₂ emissions - community heating scheme Emissions from other sources (space heating) Efficiency of boilers	kWh/year 89.50	x x		= =	Emissions (kg/year)	1
12b. CO ₂ emissions - community heating scheme Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	89.50 5482.61		0.216		Emissions (kg/year)	(367)
12b. CO ₂ emissions - community heating scheme Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = [Electrical energy for community heat distribution	89.50 5482.61		0.216		Emissions (kg/year) 1184.24 25.47	(367)
12b. CO ₂ emissions - community heating scheme Emissions from other sources (space heating) Efficiency of boilers CO ₂ emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO ₂ associated with community systems	89.50 5482.61		0.216		Emissions (kg/year) 1184.24 25.47 1209.71] (367)] (372)] (373)
12b. CO ₂ emissions - community heating scheme Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = [Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating	89.50 5482.61 49.07	X	0.216 0.519	=	Emissions (kg/year) 1184.24 25.47 1209.71 1209.71] (367)] (372)] (373)] (376)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = [Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans	89.50 5482.61 49.07	x x	0.216 0.519	=	Emissions (kg/year) 1184.24 25.47 1209.71 181.85] (367)] (372)] (373)] (376)] (378)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = [Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting	89.50 5482.61 49.07	x x	0.216 0.519	= = =	Emissions (kg/year) 1184.24 25.47 1209.71 1209.71 181.85 247.22] (367)] (372)] (373)] (376)] (378)] (379)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = [Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year	89.50 5482.61 49.07	x x	0.216 0.519	= = = (376)(382) =	Emissions (kg/year) 1184.24 25.47 1209.71 181.85 247.22 1638.77] (367)] (372)] (373)] (376)] (378)] (379)] (383)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate	89.50 5482.61 49.07	x x	0.216 0.519	= = = (376)(382) =	Emissions (kg/year) 1184.24 25.47 1209.71 1209.71 181.85 247.22 1638.77 12.66] (367)] (372)] (373)] (376)] (378)] (379)] (383)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = [Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value	89.50 5482.61 49.07	x x	0.216 0.519	= = = (376)(382) =	Emissions (kg/year) 1184.24 25.47 1209.71 181.85 247.22 1638.77 12.66 87.41] (367)] (372)] (373)] (376)] (378)] (379)] (383)] (384)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14)	89.50 5482.61 49.07	x x	0.216 0.519	= = = (376)(382) =	Emissions (kg/year) 1184.24 25.47 1209.71 181.85 247.22 1638.77 12.66 87.41 87] (367)] (372)] (373)] (376)] (378)] (379)] (383)] (384)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = [Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band	89.50 5482.61 49.07 350.38 476.33	x x	0.216 0.519	= = (376)(382) = (383) ÷ (4) =	Emissions (kg/year) 1184.24 25.47 1209.71 1209.71 181.85 247.22 1638.77 12.66 87.41 87 B] (367)] (372)] (373)] (376)] (378)] (379)] (383)] (384)] (385)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = [Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO2, kg/year Dwelling CO2 emission rate El value El rating (section 14) El band 13b. Primary energy - community heating scheme	89.50 5482.61 49.07 350.38 476.33	x	0.216 0.519 0.519 0.519	= = (376)(382) = (383) ÷ (4) =	Emissions (kg/year) 1184.24 25.47 1209.71 181.85 247.22 1638.77 12.66 87.41 87 B] (367)] (372)] (373)] (376)] (378)] (379)] (383)] (384)] (385)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = [Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value El rating (section 14) El band	89.50 5482.61 49.07 350.38 476.33	x	0.216 0.519 0.519 0.519	= = (376)(382) = (383) ÷ (4) =	Emissions (kg/year) 1184.24 25.47 1209.71 1209.71 181.85 247.22 1638.77 12.66 87.41 87 B] (367)] (372)] (373)] (376)] (378)] (379)] (383)] (384)] (385)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO2, kg/year Dwelling CO2 emission rate El value El rating (section 14) El band 13b. Primary energy - community heating scheme Primary energy from other sources (space heating) Efficiency of boilers	89.50 5482.61 49.07 350.38 476.33	x	0.216 0.519 0.519 0.519	= = (376)(382) = (383) ÷ (4) =	Emissions (kg/year) 1184.24 25.47 1209.71 1209.71 181.85 247.22 1638.77 12.66 87.41 87 B] (367)] (372)] (373)] (376)] (378)] (379)] (383)] (384)] (385)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) = [Electrical energy for community heat distribution Total CO2 associated with community systems Total CO2 associated with space and water heating Pumps and fans Electricity for lighting Total CO2, kg/year Dwelling CO2 emission rate El value El rating (section 14) El band 13b. Primary energy - community heating scheme	89.50 5482.61 49.07 350.38 476.33 Energy kWh/year	x	0.216 0.519 0.519 0.519	= = (376)(382) = (383) ÷ (4) =	Emissions (kg/year) 1184.24 25.47 1209.71 1209.71 181.85 247.22 1638.77 12.66 87.41 87 B] (367)] (372)] (373)] (376)] (378)] (379)] (383)] (384)] (385)

Electrical energy for community heat distribution	49.07	x	3.07	=	150.64	(372)
Total primary energy associated with community systems					6839.43	(373)
Total primary energy associated with space and water heating					6839.43	(376)
Pumps and fans	350.38	x	3.07	=	1075.66	(378)
Electricity for lighting	476.33	x	3.07	=	1462.34	(379)
Primary energy kWh/year					9377.43	(383)
Dwelling primary energy rate kWh/m2/year					72.45	(384)



Appendix D BRUKL – Be Lean

BRUKL Output Document



Compliance with England Building Regulations Part L 2013

Project name

Cambridge Road Estate Commercial Units

As designed

Date: Wed Sep 30 17:46:23 2020

Administrative information

Building Details

Address: .

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.b.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: $\,$ v6.1.7

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

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO₂ emission rate for the building must not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	11.8
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	11.8
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	8.8
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	U a-Limit	Ua-Calc	U i-Calc	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.3	"01 Ground Floor - Community Space_W_18"
Floor	0.25	0.15	0.15	"01 Ground Floor - Community Space_F_2"
Roof	0.25	0.13	0.13	"01 Ground Floor - Community Space_R_5"
Windows***, roof windows, and rooflights	2.2	1.3	1.3	"01 Ground Floor - Community Space_G_9"
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"
II Limiting area weighted average II values [W//m²I/)]				

U_{a-Limit} = Limiting area-weighted average U-values [W/(m²K)]

 $U_{a\text{-Calc}}$ = Calculated area-weighted average U-values [W/(m²K)]

U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability Worst acceptable standard		This building
m ³ /(h.m ²) at 50 Pa	10	5

^{*} There might be more than one surface where the maximum U-value occurs.

^{**} Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

^{***} Display windows and similar glazing are excluded from the U-value check.

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- Communal Heating

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(I/s)]	HR efficiency			
This system	0.91	4.2	-	-	-			
Standard value	0.91*	N/A	N/A	N/A	N/A			
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system NO								
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting								

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

1- Project DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]				
This building	Hot water provided by HVAC system	-				
Standard value	N/A	N/A				

Local mechanical ventilation, exhaust, and terminal units

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

Zone name		SFP [W/(I/s)]								HR efficiency	
ID of system type		В	С	D	E	F	G	Н	I	ппе	efficiency
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
01 Ground Floor - Community Space	-	-	-	1.4	-	-	-	-	-	0.85	0.5
01 Ground Floor - Retail	-	-	-	1.4	-	-	-	-	-	0.85	0.5
01 Ground Floor - Workspace	-	-	-	1.4	-	-	-	-	-	0.85	0.5
02 First Floor 1 - Community Space	-	-	-	1.4	-	-	-	-	-	0.85	0.5

General lighting and display lighting	Lumino	us effic		
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
01 Ground Floor - Community Space	-	110	-	6776
01 Ground Floor - Retail	-	110	75	1868
01 Ground Floor - Workspace	110	-	-	1254
02 First Floor 1 - Community Space	-	110	-	1768

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
01 Ground Floor - Community Space	NO (-70.3%)	NO
01 Ground Floor - Retail	NO (-55%)	NO
01 Ground Floor - Workspace	NO (-25.6%)	NO
02 First Floor 1 - Community Space	NO (-44.2%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?			
Is evidence of such assessment available as a separate submission?	NO		
Are any such measures included in the proposed design?	NO		

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	2474.4	2474.4
External area [m²]	4832.7	4832.7
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	6
Average conductance [W/K]	1571.51	1575.04
Average U-value [W/m²K]	0.33	0.33
Alpha value* [%]	10.65	28.18

 $^{^{\}star}$ Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	a Building Type
9	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
9	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions

83 D1 Non-residential Institutions: Community/Day Centre

- D1 Non-residential Institutions: Libraries, Museums, and Galleries
- D1 Non-residential Institutions: Education
- D1 Non-residential Institutions: Primary Health Care Building D1 Non-residential Institutions: Crown and County Courts D2 General Assembly and Leisure, Night Clubs, and Theatres

Others: Passenger terminals Others: Emergency services Others: Miscellaneous 24hr activities

Residential spaces

Others: Car Parks 24 hrs Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	11.1	11.08
Cooling	2.29	3.76
Auxiliary	2.23	1.43
Lighting	7.72	13.14
Hot water	0.46	0.46
Equipment*	10.12	10.12
TOTAL**	23.8	29.88

^{*} Energy used by equipment does not count towards the total for consumption or calculating emissions.

** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	71.95	81.42
Primary energy* [kWh/m²]	51.67	68.97
Total emissions [kg/m²]	8.8	11.8

^{*} Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

ŀ	HVAC Systems Performance									
Sys	System Type Heat dem MJ/m2									
[ST] Split or m	ulti-split sy	stem, [HS]	LTHW boile	er, [HFT] Na	tural Gas, [CFT] Electr	icity		
	Actual	33.9	38.1	11.1	2.3	2.2	0.85	4.62	0.91	6.5
	Notional	32.7	48.7	11.1	3.8	1.4	0.82	3.6		

Key to terms

CFT

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption

Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)

Cool SSEER = Cooling system seasonal energy efficiency ratio

Heat gen SSEFF = Heating generator seasonal efficiency

= Cooling fuel type

Cool gen SSEER = Cooling generator seasonal energy efficiency ratio

ST = System type HS = Heat source HFT = Heating fuel type

Page 5 of 6

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U i-Typ	U _{i-Min}	Surface where the minimum value occurs*
Wall	0.23	0.17	"01 Ground Floor - Community Space_W_8"
Floor	0.2	0.15	"01 Ground Floor - Community Space_F_2"
Roof	0.15	0.13	"01 Ground Floor - Community Space_R_5"
Windows, roof windows, and rooflights	1.5	1.3	"01 Ground Floor - Community Space_G_9"
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"
U _{i-Typ} = Typical individual element U-values [W/(m²K)	j		U _{i-Min} = Minimum individual element U-values [W/(m²K)]
* There might be more than one surface where the r	ninimum L	J-value oc	curs.

Air Permeability	Typical value	This building
m ³ /(h.m ²) at 50 Pa	5	5

Appendix E Dynamic Overheating Assessment





Dynamic Overheating Assessment Cambridge Road (RBK) LLP

Cambridge Road Estate

Final

Chiara FratterBArch, MSc (Hons), CEng MCIBSE

October 2020

DOCUMENT CONTROL RECORD

REPORT STATUS: FINAL

Version	Date	Reason for issue	Author	Checked by	Approved for Issue by Project Manager
v.1	02.10.2020	Draft	CFR	KP	ND
v.2	26.10.2020	Final	CFR	KP	ND

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Executive Summary

This report details the methodology and findings of the dynamic overheating assessment of representative dwellings in support of the Hybrid planning application for the proposed Cambridge Road Estate by Cambridge Road (RBK) LLP in the Royal Borough of Kingston upon Thames. This document outlines the overheating mitigation strategy for Blocks B, C, and E of Phase 1 (the detailed component) of the Cambridge Road Estate masterplan scheme.

The analysis has been undertaken in line with the current London Plan (2016) Policy 5.9 *Overheating and cooling*, the Intend to Publish London Plan (2019) Policy SI4: *Managing heat risk* and the Royal Borough of Kingston upon Thames overheating policies.

Dwellings have been selected for the overheating assessment based on design characteristics that establish them as representative of the overall proposed scheme. This selection of dwellings includes consideration of varying floors and of different orientations. Air quality and noise constraints have also been considered as part of the overheating strategy in accordance with Intend to be Publish London Plan Policy D3 *Optimising site capacity through the design-led approach* (3.3.9).

For the purposes of this report, it is assumed that dwellings will utilise openable windows as the primary means of ventilation, with a background mechanical ventilation system. Passive measures, for example, high energy efficiency, solar control glazing, and external shading in form of balconies have been explored and adopted as far as practicable to avoid the need for comfort cooling.

The performance of the dwellings has been assessed against the Charted Institute of Building Services Engineers (CIBSE) guidance CIBSE TM59: *Design Methodology for the Assessment of Overheating Risk in Homes* (2017). This dynamic overheating assessment of representative dwellings demonstrates that an acceptable overheating risk is achieved.

All dwellings assessed demonstrate an acceptable risk of overheating under mandatory Design Summer Year (DSY 1) weather conditions. The results are based on some key design features that follow the London Plan 'cooling hierarchy', as shown in Table i.

Similar overheating results are expected for the other blocks which are part of the Outline. However additional dynamic overheating modelling will be carried out for each future Reserved Matter Applications to ensure the risk of overheating is reduced.

Table i: Design features to address the cooling hierarchy (London Plan Policy SI4).		
Cooling Hierarchy	Design Feature	Discussion
1. Reduce the amount of heat entering the building	Highly efficient building fabric and air tightness standards.	As per Energy Statement
	Solar control glazing with g-value of	A low G-value reduces the solar gains,
	0.45 for the apartments and 0.50 for	therefore assists in mitigation of overheating.
	the houses (Blocks C & E).	However, it has implications on operational

Table i: Design features to	Table i: Design features to address the cooling hierarchy (London Plan Policy SI4).			
Cooling Hierarchy	Design Feature	Discussion		
		carbon emissions, fabric energy efficiency and internal daylight levels and has therefore been optimised to balance all aspects as far as possible.		
	External shading: Balcony overhangs across all blocks are included in the model as per design proposals. Internal shading: Solar reflective blinds (70% solar reflectance) in all bedrooms on the noisy facades in blocks C1&C2.	External shading is considered one of the most effective methods for solar control and overheating mitigation. When external shading cannot be used the use of internal blinds can help to reduce internal solar gains.		
2. Minimise internal heat generation	Energy efficient design of building service	ces including communal heating pipework.		
3. Manage the heat	A concrete 225mm slab has been assumed between dwellings. The thermal mass will help reduce the risk of overheating by absorbing heat during the daytime.			
4. Natural ventilation	Non-sensitive noise facades: Windows and glazed doors are assumed fully openable during occupied hours. Window schedules: Kitchen/Living Rooms: 9:00-22:00 Bedrooms: 24/7 (Space is considered used as study/home office during the day) Sensitive noise facades: Windows and glazed doors are assumed openable when the spaces are not in use to limit resident's exposure to noise. Bedrooms will require windows to be open for some hours during the hottest nights of the summer to reduce the risk of overheating. Window schedules: Kitchen/Living Rooms: 22:00-09:00 Bedrooms: 07:00-01:00	Windows are simulated to be open when internal temperature exceeds 22°C and when external temperature is lower than the internal temperature: T _{indoor} > 22°C, T _{outdoor} < T _{indoor} Night-time ventilation effectively purges excess heat build-up during the day and cools the building fabric, especially if it is thermally massive. WYG Acoustician has confirmed that the proposed opening schedule are acceptable and in line with the noise requirements.		



Table i: Design features to address the cooling hierarchy (London Plan Policy SI4).			
Cooling Hierarchy	Design Feature	Discussion	
5. Mechanical measures	Dwellings: Enhanced mechanical ventilation rate up to 4.0 ACH for sensitive noise facades (Block C) and minimum Part F requirements for all other dwellings. Communal corridors: Mechanical ventilation rate of 1.5 ACH.	A mechanical ventilation system being capable of delivering beyond minimum Part F ventilation rates (Confirmed by AWA Consultants)	
6. Active cooling	ve cooling There is no requirement for active cooling. A combination of passive measures and background mechanical ventilation in conjunction with natural ventilation have been incorporated to mitigate the overheating risk.		

Contents

	Executive Summary	
	Contents	5
1.	INTRODUCTION	6
2.	REQUIRED STANDARDS	9
3.	MODELLING APPROACH	13
4.	AIR QUALITY AND NOISE CONSTRAINTS	18
5.	MITIGATION STRATEGY	20
6.	SUMMARY OF RESULTS	21
7.	CONCLUSION	24
AP	PENDICES	27
AP	PENDIX T1 Assessed Dwellings and Corridor Internal Layouts	28
AP	PENDIX T2 Results of DSY2 and DSY3 Weather Scenarios	35
AP	PENDIX T3 Dwelling mechanical ventilation rates	39
AP	PENDIX T4 GHA Early Stage Overheating Risk Tool Scoresheet	42
AP	PENDIX T5 Blinds mark-up	44
ΑP	PENDIX T6 Results of DSY1 without blinds	47



1. INTRODUCTION

1.1 This document has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development on behalf of the Applicants, Cambridge Road (RBK) LLP, in support of a planning application for the Cambridge Road Estate which comprises Phase 1 in detail and all other Phases in outline. The site is located within the Royal Borough of Kingston upon Thames.

Site Location

1.2 The proposed development site at Cambridge Road Estate in the Royal Borough of Kingston upon Thames is approximately 9 hectares and is located to the immediate south of the A2043 Cambridge Road and Hawks Road, as shown in Figure 1 below.

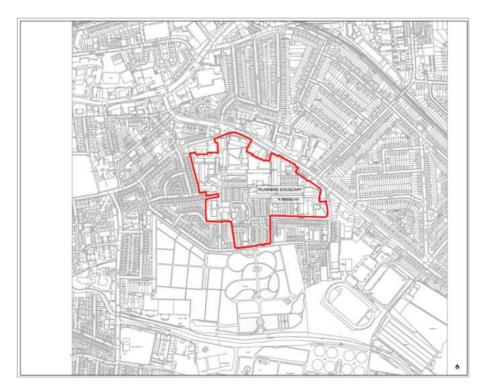


Figure 1: Site plan Courtesy of Patel Taylor

1.3 The land use in the immediate vicinity of the site is predominantly residential and of a domestic suburban character and scale. Cambridge Road Estates was built in the late 60s and early 70s and currently comprises 832 residential homes; Hawks Road Clinic within the northwest of the site; The Bull and Bush Public House and Hotel within the west of the site; and Piper Community Hall within the south of the site. The site also includes small formal and informal play spaces and ground level car parking areas.

Proposed Development

1.4 The proposed development is described as follows:

Hybrid Outline Planning Application for a mixed use development, including demolition of existing buildings and erection of up to 2,170 residential units (Use Class C3), 290sqm of flexible office floorspace (Use Class E), 1,395sqm of flexible retail/commercial floorspace (Use Class E/Sui Generis), 1,250sqm community floorspace (Use Class F2), new publicly accessible open space and associated access, servicing, landscaping and works.

Detailed permission is sought for access, layout, scale, appearance and landscaping of Phase 1 for erection of 452 residential units (Use Class C3), 1,250sqm community floorspace (Use Class F2), 290sqm of flexible office floorspace (Use Class E), 395sqm of flexible retail/commercial floorspace (Use Class E/Sui Generis), new publicly accessible open space and associated access, servicing, parking, landscaping works including tree removal, refuse/recycling and bicycle storage, energy centre and works ("the Proposed Development")."

1.5 Figure 2 below illustrates the proposed masterplan layout.

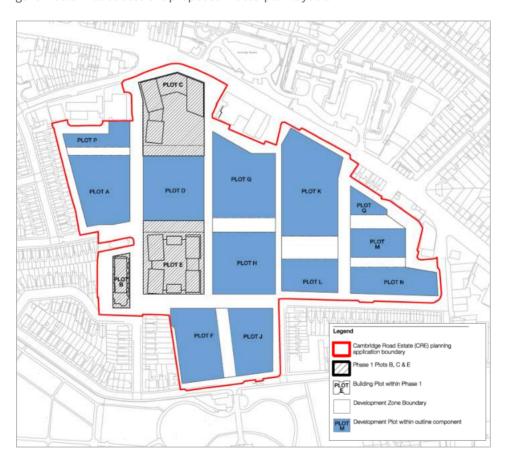


Figure 2: Parameter Plan (Patel Taylor, October 2020).



Overheating and Thermal Comfort

- 1.6 Maintaining comfortable thermal comfort conditions in the face of climate change and increasing temperatures is one of the largest challenges to be addressed by designers. The main objective is to achieve thermal comfort and minimise summertime overheating without the use of conventional air conditioning systems, which typically have associated greenhouse gas emissions and impact on the urban heat island effect.
- 1.7 Dynamic thermal simulations have been carried out for representative dwellings, to determine whether there is a risk of overheating. Appropriate mitigation measures have been recommended to mitigate the overheating risk and ensure that comfortable thermal conditions are achieved.

2. REQUIRED STANDARDS

Local Policy: Royal Borough of Kingston Upon Thames: Core Strategy and Residential Supplementary Planning Documents

- 2.1 The Royal Borough of Kingston Upon Thames' Core Strategy document was adopted in April 2012. The following policies are considered relevant to address overheating:
 - **Policy C2 Climate Change Adaptation**: The Council will ensure that future development takes into consideration the following: Hotter summers and therefore increased cooling demands; Warmer, wetter winters and increased flood risk; Water shortages and drought; Urban heat island effect; and Subsidence.
 - **Policy DM3 Designing for Changing Climate**: Design proposals should incorporate climate change adaptation measures based on the type and extent of the main changes expected in the local climate throughout the lifetime of the development, this is likely to require a flexible design that can be adapted to accommodate the changing climate e.g. provision of additional shading and cooling.
- 2.2 In addition, the **Residential Supplementary Planning Documents** (Adopted July 2013) sets out passive design principles which will contribute to reduce the likelihood of overheating within Policy Guidance 3 Sustainable Design.

The **Policy Guidance 3 – Sustainable Design** states that Developers are encouraged to exceed statutory requirements as set out in current London Plan policy 5.3, the Mayor's Housing SPG, and in Core Strategy Policies DM1 and DM3 with particular attention given to:

- > Minimising energy and CO2 emissions;
- > Efficient use of natural resources (including water);
- > Design of streets and siting of buildings- orientating homes to maximising passive solar gain or shelter from prevailing winds. Designing a residential development so that houses take advantage naturally occurring conditions or features may be challenging on constrained sites;
- > Optimising building density complementing policy objectives to optimise housing output, resource efficiency should also be promoted by encouraging higher densities in appropriate locations;
- > Incorporation of green/blue infrastructure;
- > Flood attenuation by sustainable drainage methods;
- > Enhancing biodiversity; and



> Promoting local flood growing opportunities.

Current London Plan (2016)

- 2.3 The existing London Plan sets out an integrated economic, environmental, transport and social framework for the development of London. The following key policies are considered relevant to the Proposed Development and this Overheating Assessment.
- **2.4 Policy 5.9 Overheating and Cooling** in the London Plan outlines key policies relevant to the Proposed Development and this Overheating Assessment:

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. 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).
- 2.5 It is expected that dynamic thermal modelling of the overheating risk will be undertaken to support the energy assessment, unless the applicant can demonstrate exceptional circumstances where opportunities for reducing cooling demands via passive measures are constrained.
- **2.6** Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:
- 2.7 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.
- 2.8 The dynamic thermal modelling should be in addition to any assessment of overheating risk obtained from the Part L Building Regulation compliance tools SAP and SBEM. Evidence of how the development performs against the overheating criteria should be presented along with an outline of the assumptions made (e.g. around internal gains).

The Intend to Publish London Plan (2019)

- 2.9 While not yet adopted, the Intend to Publish London Plan now carries increasing weight. This version of the Intend to Publish London Plan has been reviewed by the Secretary of State and Directions have been issued in respect of some policies but none that relate to the sustainability matters.
- **2.10** The following key policy in the Intend to Publish London Plan is considered relevant to the proposed development and this Overheating Assessment:
- 2.11 Policy SI4 Managing Heat Risk states that development proposals should minimise adverse impacts on urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure and that major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy (Figure 3):

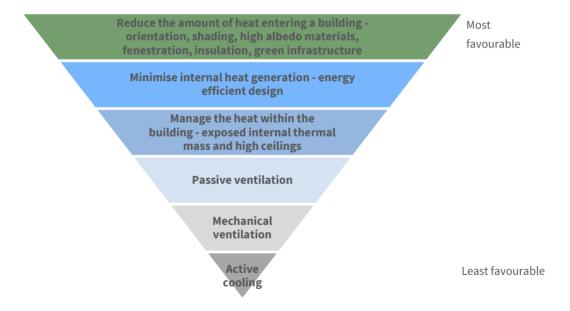


Figure 3: Cooling Hierarchy (Draft London Plan 2019)

- 2.12 Low-energy measures should be used to mitigate overheating risk. These include solar shading, building orientation and solar-controlled glazing. Occupant behaviour will also have an impact on overheating risk.
- 2.13 Passive ventilation should be prioritised, (accounting for external noise issues and local air quality). The increased use of air conditioning systems is not desirable. If active cooling systems, such as air conditioning systems, are unavoidable, these should be designed to reuse the waste heat they produce.



2.14 The Draft GLA Guidance on Preparing Energy Assessments (2020), identifies CIBSE TM59 guidance as the most appropriate methodology for the assessment of overheating risk of homes. The Good Home Alliance (GHA) overheating risk tool has also been used by the design team to investigate effective design solution to mitigate the risk of overheating.

CIBSE TM59 (2017) Assessment Criteria

- 2.15 The criteria for the assessment of overheating risk have been specified by the Chartered Institute of Building Services Engineers (CIBSE) in the CIBSE TM59: Design methodology for the assessment of overheating risk in homes (2017). CIBSE TM59 is based on CIBSE TM52 and CIBSE Guide A and provides a standardised approach to predicting overheating risk for both naturally and mechanically ventilated residential buildings.
- **2.16** The following criteria must be met in order to demonstrate compliance:
 - > **For living rooms, kitchens and bedrooms:** The indoor operative temperature should not exceed the threshold comfort temperature by 1°C or more for more than 3 % of occupied hours.
 - > **For bedrooms only:** To guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am should not exceed 26 °C for more than 1% of annual hours.
 - > **For communal corridors:** The threshold temperature of 28 °C should not be exceeded for more than 3 % of the total annual hours.

3. MODELLING APPROACH

Unit Selection

- 3.1 Dynamic thermal modelling has been undertaken using Design Builder Software (v.6). The performance of the units has been assessed under the CIBSE TM59 guidance and the adaptive thermal comfort model for a primarily natural ventilated scenario.
- **3.2** Representative dwelling units with different layouts, sizes, orientation and external shading have been assessed. The selection of the units for overheating risk assessment was based on the following design characteristics:
 - > Varying proportions of glazed areas;
 - > Units located in different orientations, on different floor levels and across all blocks;
 - > Dwellings with varying amounts of cross ventilation, including single and dual aspect units;
 - > Dwellings with and without external shading from balcony overhangs or surrounding buildings; and
 - > Units on different facades with and without external noise constraints.
- 3.3 Two representative communal corridors, associated with the assessed dwellings, were also selected for overheating assessment. The location and the internal layouts of the dwellings and corridors selected for assessment are presented in Appendix T1.

Site External Weather Conditions

- 3.4 External temperatures and incident solar gains are greatest during summer months, coinciding with periods of lower wind speeds. Solar altitude is also highest during summer months, increasing the effects of façade shading from balcony overhangs and window reveals. Such considerations should be accounted for when designing for overheating risk.
- **3.5** The effects of external conditions are vital in an overheating assessment as they influence:
 - > Solar heat gains (a function of incident direct and diffuse solar radiation and solar altitude); and
 - > Calculated natural ventilation rates (a function of external temperature, wind directions and speeds).



- 3.6 CIBSE Design Summer Year weather data for London Heathrow (representative of lower density urban and suburban areas) has been used for the 2020s, high emissions, 50% percentile scenario as required by CIBSE TM59 and the London Plan.
- 3.7 The assessment of overheating risk undertaken using the Design Summer Year 1 (DSY1) weather file, in accordance with the requirements. The final mitigation strategy has also been tested under the more extreme DSY2 and DSY3 weather files and the results are presented in Appendix T2.

Model Geometry and Local Shading

- 3.8 Overshadowing from the building blocks has been taken into account during the simulation, based on the model geometry and the site orientation.
- 3.9 Solar control forms an integral part of overheating mitigation strategies. External shading in the form of balconies is applied in most of the façades across the development as part of the design proposals. These were incorporated in the simulation model and are shown in Figure 4.



Figure 4: Design builder simulation model for Blocks B and E, sun path shown for 21st June 12:00 noon BST.

3.10 Horizontal shading devices such as balconies and overhangs are more efficient when applied in south oriented façades and during midday when the solar angle is high. Their role in reducing solar gains in the summer period is considered to be paramount.

3.11 The model has been built to include future phases of the Cambridge Road Estate masterplan as it represents the long-term context for the assessed buildings. It should also be noted that the future phases are in outline and with design and layout determined by parameter plans. This is one way in which they could be delivered.

Design Modelling Inputs for Dwellings

3.12 The following modelling inputs (Table 1) have been included in the baseline dynamic thermal simulation, in line with the Energy Statement.

Table 1: Baseline	Table 1: Baseline dynamic thermal modelling design assumptions.			
Data Input			Discussion	
Weather data	Location	CIBSE London Heathrow Design Summer Years (DSYs) for 2020s, high emissions, 50% percentile scenario	Geographically closest and most representative industry-standard CIBSE weather data file	
	External walls	0.17 W/m ² K	As per the Energy Statement	
	Roofs	0.13 W/m ² K	As per the Energy Statement	
	Ground floor	0.10 W/m ² K	As per the Energy Statement	
Building Fabric Construction details	Ceilings/floors	Assumed to be adiabatic between adjacent floors	Concrete slabs will add to the thermal capacity of the building When dwelling covering the unit above / below heat loss is assumed to be zero	
details	Party walls between units and houses	Assumed to be adiabatic between adjacent dwellings	Walls adjacent to other units are assumed to be lightweight partitions adjacent units have been included in the dynamic simulation calculations	
	Partitions within units	Steel-stud partitions	Assumed thicknesses as per Patel Taylor drawings	
	Internal doors	0.90 m width	As per Patel Taylor drawings	
Windows	Windows and Glazed Doors	U value 1.3 W/m²K	As per Energy Statement	
	Reveal depth	External reveal: 112.5 mm Internal reveal: 377.5 mm	As measured from Patel Taylor drawings	
Infiltration	Air Tightness	3.0 m ³ /hr-m ² @50 pascals	As per the Energy Statement	
	Mechanical ventilation	Dwellings: Mechanical ventilation to achieve 1.0 ach (depending on unit size up to a maximum of 66.9l/s).	Assumption made based on a MVHR system that will achieve ventilation rates beyond the minimum Part F requirements. For more details on ventilation rates refer	
			to Appendix T3.	



3.13 The following occupancy schedules and internal gains assumptions (Table 2) have been used, in accordance with CIBSE TM59 guidance.

Table 2: Occupancy and equipment gains for dwellings (CIBSE TM59).			
Unit/room type	Occupancy	Equipment Load	
1-bedroom apartment: living room/kitchen	1 person from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day	
2-bedroom apartment: living room/kitchen	2 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200 W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day	
3-bedroom apartment: living room/kitchen	3 people from 9 am to 10 pm; room is unoccupied for the rest of the day	Peak load of 450 W from 6 pm to 8 pm 200W from 8 pm to 10 pm 110 W from 9 am to 6 pm and from 10 pm to 12 pm Base load of 85 W for the rest of the day	
Double bedroom	2 people at 70% gains from 11 pm to 8 am, 2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm, 1 person at full gain in the bedroom from 9 am to 10 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during the sleeping hours	
Single bedroom	1 person at 70% gains from 11 pm to 8 am, 1 person at full gains from 8 am to 11 pm	Peak load of 80 W from 8 am to 11 pm Base load of 10 W during sleeping hours	
Utility cupboard	N/A	10 W on 24/7	

Design Modelling Inputs for Communal Corridors

3.14 The same building fabric details outlined within Table 1 have been used in the modelling of the communal corridor. Occupancy schedules and internal gains assumptions are taken from CIBSE TM59 guidance, while heat losses from communal heating pipework have been provided by AWA consultants (Table 3).

Table 3: Occupancy and equipment gains for communal corridors (AWA Consultant).			
Corridor	Element	Occupancy	Equipment Load
Block B _ Communal	South corridor, ceiling Void	N/A	124 W
corridor on the 4 th floor	North corridor ceiling Void	N/A	248 W
Block E1 _ Communal corridor on the 11 th floor	Ceiling Void	N/A	233 W
All corridors	Mechanical Risers	N/A	20.75 W

Table 3: Occupancy and equipment gains for communal corridors (AWA Consultant).			
Corridor	Element	Occupancy	Equipment Load
			(calculated based on the heat losses per meter)
	Lighting	N/A	0.0 W (PIR sensors)



4. AIR QUALITY AND NOISE CONSTRAINTS

- The Air Quality Assessment has been undertaken by Ensafe Consultants (presented in Chapter 7 of the ES submitted in support of the planning application). It has been confirmed that only the ground floor level of the façades facing Cambridge Road on Block C will be above national air quality objectives for the pollutant Nitrogen Dioxide. Nitrogen Dioxide concentrations are lower at elevated heights due to increased distance from emission sources, such as roads. Therefore, predicted concentrations at heights above ground floor level are considered to be acceptable and windows do not need to be sealed and can be used to ventilate the spaces. This is valid for all blocks B, C, and E part of the detailed design.
- 4.2 WYG Acoustics have undertaken an Acoustic Assessment for the proposed development (Cambridge Road Estate, Nosie Assessment, WYG, October 2020). An assessment of the predicted noise level based on noise risk categories set out within the Association of Noise Consultants Acoustics, Ventilation and Overheating Residential Design Guide (AVO Guide) (January 2020) was also provided.
- **4.3** Figure 5 shows the facades affected by external noise constraints in block C. The findings indicate that northern and eastern facades of Blocks C1 & C2 fall within AVO noise risk category 'high' and western facades fall within AVO noise risk category 'medium' during both day and night-time.
- 4.4 All other facades in Block C as well as all other blocks part of the detailed planning application (Blocks B and E) fall under 'low' and 'negligible' noise risk category.

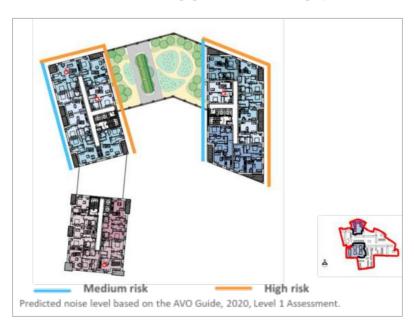


Figure 5: Diagram of the results of the noise modelling in line with AVO Guide risk assessment. (Patel Taylor 1st floor plan drawings with the noise information provided by WYG)

4.5 Window opening schedules (Table 4) have therefore been adapted to allow natural ventilation to mitigate overheating without exposing residents to unacceptable noise levels and air quality issues.

Table 4: Proposed natural ventilation strategy for dwellings based on the noise constraints				
Noise risk category	Room	Occupied Hours (TM59)	Window opening schedule	Discussion
Non-sensitive noise facades Kitchen / Living areas		Kitchen/Living room: 9:00- 22:00	Windows open during the day in the kitchen/living	
of the blocks) Bedr	Bedrooms	24/7 (sleeping hours 22:00-07:00)	Bedrooms: 24/7	rooms and during the night in the bedrooms
	Kitchen / Living areas	09:00-22:00	Kitchen/Living room: 22:00- 9:00	Windows open when the spaces are not in use.
Sensitive noise facades (Facades at medium and high noise category on Block C)	Bedrooms	24/7 (sleeping hours 22:00-07:00)	9:00 Bedrooms require windows to be open f some hours during th hottest nights of the y to cool down the space	

4.6 Windows are simulated to be open when the internal temperature exceeds 22 °C and the external temperature is lower than the internal temperature.



5. MITIGATION STRATEGY

- 5.1 It is important to identify potential overheating risk early on in the design process and incorporate as many suitable passive design measures as possible. Particularly when the site presents external constraints such as noise issues that can limit the use of openable windows to ventilate the habitable spaces.
- The GHA overheating early stage risk tool have been employed during the design process to investigate design solution to minimise the risk of overheating. Appendix T4 presents the GHA scoresheets for the blocks with and without noise constraints of Phase 1.

Proposed passive measures

- The following passive design measures have been incorporated in accordance with the London Plan Cooling Hierarchy:
 - > Highly efficient fabric envelope and high efficiency building services heating system, lighting and appliances are proposed in all dwellings to reduce internal gains;
 - > High performance solar control glazing with a g-value ranging from 0.50 to 0.45. This has been balanced to mitigate overheating risk whilst achieving fabric energy efficiency targets, noise constraints and natural daylight provision;
 - > Openable parts of windows have been maximised and sized to allow enhanced levels of natural ventilation above minimum Part F requirements following GHA overheating recommendations;
 - > Window openability has been maximised by choosing a type of window that allows to be fully open 90-degrees outwards;
 - > External shading is provided to large glazed windows in form of balconies across all blocks to control solar gains;
 - > A concrete floor slab provides some thermal capacity to absorb excessive heat within the building;
 - > Internal reflective blinds (70% solar reflectance) are employed in the bedrooms on the sensitive noise facades to control solar gains and mitigate residual risk of overheating (Appendix T5)
 - > Enhanced mechanical ventilation rates up to 4.0 air changes per hour to assist in mitigating the risk of overheating for the units on the sensitive noise façades in Block C.

6. SUMMARY OF RESULTS

6.1 This chapter summarises the results given by running dynamic thermal simulations for the buildings under the current design summer year (1989) for the 2020s high emission, 50% percentile scenario, as required by CIBSE TM59 and planning policies.

Dwellings

Results presented in Table 5 indicate that all assessed units demonstrate an acceptable risk of overheating in accordance with CIBSE TM59.

Table 5: Overheating Results for DSY1 2020s - TM59				
Unit	Room	TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
	Bedroom 1	0.00	18.83	Pass
B1.2.9 2B4P	Bedroom 2	0.02	10.83	Pass
	Living/Kitchen/Dining	0.00	N/A	Pass
	Bedroom 1 Single	0.00	20.33	Pass
C1.1.5 2B3P	Bedroom 2	0.02	19.33	Pass
	Living/Kitchen/Dining	0.00	N/A	Pass
	Bedroom 1	0.00	14.50	Pass
C2 11 C 2DED	Bedroom 2	0.00	30.83	Pass
C2.11.6 3B5P	Bedroom 3 Single	0.00	31.33	Pass
	Living/Kitchen/Dining	0.10	N/A	Pass
	Bedroom 1	0.00	17.83	Pass
C2 F F 2D 4D	Bedroom 2 Single	0.00	18.17	Pass
C3.5.5 3B4P	Bedroom 3 Single	0.00	16.33	Pass
	Living/Kitchen/Dining	0.00	N/A	Pass
	Bedroom 1	0.00	22.83	Pass
E1.11.1 3B6P	Bedroom 2	0.00	25.83	Pass
E1.11.1 3B6P	Bedroom 3	0.00	19.00	Pass
	Living/Kitchen/Dining	1.43	N/A	Pass
	Bedroom 1	0.00	11.83	Pass
E3.7.2 3B5P	Bedroom 2	0.00	14.83	Pass
	Bedroom 3 Single	0.05	19.33	Pass



Table 5: Overheating Results for DSY1 2020s - TM59				
Unit	Room	TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
E3.7.2 3B5P	Living/Kitchen/Dining	2.00	N/A	Pass
F4 7 2 1 D 2 D	Bedroom 1	0.06	22.67	Pass
E4.7.3 1B2P	Living/Kitchen/Dining	0.75	N/A	Pass
Haves 1F FC 1 3	Bedroom 1 Single	0.00	8.67	Pass
House 1F E6.1.2	Living Room	0.00	N/A	Pass
	Bedroom 1 Single	0.00	7.67	Pass
House 2F E6.2.2	Bedroom 2 Single	0.00	8.50	Pass
	Bedroom 3 Single	0.00	9.00	Pass
House 3F E6.3.2	Bedroom 4	0.00	7.33	Pass
House GF E6.0.2	Kitchen	0.00	N/A	Pass

- 6.3 The more extreme weather files DSY2, DSY3 have also been tested and results are presented in Appendix T2.
- 6.4 Additionally, the results without the use of internal blinds for the dwellings on the noisy facades in Block C are shown in Appendix T6.

Communal Corridors

- 6.5 Under CIBSE TM59 (2017) guidance, the maximum recommended temperature of 28 °C should not be exceeded for more than 3 % of the total annual hours for the communal corridor areas.
- 6.6 With a mechanical extract ventilation system achieving air flow rate of at least 1.5 air changes per hour (ach) the corridors temperatures remain below the 3% target as shown in Table 6.

Table 6: TM59 overheating results for the assessed corridor with mechanical ventilation of 1.5 ACH			
Corridors		TM59 Overheating Criterion (≤ 3% over 28°C)	Overall compliance with TM59
Block B 4F Corridor North		0.00	Pass
Corridor	Corridor South	0.00	Pass
Block E 11F Corridor		0.53	Pass

Cambridge Road Estate Cambridge Road (RBK) LLP

Dynamic Overheating Assessment October 2020

Results for DSY2 and DSY3 extreme weather files presented in Appendix T2, indicate that the proposed ventilation strategy be effective in achieving thermal comfort in accordance with the CIBSE TM59 criterion.



7. CONCLUSION

- 7.1 This report details the methodology and findings of the dynamic overheating assessment of representative dwellings in support of the Hybrid planning application for the proposed Cambridge Road Estate by Cambridge Road (RBK) LLP in the Royal Borough of Kingston upon Thames. This document outlines the overheating mitigation strategy for Blocks B, C, and E of Phase 1 (the detailed component) of the Cambridge Road Estate masterplan scheme.
- 7.2 The analysis has been undertaken in line with the current London Plan (2016) Policy 5.9 Overheating and cooling, the Intend to Publish London Plan (2019) Policy SI4: Managing heat risk and the Royal Borough of Kingston upon Thames overheating policies.
- 7.3 Dwellings have been selected for the overheating assessment based on design characteristics that establish them as representative of the overall proposed scheme. This selection of dwellings includes consideration of varying floors and of different orientations. Air quality and noise constraints have also been considered as part of the overheating strategy in accordance with Intend to be Publish London Plan Policy D3 *Optimising site capacity through the design-led approach* (3.3.9).
- **7.4** For the purposes of this report, it is assumed that dwellings will utilise openable windows as the primary means of ventilation, with a background mechanical ventilation system. Passive measures, for example, high energy efficiency, solar control glazing, and external shading in form of balconies have been explored and adopted as far as practicable to avoid the need for comfort cooling.
- 7.5 The performance of the dwellings has been assessed against the Charted Institute of Building Services Engineers (CIBSE) guidance CIBSE TM59: *Design Methodology for the Assessment of Overheating Risk in Homes* (2017). This dynamic overheating assessment of representative dwellings demonstrates that an acceptable overheating risk is achieved.
- 7.6 All dwellings assessed demonstrate an acceptable risk of overheating under mandatory Design Summer Year (DSY 1) weather conditions. The results are based on some key design features that follow the London Plan 'cooling hierarchy', as shown in Table 7.
- 7.7 Similar overheating results are expected for the other blocks which are part of the Outline.

 However additional dynamic overheating modelling will be carried out for each future Reserved Matter Applications to ensure the risk of overheating is reduced.

Table 7: Design features to address the cooling hierarchy (London Plan Policy SI4).			
Cooling Hierarchy	Design Feature	Discussion	
1. Reduce the amount of heat entering the building	Highly efficient building fabric and air tightness standards.	As per Energy Statement	

Table 7: Design features to address the cooling hierarchy (London Plan Policy SI4).				
Cooling Hierarchy	Design Feature	Discussion		
	Solar control glazing with g-value of 0.45 for the apartments and 0.50 for the houses (Blocks C & E).	A low G-value reduces the solar gains, therefore assists in mitigation of overheating. However, it has implications on operational carbon emissions, fabric energy efficiency and internal daylight levels and has therefore been optimised to balance all aspects as far as possible.		
	External shading: Balcony overhangs across all blocks are included in the model as per design proposals. Internal shading: Solar reflective blinds (70% solar reflectance) in all bedrooms on the noisy facades in blocks C1&C2.	External shading is considered one of the most effective methods for solar control and overheating mitigation. When external shading cannot be used the use of internal blinds can help to reduce internal solar gains.		
2. Minimise internal heat generation	Energy efficient design of building services including communal heating pipework.			
3. Manage the heat	A concrete 225mm slab has been assumed between dwellings. The thermal mass of this will help reduce the risk of overheating by absorbing heat during the daytime.			
4. Natural ventilation	will help reduce the risk of overheating by absorbing heat during the daytime. Non-sensitive noise facades: Windows and glazed doors are assumed fully openable during occupied hours. Window schedules: Kitchen/Living Rooms: 9:00-22:00 Bedrooms: 24/7 (Space is considered used as study/home office during the day) Night-time ventilation effectively purges extheat build-up during the day and cools the building fabric, especially if it is thermally massive. Sensitive noise facades: Windows are simulated to be open when internal temperature exceeds 22°C and whe external temperature is lower than the internal temperature: T _{indoor} > 22°C, T _{outdoor} < T _{indoor} Night-time ventilation effectively purges extheat building fabric, especially if it is thermally massive. Windows and glazed doors are assumed openable when the spaces are not in use to limit resident's exposure to noise. Bedrooms will require windows to be open for some hours during the hottest nights of the summer to reduce the risk of overheating. Windows are simulated to be open when internal temperature exceeds 22°C and whe external temperature: T _{indoor} > 22°C, T _{outdoor} < T _{indoor} Windows are simulated to be open when internal temperature exceeds 22°C and whe external temperature is lower than the internal temperature is lower than the internal temperature exceeds 22°C, and whe external temperature is lower than the internal temperature exceeds 22°C, Toutdoor < T _{indoor} < Vindoor < Toutdoor < Toutdo			



Table 7: Design features to address the cooling hierarchy (London Plan Policy SI4).				
Cooling Hierarchy	Design Feature	Discussion		
	Kitchen/Living Rooms: 22:00-09:00 Bedrooms: 07:00-01:00			
5. Mechanical measures	Dwellings: Enhanced mechanical ventilation rate up to 4.0 ACH for sensitive noise facades (Block C) and minimum Part F requirements for all other dwellings. Communal corridors: Mechanical ventilation rate of 1.5 ACH.	A mechanical ventilation system being capable of delivering beyond minimum Part F ventilation rates (Confirmed by AWA Consultants)		
6. Active cooling	There is no requirement for active cooling. A combination of passive measures and background mechanical ventilation in conjunction with natural ventilation have been incorporated to mitigate the overheating risk.			

APPENDICES

Appendix T1

Assessed Dwellings and Corridor Internal Layouts

Appendix T2

Results of DSY2 and DSY3 Weather Scenarios

Appendix T3

Dwellings mechanical ventilation rates

Appendix T4

GHA Early Stage Overheating Risk Tool Scoresheet

Appendix T5

Blinds and enhanced MVHR mark-up

Appendix T6

Results of DSY 1 without blinds



APPENDIX T1

Assessed Dwellings and Corridor Internal Layouts

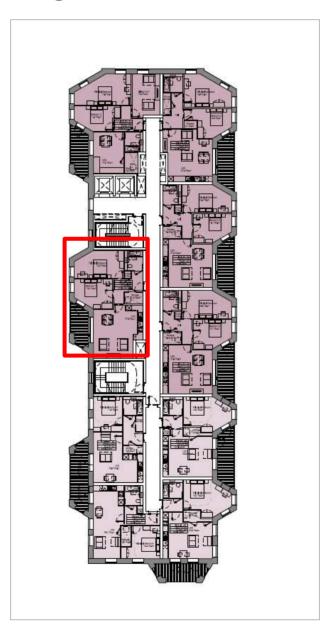


Figure T1.1. Block B, 2nd floor selected middle floor 2bed dwelling facing west (Patel Taylor drawings 21.09.2020).

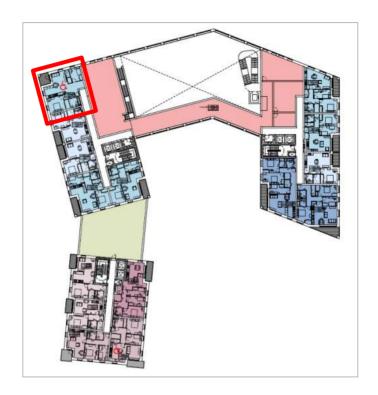


Figure T1.2. Block C, 1st floor selected 2bed dwelling on the nosy façade (Patel Taylor drawings 21.09.2020).

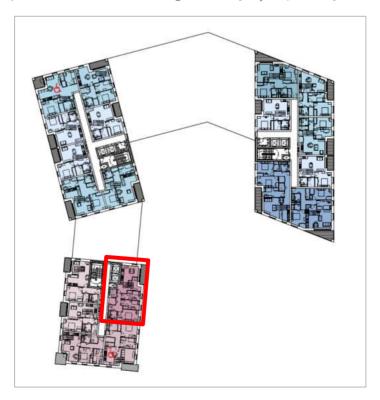


Figure T1.3. Block C, 5th floor selected 3Bed dwelling on the middle level (Patel Taylor drawings 21.09.2020).



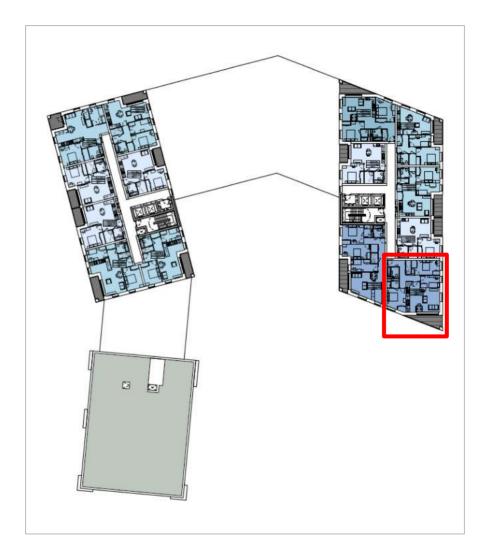


Figure T1.4. Block C, 11th floor selected 3bed dwelling on the top level (Patel Taylor drawings 21.09.2020).

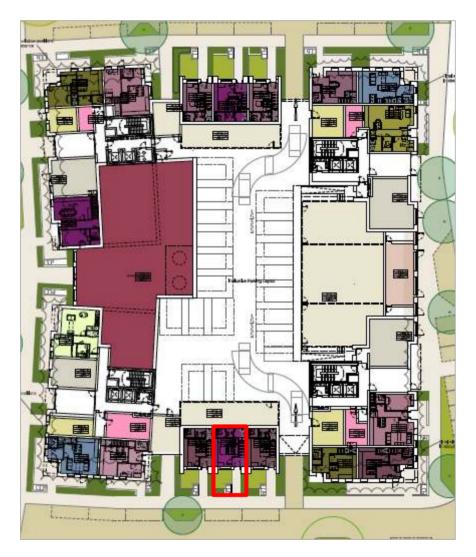


Figure T1.5. Block E, ground floor level selected Maisonette facing south (Patel Taylor drawings 21.09.2020).





Figure T1.6. Block E, 7th level selected 1bed dwelling facing west on the middle level and top floor dual-aspect 3Bed dwelling (Patel Taylor drawings 21.09.2020).

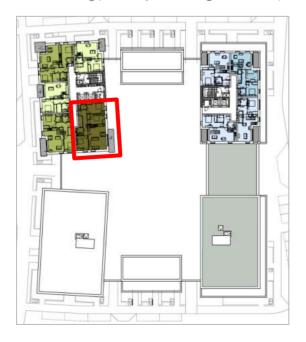


Figure T1.7. Block E, 11th level selected 3bed south-east dwelling top floor dual-aspect (Patel Taylor drawings 21.09.2020).

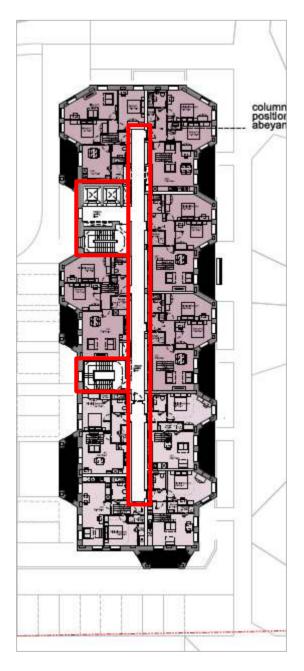


Figure T1.7. Block B 4th floor, middle-floor communal Corridor (Patel Taylor drawings 21.09.2020).



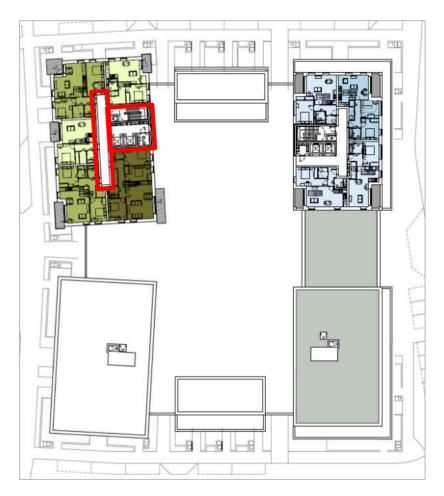


Figure T1.8. Block E 11th floor, top floor communal Corridor (Patel Taylor drawings 21.09.2020).

APPENDIX T2

Results of DSY2 and DSY3 Weather Scenarios

Based on the CIBSE TM59 guidance, achieving compliance with the DSY1 (Design Summer Year) file most appropriate for the site location for the 2020s, high emissions, 50% percentile scenario is mandatory.

Further weather scenarios can be tested to explore the performance of the design under extreme weather events (e.g. heatwaves and prolonged warmth). Meeting the criteria for the DSY2 and DSY3 weather files can be challenging and therefore the CIBSE Guidance sets out that where compliance criteria are not met, the assessment should demonstrate how the risk of overheating has been reduced as far as practical.

The overheating mitigation measures for the proposed development are set out in chapter five of this report.

The results of the overheating assessment for the DSY2 and DSY3 weather files with the current overheating mitigation strategy are presented in Tables T2.1 to T2.4.

Table T2.1: Dwellings TM59 overheating results for DSY2 2020s					
Unit	Room	TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	Overall compliance with TM59	
		% Hours of overheating	Hours of overheating		
	Bedroom 1	0.06	43.00	Fail	
B1.2.9 2B4P	Bedroom 2	0.32	25.50	Pass	
	Living/Kitchen/Dining	0.46	N/A	Pass	
	Bedroom 1 Single	0.33	55.17	Fail	
C1.1.5 2B3P	Bedroom 2	0.45	53.83	Fail	
	Living/Kitchen/Dining	0.48	N/A	Pass	
	Bedroom 1	0.15	35.67	Fail	
C2.11.6 3B5P	Bedroom 2	0.13	68.50	Fail	
C2.11.6 3B5P	Bedroom 3 Single	0.27	64.00	Fail	
	Living/Kitchen/Dining	1.06	N/A	Pass	
C3.5.5 3B4P	Bedroom 1	0.10	48.67	Fail	
	Bedroom 2 Single	0.34	46.00	Fail	
	Bedroom 3 Single	0.16	44.50	Fail	
	Living/Kitchen/Dining	0.98	N/A	Pass	
E1.11.1 3B6P	Bedroom 1	0.25	49.17	Fail	
	Bedroom 2	0.21	45.50	Fail	



Table T2.1: Dwellings TM59 overheating results for DSY2 2020s				
Unit	Room	TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
	Bedroom 3	0.00	39.33	Fail
	Living/Kitchen/Dining	2.31	N/A	Pass
	Bedroom 1	0.02	28.00	Pass
E3.7.2 3B5P	Bedroom 2	0.00	34.00	Fail
	Bedroom 3 Single	0.40	41.67	Fail
E3.7.2 3B5P	Living/Kitchen/Dining	2.39	N/A	Pass
E4.7.3 1B2P	Bedroom 1	0.59	52.50	Fail
E4.1.3 1DZP	Living/Kitchen/Dining	1.66	N/A	Pass
House GF E6.0.2	Kitchen	0.00	N/A	Pass
House 1F FC 1 2	Bedroom 1 Single	0.02	25.67	Pass
House 1F E6.1.2	Living Room	0.00	N/A	Pass
House 2F E6.2.2	Bedroom 1 Single	0.00	28.33	Pass
	Bedroom 2 Single	0.00	20.33	Pass
	Bedroom 3 Single	0.00	21.67	Pass
House 3F E6.3.2	Bedroom 4	0.00	22.17	Pass

Table T2.2: Corridor TM59 overheating results for DSY2 2020s				
Corridors		TM59 Overheating Criterion (≤ 3% over 28°C)	Overall compliance with TM59	
Block B 4F Corridor	Corridor North	0.20	Pass	
	Corridor South	0.57	Pass	
Block E 11F Corridor		1.53	Pass	

Table T2.3: Dwellings: TM59 overheating results for DSY3 2020s				
Unit	Room	TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	Overall compliance with TM59
		% Hours of overheating	Hours of overheating	
	Bedroom 1	0.18	69.83	Fail
B1.2.9 2B4P	Bedroom 2	0.76	36.50	Fail
	Living/Kitchen/Dining	1.05	N/A	Pass
	Bedroom 1 Single	0.17	86.00	Fail
C1.1.5 2B3P	Bedroom 2	0.56	82.67	Fail
	Living/Kitchen/Dining	0.25	N/A	Pass
	Bedroom 1	0.00	60.00	Fail
	Bedroom 2	0.00	86.67	Fail
C2.11.6 3B5P	Bedroom 3 Single	0.07	79.67	Fail
	Living/Kitchen/Dining	0.79	N/A	Pass
	Bedroom 1	0.00	67.00	Fail
	Bedroom 2 Single	0.07	62.33	Fail
C3.5.5 3B4P	Bedroom 3 Single	0.00	59.83	Fail
	Living/Kitchen/Dining	0.89	N/A	Pass
	Bedroom 1	0.00	80.67	Fail
	Bedroom 2	0.03	59.17	Fail
E1.11.1 3B6P	Bedroom 3	0.00	51.83	Fail
	Living/Kitchen/Dining	4.53	N/A	Fail
	Bedroom 1	0.00	40.17	Fail
E3.7.2 3B5P	Bedroom 2	0.00	44.50	Fail
	Bedroom 3 Single	0.82	76.17	Fail
E3.7.2 3B5P	Living/Kitchen/Dining	4.53	N/A	Fail
	Bedroom 1	1.47	79.33	Fail
E4.7.3 1B2P	Living/Kitchen/Dining	3.57	N/A	Fail
House GF E6.0.2	Kitchen	0.00	N/A	Pass
House 1F E6.1.2	Bedroom 1 Single	0.00	35.00	Fail
	Living Room	0.00	N/A	Pass
	Bedroom 1 Single	0.00	33.83	Fail
House 2F E6.2.2	Bedroom 2 Single	0.00	36.50	Fail
	Bedroom 3 Single	0.00	38.67	Fail
House 3F E6.3.2	Bedroom 4	0.00	36.17	Fail



Table T2.4: Corridor TM59 overheating results for DSY3 2020s				
Corridors		TM59 Overheating Criterion (≤ 3% over 28°C)	Overall compliance with TM59	
Block B 4F Corridor	Corridor North	0.27	Pass	
	Corridor South	0.78	Pass	
Block E 11F Corridor		2.62	Pass	

Dwelling mechanical ventilation rates

Minimum Part F ventilation rates have been calculated and presented in the Table T3.1a-b below. A maximum of 4.0 ach beyond the minimum Part F ventilation rates is required to assist in overheating mitigation for the dwellings on the sensitive noise façades of Block C (Table T3.2).

Table T3.1a: Capacity of mechanical system for Minimum Part F requirements						
Dwelling	B1.2.9 - 2bed	C1.1.5 - 2 bed	C3.5.5 - 3bed	C2.11.6- 3bed	E4.7.3- 1bed	
Floor Area (m²)	71.67	72.16	77.58	94.96	50.43	m ²
Storey height (m)	2.5	2.5	2.5	2.5	2.5	m
Volume (m³)	179.175	180.4	193.95	237.4	126.075	m ³
		Minimun	n high rate (l/	/s)		
Kitchen	13	13	13	13	13	l/s
Utility cupboard	8	8	8	8	8	l/s
Bathroom 1	8	8	8	8	8	l/s
Bathroom 2		8		8		l/s
Toilet						l/s
Boost rate (l/s)*	29	37	29	37	29	l/s
Whole dwelling ventilation rate (m³/hr)	104.4	133.2	104.4	133.2	104.4	m³/hr
Air change Rate (ach)	0.58	0.74	0.54	0.56	0.83	ach
* Maximum whole dwelling extract ventilation rate						



Table T3.1b: Capacity of mechanical system for Minimum Part F requirements					
Dwelling	E3.7.2 -3 bed	E1.11.1- 3bed	E6.0.2 House		
Floor Area (m²)	87.06	94.96	160.6		m ²
Storey height (m)	2.5	2.5	2.5		m
Volume (m³)	217.65	237.4	270.08		m³
		Minimun	n high rate (l	/s)	
Kitchen	13	13	13		l/s
Utility cupboard	8	8	8		l/s
Bathroom 1	8	8	16		l/s
Bathroom 2	8	8	16		l/s
Toilet					l/s
Boost rate (l/s)*	37	37	53		l/s
Whole dwelling ventilation rate (m³/hr)	133.2	133.2	190.8		m³/hr
Air change Rate (ach)	0.61	0.56	0.71		ach

Table T3.2: Capacity of mechanical system for 4.0 ACH on sensitive noise facades						
Dwelling	C1.1.5 - 1 bed	C2.11.6- 3bed				
Floor Area (m²)	72.16	94.96	m ²			
Storey height (m)	2.5	2.5	m			
Volume (m³)	180.4	237.4	m^3			
Minimum high rate (l/s)	Minimum high rate (l/s)					
Kitchen	13	13	l/s			
Utility cupboard	8	8	l/s			
Bathroom 1	8	8	l/s			
Bathroom 2	8	8	l/s			
Toilet			l/s			
Boost rate (l/s)*	200.4	263.8	l/s			
Whole dwelling ventilation rate (m³/hr)	721.6	949.6	m³/hr			
Air change Rate (ach)	4.00	4.00	ach			
* Maximum whole dwelling extract ventilation rate						



GHA Early Stage Overheating Risk Tool Scoresheet

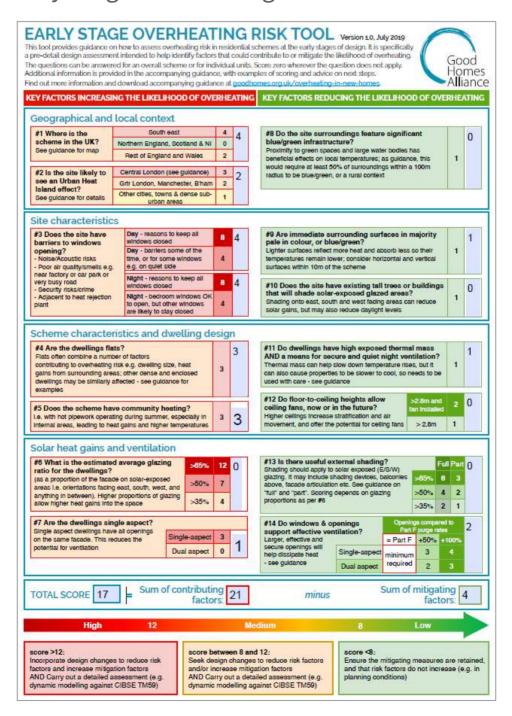


Figure T4.1. GHA overheating scoresheet for Phase 1 - Block C with noise constraints.

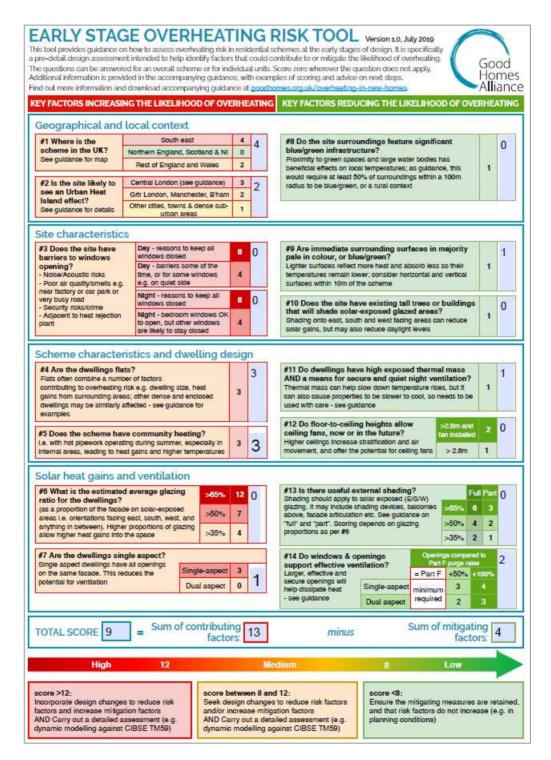


Figure T4.2. GHA overheating scoresheet for Phase 1 - Blocks B & E without noise constraints.



Blinds mark-up



Figure T5.1. Block C1, east elevation. Windows that require blinds are marked up in blue (Patel Taylor drawings 23.10.2020).



Figure T5.2. Block C1, west elevation. Windows that require blinds are marked up in blue (Patel Taylor drawings 23.10.2020).

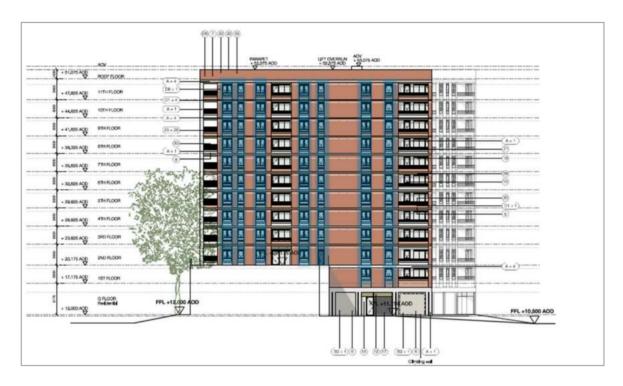


Figure T5.3. Block C2, east elevation. Windows that require blinds are marked up in blue (Patel Taylor drawings 23.10.2020).

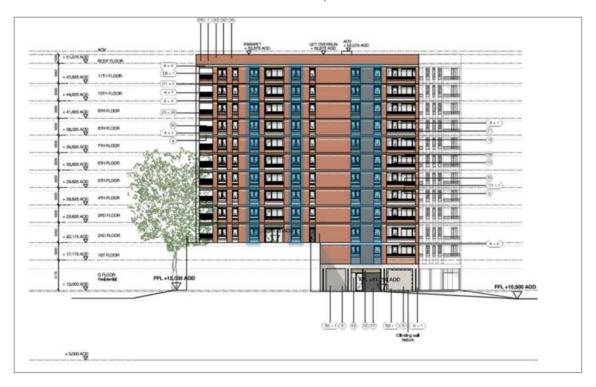


Figure T5.4. Block C2, west elevation. Windows that require blinds are marked up in blue (Patel Taylor drawings 23.10.2020).





Figure T5.5. Blocks C1 & C2, west elevation. Windows that require blinds are marked up in blue (Patel Taylor drawings 23.10.2020).

Results of DSY1 without blinds

Table below shows the results of the overheating assessment for the selected dwellings on the sensitive noise facades in Block C without the use of internal blinds.

Table T6.1: Dwellings TM59 overheating results for DSY1 2020s without blinds					
Unit	Room	TM59 Criterion A: Hours of exceedance (pass<3%)	TM59 Criterion B: Bedroom temperature hours >26°C (pass<32)	Overall compliance with TM59	
		% Hours of overheating	Hours of overheating		
	Bedroom 1 Single	0.12	35.33	Fail	
C1.1.5 2B3P	Bedroom 2	0.34	36.17	Fail	
	Living/Kitchen/Dining	0.36	N/A	Pass	
C2.11.6 3B5P	Bedroom 1	0.00	15.17	Pass	
	Bedroom 2	0.00	33.83	Fail	
	Bedroom 3 Single	0.00	33.67	Fail	
	Living/Kitchen/Dining	0.10	N/A	Pass	



Appendix F Whole Life Cycle Carbon Assessment





Whole Life Cycle Carbon Emissions Assessment Cambridge Road (RBK) LLP

Cambridge Road Estate

Final

Zeta WatkinsBSc (Hons), MSc, CEnv, MIEMA

October 2020



DOCUMENT CONTROL RECORD

REPORT STATUS: FINAL

Version	Date	Reason for issue	Author	Checked by	Approved for Issue by Project Manager
v.1	02.10.2020	Draft	ZW	KP	ND
v.2	27.10.2020	Final	ZW	ND	ND

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Our team of technical specialists offer advanced levels of expertise and experience to our clients. We have a wide experience of the construction and development industry and tailor teams to suit each individual project.

We are able to advise at all stages of projects from planning applications to handover.

Our emphasis is to provide innovative and cost-effective solutions that respond to increasing demands for quality and construction efficiency.

This report has been prepared by Hodkinson Consultancy using all reasonable skill, care and diligence and using evidence supplied by the design team, client and where relevant through desktop research.

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Executive Summary

The purpose of this Whole Life Cycle Carbon Emissions (WLCCE) assessment is to demonstrate that the proposed Cambridge Road Estate development by Cambridge Road (RBK) LLP in the Royal Borough of Kingston upon Thames, has taken actions to reduce embodied carbon where possible. This is an initial assessment based on the best available information to date.

The hybrid planning application comprises Plots B, C and E (Detailed) and Plots A, D, F-H, J-N and Q (Outline) – both are included in this assessment.

Whole Life-Cycle Carbon (WLC) emissions are the carbon emissions resulting from the construction and the use of a building over its entire life, including its demolition and disposal. They capture a building's operational carbon emissions from both regulated and unregulated energy use, as well as its embodied carbon emissions, i.e. those associated with raw material extraction, manufacture and transport of building materials, construction and the emissions associated with maintenance, repair and replacement as well as dismantling, demolition and eventual material disposal. It provides a picture of a building's carbon impact on the environment

At this stage of the design a baseline energy model of embodied carbon has been created using generic data and estimates the total carbon emissions to be **319 kg CO₂e/m² GIA** over 60 years, this however does not account for the operational energy and water use, as per GLA requirements. When these are included the total emissions are **664 kgCO₂/m² GIA over 60 years**.

The proposed development is exceeding both the WLC Benchmark set by the GLA and the Aspirational Benchmark, thus demonstrating a sustainable design.

A set of high-level observations are set out in the report which could be considered at detailed design stage. As the GLA guidance is not yet adopted, or the associated methodology consulted upon, these serve to inform the design team on best practice in the design.



CONTENTS

	Executive Summary	3
1.	INTRODUCTION	5
2.	POLICY AND REGULATIONS	5
3.	DEVELOPMENT OVERVIEW	7
4.	WHOLE LIFE CYCLE CARBON EMISSIONS ASSESSMENT	10
5.	METHODOLOGY	11
	Operational Carbon	11
	Embodied Carbon	12
6.	GENERAL OBSERVATIONS	14
7.	WHOLE LIFE CYCLE CARBON RESULTS	16
8.	HIGH LEVEL OBSERVATIONS	19
9.	CONCLUSION	20

1. INTRODUCTION

- This Whole Life Cycle Carbon Emissions (WLCCE) Assessment has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development, appointed by Cambridge Road (RBK) LLP.
- 1.2 The purpose of a WLLCE assessment is to demonstrate that the proposed development at Cambridge Road Estate in the Royal Borough of Kingston upon Thames, has taken actions to reduce embodied carbon where possible. This is an initial assessment based on the best available information to date.
- 1.3 This assessment will aim to help the design team understand, at concept design stage, the lifetime consequences of their design decisions.

2. POLICY AND REGULATIONS

Intend to Publish London Plan (2019)

- The Panel of Inspectors report into the draft London Plan was published in October 2019. The Mayor considered the Inspectors' recommendations and, in December 2019, issued to the Secretary of State the Intend to Publish London Plan. The Secretary of State responded to this in March 2020 and the Mayor is now considering the Secretary of State's response and taking the steps to finalise the plan.
- The following policies are proposed in the Intend to Publish London Plan are considered relevant to the proposed development and this Statement:

2.3 Policy SI 2 Minimising Greenhouse Gas Emissions, states:

'Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions:

Operational carbon emissions will make up a declining proportion of a development's whole life-cycle carbon emissions as operational carbon targets become more stringent. To fully capture a development's carbon impact, a whole life-cycle approach is needed to capture its unregulated emissions (i.e. those associated with cooking and small appliances), its embodied emissions (i.e. those associated with raw material extraction, manufacture and transport of building materials and construction) and emissions associated with maintenance, repair and replacement as well as



dismantling, demolition and eventual material disposal). Whole life-cycle carbon emission assessments are therefore required for development proposals referable to the Mayor. Major non-referable development should calculate unregulated emissions and are encouraged to undertake whole life-cycle carbon assessments. The approach to whole life-cycle carbon emissions assessments, including when they should take place, what they should contain and how information should be reported, will be set out in guidance'.

- 2.4 The above policy explains that referable schemes, submitted following adoption of the new London Plan will be required to carry out a WLCCE assessment. The methodology for demonstrating compliance is out in draft and will be consulted upon on following publication of the new London Plan. The draft highlights that project could be required to report at preapplication, planning and post-completion stages.
- 2.5 This assessment would form a part of the concept design and inform the design and material choices through the course of the project rather than appear as an afterthought later in the design.

Local Policy: Royal Borough of Kingston Upon Thames

- 2.6 The Royal Borough of Kingston Upon Thames' Core Strategy document was adopted in April 2012. The following policies are considered relevant to this Statement:
- **2.7 Policy CS1 Climate Change Mitigation**: All development must be designed and built to make the most efficient use of resources, reduce its lifecycle impact on the environment and contribute to climate change mitigation and adaptation by:
 - > Reducing CO₂ emissions during construction and throughout the lifetime of the development;
 - > Building to the highest sustainable design and construction standards;
 - > Minimising water consumption;
 - > Using sustainable materials;
 - > Reducing levels of pollution, air, water noise and light; and
 - > Planning for increased flood risk.
- Policy DM1 Sustainable Design and Construction Standards: The Council will require all new residential developments to achieve successively higher levels of the Code for Sustainable Homes Level category for energy/CO₂. New development should minimise air, noise and contaminated land impacts in line with industry best practice. Development proposals for contaminated land should include remediation measures. The Council will promote good carbon management by monitoring CO₂ emissions to ensure the development is operated within the CO₂ emissions standards of the as-built specification and those outlined within the Council's Sustainable Design

- and Construction SPD. Measures to ensure these standards are maintained will be monitored by the Council.
- 2.9 Where appropriate, other new build developments over 500 m² are encouraged to achieve higher levels of the appropriate BREEAM standard.
- 2.10 Since the publication of the Royal Borough of Kingston Upon Thames' Core Strategy Document in April 2012, the Code for Sustainable Homes was formally wound down following a technical housing standard review. This was announced by the Ministerial Statement by Rt. Honourable Eric Pickles on 25th March 2015 and the Government withdrew the Code for Sustainable Homes on 22nd April 2015.

Guidance Documents

- 2.11 Preliminary guidance has been released by the Greater London *Authority "Whole Life-Cycle Carbon Assessments guidance April 2020"*. It outlines how to prepare a WLCCE assessment which should accompany all referable planning applications in line with London Plan Policy SI 2. This document is currently out for consultation but has been used and referenced throughout this assessment.
- **2.12** In addition, the following guidance is available to conduct assessments:
 - > **BS EN 15978:2011 -** Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method.
 - > **ISO 14040:2006 -** Environmental management Life cycle assessment Principles and framework.
 - > RICS Professional Statement Whole life carbon assessment: 2017 Whole life carbon assessment for the built environment.

3. DEVELOPMENT OVERVIEW

Site Location

3.1 The proposed development site at Cambridge Road Estate in the Royal Borough of Kingston upon Thames is approximately 9 hectares and is located to the immediate south of the A2043 Cambridge Road and Hawks Road, as shown in Figure 1 below.





Figure 1: Site Location - Map data © 2020 Google

3.2 The land use in the immediate vicinity of the site is predominantly residential and of a domestic suburban character and scale. Cambridge Road Estates was built in the late 1960s and early 1970s and currently comprises 832 residential homes; Hawks Road Clinic within the northwest of the site; The Bull and Bush Hotel within the west of the site; and Piper Community Hall within the south of the site. The site also includes small formal and informal play spaces and ground level car parking areas.

Proposed Development

3.3 The proposed development is described as follows:

"Hybrid Outline Planning Application for a mixed use development, including demolition of existing buildings and erection of up to 2,170 residential units (Use Class C3), 290sqm of flexible office floorspace (Use Class E), 1,395sqm of flexible retail/commercial floorspace (Use Class E/Sui Generis), 1,250sqm community floorspace (Use Class F2), new publicly accessible open space and associated access, servicing, landscaping and works.

Detailed permission is sought for access, layout, scale, appearance and landscaping of Phase 1 for erection of 452 residential units (Use Class C3), 1,250sqm community floorspace (Use Class F2), 290sqm of flexible office floorspace (Use Class E), 395sqm of flexible retail/commercial floorspace (Use Class

E/Sui Generis), new publicly accessible open space and associated access, servicing, parking, landscaping works including tree removal, refuse/recycling and bicycle storage, energy centre and works ("the Proposed Development")."





Figure 2: Proposed Masterplan Layout - Patel Taylor (October 2020)

BREEAM

- 3.5 BREEAM New Construction 2018 is being used to assess the commercial units. This is an assessment method to ensure best environmental practice is incorporated in the planning, design, construction and operation of commercial buildings and the wider built environment.
- There are specific credits within BREEAM that aim to reduce the burden on the environment from construction products by recognising and encouraging measures to optimise construction product consumption efficiency and the selection of products with a low environmental impact (including embodied carbon), over the life cycle of the building.
- 3.7 It is anticipated that the BREEAM assessment for the shell only commercial units will seek to achieve these credits.



4. WHOLE LIFE CYCLE CARBON EMISSIONS ASSESSMENT

- 4.1 Undertaking WLCCE assessments is a way to fully understand and minimise the carbon emissions associated with building designs over the entire life cycle of the building. This will be done at the proposed development in order to quantify the carbon dioxide emissions that will be released from the proposed development, considering not only operational and embodied emissions but also demolition, construction, and refurbishment/replacement cycles.
- The new draft London Plan has proposed a requirement for all new referable developments to calculate and reduce WLCCE, this is both embodied and operational carbon:
 - > **Operational carbon** is the energy required to heat and power a building during use;
 - > **Embodied carbon** is the carbon that is released in the manufacturing, production, and transportation and construction of the building materials used.
- 4.3 In addition to the two metrics above there are additional life cycle stages that are considered during WLLCE assessments, these include demolition, end of life and refurbishment/replacement cycles.
- 4.4 The two metrics (operation and embodied) and the additional life cycle stages, as noted above, have been included in this but additional information will be required as the design progresses to ensure the assessment can give valuable results.
- 4.5 Undertaking a WLCCE assessment provides a full overview of the material and building environmental impacts of a building using science-based metrics (e.g. Global Warming Potential). It also identifies the overall best combined opportunities for reducing lifetime emissions, and also helps to avoid any unintended consequences of focusing on operational emissions alone.
- 4.6 A low carbon building is one that optimises the use of resources both to build it and to use it over its lifetime. The assessment will help the design team understand, at design stage, the lifetime consequences of their design decisions. This promotes durability, resource efficiency, reuse, and future adaptability, all of which contribute to life-time carbon reductions.

5. METHODOLOGY

- This is an initial assessment based on the best available information which will need to be updated as the project progresses. WLCCE assessments are sensitive to changes in design and specification and therefore detailed design will impact the results as the schemes progress.
- As detailed information is not yet available a baseline figure has been determined through the use of a carbon designer tool available on One Click. The Carbon Designer tool allows very quick baseline building creation with minimal knowledge about the project and allows optioneering choices and their impacts easily. Based on this we can provided some high-level observations that could reduce the embodied emissions.
- As the design progresses into the detail stages, the embodied emissions associated with the development can be developed and refined with bespoke recommendations made. In the interim, the estimated emissions associated with the operational energy of the development are reported, with metric of potential methods to alter these during detail design.

Operational Carbon

- 5.4 Operational energy is the inputted energy required for all heating and power needs. It can be split into two variants:
 - > **Regulated Emissions** which are assessed using the Government's approved methodology for Building Regulations Part L compliance, the Standard Assessment Procedure (SAP); and
 - > **Unregulated Emissions** energy use as a direct result of user behaviour. This includes cooking, white goods (fridges, washing machines etc), and plug in electrical loads (televisions, laptops, lamps etc).
- Both of the above elements will be accounted for in this WLCCE assessment. For clarity, as unregulated energy demands are largely reliant on the behaviour of occupants, they have been considered a fixed entity in the calculations.

Residential

The estimated energy demand for the residential portion of the development has been calculated using the Standard Assessment Procedure 2012 methodology. SAP calculates the Regulated energy demand for residential dwellings.



- 5.7 SAP calculations have been carried out for representative dwelling types (for the detailed component of the development). These encompass ground, mid, and top floor flats and represent a fair aggregation of the expected unit mix of the development.
- In order to calculate the energy demands across the entire scheme, the current accommodation schedule has been used to extrapolate the results from the modelled units. This has been done for both the detailed and outline parts of the application.
- The Unregulated energy demands for the residential units have been calculated using the methodology outlined in the SAP 2012 document. This calculates the CO₂ emissions associated with appliances and cooking.

Non-Residential

- The estimated energy demand for the non-residential elements of the development has been calculated using Simplified Building Energy Model (SBEM) software, using the National Calculation Method (NCM 2013 Edition). SBEM calculates the Regulated energy demands associated with hot water, space heating and fixed electrical items, as well as Unregulated energy demands.
- 5.11 Sample SBEM calculations have been carried out on example units of the expected use types for the Proposed Development. For the outline scheme, these are not fixed, but sample calculations have been extrapolated in order to gain energy demand estimates for the whole scheme. At present, these have not been included in the WLLCE assessment. The completion of the SBEM modelling is not likely to increase the operational carbon of the development as they are being constructed to a shell only specification.

Embodied Carbon

5.12 Embodied carbon is the sum of Green House Gas (GHG) emissions resulting from the mining, harvesting, processing, manufacturing, transportation, and installation of building materials.

One Click LCA

5.13 OneClick LCA is the software that has been used to conduct the WLCCE assessment. This is a web based approved tool for WLCCE assessments and design software for buildings and infrastructure. It consists of a large database of generic and average Life Cycle Indicator (LCI) data, and global Environmental Product Declaration (EPDs). The most suitable option for each material (where available) was chosen from the database in OneClick. The material LCI data has been chosen to be representative of the typical UK supply chain.

- The OneClick LCA default values for distances travelled to site for the construction materials were used for each material item. More specific values will be used when the assessment is re-run once the design of the development has progressed further.
- **5.15** The following life cycle stages are included within the assessment as standard:
 - > A1 A3 This includes all construction materials;
 - > A4 This includes all transportation to site;
 - > **A5** This includes all construction site impacts;
 - > **B3 B5 -** This includes the repair, refurbishment, and replacement of building elements;
 - > **B6 B7 -** This includes use the energy, and water;
 - > **C1 C4 -** This includes the end of life scenarios for building elements.
- 5.16 As noted above, the One Click Carbon Designer tool has been used to determine the baseline embodied emissions as a building model is not yet available. As the design develops, we will update and refine the tool to reflect the quantity and types of materials being used.

Construction Impacts

- In addition to embodied carbon in the materials used for construction, GHG emissions will be created by transportation of materials to site and operation of onsite plant and machinery. These emissions are typically materially smaller than embedded GHG emissions. Guidance from the Building Research Establishment (BRE) indicates 1,400 kg of CO₂e per £100,000 of project value.
- 5.18 The project value has been provided by the Applicant, which would result in construction transport GHG emissions of 8,265 tonnes of CO₂e.

Study Period

- 5.19 The reference study period (RSP) for domestic projects is 60 years, this is based on the principles outlined in BS EN 15978: 2011, section 7.3 and the RICS guidance.
- **5.20** RSPs are fixed to enable comparability between whole life carbon results for different projects. It ensures that the assessment is representative of typical service life of different building elements.

Data Sources

The assessment has utilised multiple data sources described above and is based on the level of detail available at the current stage of design. The following data sources have been used to complete the WLCCE assessment:



Table 1: Data Sources

Data	Data source
Operational energy	SAP and SBEM Energy calculations – Hodkinson Consultancy
Construction site impacts	Project value provided by applicant and baseline target provided by BRE
Material types and volumes	Information provided by Patel Taylor on 22 nd September 2020
Transport data	RICS guidance
Building areas	212,199m² taken from accommodation schedules

6. GENERAL OBSERVATIONS

Green Infrastructure

- 6.1 It is known that green roofs will be installed, these are considered effective in the reduction of CO₂ (when greater than 1000 m² in size) because of their ability to reduce energy consumption of buildings and sequester carbon in plants and substrate.
- The installation of green roofs typically contains less embodied energy than that of traditional roof systems. Typical roof systems have an expected lifespan of 30 years (RICS Guidance), the implementation of a green roof extends the roof's lifetime beyond this.
- The landscaping strategy is currently proposed to be a mix of both soft and hard landscaping as demonstrated in Figure 3. In order to reduce the embodied carbon of the hard landscaping any demolished concrete should be crushed on-site and potentially used a subbase to reduce the overall embodied carbon of the landscaping.



Figure 3: Hard and soft landscaping (Patel Taylor, 2020)

- Plants and trees capture and store carbon dioxide emissions from the atmosphere, this is known as sequestering carbon dioxide emissions. The development proposal increases the available flora and fauna through a net increase trees and provision of green and brown roofs. Trees have been included within the One Click Assessment under the 'carbon sequestration' section.
- Based on research papers by the Natural Environment Research Council Centre for Ecology and Hydrology (formerly Institute of Terrestrial Ecology) and referenced papers by The Royal Institution of Chartered Surveyors (RICS). The trees and green and brown roof proposed will sequester an additional ~26,000 kgCO₂.

Building Materials

5.6 The construction of the proposed development is likely to be reinforced concrete framed buildings. The efficient stacking of floor plates will allow for efficiency in design and mitigate the risk of over engineering and excessive material use.

Building Heights and Form

Apartment blocks up to 13 storeys high are proposed at Cambridge Road Estate. High-rise buildings, like those in this proposed development, gain efficiency in the ratio of envelope to gross floor area because while each floor will typically have a similar amount of façade, the environmental impact of the roof and ground floor is divided by the number of floors – the more floors the better in this respect.



- The avoidance of overly complex building forms and junction designs across the site offers a more consistent and reliable standard of construction which will assist in air tightness and reducing the impact of heat loss through thermal bridges.
- It is proposed that the developer will engage Countryside Properties as its Construction Manager. They have a track record of limiting and diverting waste to landfill. In 2018 they diverted 99.4% of the waste. This means materials are used efficiently. Where possible and safe to do so, recycled materials are used. These actions reduce the embodied energy of the development.
- The Cambridge Road Estate will total around 2,170 new dwellings which is an increase over the existing number of dwellings on the development. This improves the efficiency of how the land is used. Efficient land use along with the developer's record on waste diversion will help to reduce the embodied energy associated with the development further.

Zero Carbon

- As of 1st October 2016, London Plan Policy requires that all major residential developments are subject to an additional offset payment to meet a 100% reduction in Regulated CO₂ emissions to achieve the standard of Zero Carbon. This payment is made to the local borough's Carbon Offsetting Fund and is expected to be allocated to carbon reduction savings elsewhere in the borough.
- As set out in the Energy Statement provided by Hodkinson Consultancy the site is meeting the Greater London Authority's (GLA) definition of Net Zero Carbon. Based on this, the operational emissions can be set as zero for the first thirty years when finalising the assessment once the design is more progressed.

7. WHOLE LIFE CYCLE CARBON RESULTS

Benchmark Comparison

7.1 The results when compared to the GLA benchmark values are shown in Table 2 below:

Table 2: Whole Life Carbon Baseline (GLA Guidance)

	Project kg CO₂/m² GIA	WLC Benchmark kg CO₂e/ m² GIA	Aspirational Benchmark kg CO₂e/ m² GIA
Modules A1 – A5	264	750 to 850	450 to 500
Modules B – C (excluding B6 and B7)	55	300 to 400	180 to 240

- 7.2 It must be noted that no benchmark has been set by the GLA for operational and energy use (life cycle stages B6-B7) due to insufficient data at present. The results for these have therefore been omitted from the totals above. The total is therefore 319kgCO₂/m² GIA over 60 years.
- 7.3 When these emissions are included in the calculation the total emissions are expected to be 664 kgCO₂/m² GIA over 60 years.
- 7.4 It is important to note that baseline data (via the Carbon Designer) has been used for building elements and no services or external areas have been included in this iteration of the WLLCE assessment and therefore the comparison to the baseline above is not yet conclusive.
- 7.5 The proposed development is exceeding both the WLC Benchmark set by the GLA and the Aspirational Benchmark, thus demonstrating a sustainable design.

Results

7.6 Once all of the data (including the baseline data for embodied energy) was inputted into One Click LCA, the results for both the outline and detailed applications are as follows:

Table 3: One Click LCA Results

Category	Global warming potential	Total kgCO₂e over 60 years
A1-A3	Construction Materials	52,770,194
A4	Transport	1,686,700
A5	Site operations	1,563,381
В3	Repair	0
B4	Replacement	7,815,140
B6-B7	Operational energy and water use	74,334,057
C1-C4	Re-use, recycling, or disposal	3,796,906
	Total	140,966,378

7.7 Preliminary SAP and SBEM modelling have allowed us to provide a good estimate of the predicted operational emissions associated with the proposed development.



7.8 As demonstrated in Figure 4 below, categories B6 and B7 (operational energy and operational water use) are the highest contributors to the overall emissions.

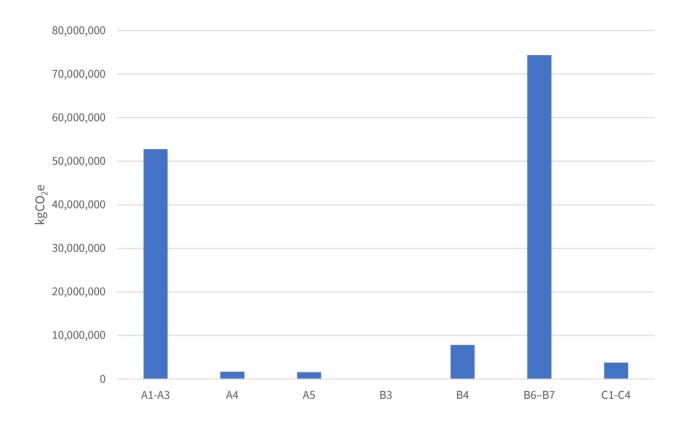


Figure 4: Total kgCO₂e - Life Cycle Stages

- 7.9 The operational energy and water use (B6 and B7) make up 52% of the overall emissions for the proposed development whilst materials (A1 A3) make up 37.5% of the overall emissions.
- **7.10** Of the materials used in the proposed development concrete is expected to emit the most kgCO₂e, followed by metals. A more detailed breakdown is provided in Figure 5 below.

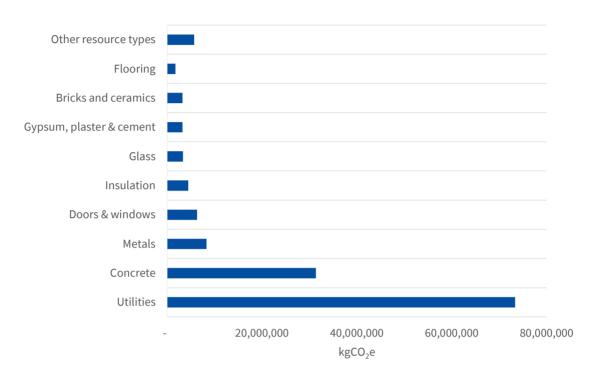


Figure 5: Total kgCO2e - Resource Types

8. HIGH LEVEL OBSERVATIONS

- A set of high-level observations are set out below that could be considered as a part of the detail design post planning.
- **1.2** These are presented from the perspective of embodied carbon and life cycle only and must be considered alongside other design considerations by other members of the design team.
 - > To maximise the opportunities arising from the potential demolition of the existing site, **a pre-demolition audit** could be undertaken as part of the Construction Method Statement. This would identify and quantify the materials to encourage and maximise reuse and recycling.; for example, all demolished concrete can be crushed on-site and used onsite as hard core, fill, or in landscaping.
 - > The **future demolition and deconstruction** of the development could be considered at the design stage. Consideration to be given to ways to facilitate dismantling, such as keeping the use of welding to a minimum (although it is acknowledged this may not always be possible);



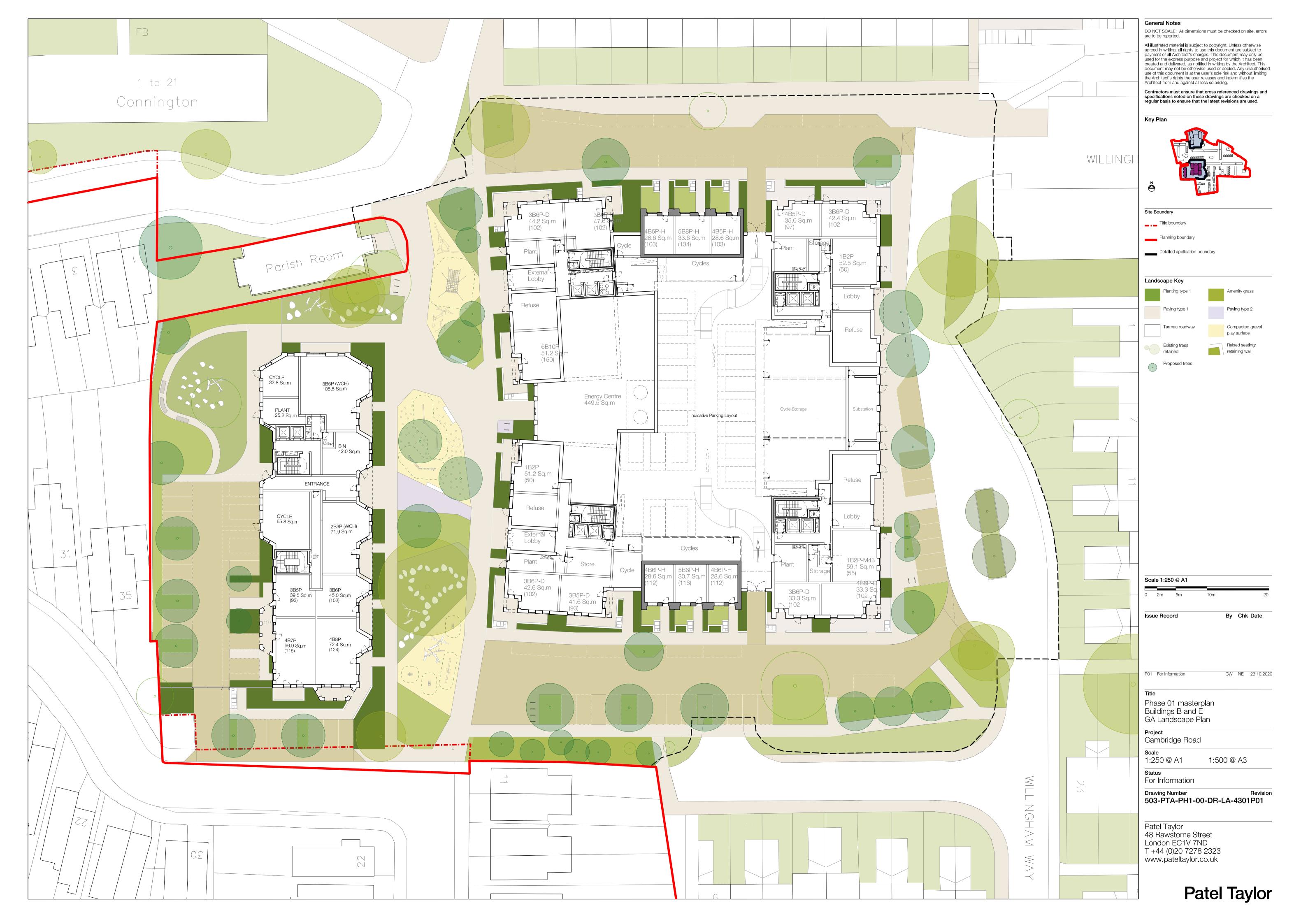
- > Similarly, a **maintenance and repair schedule** could also be produced during the design life of the development to ensure that materials and pieces of equipment are able to remain in situ during their expected lifespan. This will minimise the need to replace and refurbish and reduce emissions under life cycle stages C1-C4.
- > **Using concrete as a finish** can reduce the need for other finishing materials. In addition, exposed areas of concrete can optimise the thermal mass performance. Thermal mass, with adequate ventilation, can be used to control daytime peak temperatures of a space and therefore reduce or minimise the need for air-conditioning. The areas where this can be done would need to be carefully considered. The durability of concrete also offers further potential savings through a reduction in the need for maintenance and repair (compared to a painted finish for example).
- > The transportation of materials from the manufacturing facility to the building site adds to the carbon of the development. **Buying from local sources** or **utilising off-site manufacturing processes** could help reduce the emissions produced during transportation. There is a balance to be struck between material transport and processes deployed in their manufacture. As such details on this cannot be known until the detailed design phase. This review would have impacts under life cycle A4, emissions from transportation to site.
- > **Innovative cement mixes** are now increasingly available, using a mixture that is 95% ground granulated furnace slag (GGBS) and 5% as the activator can save up to 90% in emissions. This cement mixture could be investigated further for use at the appropriate stage, and if suitable could be used for building elements such as piles, floors, walls, and reinforced foundations. If implemented this could facilitate the reduction of life cycle stages A1-A3 (materials) quite significantly.
- > The façade is under constant wear from the environment which can lead to frequent repairs and maintenance. By using **durable materials**, this not only reduces the cost and frequency of refurbishment but also reduces the use of material replacement and its associated carbon footprint.

9. CONCLUSION

- The purpose of this Whole Life Cycle Carbon Emissions (WLCCE) assessment is to demonstrate that the proposed Cambridge Road Estate development by Cambridge Road (RBK) LLP in the Royal Borough of Kingston upon Thames, has taken actions to reduce embodied carbon where possible. This is an initial assessment based on the best available information to date.
- The hybrid planning application comprises Plots B, C and E (Detailed) and Plots A, D, F-H, J-N and Q (Outline) both are included in this assessment.

- 9.3 Whole Life-Cycle Carbon (WLC) emissions are the carbon emissions resulting from the construction and the use of a building over its entire life, including its demolition and disposal. They capture a building's operational carbon emissions from both regulated and unregulated energy use, as well as its embodied carbon emissions, i.e. those associated with raw material extraction, manufacture and transport of building materials, construction and the emissions associated with maintenance, repair and replacement as well as dismantling, demolition and eventual material disposal. It provides a picture of a building's carbon impact on the environment
- 9.4 At this stage of the design a baseline energy model of embodied carbon has been created using generic data and estimates the total carbon emissions to be 319 kg CO2e/ m2 GIA over 60 years, this however does not account for the operational energy and water use, as per GLA requirements. When these are included the total emissions are 664 kgCO2/m2 GIA over 60 years.
- **9.5** The proposed development is exceeding both the WLC Benchmark set by the GLA and the Aspirational Benchmark, thus demonstrating a sustainable design.
- 9.6 A set of high-level observations are set out in the report which could be considered at detailed design stage. As the GLA guidance is not yet adopted, or the associated methodology consulted upon, these serve to inform the design team on best practice in the design.

Appendix G Indicative Energy Centre Layouts (GA / Section)





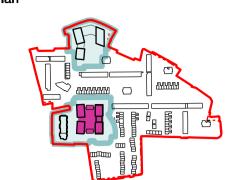
General Notes

DO NOT SCALE. All dimensions must be checked on site, errors

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Contractors must ensure that cross referenced drawings and specifications noted on these drawings are checked on a regular basis to ensure that the latest revisions are used.

Key Plan



Material key (Building E)

Brick type A (White brick)
Brick type B (Buff)
B1. Brick type B1 (Buff 1)
B2. Brick type B2 (Buff 2)
B3. Brick type B3 (Buff 3)
B4. Brick type B4 (Buff 4)
Brick type C (Dark plinth)
Brick type D (Red brick)
D1. Brick type D1 (Red 1)
D2. Brick type D2 (Red 2)
D3. Brick type D3 (Red 3)
D4. Brick type D4 (Red 4)
D5. Brick type D5 (Red 5)

Stretcher bond brickwork Soldier course brickwork

Stack bond brickwork
Bonded soldier course brickwork Projecting stepped basketweave brickwork Recessed brickwork Rusticated brickwork

Projecting header brickwork pattern Striped band brickwork

Precast string course Precast entrance canopy and surround 12. PPC metal cladding system, mid bronze-coloured.

Diamond pattern
PPC perforated mid bronze-coloured metal canopy system PPC dark bronze-coloured metal surround to double

PPC metal faced outward opening top-hung reversible window. Dark bronze-coloured. Single, double or triple paned windows as drawn.
Integrated ventilation panel with PPC metal perforated

Precast sill Brick sill Metal sill flashing

PPC metal perforated screen door PPC metal faced dark bronze-coloured external door 22. Timber faced external door system

PPC metal balcony balustrade. Metal flats. 40mm metal ats @ 100mm centres. 75mm brick balustrade topped with metal pickets.

10mm square roots @ 100mm centres.
PPC perforated metal balustrade. Nom. 50% free area.
Refer to DAS Volume 2 Chapter 6 for perforation pattern
1500mm high balcony balustrade (wind mitigation)

PPC metal, dark bronze-coloured fascia and soffit PPC metal, mid bronze-coloured fascia and soffit PPC metal, light bronze-coloured fascia and soffit 30. Rendered soffit to match brickwork colour

Metal coping Precast coping Brick parapet

Metal parapet Bio-diverse roof with PV panels

37. Decorative PPC dark brongates.38. Free standing brick wall

Scale 1:250 @ A1

By Chk Date

P02 For Information
P01 For Information

Building E

Section Elevations G-G, H-H

Cambridge Road 1:250 @ A1 1:500 @ A3

For Information

Key Plan

Drawing Number Revisio 503-PTA-EZ-ZZ-DR-A-1922 P02

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