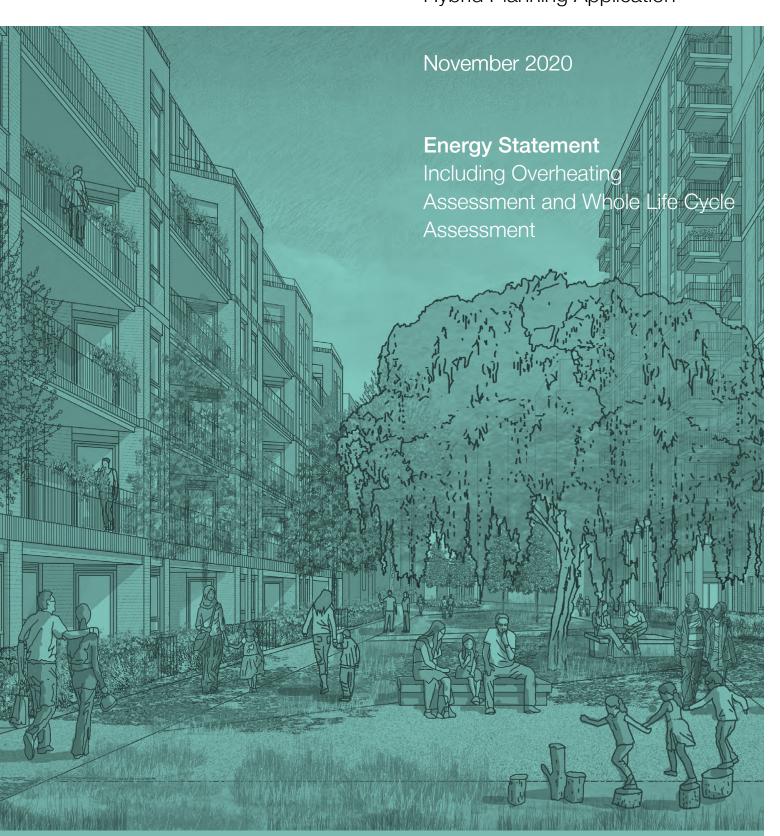
Cambridge Road Estate Hybrid Planning Application









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

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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 Energy Statement is to demonstrate the commitments, key measures and CO_2 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	issions (Tonnes CO₂ per Annum)				
	Regulated	Unregulated				
Baseline: Part L 2013 Compliant Development	2,148	1,225				
After Be Lean Measures	1,860	1,225				
After Be Clean Measures	839	1,225				
After Be Green Measures	792	1,225				
Stage	Regulated Carbon Dioxide Savings					
	Tonnes CO ₂ per Annum	Percentage				
Savings from Be Lean Measures	288	13%				
Savings from Be Clean Measures	1,021	48%				
Savings from Be Green 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 Be Clean 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 Be Clean Measures	0	0%			
Savings from Be Green 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 Be Clean Measures	865	1,021	47%				
After Be Green Measures	810	55	3%				
Completive On Cite Servings			2007				
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			



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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

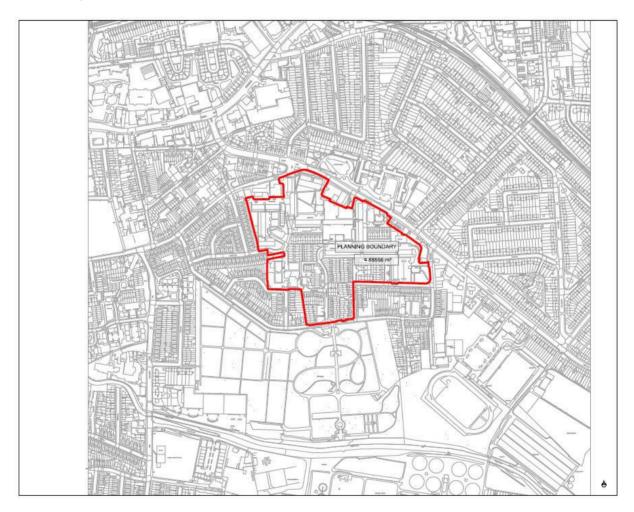


Figure 1: Site plan Courtesy of Patel Taylor

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.

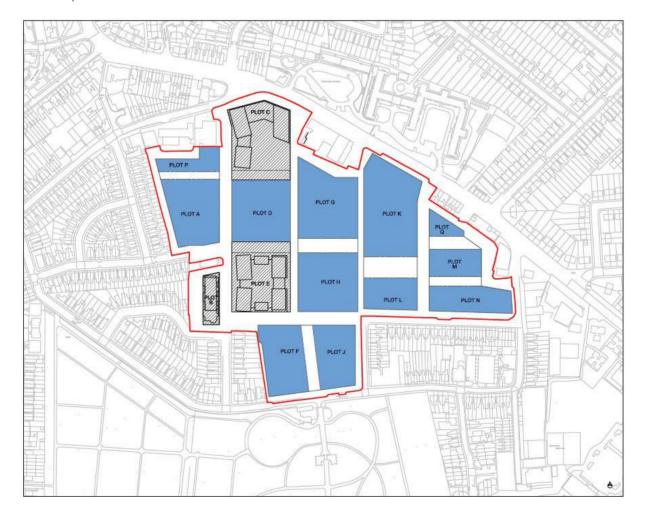


Figure 2: Proposed Masterplan Layout - Patel Taylor (October 2020)



3. RELEVANT PLANNING POLICY

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

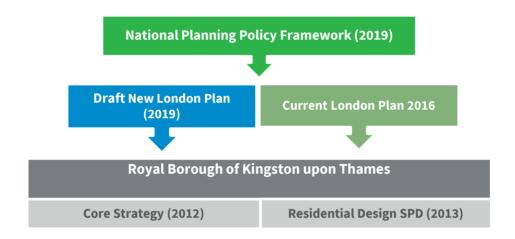


Figure 3: Relevant Planning Policy Documents

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;

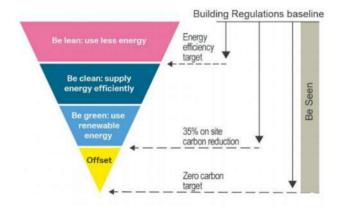


Figure 3: New London Plan Energy Hierarchy (GLA)

- > 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 £60/TCO₂.
- 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.

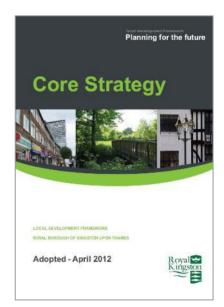
Local Policy: Royal Borough of Kingston Upon Thames

- 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)

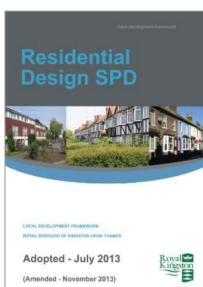
3.33 The Royal Borough of Kingston Upon Thames' Residential Design SPD document was adopted in July 2013. The following policies are considered relevant to this Statement:



- 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	Usage	SAP 10.0 Carbon D	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 between 0.45 0.50 depending on façade (confirmed in the overheating assessment).

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.

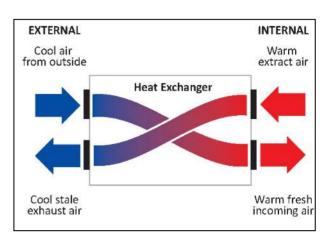


Figure 4: Mechanical Ventilation with Heat Recovery

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.

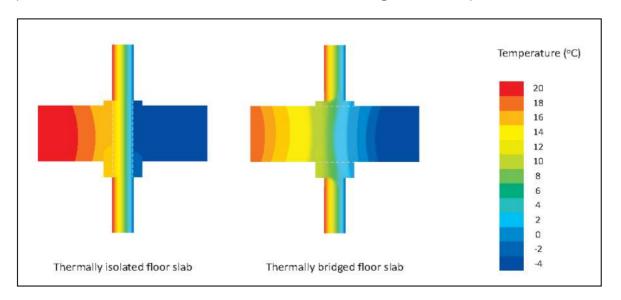


Figure 5: Thermal Bridges

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.



Tabl	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			
pe	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 Be Lean 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			
e e	After Be Lean 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.

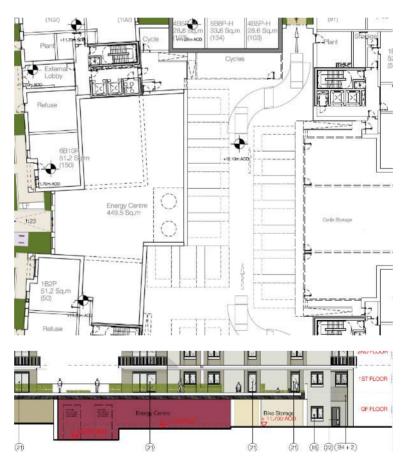


Figure 6: Block E energy centre plan and section courtesy of Patel Taylor



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.

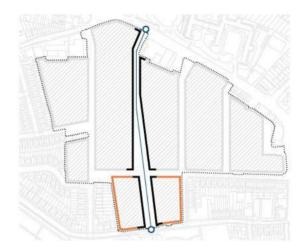


Figure 9: Safe guarded route for RBKUT DEN courtesy of Patel Taylor

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	ole 13: Regulated Carbon Dioxide Emiss	sions at <i>Be Clean</i> Stage		
	Store	SAP 10.0 Carbon Dioxide E	Emissions (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 Be Clean 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 Be Clean	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.



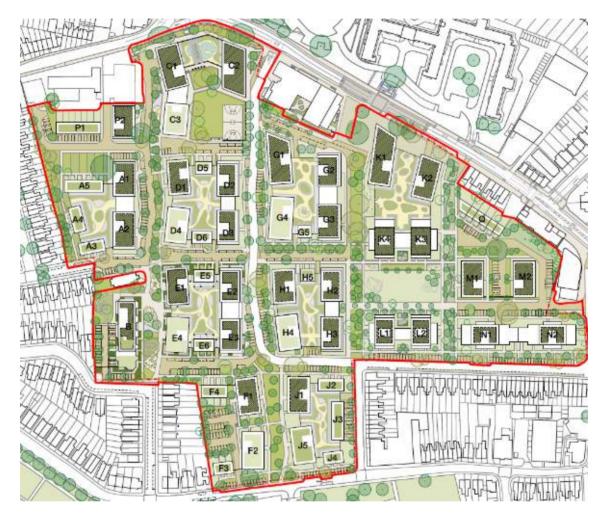


Figure 12: Indicative roof plan with PV area maximised

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.

	Chara	SAP 10.0 Carbon L	Dioxide Emissions (Tonne	es CO ₂ per Annum)
	Stage	Residential	Non-Residential	Cumulative
	Baseline	450	16	466
	After Be Lean Measures	390	13	403
0	After Be Clean Measures	176	13	189
Detailed	After Be Green Measures	166	9	175
De		202		001
	Total Emissions Reduction	283	8	291
	Percentage Reduction after Be Green	63%	47%	62%
	Baseline	1,698	16	1,714
	After <i>Be Lean</i> Measures	1,470	13	1,483
(I)	After <i>Be Clean</i> Measures	663	13	676
Outline	After Be Green 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 Be Lean Measures	1,860	26	1,886
	After Be Clean Measures	839	26	865
Entire	After Be Green 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
70	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



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.
- 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 Be Clean Measures	839	1,225
After Be Green Measures	792	1,225
Stage	Regulated Carbon	n Dioxide Savings
	Tonnes CO ₂ per Annum	Percentage
Savings from Be Lean Measures	288	13%
Savings from Be Clean Measures	1,021	48%
Savings from Be Green 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	s (Tonnes CO ₂ per Annum)
	Regulated	Unregulated
Baseline: Part L 2013 Compliant Development	33	7
After Be Lean Measures	26	7
After Be Clean Measures	26	7
After Be Green Measures	17	7
Stage	Regulated Carbon	n Dioxide Savings
	Tonnes CO ₂ per Annum	Percentage
Savings from Be Lean Measures	6	20%
Savings from Be Clean Measures	0	0%
Savings from Be Green 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	_	irbon 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 Be Clean Measures	865	1,021	47%
After Be Green Measures	810	55	3%
Cumulative On-Site Savings		4 074	C20/
Cullidative Oil-Site Saviligs		1,371	63%

Tabl	e 19 Shortfall in Regulated Carbon dioxide emis	sion 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
۵	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
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



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

The applicant show	ıld complete a	all the light blu	e cells including	information on the	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					SAF	P10 CO2 PERFORM	ANCE								
DOMESTIC E	NERGY CO	NSUMPTIC	ON AND CO2	ANALYSIS		"																					DON	MESTIC ENERG	Y DEMAND DA	TA	
Unit identifier	Model total	1 .	Total area		TION CHECK				N PER UNIT (kWh p.a							NS PER UNIT (kgCO						TED CO2 EMISSION				Fabric Energy Efficiency (FEE)			MAND PER UNIT PER		
(e.g. plot number, dwelling type etc.)	floor area		represented by model (m²)	Calculated DER 2012 (kgCO2 / m2)	DER Worksheet DER 2012 (kgCO2 / m2)	t Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)	Space Heating CO2 emissions (kgCO2 p.a.)	Domestic Hot Water CO2 emissions (kgCO2 p.a.)	Lighting CO2 emissions (kgCO2 p.a.)	Auxiliary CO2 emissions (kgCO2 p.a.)	Cooling CO2 emissions (kgCO2 p.a.)	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)	Dwelling Fabric Energy Efficiency (DFEE) (kWh/m²)	(kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
					DER Sheet (Row 384)	DER Sheet [(Row 307a) ÷ (Row 367a x	Select fuel type	DER Sheet [(Row 310a) ÷ (Row 367a x			DER Sheet (Row 313 + 331)	DER Sheet Row 315								(-6)											
1B2P - Ground Flo 1B2P - Mid Floor	50.88	17 131	869.04 6665.28	17.5 16.2	17.5 16.2	0.01)] 1468.815642 1157.631285		0.01)] 1763.843575 1760.73743	Natural Gas Natural Gas	246.61 247.99	130.8446 127.6856		317 250	381 380	128 129	68 66		894 825	308 243	370 370	57 58	30 30		767 700	15.0 13.8	44.19359212 39.61558444	1,158	1,764 1,761	247 248	131 128	
1B2P - Top Floor B 2B3P - Top Floor B 2B4P - Mid Floor	64.62	17 53 106	855.44 3424.86 7816.44	16.9 19.5 14.4	16.9 19.5 14.4	1290.100559 2756.603352 1660.960894	Natural Gas	1753.50838 1932.927374 2031.396648	Natural Gas	244.38 290.37 325.11	127.6231 187.7927 180.4729		279 595 359	379 418 439	127 151 169	66 97 94		850 1,261 1,060	271 579 349	368 406 427	57 68 76	30 44 42		726 1,096 893	14.4 17.0 12.1	41.94122884 54.95205384 38.10234839	2,757	1,754 1,933 2,031	244 290 325	128 188 180	
2B4P - Mid Floor B 3B4P - Top Floor 3B5P - Ground Flo	72.42	106 4 4	7844 289.68 416.28	14.1 16.0 15.0	14.1 16.0 15.0	1528.011173 2143.407821 3292.793296		2033.932961 2018.24581 2224.614525	Natural Gas	325.04 320.59 425.01	199.6414 181.8032 285.0893		330 463 711	439 436 481	169 166 221	104 94 148		1,042 1,160 1,560	321 450 691	427 424 467	76 75 99	47 42 66		870 991 1,324	11.8 13.7 12.7	36.50798889 44.18403989 44.76788586	2,143	2,034 2,018 2,225	325 321 425	200 182 285	
3B6P - Top Floor 4P8P - Duplex	94.73 129.44	7	663.11 906.08	15.4 12.8	15.4 12.8	2967.452514 3309.117318	Natural Gas Natural Gas	2185.575419 2276.949721		408.17 476.33	260.6134 397.9946		641 715	472 492	212 247	135 207		1,460 1,660	623 695	459 478	95 111	61 93		1,238 1,377	13.1 10.6	44.22994758 38.18792267		2,186 2,277	408 476	261 398	
Sum			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		77,844	0
			Total area		SIS TION CHECK	REG	GULATED ENERGY CO	NSUMPTION BY EN	D USE (kWh/m² p.a.) 'BE LEAN' BER - S	OURCE: BRUKL OUT	PUT	LATED ENERGY CO	NSUMPTION BY F	UEL TYPE (kWh/m	² p.a.) 'BE LEAN' BE	R - SOURCE: BRU	KL.INP or *SIM.CS			REGULAT	TED CO2 EMISSION	IS PER UNIT						MERGY DEMAN		ı.a.)
Building Use	Area per unit	it Number of units	represented by model (m²)	BER 2012	BRUKL BER 2012	Space Heating	Fuel type Space Heating	Water	Fuel type Domestic Hot	Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)	Natural Gas	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)	Natural Gas	Grid Electricity				SAP10 CO2 emissions (kgCO2 p.a.)	BRUKL BER SAP10	1	Space Heating (kWh p.a.)	Domestic Hot Water	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Commercial	1935	1	2474.4	(kgCO2 / m2) 8.8	(kgCO2 / m2) 8.8	11.1	Natural Gas	(kWh/m² p.a.) 0.46	Natural Gas	7.72	2.23	2.29	12	12				17,124	12	12				10,216	(kgCO2 / m2) 5.3	-		(kWh p.a.) 890	14,938		
																										NA					
																										421					
IM ITE-WIDE EN	1,935 IERGY COI		2,474 ON AND CO2	11.3 ANALYSIS		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	4,431
								PEGULAT	TED ENERGY CONSUM	MPTION								REGULATED CO2						REGULATED (CO2 EMISSIONS		REG	ULATED ENERGY D	MAND PER UNIT PER	R ANNUM (kWh p	.a.)
		_		Calculated														EMISSIONS													
Use		Total Area (m	n²)	Calculated BER 2012 (kgCO2 / m2)	-	Space Heating (kWh p.a.)	nl ^a	Domestic Hot Water (kWh p.a.)		Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)						2012 CO2 emissions (kgCO2 p.a.)						SAP10 CO2 emissions (kgCO2 p.a.)	Calculated BER SAP10 (kgCO2 / m2)	Me	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.

me applicant should			iis iiiciddiiig iiii	formation on the	'be lean' energy o	onsumption figures,	the 'be lean' DER, th	he DFEE and the re	gulated energy dem	and of the 'be lear	n' scenario.				SAP 2012 CO2 F	ERFORMANCE					SAP	10 CO2 PERFORMA	NCE								
DOMESTIC ENE	RGY CONSU	UMPTION	AND CO2 A	ANALYSIS																							DO	MESTIC ENERG	SY DEMAND DA	TA	
Unit identifier			Total area	VALIDATI	ON CHECK		REGULATED ENER	GY CONSUMPTION	PER UNIT (kWh p.a	.) - 'BE LEAN' SAP [DER WORKSHEET			REGULA	ATED CO2 EMISSIO	NS PER UNIT (kgCO2	p.a.)				REGULATI	ED CO2 EMISSIONS	PER UNIT			Fabric Energy Efficiency (FEE)	RE	GULATED ENERGY D	EMAND PER UNIT PE	R ANNUM (kWh	h p.a.)
/ IV			by model (m²)	Calculated DER 2012 (kgCO2 / m2)	DER Worksheet DER 2012 (kgCO2 / m2)	Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	Space Heating	Domestic Hot Water	Lighting	Auxiliary		2012 CO2 emissions (kgCO2 p.a.)	CO2 emissions	CO2 emissions		Auxiliary CO2 emissions (kgCO2 p.a.)		SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)	Dwelling Fabric Energy Efficiency (DFEE) (kWh/m²	(kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Co (kW
					DER Sheet (Row 384)	DER Sheet [(Row 307a) ÷	Select fuel type	DER Sheet [(Row 310a) ÷	Select fuel type		DER Sheet (Row 313 + 331)	DER Sheet Row 315								(kgCO2 p.a.)											
B2P - Ground Flo		71	869.04	17.5	17.5	(Row 367a x 0.01)] 1468.815642	Natural Gas	(Row 367a x 0.01)] 1763.843575	Natural Gas	246.61	130.8446		317	381	128	68		894	308	370	57	30		767	15.0	44.19359212		1,764	247	131	
B2P - Mid Floor B2P - Top Floor B B3P - Top Floor B		566 71 178	6665.28 855.44 3424.86	16.2 16.9 19.5	16.2 16.9 19.5	1157.631285 1290.100559 2756.603352	Natural Gas Natural Gas Natural Gas	1760.73743 1753.50838 1932.927374	Natural Gas Natural Gas Natural Gas	247.99 244.38 290.37	127.6856 127.6231 187.7927		250 279 595	380 379 418	129 127 151	66 66 97		825 850 1,261	243 271 579	370 368 406	58 57 68	30 30 44		700 726 1,096	13.8 14.4 17.0	39.61558444 41.94122884 54.95205384	1,290	1,761 1,754 1,933	248 244 290	128 128 188	
	73.74 74	356 356	7816.44 7844	14.4	14.4 14.1	1660.960894 1528.011173	Natural Gas Natural Gas	2031.396648 2033.932961	Natural Gas	325.11 325.04	180.4729 199.6414		359 330	439 439	169 169	94 104		1,060 1,042	349 321	427 427	76 76	42 47		893 870	12.1 11.8	38.10234839 36.50798889		2,031 2,034	325 325	180 200	
5P - Ground Flo	72.42 104.07	41 41	289.68 416.28	16.0 15.0	16.0 15.0	2143.407821 3292.793296	Natural Gas Natural Gas	2018.24581 2224.614525		320.59 425.01	181.8032 285.0893		463 711	436 481	166 221	94 148		1,160 1,560	450 691	424 467	75 99	42 66		991 1,324	13.7 12.7	44.18403989 44.76788586		2,018 2,225	321 425	182 285	
	94.73 129.44	19 19	663.11 906.08	15.4 12.8	15.4 12.8	2967.452514 3309.117318	Natural Gas Natural Gas	2185.575419 2276.949721		408.17 476.33	260.6134 397.9946		641 715	472 492	212 247	135 207		1,460 1,660	623 695	459 478	95 111	61 93		1,238 1,377	13.1 10.6	44.22994758 38.18792267		2,186 2,277	408 476	261 398	
	111,593	1,718	29.750	4.1		2,819,191	N/A	3,296,373	N/A	505,737	291,025	0	608,945	712,017	262,477	151,042	0	460,114	592,030	692,238	117,837	67,809	0	389,715	3.5	40.69	2 910 101	3,296,373	505,737	291,025	
	C ENERGY C					2,819,191	N/A	3,290,373	N/A	303,737	251,025	v	000,543	712,017	202,477	151,042	U U	480,114	392,030	052,238	117,837	67,805	· ·	389,713	3.3	40.09		N-DOMESTIC I			
uilding Use Ar										'BE LEAN' BER - S	OURCE: BRUKL OUT	PUT	LATED ENERGY CON	NSUMPTION BY FU	JEL TYPE (kWh/m²	na) 'RE I FAN' RER	COLIDER DOLLIN IN									-0			ENERGY DEMA	ND.	
	rea per unit Nu	Number of 1			ON CHECK		JLATED ENERGY COM	Domostic Hot								part be term ben		NP or *SIM.CS\ 2012 CO2			REGULATI	ED CO2 EMISSIONS	PER UNIT	SAP10 CO2	PRIIVI		RE		EMAND PER UNIT PE	R ANNUM (kWh	
		Number of 1	by model (m²)	Calculated BER 2012 (kgCO2 / m2)	ON CHECK BRUKL BER 2012	Space Heating	JLATED ENERGY CON Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot	Lighting	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)		Grid Electricity	,	platy be term ben		2012 CO2 emissions (kgCO2 p.a.)	Natural Gas		REGULATI	ED CO2 EMISSIONS	PER UNIT	SAP10 CO2 emissions (kgCO2 p.a.)	BRUKL BER SAP10 (kgCO2 / m2)	-	Space Heating (kWh p.a.)	Domestic Hot Water		R ANNUM (kWh	Co
nercial	(m²)	Number of units	by model (m²)	Calculated BER 2012	ON CHECK BRUKL BER 2012	Space Heating	Fuel type	Domestic Hot	Fuel type Domestic Hot	Lighting	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)	Natural Gas	Grid Electricity		puly Scient Sen		2012 CO2 emissions (kgCO2 p.a.)	Natural Gas		REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions	BER SAP10	-	Space Heating	Domestic Hot Water (kWh p.a.)	EMAND PER UNIT PE	R ANNUM (kWh Auxiliary (kWh p.a.)	(k
mercial	(m²)	Number of units	represented by model (m²)	Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	(kWh/m² p.a.)	(kWh/m² p.a.)	*******************	Grid Electricity		, , , , , , , , , , , , , , , , , , ,		2012 CO2 emissions (kgCO2 p.a.)	***************************************	***************************************	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.)	BER SAP10 (kgCO2 / m2)	-	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	EMAND PER UNIT PE Lighting (kWh p.a.)	R ANNUM (kWh Auxiliary (kWh p.a.)	(k
nercial	(m²)	Number of units	represented by model (m²)	Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	(kWh/m² p.a.)	(kWh/m² p.a.)	*******************	Grid Electricity		, , , , , , , , , , , , , , , , , , , ,		2012 CO2 emissions (kgCO2 p.a.)	***************************************	***************************************	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.)	BER SAP10 (kgCO2 / m2)		Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	EMAND PER UNIT PE Lighting (kWh p.a.)	R ANNUM (kWh Auxiliary (kWh p.a.)	(k
mercial	(m²)	Number of units	represented by model (m²)	Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	(kWh/m² p.a.)	(kWh/m² p.a.)	*******************	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)	***************************************	***************************************	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.)	BER SAP10 (kgCO2 / m2)		Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	EMAND PER UNIT PE Lighting (kWh p.a.)	R ANNUM (kWh Auxiliary (kWh p.a.)	(k
mercial	(m²)	Number of units	represented by model (m²)	Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	(kWh/m² p.a.)	(kWh/m² p.a.)	*******************	Grid Electricity		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		2012 CO2 emissions (kgCO2 p.a.)	***************************************	***************************************	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.)	BER SAP10 (kgCO2 / m2)		Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	EMAND PER UNIT PE Lighting (kWh p.a.)	R ANNUM (kWh Auxiliary (kWh p.a.)	(k
mercial	(m²)	Number of units	represented by model (m²)	Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	(kWh/m² p.a.)	(kWh/m² p.a.)	*******************	Grid Electricity		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		2012 CO2 emissions (kgCO2 p.a.)	***************************************	***************************************	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.)	BER SAP10 (kgCO2 / m2)		Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	EMAND PER UNIT PE Lighting (kWh p.a.)	R ANNUM (kWh Auxiliary (kWh p.a.)	(1
mercial	(m²)	Number of units	represented by model (m²)	Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	(kWh/m² p.a.)	(kWh/m² p.a.)	*******************	Grid Electricity		, , , , , , , , , , , , , , , , , , , ,		2012 CO2 emissions (kgCO2 p.a.)	***************************************	***************************************	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.)	BER SAP10 (kgCO2 / m2)	71 ²	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	EMAND PER UNIT PE Lighting (kWh p.a.)	R ANNUM (kWh Auxiliary (kWh p.a.)	(
nerdal	(m²)	Number of units	represented by model (m²)	Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	(kWh/m² p.a.)	(kWh/m² p.a.)	*******************	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)	***************************************	***************************************	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.)	BER SAP10 (kgCO2 / m2)	41 ^p	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	EMAND PER UNIT PE Lighting (kWh p.a.)	R ANNUM (kWh Auxiliary (kWh p.a.)	(
nercial	(m²)	Number of units	represented by model (m²)	Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	(kWh/m² p.a.)	(kWh/m² p.a.)	*******************	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)	***************************************	***************************************	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.)	BER SAP10 (kgCO2 / m2)	*11°	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	EMAND PER UNIT PE Lighting (kWh p.a.)	R ANNUM (kWh Auxiliary (kWh p.a.)	
mercial	(m²)	Number of units	represented by model (m²)	Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	(kWh/m² p.a.)	(kWh/m² p.a.)	*******************	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)	***************************************	***************************************	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.)	BER SAP10 (kgCO2 / m2)	₇ 1 ²	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	EMAND PER UNIT PE Lighting (kWh p.a.)	R ANNUM (kWh Auxiliary (kWh p.a.)	
mercial	(m²)	Number of units	represented by model (m²)	Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	(kWh/m² p.a.)	(kWh/m² p.a.)	*******************	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)	***************************************	***************************************	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.)	BER SAP10 (kgCO2 / m2)	7/2	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	EMAND PER UNIT PE Lighting (kWh p.a.)	R ANNUM (kWh Auxiliary (kWh p.a.)	(1
mmercial	(m²)	Number of units	represented by model (m²)	Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	(kWh/m² p.a.)	(kWh/m² p.a.)	*******************	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)	***************************************	***************************************	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.)	BER SAP10 (kgCO2 / m2)	*1P	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	EMAND PER UNIT PE Lighting (kWh p.a.)	R ANNUM (kWh Auxiliary (kWh p.a.)	(1
nercial	(m²)	Number of units	represented by model (m²)	Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	(kWh/m² p.a.)	(kWh/m² p.a.)	*******************	Grid Electricity				2012 CO2 emissions (kgCO2 p.a.)	***************************************	***************************************	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.)	BER SAP10 (kgCO2 / m2)	⁴ 7 ₆ -	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	EMAND PER UNIT PE Lighting (kWh p.a.)	R ANNUM (kWh Auxiliary (kWh p.a.)	(1
	1,000	Number of units	represented by model (m²) 2474.4	Calculated BER 2012 (kgCO2 / m2) 8.8	BRUKL BER 2012 (kgCO2 / m2)	Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	(kWh/m² p.a.)	(kWh/m² p.a.)	*******************	Grid Electricity	N/A	N/A	(6	2012 CO2 emissions (kgCO2 p.a.)	***************************************	***************************************	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.)	BER SAP10 (kgCO2 / m2)	41°	Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	EMAND PER UNIT PE Lighting (kWh p.a.)	R ANNUM (kWh Auxiliary (kWh p.a.)	(k
	1,000	Number of units	represented by model (m²) 2474.4	Calculated BER 2012 (kgCO2 / m2) 8.8	BRUKL BER 2012 (kgCO2 / m2) 8.8	Space Heating (kWh/m² p.a.)	Fuel type Space Heating Natural Gas	Domestic Hot Water (kWh/m² p.a.) 0.46	Fuel type Domestic Hot Water Natural Gas	Lighting (kWh/m² p.a.) 7.72 7,720	2.23	(kWh/m² p.a.) 2.29	12	Grid Electricity			N/A REG	2012 CO2 emissions (kgCO2 p.a.) 8,850	12	12	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.) 5,280	BER SAP10 (kgC02 / m2) 5.3	ziP	Space Heating (kWh p.a.) 11,100	Domestic Hot Water (kWh p.a.) 460	EMAND PER UNIT PE Lighting (kWh p.a.)	R ANNUM (kWh Auxillary (kWh p.a.) 2,230	(k
	1,000 RGY CONSU	Number of units	represented by model (m²) 2474.4	Calculated BER 2012 (kgCO2 / m2) 8.8	BRUKL BER 2012 (kgCO2 / m2) 8.8	Space Heating (kWh/m² p.a.) 11.1 11,100 Space Heating	Fuel type Space Heating Natural Gas	Domestic Hot Water (kWh/m² p.a.) 0.46	Fuel type Domestic Hot Water Natural Gas	Lighting (kWh/m² p.a.) 7.72 7,720 MPTION	2.23 2.23 2.230 Auxiliary	2.29 2,290 Cooling	12	Grid Electricity			N/A REG	2012 CO2 emissions kgcO2 p.a.) 8,850	12	12	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.) 5,280	BER SAP10 (kgC02 / m2) 5.3	-	Space Heating (kWh p.a.) 11,100 11,100 RE	Domestic Hot Water (kWh p.a.) 460 460 GULATED ENERGY D	EMAND PER UNIT PE Lighting (kWh p.a.) 7,720 7,720 EMAND PER UNIT PE Lighting	R ANNUM (kWh Auxillary (kWh p.a.) 2,230 2,230 Auxillary Auxillary	(k' (k')
'E-WIDE ENE	1,000 RGY CONSU	Number of units	represented by model (m²) 2474.4	Calculated BER 2012 (kgCO2 / m2) 8.8 21.9 NALYSIS Calculated BER 2012	BRUKL BER 2012 (kgCO2 / m2) 8.8	Space Heating (kWh/m² p.a.) 11.1 11.1 11.10	Fuel type Space Heating Natural Gas	Domestic Hot Water (kWh/m² p.a.) 0.46 460 REGULAT	Fuel type Domestic Hot Water Natural Gas	Lighting (kWh/m² p.a.) 7.72 7,720	2.23 2.23 2.230	2.29 2.29	12	Grid Electricity			N/A REG EMI	2012 CO2 emissions (kgCO2 p.a.) 8,850 21,897 21,897	12	12	REGULATI	ED CO2 EMISSIONS	PER UNIT	emissions (kgCO2 p.a.) 5,280 13,064 REGULATED C SAP10 CO2	BER SAP10 (kgCO2 / m2) 5.3 13.1 CO2 EMISSIONS Calculated	n ¹ P	Space Heating (kWh p.a.) 11,100 11,100	Domestic Hot Water (kWh p.a.) 460 460 GULATED ENERGY D Domestic Hot	EMAND PER UNIT PE Lighting (kWh p.a.) 7,720 7,720 EMAND PER UNIT PE	R ANNUM (kWh Auxillary (kWh p.a.) 2,230 2,230	Co (kW) 2



Appendix B TER Worksheets



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							La	st modified		30/09	/2020	
Address	1B2P, Kings	ton upon	Thames, K	T1								
1. Overall dwelling dimens	ions											
				Aı	rea (m²)			age storey eight (m)		Vo	olume (m³)	
Lowest occupied					51.12] (1a) x		2.50	(2a) =		127.80	(3a)
Total floor area	(1a) + ((1b) + (1c)) + (1d)(1	n) =	51.12	(4)						
Dwelling volume							(3a)	+ (3b) + (3	c) + (3d)(3	3n) =	127.80	(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	er
Infiltration due to chimneys,	flues, fans, P	SVs		(6a)	+ (6b) + (7a	a) + (7b) + (7	7c) =	20	÷ (5) =	=	0.16	(8)
If a pressurisation test has b	een carried o	ut or is in	tended, pro	oceed to (1	17), otherw	ise continue	e from (9) t	o (16)				
Air permeability value, q50,	expressed in	cubic me	tres per ho	ur per squ	are metre	of envelope	area				5.00	(17)
If based on air permeability	value, then (1	18) = [(17)	÷ 20] + (8)), otherwis	se (18) = (16	5)					0.41	(18)
Number of sides on which th	ne dwelling is	sheltered	d								1	(19)
Shelter factor								1 -	[0.075 x (1	9)] =	0.93	(20)
Infiltration rate incorporatin	g shelter fact	or							(18) x (20) =	0.38	(21)
Infiltration rate modified for	monthly win	d speed:										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed	d 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 (all	lowing for she	elter and	wind facto	r) (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

	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 infiltra	tion rate (a	llowing for	shelter and	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 effecti	ve air chan	ge rate for	the applica	ble case:									
If mechanica	l ventilatior	n: air chang	e rate thro	ugh system								N/A	(23a)
If halancad u	iith hoat ro	covery offi	cionavin 9/	allowing fo	ar in usa fa	ctor from T	abla 4b					NI/A	(220)

If balanced w	If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h											N/A	(23c)
d) natural ver	d) natural ventilation or whole house positive input ventilation 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)
Effective air char	Effective air change rate - enter (24a) or (24b) or (24d) in (25)												
	0.61	0.61	0.61	0.59	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.60	(25)



Element				Gross	Openings	Net	area	U-value	A x U W	/K к-v	alue.	Ахк,	
			;	area, m²	m ²	A,		W/m ² K	A X O W		/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) + (3	32) =	27.64	(33
Heat capacity Cn	n = ∑(A x к)							(28)	.(30) + (32)	+ (32a)(32	2e) =	N/A	(34
hermal mass pa	arameter (T	MP) in kJ/m	n²K									250.00	(35
hermal bridges	: ∑(L x Ψ) ca	alculated us	ing Apper	ndix K								7.49	(36
otal fabric heat	loss									(33) + (3	36) =	35.13	(37
	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)									
	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
leat 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	7
									Average = 2	(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
				1					Average = 2	(40)112/	/12 =	1.17	(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	t										_
Assumed occupa	ancy, N											1.72	(42
Annual average l	hot water i			Vd average									1/12
	not water t	usage in litre	es per day	vu,average	= (25 x N) +	36						75.12	(43
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	75.12 Dec] (43
Hot water usage	Jan in litres pe	Feb er day for ea	Mar ich month	Apr Vd,m = fac	May tor from Tab	Jun le 1c x (43		_				Dec] (4:
lot water usage	Jan	Feb	Mar	Apr	May	Jun		Aug 70.62	Sep 73.62	76.63	79.63] (4:
	Jan e in litres pe 82.64	Feb er day for ea 79.63	Mar och month 76.63	Apr Vd,m = fac 73.62	May tor from Tabl	Jun le 1c x (43 67.61	67.61	70.62			79.63	Dec	
	Jan e in litres pe 82.64	Feb er day for ea 79.63	Mar nch month 76.63	Apr Vd,m = fac 73.62 x nm x Tm/3	May tor from Tabl	Jun le 1c x (43 67.61	67.61	70.62		76.63	79.63	Dec 82.64] (44
Hot water usage Energy content o	Jan e in litres pe 82.64	Feb er day for ea 79.63	Mar och month 76.63	Apr Vd,m = fac 73.62	May tor from Tabl	Jun le 1c x (43 67.61	67.61	70.62		76.63 Σ(44)1	79.63 12 =	Dec 82.64	
	Jan e in litres pe 82.64	Feb er day for ea 79.63	Mar nch month 76.63	Apr Vd,m = fac 73.62 x nm x Tm/3	May tor from Tabl 70.62	Jun le 1c x (43 67.61 onth (see	67.61 Tables 1b	70.62	73.62	76.63 Σ(44)1	79.63 12 =	82.64 901.49	
	Jan e in litres pe 82.64 of hot wate 122.55	Feb er day for ea 79.63 er used = 4.1 107.18	Mar nch month 76.63	Apr Vd,m = fac 73.62 x nm x Tm/3	May tor from Tabl 70.62	Jun le 1c x (43 67.61 onth (see	67.61 Tables 1b	70.62 , 1c 1d) 84.90	73.62	76.63 Σ(44)1	79.63 12 =	82.64 901.49 118.68]] (44
energy content o	Jan e in litres pe 82.64 of hot wate 122.55	Feb er day for ea 79.63 er used = 4.1 107.18	Mar nch month 76.63	Apr Vd,m = fac 73.62 x nm x Tm/3	May tor from Tabl 70.62	Jun le 1c x (43 67.61 onth (see	67.61 Tables 1b	70.62	73.62	76.63 Σ(44)1	79.63 12 =	82.64 901.49 118.68]] (44]] (45
inergy content o	Jan 2 in litres per 82.64 of hot wate 122.55 0.15 x (45) 18.38	Feb er day for ea 79.63 er used = 4.1 107.18 er 16.08	Mar 16.63 18 x Vd,m 110.60	Apr Vd,m = fac 73.62 x nm x Tm/3 96.42	May tor from Table 70.62 8600 kWh/m 92.52	Jun le 1c x (43 67.61 onth (see 79.84	67.61 Tables 1b	70.62 , 1c 1d) 84.90	73.62	76.63 Σ(44)1 100.12 Σ(45)1	79.63 12 = 109.29 .12 =	901.49 118.68 1181.99	(44)
inergy content of the	Jan 2 in litres per 82.64 of hot wate 122.55 0.15 x (45) 18.38 (litres) include	Feb er day for ea 79.63 er used = 4.1 107.18 er 16.08	Mar 16.63 18 x Vd,m 110.60	Apr Vd,m = fac 73.62 x nm x Tm/3 96.42	May tor from Table 70.62 8600 kWh/m 92.52	Jun le 1c x (43 67.61 onth (see 79.84	67.61 Tables 1b	70.62 , 1c 1d) 84.90	73.62	76.63 Σ(44)1 100.12 Σ(45)1	79.63 12 = 109.29 .12 =	Dec 82.64 901.49 118.68 1181.99 17.80	(44)
nergy content of the	Jan 2 in litres per 2 82.64 of hot wate 122.55 0.15 x (45) 18.38 (litres) includes:	Feb er day for ea 79.63 er used = 4.1 107.18)m 16.08 uding any so	Mar 76.63 .8 x Vd,m 110.60 16.59 blar or WV	Apr Vd,m = fac 73.62 x nm x Tm/3 96.42 14.46 VHRS storage	May tor from Table 70.62 3600 kWh/m 92.52 13.88 ge within sam	Jun le 1c x (43 67.61 onth (see 79.84	67.61 Tables 1b	70.62 , 1c 1d) 84.90	73.62	76.63 Σ(44)1 100.12 Σ(45)1	79.63 12 = 109.29 .12 =	Dec 82.64 901.49 118.68 1181.99 17.80	(44)
Energy content of Distribution loss Storage volume Water storage lo	Jan e in litres per 82.64 of hot wate 122.55 0.15 x (45) 18.38 (litres) incluses: er's declare	Feb er day for ea 79.63 er used = 4.1 107.18)m 16.08 uding any so	Mar 76.63 .8 x Vd,m 110.60 16.59 blar or WV	Apr Vd,m = fac 73.62 x nm x Tm/3 96.42 14.46 VHRS storage	May tor from Table 70.62 3600 kWh/m 92.52 13.88 ge within sam	Jun le 1c x (43 67.61 onth (see 79.84	67.61 Tables 1b	70.62 , 1c 1d) 84.90	73.62	76.63 Σ(44)1 100.12 Σ(45)1	79.63 12 = 109.29 .12 =	901.49 118.68 1181.99 17.80 3.00	(45)
Energy content of Distribution loss Storage volume (Nater storage loss) If manufacture	Jan e in litres per 82.64 of hot wate 122.55 0.15 x (45) 18.38 (litres) incluses: er's declared a factor from	reber day for ear 79.63 rused = 4.1 107.18)m 16.08 uding any so ed loss factor Table 2b	Mar och month 76.63 8 x Vd,m 110.60 16.59 blar or WV	Apr Vd,m = fac 73.62 x nm x Tm/3 96.42 14.46 VHRS storage n (kWh/day)	May tor from Table 70.62 3600 kWh/m 92.52 13.88 ge within sam	Jun le 1c x (43 67.61 onth (see 79.84	67.61 Tables 1b	70.62 , 1c 1d) 84.90	73.62	76.63 Σ(44)1 100.12 Σ(45)1	79.63 12 = 109.29 .12 =	118.68 1181.99 17.80 3.00	(445) (45) (45) (47) (47) (48) (49)
Energy content of Distribution loss Storage volume Water storage lo I) If manufacture Temperature Energy lost fr	Jan 2 in litres per 82.64 of hot wate 122.55 18.38 (litres) includes: er's declared affector from water serior from the serior from water serior from water serior from water serior from the serior from	reber day for ear 79.63 rused = 4.1 107.18)m 16.08 uding any so ed loss factor Table 2b	Mar och month 76.63 8 x Vd,m 110.60 16.59 blar or WV	Apr Vd,m = fac 73.62 x nm x Tm/3 96.42 14.46 VHRS storage n (kWh/day)	May tor from Table 70.62 3600 kWh/m 92.52 13.88 ge within sam	Jun le 1c x (43 67.61 onth (see 79.84	67.61 Tables 1b	70.62 , 1c 1d) 84.90	73.62	76.63 Σ(44)1 100.12 Σ(45)1	79.63 12 = 109.29 .12 =	82.64 901.49 118.68 1181.99 17.80 3.00 0.26 0.54	(44) (45) (46) (47) (48) (48) (49) (50)
Energy content of Distribution loss Storage volume (Nater storage loss) If manufacture Temperature	Jan e in litres per 82.64 of hot wate 122.55 0.15 x (45) 18.38 (litres) incluses: er's declared factor from water services in (55)	reber day for ear 79.63 rused = 4.1 107.18)m 16.08 uding any so ed loss factor Table 2b storage (kW	Mar och month 76.63 8 x Vd,m 110.60 16.59 olar or WV	Apr Vd,m = fac 73.62 x nm x Tm/3 96.42 14.46 VHRS storage n (kWh/day) 8) x (49)	May tor from Table 70.62 3600 kWh/m 92.52 13.88 ge within sam	Jun le 1c x (43 67.61 onth (see 79.84	67.61 Tables 1b	70.62 , 1c 1d) 84.90	73.62	76.63 Σ(44)1 100.12 Σ(45)1	79.63 12 = 109.29 .12 =	82.64 901.49 118.68 1181.99 17.80 3.00 0.26 0.54 0.14	(45) (45) (45) (45) (45) (45) (45) (45)
Energy content of Distribution loss Storage volume (Nater storage lost) If manufacture Temperature Energy lost frenter (50) or (54)	Jan e in litres per 82.64 of hot wate 122.55 0.15 x (45) 18.38 (litres) incluses: er's declared factor from water services in (55)	reber day for ear 79.63 rused = 4.1 107.18)m 16.08 uding any so ed loss factor Table 2b storage (kW	Mar och month 76.63 8 x Vd,m 110.60 16.59 olar or WV	Apr Vd,m = fac 73.62 x nm x Tm/3 96.42 14.46 VHRS storage n (kWh/day) 8) x (49)	May tor from Table 70.62 3600 kWh/m 92.52 13.88 ge within sam	Jun le 1c x (43 67.61 onth (see 79.84	67.61 Tables 1b	70.62 , 1c 1d) 84.90	73.62	76.63 Σ(44)1 100.12 Σ(45)1	79.63 12 = 109.29 .12 =	82.64 901.49 118.68 1181.99 17.80 3.00 0.26 0.54 0.14	(45) (45) (45) (45) (45) (45) (45) (45)
Energy content of Distribution loss Storage volume (Nater storage lost) If manufacture Temperature Energy lost frenter (50) or (54)	Jan e in litres per 82.64 of hot wate 122.55 18.38 (litres) incluses: er's declared factor from water services calculate 4.36	reb r day for ea 79.63 r used = 4.1 107.18)m 16.08 uding any so ed loss facto m Table 2b storage (kW ed for each 3.93	Mar sch month 76.63 8 x Vd,m 110.60 16.59 blar or WV or is known th/day) (4 month (5 4.36	Apr Vd,m = fac 73.62 x nm x Tm/3 96.42 14.46 VHRS storage n (kWh/day) 8) x (49) 5) x (41)m 4.21	May tor from Table 70.62 8600 kWh/m 92.52 82 82 82 82 82 82 82 82 82 82 82 82 82	Jun le 1c x (43 67.61 onth (see 79.84 11.98 ne vessel	67.61 Tables 1b 73.98 11.10	70.62 , 1c 1d) 84.90 12.73	73.62 85.91	76.63 Σ(44)1 100.12 Σ(45)1 15.02	79.63 12 = 109.29 12 =	118.68 1181.99 17.80 3.00 0.26 0.54 0.14 0.14]] (44

Primary circuit lo	ss 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 ea	ich 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 requir	ed for wat	er heating o	calculated f	or each mo	onth 0.85 x	(45)m + (4	l6)m + (57)r	m + (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	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 wat		for each mo	nth (kWh/	1	2)m + (63)n	n						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	
ı					-					∑(64)1		507.17	_ (64)
Heat gains from v	water heat	ting (kWh/m	nonth) 0.2!	5 × [0.85 ×	(45)m + (61	1)m] + 0.8 >	< [(46)m + (!	57)m + (59)m]	2(0.)2			(0.,
	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)
		•			•	1					•	•	_
5. Internal gains	S												
Metabolic gains (Jan (Table 5)	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	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 (ca	lculated in	n Appendix I	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 (calculated	in Appendi	x L, equation	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 (ca													(,
	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 ga		!	02.02	02.02	02.02	02.02	02.02	02.02	32.02	02.02	02.02	02.02	_ (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. evapo		1	0.00	3.00	0.00	3.55	0.00	1 0.00	0.00	0.00	1 0.00		_ (, 0)
]	-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)
ا Water heating ga		•	00.32	00.32	00.32	1 00.32	00.52	1 00.32	00.32	00.32	1 00.32		(, _)
]	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)
ا Total internal gai							02.70	07.04	03.37	74.44	80.17	82.74	(/2)
							222.14	227.02	244.00	260.97	270.00	202.45	7 (72)
l	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	actor	Area	So	lar flux		g	FF		Gains	
			Table	6d	m²	١	V/m²	-	ific data	specific o		W	
									able 6b	or Table			-
West			0.7	7x	8.18	x	19.64 x	0.9 x	0.63 x	0.70	=	49.10	(80)
Solar gains in war							1		1	1	1		7
	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	rnal and so	olar (73)m +	(83)m					,					_
	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	al te <u>mpera</u>	iture (h <u>eati</u> i	ng season)										
Temperature dur				area from T	Table 9 Th1	1(°C)						21.00	(85)
. speracare dui	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(55)
Utilisation factor				•	•			,	204				
	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)
Moan internal to		1	l .		1	1 0.07	1 0.30	1 0.30	0.01	0.57	1 0.33	1.00	(00)
Mean internal te	mp of livin	ig area II (S	steps 3 to 7	in rable 90	~]								

		1	ı				ı	1	1	ı		1	٦
	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	T	7
	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 facto		T	_	T		1	1		1		1	_	7
	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 t	emperature	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 t	emperature	for the wh	ole dwellin	g fLA x T1 -	+(1 - fLA) x	T2							_
	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 me	ean interna	l temperati	ure from Ta	able 4e whe	ere appropr	iate						_
	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 heati	ng requirem	ant											
o. Space ficati	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto			IVIGI	Aþi	iviay	Juli	Jul	Aug	Зер	Oct	NOV	Dec	
Othisation facto		0.99	0.97	0.92	0.81	0.62	0.44	0.49	0.77	0.95	0.99	1.00	7 (04)
Usoful gains nr	0.99	1		0.92	0.81	0.62	0.44	0.49	0.77	0.95	0.99	1.00	(94)
Useful gains, ηr			1	464.00	126.71	220.00	224.47	222.70	220.64	255.00	226.26	221.10	(05)
Monthly averag	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		-	1	T.	14.70	11.50	16.60	16.40	1110	10.50	7.40	4.20	7 (00)
Heat loss rate f	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			1				226.26	227.44	200.00	FFC 00	727.60	004.27	7 (07)
Cases booting a	897.45	869.65	790.05	660.93	510.97	342.53	226.36	237.44	369.90	556.80	737.69	891.37	<u> </u> (97)
Space heating r			1							1	1	1	_
	409.27				1 55 35	0.00	0.00	0.00	0.00	140 47	200 02		
		322.23	264.41	141.15	55.25	0.00	0.00	0.00	0.00	149.47	289.03	416.78]] (08)
Casas bastina a				141.15	55.25	0.00	0.00	0.00		3)15, 10	.12 = 2	2047.57] (98)
Space heating r				141.15	55.25	0.00	0.00	0.00		3)15, 10	.12 = 2		(98) (99)
Space heating r	equirement	kWh/m²/ye	ear				0.00	0.00		3)15, 10	.12 = 2	2047.57	_ ` <i>'</i>
	equirement	kWh/m²/ye	ear				0.00	0.00		3)15, 10	.12 = 2	2047.57	_ ` <i>'</i>
9a. Energy rec	equirement	kWh/m²/ye	ear heating sy	stems inclu	uding micro	o-CHP	0.00	0.00		3)15, 10	.12 = 2	2047.57	_ ` <i>'</i>
9a. Energy rec	requirement quirements -	kWh/m²/yo	ear heating sy	stems inclu	uding micro	o-CHP	0.00	0.00		3)15, 10	12 = 2 ÷ (4)	2047.57 40.05	(99)
9a. Energy rec Space heating Fraction of space	requirement quirements - ce heat from	kWh/m²/yo individual a secondary n main syste	heating sys /suppleme em(s)	stems inclu	uding micro	o-CHP	0.00	0.00		(98)	12 = 2 ÷ (4)	2047.57 40.05	(99)
9a. Energy rec Space heating Fraction of space Fraction of space	requirements - quirements - ce heat from ce heat from	kWh/m²/yo individual a secondary a main syste	heating sy. /suppleme em(s)	stems inclu	uding micro	o-CHP	0.00	0.00	Σ(98	(98)	12 = 2 ÷ (4) = 01) = =	0.00 1.00	(99)
9a. Energy rec Space heating Fraction of space Fraction of space	requirements - ce heat from the heat from th	kWh/m²/ye individual a secondary, a main syste a main syste from main	heating system 2 system 1	stems inclu	uding micro	o-CHP	0.00	0.00	Σ(98	(98) 1 - (20	.12 = 2 ÷ (4)	0.00 1.00	(201) (202) (202)
9a. Energy reconstruction of space Fraction of space Fraction of space Fraction of total Fraction of total	requirements - ce heat from ce heat from ce heat from cle heat from cle heat from cle heat from	kWh/m²/yo individual a secondary, a main syste a main syste from main	heating system 2 system 1	stems inclu	uding micro	o-CHP	0.00	0.00	Σ(98	1 - (20 22) x [1- (20	.12 = 2 ÷ (4)	0.00 1.00 1.00	(201) (202) (202) (202) (204) (205)
9a. Energy reconstruction of space Fraction of space Fraction of space Fraction of total	requirements - ce heat from ce heat from ce heat from cle heat from cle heat from cle heat from	kWh/m²/yo individual a secondary, a main syste a main syste from main	heating system 2 system 1	stems inclu	uding micro	o-CHP	Jul		Σ(98	1 - (20 22) x [1- (20	.12 = 2 ÷ (4)	0.00 1.00 0.00 0.00	(201) (202) (202) (204)
9a. Energy reconstruction of space Fraction of space Fraction of space Fraction of total Fraction of total	requirements - ce heat from ce heat from ce heat from cl space heat cl space heat ain system 1 Jan	kWh/m²/yo individual a secondary, a main syste a main syste from main from main (%) Feb	heating system 2 system 1 system 2 Mar	stems inclu	uding micro	о-снр		0.00 Aug	Σ(98	1 - (20 (202) x (20	12 = 2 ÷ (4)	0.00 1.00 0.00 1.00 0.00 93.50	(201) (202) (202) (202) (204) (205)
9a. Energy rec Space heating Fraction of space Fraction of space Fraction of tota Fraction of tota Efficiency of ma	requirements - ce heat from ce heat from ce heat from cl space heat cl space heat ain system 1 Jan	kWh/m²/yo individual a secondary, a main syste a main syste from main from main (%) Feb	heating system 2 system 1 system 2 Mar	stems inclu	uding micro	о-снр			Σ(98	1 - (20 (202) x (20	12 = 2 ÷ (4)	0.00 1.00 0.00 1.00 0.00 93.50	(201) (202) (202) (202) (204) (205)
9a. Energy rec Space heating Fraction of space Fraction of space Fraction of tota Fraction of tota Efficiency of ma	requirements - ce heat from ce heat from ce heat from cl space heat di space heat ain system 1 Jan fuel (main sy	kWh/m²/ye individual a secondary, a main syste from main from main (%) Feb stem 1), kW	heating sy: /suppleme em(s) em 2 system 1 system 2 Mar wh/month	stems inclu ntary syste	m (table 11	Jun	Jul	Aug	Σ(98) (20) Sep	1 - (20 02) x [1- (20 (202) x (20 Oct	12 = 2 ÷ (4)	0.00 1.00 0.00 1.00 0.00 93.50 Dec	(201) (202) (202) (202) (204) (205)
9a. Energy reconstruction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of materials of the space heating for the space fraction of total Efficiency of materials of the space heating for the space fraction of total Efficiency of materials of the space heating for the space fraction of the space fraction of total Efficiency of materials of the space fraction of the space	requirements - ce heat from ce heat from ce heat from cl space heat di space heat ain system 1 Jan fuel (main sy	kWh/m²/ye individual a secondary, a main syste from main from main (%) Feb stem 1), kW	heating sy: /suppleme em(s) em 2 system 1 system 2 Mar wh/month	stems inclu ntary syste	m (table 11	Jun	Jul	Aug	Σ(98) (20) Sep	1 - (20 (202) x [1- (20 (202) x (20 Oct	12 = 2 ÷ (4)	0.00 1.00 0.00 1.00 0.00 1.00 0.00 93.50 Dec	(201) (202) (202) (202) (204) (205) (206)
9a. Energy reconstruction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of management of the Space heating for the Space heating for the Space fraction of total Efficiency of management of the Space heating for the Space heating for the Space fraction of total Efficiency of management of the Space heating for the Space fraction of the Space fractio	requirements the heat from th	kWh/m²/ye individual a secondary, a main syste from main from main (%) Feb stem 1), kW	heating sy: /suppleme em(s) em 2 system 1 system 2 Mar wh/month	stems inclu ntary syste	m (table 11	Jun	Jul	Aug	Σ(98) (20) Sep	1 - (20 (202) x [1- (20 (202) x (20 Oct	12 = 2 ÷ (4)	0.00 1.00 0.00 1.00 0.00 1.00 0.00 445.75	(201) (202) (202) (202) (204) (205) (206)
9a. Energy reconstruction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of materials of the space heating for the space fraction of total Efficiency of materials of the space heating for the space fraction of total Efficiency of materials of the space heating for the space fraction of the space fraction of total Efficiency of materials of the space fraction of the space	tequirements te heat from the	kWh/m²/yo individual a secondary, a main syste a main syste from main from main (%) Feb estem 1), kW 344.63	heating system 2 system 1 system 2 Mar Wh/month 282.79	Apr 150.96	May 59.09	Jun 0.00	Jul 0.00	Aug 0.00	Σ(98 Sep 0.00 Σ(21:	1 - (20 22) x [1- (20 (202) x (20 Oct 159.86	12 = 2 ÷ (4)	0.00 1.00 0.00 1.00 0.00 1.00 0.00 93.50 Dec 445.75 2189.92	(99) (201) (202) (202) (204) (205) (206)
9a. Energy recompany rection of space fraction of space fraction of space fraction of total fraction o	tequirement te heat from the	kWh/m²/yo individual a secondary main syste main syste from main from main (%) Feb stem 1), kW 344.63	heating sy: /suppleme em(s) em 2 system 1 system 2 Mar wh/month	stems inclu ntary syste	m (table 11	Jun	Jul	Aug	Σ(98) (20) Sep	1 - (20 (202) x [1- (20 (202) x (20 Oct	12 = 2 ÷ (4)	0.00 1.00 0.00 1.00 0.00 1.00 0.00 445.75	(201) (202) (202) (202) (204) (205) (206)
9a. Energy reconstruction of space Fraction of space Fraction of space Fraction of total Fraction of total Efficiency of management of the Space heating for the Space heating for the Space fraction of total Efficiency of management of the Space heating for the Space heating for the Space fraction of total Efficiency of management of the Space heating for the Space fraction of the Space fractio	tequirement te heat from the	kWh/m²/yo individual a secondary, main syste main syste from main from main (%) Feb stem 1), kW 344.63	heating system 2 system 1 system 2 Mar Vh/month 282.79	Apr 150.96	May 59.09	Jun 0.00	Jul 0.00	Aug 0.00	Σ(98 (20 Sep 0.00 Σ(21:	1 - (20 22) x [1- (20 (202) x (20 Oct 159.86 1)15, 10	12 = 2 ÷ (4)	0.00 1.00 0.00 1.00 0.00 1.00 0.00 93.50 Dec 445.75 2189.92	(99) (201) (202) (202) (204) (205) (206)
9a. Energy recompany rection of space fraction of space fraction of space fraction of total fraction o	tequirement te heat from the	kWh/m²/yo individual a secondary main syste main syste from main from main (%) Feb stem 1), kW 344.63	heating system 2 system 1 system 2 Mar Wh/month 282.79	Apr 150.96	May 59.09	Jun 0.00	Jul 0.00	Aug 0.00	Σ(98 Sep 0.00 Σ(21:	1 - (20 12) x [1- (20 (202) x (20 Oct 159.86 1)15, 10	12 = 2 ÷ (4)	0.00 1.00 0.00 1.00 0.00 1.00 0.00 93.50 Dec 445.75 2189.92	(99) (201) (202) (202) (204) (205) (206) (211)
9a. Energy recompany rection of space fraction of space fraction of space fraction of total fraction of total fraction of total efficiency of many space heating fraction of total fraction of t	tequirement te heat from the	kWh/m²/yo individual a secondary, main syste main syste from main from main (%) Feb stem 1), kW 344.63	heating system 2 system 1 system 2 Mar Vh/month 282.79	Apr 150.96	May 59.09	Jun 0.00	Jul 0.00	Aug 0.00	Σ(98 (20 Sep 0.00 Σ(21:	1 - (20 22) x [1- (20 (202) x (20 Oct 159.86 1)15, 10	12 = 2 ÷ (4)	0.00 1.00 0.00 1.00 0.00 1.00 0.00 93.50 Dec 445.75 2189.92	(99) (201) (202) (202) (204) (205) (206)
9a. Energy recompany rection of space fraction of space fraction of space fraction of total fraction of total fraction of total efficiency of mass Space heating fraction of total fraction of t	tequirement te heat from the	kWh/m²/ye individual a secondary, main syste from main from main (%) Feb stem 1), kW 344.63 87.10 bonth 151.69	heating system 2 system 1 system 2 Mar Vh/month 282.79	Apr 150.96	May 59.09	Jun 0.00	Jul 0.00	Aug 0.00	Σ(98 (20 Sep 0.00 Σ(21:	1 - (20 12) x [1- (20 (202) x (20 Oct 159.86 1)15, 10	12 = 2 ÷ (4)	2047.57 40.05 0.00 1.00 0.00 1.00 0.00 93.50 Dec 445.75 2189.92 87.45	(99) (201) (202) (202) (204) (205) (206) (211)
9a. Energy recompany rection of space fraction of space fraction of space fraction of total fraction of total fraction of total efficiency of many space heating fraction of total fraction of t	tequirement te heat from the	kWh/m²/ye individual a secondary, main syste from main from main (%) Feb stem 1), kW 344.63 87.10 bonth 151.69	heating system 2 system 1 system 2 Mar Vh/month 282.79	Apr 150.96	May 59.09	Jun 0.00	Jul 0.00	Aug 0.00	Σ(98 (20 Sep 0.00 Σ(21:	1 - (20 12) x [1- (20 (202) x (20 Oct 159.86 1)15, 10	12 = 2 ÷ (4)	0.00 1.00 0.00 1.00 0.00 1.00 0.00 93.50 Dec 445.75 2189.92	(99) (201) (202) (202) (204) (205) (206) (211)

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)

10a. Fuel costs - individual heating systems inclu	ding micro-CHP					
	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. 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	2189.92	х	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 CO₂, 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	x	1.22	=	2671.70	(261
Water heating	1789.77	x	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	x	3.07	=	757.11	(268
Primary energy kWh/year					5842.57	(272
Dwelling primary energy rate kWh/m2/year					114.29	(273



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 modifie	d	30/0	9/2020	
Address	1B2P, Kingston	upon Thames,	KT1								
1. Overall dwelling dime	nsions										
			А	rea (m²)			erage store height (m)	У	V	olume (m³)	
Lowest occupied				50.88	(1a) x		2.50	(2a) =		127.20	(3a)
Total floor area	(1a) + (1b)	+ (1c) + (1d)((1n) =	50.88	(4)						
Dwelling volume						(3	a) + (3b) + (3	3c) + (3d)(3	3n) =	127.20	(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 fa	ns						2	x 10 =		20	(7a)
Number of passive vents							0	x 10 =		0	(7b)
Number of flueless gas fire	es						0	x 40 =		0	(7c)
									Air	changes pe	er
Infiltration due to chimney	s, flues, fans, PSVs		(6a)	+ (6b) + (7a	a) + (7b) + (7c) =	20	÷ (5) =	: [0.16	(8)
If a pressurisation test has	been carried out o	or is intended, p	roceed to (17), otherw	ise continue	e from (9) to (16)				
Air permeability value, q50	O, expressed in cub	ic metres per h	our per squ	are metre	of envelope	e area				5.00	(17)
If based on air permeabilit	y value, then (18) =	= [(17) ÷ 20] + (8), otherwis	se (18) = (16	5)					0.41	(18)
Number of sides on which	the dwelling is she	eltered								3	(19)
Shelter factor							1	- [0.075 x (1	9)] =	0.78	(20)
Infiltration rate incorporat	ing shelter factor							(18) x (2	20) =	0.32	(21)
Infiltration rate modified f	or monthly wind sp	peed:									
Jan	Feb Ma	ar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spe	eed from Table U2										
5.10	5.00 4.9	0 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 1.2	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelte	r and wind fact	or) (21) x (2	22a)m							
0.40	0.39 0.3	9 0.35	0.34	0.30	0.30	0.29	0.32	0.34	0.36	0.37	(22b)
Calculate effective air char	nge rate for the app	plicable case:							_		_
If mechanical ventilation	on: air change rate	through system	า							N/A	(23a)



0.58

0.58

N/A

0.57

0.57

0.56

0.56

(23c)

(24d)

(25)

0.54

0.54

0.54

0.54

0.54

0.54

0.55

0.55

0.56

0.56

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

0.56

0.56

0.56

0.56

0.57

0.57

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

0.58

0.58

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

3. Heat losses	and heat lo	ss paramet	er										
Element			á	Gross area, m²	Openings m ²	Net a		U-value W/m²K	AxUW		/alue, /m².K	Αxκ, kJ/K	
Window						7.7	76 x	1.33	= 10.29)			(27)
Door						1.8	30 x	1.00	= 1.80				(26)
External wall						51.	45 x	0.18	= 9.26				(29a
Party wall						11.	68 x	0.00	= 0.00				(32)
Total area of ex	xternal elem	ents ∑A, m²	2			61.	01						(31)
Fabric heat loss	s, W/K = ∑(A	× U)							(2	6)(30) + (32) =	21.35	(33)
Heat capacity C	Cm = ∑(A x к)							(28).	(30) + (32)	+ (32a)(3	2e) =	N/A	(34)
Thermal mass p	parameter (T	MP) in kJ/r	n²K									250.00	(35)
Thermal bridge	es: Σ(L x Ψ) ca	alculated us	sing Apper	dix K								5.08	(36)
Total fabric hea	at loss									(33) + (3	36) =	26.43	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation hea	at loss 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	(38)
Heat transfer c	oefficient, 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	
									Average = 2	∑(39)112,	/12 =	49.94	(39)
Heat loss paran	meter (HLP),	W/m²K (39	9)m ÷ (4)										
	1.00	1.00	0.99	0.98	0.98	0.97	0.97	0.97	0.97	0.98	0.98	0.99	
									Average = 2	∑(40)112 <i>/</i>	/12 =	0.98	(40)
Number of day	s in month (Table 1a)											
	31.00	28.00	31.00	30.00	31.00	30.00			1		1		_
			31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
4. Water heat	ting energy r	1		30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
4. Water heat		1		30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00		
Assumed occup	pancy, N	equiremen	t				31.00	31.00	30.00	31.00	30.00	1.72	(42)
	pancy, N e hot water ι	equiremen	t es per day	Vd,average	e = (25 x N) +	36						1.72 74.96	
Assumed occup Annual average	pancy, N e hot water u Jan	equiremen usage in litro Feb	t es per day Mar	Vd,average Apr	e = (25 x N) + May	36 Jun	Jul	31.00 Aug	30.00 Sep	Oct	30.00 Nov	1.72	(42)
Assumed occup	pancy, N e hot water u Jan ge in litres pe	equiremenusage in litro Feb er day for ea	es per day Mar ach month	Vd,average Apr Vd,m = fact	e = (25 x N) + May tor from Tab	36 Jun le 1c x (43	Jul	Aug	Sep	Oct	Nov	1.72 74.96 Dec	(42)
Assumed occup Annual average	pancy, N e hot water u Jan	equiremen usage in litro Feb	t es per day Mar	Vd,average Apr	e = (25 x N) + May	36 Jun	Jul			Oct 76.45	Nov 79.45	1.72 74.96 Dec	(42)
Assumed occup Annual average Hot water usag	pancy, N e hot water u Jan ge in litres pe 82.45	equirements asage in litro Feb er day for ea	es per day Mar ach month 76.45	Vd,average Apr Vd,m = fact 73.46	e = (25 x N) + May tor from Tab 70.46	36 Jun le 1c x (43) 67.46	Jul) 67.46	Aug 70.46	Sep	Oct	Nov 79.45	1.72 74.96 Dec	(42)
Assumed occup Annual average	pancy, N e hot water u Jan ge in litres pe 82.45 t of hot wate	equiremenusage in litro Feber day for ea 79.45	es per day Mar ach month 76.45	Vd,average Apr Vd,m = fact 73.46	e = (25 x N) + May tor from Tab 70.46	36 Jun le 1c x (43) 67.46	Jul) 67.46 Tables 1b	Aug 70.46	Sep 73.46	Oct 76.45 Σ(44)1	Nov 79.45	1.72 74.96 Dec 82.45 899.47	(42)
Assumed occup Annual average Hot water usag	pancy, N e hot water u Jan ge in litres pe 82.45	equirements asage in litro Feb er day for ea	es per day Mar ach month 76.45	Vd,average Apr Vd,m = fact 73.46	e = (25 x N) + May tor from Tab 70.46	36 Jun le 1c x (43) 67.46	Jul) 67.46	Aug 70.46	Sep	Oct 76.45 Σ(44)1	Nov 79.45 .12 = 109.04	1.72 74.96 Dec 82.45 899.47	(42) (43) (43)
Assumed occup Annual average Hot water usag Energy content	pancy, N e hot water u Jan ge in litres pe 82.45 t of hot wate 122.27	equiremenusage in litro Feber day for ea 79.45 rr used = 4.1	es per day Mar ach month 76.45	Vd,average Apr Vd,m = fact 73.46	e = (25 x N) + May tor from Tab 70.46	36 Jun le 1c x (43) 67.46	Jul) 67.46 Tables 1b	Aug 70.46	Sep 73.46	Oct 76.45 Σ(44)1	Nov 79.45 .12 = 109.04	1.72 74.96 Dec 82.45 899.47	(42)
Assumed occup Annual average Hot water usag Energy content	pancy, N e hot water u Jan ge in litres pe 82.45 t of hot wate 122.27	equiremenusage in litro Feb er day for ea 79.45 er used = 4.2	es per day Mar ach month 76.45 18 x Vd,m =	Vd,average	e = (25 x N) + May tor from Tab 70.46 3600 kWh/m 92.31	36 Jun le 1c x (43) 67.46 onth (see	Jul) 67.46 Tables 1b 73.82	Aug 70.46 7, 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1 99.90 Σ(45)1	Nov 79.45 .12 = 109.04 .12 = 12 = 12	1.72 74.96 Dec 82.45 899.47 118.41 1179.35	(42) (43) (44) (45)
Assumed occup Annual average Hot water usag Energy content Distribution los	pancy, N e hot water u Jan ge in litres pe 82.45 t of hot wate 122.27 ss 0.15 x (45	equiremenusage in litro Feb er day for ea 79.45 er used = 4.3 106.94)m 16.04	es per day Mar ach month 76.45 18 x Vd,m 3 110.35	Vd,average	e = (25 x N) + May tor from Tab 70.46 3600 kWh/m 92.31	36 Jun le 1c x (43) 67.46 onth (see 79.66	Jul) 67.46 Tables 1b	Aug 70.46	Sep 73.46	Oct 76.45 Σ(44)1	Nov 79.45 .12 = 109.04	1.72 74.96 Dec 82.45 899.47 118.41 1179.35	(42) (43) (44) (45) (46)
Assumed occup Annual average Hot water usag Energy content Distribution los	pancy, N e hot water u Jan ge in litres pe 82.45 t of hot wate 122.27 ss 0.15 x (45 18.34 e (litres) include	equiremenusage in litro Feb er day for ea 79.45 er used = 4.3 106.94)m 16.04	es per day Mar ach month 76.45 18 x Vd,m 3 110.35	Vd,average	e = (25 x N) + May tor from Tab 70.46 3600 kWh/m 92.31	36 Jun le 1c x (43) 67.46 onth (see 79.66	Jul) 67.46 Tables 1b 73.82	Aug 70.46 7, 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1 99.90 Σ(45)1	Nov 79.45 .12 = 109.04 .12 = 12 = 12	1.72 74.96 Dec 82.45 899.47 118.41 1179.35	(42) (43) (44) (45) (46)
Assumed occup Annual average Hot water usag Energy content Distribution los Storage volume Water storage	pancy, N e hot water u Jan ge in litres pe 82.45 t of hot wate 122.27 ss 0.15 x (45 18.34 e (litres) includes:	equirement usage in litro Feb er day for ear 79.45 er used = 4.1 106.94 er used and the same of the sa	es per day Mar ach month 76.45 18 x Vd,m : 110.35	Vd,average	e = (25 x N) + May tor from Tab 70.46 3600 kWh/m 92.31 13.85 ge within sam	36 Jun le 1c x (43) 67.46 onth (see 79.66	Jul) 67.46 Tables 1b 73.82	Aug 70.46 7, 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1 99.90 Σ(45)1	Nov 79.45 .12 = 109.04 .12 = 12 = 12	1.72 74.96 Dec 82.45 899.47 118.41 1179.35 17.76 3.00	(42) (43) (44) (45) (45) (46)
Assumed occup Annual average Hot water usag Energy content Distribution los Storage volume Water storage a) If manufactu	pancy, N e hot water u Jan ge in litres pe 82.45 t of hot wate 122.27 ss 0.15 x (45 18.34 e (litres) includos:	equiremenusage in litro Feb er day for ea 79.45 r used = 4.2 106.94)m 16.04 uding any seed loss factor	es per day Mar ach month 76.45 18 x Vd,m : 110.35	Vd,average	e = (25 x N) + May tor from Tab 70.46 3600 kWh/m 92.31 13.85 ge within sam	36 Jun le 1c x (43) 67.46 onth (see 79.66	Jul) 67.46 Tables 1b 73.82	Aug 70.46 7, 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1 99.90 Σ(45)1	Nov 79.45 .12 = 109.04 .12 = 12 = 12	1.72 74.96 Dec 82.45 899.47 118.41 1179.35 17.76 3.00	(42) (43) (43) (44) (45) (46) (47) (48)
Assumed occup Annual average Hot water usag Energy content Distribution los Storage volume Water storage a) If manufactu Temperatur	pancy, N e hot water u Jan ge in litres pe 82.45 t of hot wate 122.27 ss 0.15 x (45 18.34 e (litres) includes: urer's declared	equirement usage in litro Feb er day for ea 79.45 er used = 4.3 106.94 ed loss factor Table 2b	es per day Mar ach month 76.45 18 x Vd,m x 110.35 16.55 olar or WV	Vd,average Apr Vd,m = fact 73.46 x nm x Tm/3 96.21 14.43 VHRS storage (kWh/day)	e = (25 x N) + May tor from Tab 70.46 3600 kWh/m 92.31 13.85 ge within sam	36 Jun le 1c x (43) 67.46 onth (see 79.66	Jul) 67.46 Tables 1b 73.82	Aug 70.46 7, 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1 99.90 Σ(45)1	Nov 79.45 .12 = 109.04 .12 = 12 = 12	1.72 74.96 Dec 82.45 899.47 118.41 1179.35 17.76 3.00	(42) (43) (43) (44) (45) (45) (46) (47) (48) (49)
Assumed occup Annual average Hot water usag Energy content Distribution los Storage volume Water storage a) If manufactu Temperatur Energy lost	pancy, N e hot water u Jan ge in litres pe 82.45 t of hot wate 122.27 ss 0.15 x (45 18.34 e (litres) includes: urer's declared are factor from water s	equirement usage in litro Feb er day for ea 79.45 er used = 4.3 106.94 ed loss factor Table 2b	es per day Mar ach month 76.45 18 x Vd,m x 110.35 16.55 olar or WV	Vd,average Apr Vd,m = fact 73.46 x nm x Tm/3 96.21 14.43 VHRS storage (kWh/day)	e = (25 x N) + May tor from Tab 70.46 3600 kWh/m 92.31 13.85 ge within sam	36 Jun le 1c x (43) 67.46 onth (see 79.66	Jul) 67.46 Tables 1b 73.82	Aug 70.46 7, 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1 99.90 Σ(45)1	Nov 79.45 .12 = 109.04 .12 = 12 = 12	1.72 74.96 Dec 82.45 899.47 118.41 1179.35 17.76 3.00 0.26 0.54 0.14	(42) (43) (43) (44) (45) (46) (47) (48) (49) (50)
Assumed occup Annual average Hot water usag Energy content Distribution los Storage volume Water storage a) If manufactu Temperatur Energy lost Enter (50) or (5	pancy, N e hot water u Jan ge in litres pe 82.45 t of hot wate 122.27 ss 0.15 x (45 18.34 e (litres) includes: urer's declared from water seconds (54) in (55)	r used = 4.2 106.94 16.04 uding any solution Table 2b storage (kW	es per day Mar ach month 76.45 18 x Vd,m x 110.35 16.55 olar or WV or is known	Vd,average	e = (25 x N) + May tor from Tab 70.46 3600 kWh/m 92.31 13.85 ge within sam	36 Jun le 1c x (43) 67.46 onth (see 79.66	Jul) 67.46 Tables 1b 73.82	Aug 70.46 7, 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1 99.90 Σ(45)1	Nov 79.45 .12 = 109.04 .12 = 12 = 12	1.72 74.96 Dec 82.45 899.47 118.41 1179.35 17.76 3.00	(42) (43) (43) (44) (45) (46) (47) (48) (49) (50)
Assumed occup Annual average Hot water usag Energy content Distribution los Storage volume Water storage a) If manufactu Temperatur	pancy, N e hot water u Jan ge in litres pe 82.45 t of hot wate 122.27 ss 0.15 x (45 18.34 e (litres) includes: urer's declared are factor from water states (45) in (55) loss calculate	equiremen usage in litro Feb er day for ea 79.45 r used = 4.2 106.94)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 WV or is known /h/day) (4	Vd,average	e = (25 x N) + May tor from Tab 70.46 3600 kWh/m 92.31 13.85 ge within sam	36 Jun le 1c x (43) 67.46 onth (see 79.66 11.95 ne vessel	Jul) 67.46 Tables 1b 73.82	Aug 70.46 7, 1c 1d) 84.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1 99.90 Σ(45)1 14.98	Nov 79.45 .12 = 109.04 .12 = 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	(42) (43) (43) (44) (45) (46) (47) (48) (49) (50) (55)
Assumed occup Annual average Hot water usag Energy content Distribution los Storage volume Water storage a) If manufactu Temperatur Energy lost Enter (50) or (5 Water storage	pancy, N e hot water u Jan ge in litres pe 82.45 t of hot wate 122.27 ss 0.15 x (45 18.34 e (litres) includes: urer's declared refactor from water s from water s 64) in (55) loss calculate 4.36	r used = 4.2 106.94 16.04 uding any solution 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 WV or is known /h/day) (4 month (5 4.36	Vd,average	e = (25 x N) + May tor from Tab 70.46 3600 kWh/m 92.31 13.85 ge within sam 4.36	36 Jun le 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 7. 1c 1d) 84.71 12.71	Sep 73.46 85.72	Oct 76.45 Σ(44)1 99.90 Σ(45)1	Nov 79.45 .12 = 109.04 .12 = 12 = 12	1.72 74.96 Dec 82.45 899.47 118.41 1179.35 17.76 3.00 0.26 0.54 0.14	(42) (43) (43) (44) (45) (46) (47) (48) (49) (50)
Assumed occup Annual average Hot water usag Energy content Distribution los Storage volume Water storage a) If manufactu Temperatur Energy lost Enter (50) or (5	pancy, N e hot water u Jan ge in litres pe 82.45 t of hot wate 122.27 ss 0.15 x (45 18.34 e (litres) includes: urer's declared from water states for the s	equiremen usage in litro Feb er day for ea 79.45 r used = 4.2 106.94)m 16.04 uding any so ed loss factor m Table 2b storage (kW) ed for each 3.93 ated solar s	es per day Mar ach month 76.45 18 x Vd,m x 110.35 16.55 olar or WV or is known /h/day) (4 month (5 4.36 torage or o	Vd,average Apr Vd,m = fact 73.46 x nm x Tm/3 96.21 14.43 /HRS storage (kWh/day) 8) x (49) 5) x (41)m 4.21 dedicated V	e = (25 x N) + May tor from Tab 70.46 3600 kWh/m 92.31 13.85 ge within sam 4.36 VWHRS (56)r	36 Jun le 1c x (43) 67.46 onth (see 79.66 11.95 ne vessel 4.21 m x [(47) - 1	Jul) 67.46 Tables 1b 73.82 11.07	Aug 70.46 71c 1d) 84.71 12.71 4.36 , else (56)	Sep 73.46 85.72 12.86	Oct 76.45 Σ(44)1 99.90 Σ(45)1 14.98	Nov 79.45 .12 = 109.04 .12 = 4.21	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 4.36	(42) (43) (43) (44) (45) (46) (47) (48) (49) (50) (55)
Assumed occup Annual average Hot water usag Energy content Distribution los Storage volume Water storage a) If manufactu Temperatur Energy lost Enter (50) or (5	pancy, N e hot water u Jan ge in litres pe 82.45 t of hot wate 122.27 ss 0.15 x (45 18.34 e (litres) includes: urer's declared from water s 64) in (55) loss calculate 4.36 entains dedica 4.36	equiremenusage in litro Feb er day for ea 79.45 r used = 4.2 106.94)m 16.04 uding any so ed loss factor n Table 2b storage (kW) ed for each 3.93 ated solar s 3.93	es per day Mar ach month 76.45 18 x Vd,m = 110.35 16.55 olar or WV or is knowr /h/day) (4 month (5 4.36 torage or 6 4.36	Vd,average	e = (25 x N) + May tor from Tab 70.46 3600 kWh/m 92.31 13.85 ge within sam 4.36	36 Jun le 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 7. 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 79.45 .12 = 109.04 .12 = 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	(42) (43) (44) (45) (46) (47) (48) (49) (50) (55)

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
ch 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
ed for wat	er heating c	calculated (for each mo	onth 0.85 x	(45)m + (4	ֈ6)m + (57)։	m + (59)m +	- (61)m			
149.89	131.89	137.97	122.94	119.93	106.39	101.43	112.32	112.44	127.51	135.77	146.03
calculated	using Appe	endix G or	Appendix F	I	!			!	!		
		1			0.00	0.00	0.00	0.00	0.00	0.00	0.00
				1		0.00	0.00	0.00	0.00	0.00	0.00
		1	1	1	1	101.42	112.22	112.44	127.51	125 77	146.02
149.89	131.89	137.97	122.94	119.93	106.39	101.43	112.32	112.44			146.03
			_						∑(64)1	.12 =	1504.52
	ing (kWh/m	10nth) 0.2	5 × [0.85 ×	(45)m + (61	.)m] + 0.8 >	< [(46)m + (57)m + (59)	m]	i	i	1
62.75	55.51	58.79	53.37	52.79	47.87	46.64	50.26	49.88	55.31	57.64	61.47
	F - 1-		A	0.0		11		6	0.4	NI	D
	reb	iviar	Apr	iviay	Jun	Jui	Aug	Sep	Oct	NOV	Dec
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
Iculated in	Appendix I	L, equation	1 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
calculated	in Appendi	x L, equati	on L13 or L	13a), also s	ee Table 5						
149.52	151.07	147.16	138.84	128.33	118.46	111.86	110.31	114.22	122.54	133.05	142.92
lculated ir	n Appendix !	L, equatior	າ L15 or L15	āa), also see	Table 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
		02.00	1 02.00	02.00	02.00	02.00	02.00	02.00	02.00	02.00	02.00
		2.00	7 2 00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00
		3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
•	,		1 60 64	50.04							T
		-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64
									1		_
84.34	82.61	79.01	74.13	70.95	66.48	62.69	67.55	69.28	74.34	80.05	82.62
ns (66)m +	+ (67)m + (6	i8)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
							snec			lata	Gains W
		Tubic	. 00			•,	•		•		•••
		0.7	77 x	4.56	x 1	10.63 x	0 9 x (0.63 x	0.70		14.82
		0.7	<u> </u>	4.50	╛^╚┋						19.21
		0.7	7 .	3 20		10 6/1 V	navl			-	13.21
+c 5/74\m	(92)m	0.7	77 x	3.20	x1	19.64 x	0.9 x	0.63 ×			
tts ∑(74)m						,					1 00 15
34.03	65.89	110.00	77 x [3.20	x 1	211.86	0.9 x (129.82	78.29	42.23	28.15
34.03 rnal and so	65.89 blar (73)m +	110.00 (83)m	167.54	214.72	224.69	211.86	175.15	129.82	78.29		
34.03	65.89	110.00				,				42.23 320.61	28.15
34.03 rnal and so 333.67	65.89 blar (73)m + 363.79	110.00 (83)m 398.06	167.54	214.72	224.69	211.86	175.15	129.82	78.29		
34.03 rnal and so 333.67	65.89 blar (73)m + 363.79 sture (heatin	110.00 (83)m 398.06	167.54	214.72	224.69 466.21	211.86	175.15	129.82	78.29		319.86
34.03 rnal and so 333.67 al tempera	65.89 olar (73)m + 363.79 ture (heating periods in	110.00 (83)m 398.06 ng season)	167.54 439.92 area from	214.72 471.49 Table 9, Th1	224.69 466.21	211.86	175.15 411.56	129.82 374.20	78.29	320.61	21.00
34.03 rnal and so 333.67 al tempera ring heating Jan	65.89 plar (73)m + 363.79 ture (heating periods in Feb	110.00 (83)m 398.06 ng season) the living Mar	167.54 439.92 area from Apr	214.72 471.49 Table 9, Th1	224.69 466.21	211.86	175.15	129.82	78.29		319.86
34.03 rnal and so 333.67 al tempera ring heating Jan	65.89 olar (73)m + 363.79 ture (heating periods in	110.00 (83)m 398.06 ng season) the living Mar	167.54 439.92 area from Apr	214.72 471.49 Table 9, Th1	224.69 466.21	211.86	175.15 411.56	129.82 374.20	78.29	320.61	21.00
34.03 rnal and so 333.67 al tempera ring heating Jan	65.89 plar (73)m + 363.79 ture (heating periods in Feb	110.00 (83)m 398.06 ng season) the living Mar	167.54 439.92 area from Apr	214.72 471.49 Table 9, Th1	224.69 466.21	211.86	175.15 411.56	129.82 374.20	78.29	320.61	21.00
	ch month 0.00 ed for water 149.89 calculated 0.00 er heater f 149.89 water heat 62.75 Jan Table 5) 85.80 lculated in 14.04 calculated 149.52 lculated in 31.58 ins (Table ! 3.00 ration (Tall -68.64 ins (Table ! 84.34 ins (66)m -	ch month from Table 0.00	ch month from Table 3a, 3b or 3 0.00	Ch month from Table 3a, 3b or 3c	ch month from Table 3a, 3b or 3c 0.00	ch month from Table 3a, 3b or 3c 0.00	ch month from Table 3a, 3b or 3c 0.00	ch month from Table 3a, 3b or 3c 0.00	th month from Table 3a, 3b or 3c 0.00	th month from Table 3a, 3b or 3c 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	th month from Table 3a, 3b or 3c 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.

													_
	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 durir	ng heating	g periods in	the rest of	f dwelling fr	rom Table 9	9, Th2(°C)							
	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 fo	or gains fo	or rest of d	welling n2,	m									
	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 tem	nperature	in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9)c)						
	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 fraction	n									ving area ÷		0.45	(91)
Mean internal tem		for the who	ole dwellin	ıg fLA x T1 +	+(1 - fLA) x 7	Г2				0	` ,] (- ,
Г	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 adjustment							l .	20.31	20.43	20.12	15.00	15.52] (32)
Apply adjustillent							1	20.51	20.45	20.12	10.00	10.22] (02)
L	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 heating	requirem	ent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor fo	or gains, r	nm		•	•			J	•				
	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)
Luseful gains, ηmG				0.55	0.01	0.01	0.43	0.45	0.77	0.55	0.55	1.00] (34)
_				110.41	202.10	202.27	101.00	200 50	207.67	222.02	217.22	210.51] (05)
	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 average 6					1				I		I		1 ,
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 for r										1	1		1
L	764.43	739.46	670.27	560.41	432.91	290.72	192.89	202.29	314.27	474.17	629.53	760.61	(97)
Space heating requ	uirement,	kWh/mont	th 0.024 x	[(97)m - (9!	5)m] x (41)r	m				1			,
L	321.80	254.73	209.03	108.00	37.00	0.00	0.00	0.00	0.00	112.59	224.86	328.92]
									∑(98	3)15, 10	.12 = 1	1596.93	(98)
Space heating requ	uirement	kWh/m²/ye	ear							(98)	÷ (4)	31.39	(99)
0. 5		to discrete all			1:	CUD							
9a. Energy requir	rements -	individual	neating sy	stems inclu	aing micro	-СНР							
Space heating													
Fraction of space h	neat from												1
Fraction of space h		secondary,	/suppleme	ntary syste	m (table 11)						0.00	(201
action or space i	neat from	•	• • •	ntary syste	m (table 11)				1 - (20	01) =	0.00	(201 (202
Fraction of space h		main syste	em(s)	ntary syste	m (table 11)				1 - (20	01) =		7
·	neat from	main syste	em(s) em 2	ntary syste	m (table 11	.)			(20	1 - (20 02) x [1- (20		1.00	(202
Fraction of space h	neat from pace heat	main syste main syste from main	em(s) em 2 system 1	ntary syste	m (table 11)			(20	·	3)] =	1.00	(202
Fraction of space h	neat from pace heat pace heat	main syste main syste from main from main	em(s) em 2 system 1	ntary syste	m (table 11)			(20)2) x [1- (20	3)] =	1.00 0.00 1.00	(202 (202 (204
Fraction of space h Fraction of total sp Fraction of total sp	neat from pace heat pace heat	main syste main syste from main from main	em(s) em 2 system 1	ntary syster	m (table 11) Jun	Jul	Aug	(20 Sep)2) x [1- (20	3)] =	1.00 0.00 1.00 0.00	(202 (202 (204 (205
Fraction of space h Fraction of total sp Fraction of total sp	neat from pace heat pace heat system 1 Jan	main syste main syste from main from main (%) Feb	em(s) em 2 system 1 system 2				Jul	Aug)2) x [1- (20 (202) x (20	3)] =	1.00 0.00 1.00 0.00 93.50	(202 (202 (204 (205
Fraction of space h Fraction of total sp Fraction of total sp Efficiency of main	neat from pace heat pace heat system 1 Jan	main syste main syste from main from main (%) Feb	em(s) em 2 system 1 system 2				Jul 0.00	Aug)2) x [1- (20 (202) x (20	3)] =	1.00 0.00 1.00 0.00 93.50	(202 (202 (204 (205
Fraction of space h Fraction of total sp Fraction of total sp Efficiency of main	neat from pace heat pace heat system 1 Jan I (main sys	main syste main syste from main from main (%) Feb stem 1), kW	em(s) em 2 system 1 system 2 Mar /h/month	Apr	May	Jun			Sep 0.00	02) x [1- (20 (202) x (20 Oct	3)] =	1.00 0.00 1.00 0.00 93.50 Dec	(202 (202 (204 (205 (206
Fraction of space he Fraction of total space fraction of total space fraction of total space fraction of main	neat from pace heat pace heat system 1 Jan I (main sys	main syste main syste from main from main (%) Feb stem 1), kW	em(s) em 2 system 1 system 2 Mar /h/month	Apr	May	Jun			Sep 0.00	02) x [1- (20 (202) x (20 Oct	3)] =	1.00 0.00 1.00 0.00 93.50 Dec	(202 (202 (204 (205
Fraction of space he Fraction of total space fraction of total space fraction of total space fraction of main Space heating fuel Water heating	neat from pace heat pace heat system 1 Jan (main sys	main syste main syste from main from main (%) Feb stem 1), kW	em(s) em 2 system 1 system 2 Mar /h/month	Apr	May	Jun			Sep 0.00	02) x [1- (20 (202) x (20 Oct	3)] =	1.00 0.00 1.00 0.00 93.50 Dec	(202 (202 (204 (205 (206
Fraction of space he Fraction of total space fraction of total space fraction of total space fraction of main	neat from pace heat pace heat system 1 Jan (main system 344.17	main syste main syste from main from main (%) Feb stem 1), kW	em(s) em 2 system 1 system 2 Mar /h/month 223.56	Apr 115.51	May 39.57	Jun 0.00	0.00	0.00	Sep 0.00 Σ(21:	02) x [1- (20 (202) x (20 Oct 120.42	3)] =	1.00 0.00 1.00 0.00 93.50 Dec 351.79	(202 (202 (204 (205 (206 (206
Fraction of space heraction of total space fraction of total space fraction of total space fraction of total space fraction of main Space heating fuel Water heating Efficiency of water	neat from pace heat system 1 Jan (main sys 344.17	main syste main syste from main from main (%) Feb stem 1), kW 272.44	em(s) em 2 system 1 system 2 Mar /h/month	Apr	May	Jun			Sep 0.00	02) x [1- (20 (202) x (20 Oct	3)] =	1.00 0.00 1.00 0.00 93.50 Dec	(202 (202 (204 (205 (206
Fraction of space heraction of total space fraction of	neat from pace heat pace heat system 1 Jan I (main system) 344.17	main syste main syste from main from main (%) Feb stem 1), kW 272.44 86.54 onth	em(s) em 2 system 1 system 2 Mar /h/month 223.56	Apr 115.51	May 39.57	Jun 0.00	79.80	79.80	Sep 0.00 Σ(21:	02) x [1- (20 (202) x (20 Oct 120.42 1)15, 10	3)] =	1.00 0.00 1.00 93.50 Dec 351.79 1707.95	(202 (202 (204 (205 (206 (206
Fraction of space heraction of total space fraction of	neat from pace heat system 1 Jan (main sys 344.17	main syste main syste from main from main (%) Feb stem 1), kW 272.44	em(s) em 2 system 1 system 2 Mar /h/month 223.56	Apr 115.51	May 39.57	Jun 0.00	0.00	0.00	Sep 0.00 Σ(21:	02) x [1- (20 (202) x (20 Oct 120.42 1)15, 10	3)] =	1.00 0.00 1.00 0.00 93.50 Dec 351.79 1707.95] (202] (202] (204] (205] (206] (211
Fraction of space h Fraction of total sp Fraction of total sp Efficiency of main Space heating fuel Water heating Efficiency of water Water heating fue	neat from pace heat pace heat system 1 Jan I (main system) 344.17	main syste main syste from main from main (%) Feb stem 1), kW 272.44 86.54 onth	em(s) em 2 system 1 system 2 Mar /h/month 223.56	Apr 115.51	May 39.57	Jun 0.00	79.80	79.80	Sep 0.00 Σ(21:	02) x [1- (20 (202) x (20 Oct 120.42 1)15, 10	3)] =	1.00 0.00 1.00 93.50 Dec 351.79 1707.95	(202 (202 (204 (205 (206 (206
Fraction of space heraction of total space fraction of	neat from pace heat pace heat system 1 Jan I (main system) 344.17	main syste main syste from main from main (%) Feb stem 1), kW 272.44 86.54 onth	em(s) em 2 system 1 system 2 Mar /h/month 223.56	Apr 115.51	May 39.57	Jun 0.00	79.80	79.80	Sep 0.00 Σ(21:	02) x [1- (20 (202) x (20 Oct 120.42 1)15, 10	3)] =	1.00 0.00 1.00 0.00 93.50 Dec 351.79 1707.95] (202] (202] (204] (205] (206] (211
Fraction of space h Fraction of total sp Fraction of total sp Efficiency of main Space heating fuel Water heating Efficiency of water Water heating fue	neat from pace heat pace heat system 1 Jan (main sys 344.17	main syste main syste from main from main (%) Feb stem 1), kW 272.44 86.54 onth 152.40	em(s) em 2 system 1 system 2 Mar /h/month 223.56	Apr 115.51	May 39.57	Jun 0.00	79.80	79.80	Sep 0.00 Σ(21:	02) x [1- (20 (202) x (20 Oct 120.42 1)15, 10	3)] =	1.00 0.00 1.00 0.00 93.50 Dec 351.79 1707.95] (202] (202] (204] (205] (206] (211

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)

10a. Fuel costs - individual heating systems inc	luding micro-CHP					
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1707.95	х	3.48	x 0.01 =	59.44	(240)
Water heating	1795.93	х	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 inc	cluding micro-CHP					
Energy cost deflator (Table 12)					0.42	(256)

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]

	Energy kWh/year		Emission factor kg CO₂/kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	1707.95	х	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	x	0.519	=	128.71	(268
Total CO ₂ , kg/year				(265)(271) =	924.47	(272
Dwelling CO₂ emission rate				(272) ÷ (4) =	18.17	(273
El value					87.08]
El rating (section 14)					87	(274
EI 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) + (2	63) + (264) =	4274.74	(265)
Pumps and fans	75.00	х	3.07	=	230.25	(267)
Electricity for lighting	247.99	х	3.07	=	761.32	(268)
Primary energy kWh/year					5266.31	(272)
Dwelling primary energy rate kWh/m2/year					103.50	(273)



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	k	30/09	9/2020	
Address	1B2P, Kin	gston upor	n Thames, I	KT1								
1. Overall dwelling dime	nsions											
				Α	rea (m²)		Α	verage storey height (m)	'	Vo	olume (m³)	
Lowest occupied					50.32	(1a) x		2.50	(2a) =		125.80	(3a)
Total floor area	(1a)	+ (1b) + (1d	c) + (1d)(2	ln) =	50.32	(4)						
Dwelling volume							(3a) + (3b) + (3	sc) + (3d)(3	(n) =	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 fa	ns							2	x 10 =		20	(7a)
Number of passive vents								0	x 10 =		0	(7b)
Number of flueless gas fire	es							0	x 40 =		0	(7c)
										Air	changes pe hour	r
Infiltration due to chimney	s, flues, fans	s, PSVs		(6a)	+ (6b) + (7a	a) + (7b) + ((7c) =	20	÷ (5) =	:	0.16	(8)
If a pressurisation test has	been carried	d out or is ii	ntended, pr	roceed to (17), otherw	ise continu	e from (9) to (16)				
Air permeability value, q50), expressed	in cubic me	etres per ho	our per squ	are metre	of envelop	e area				5.00	(17)
If based on air permeabilit	y value, then	(18) = [(17	') ÷ 20] + (8	3), otherwis	se (18) = (16	5)					0.41	(18)
Number of sides on which	the dwelling	is sheltere	d								2	(19)
Shelter factor								1	- [0.075 x (1	9)] =	0.85	(20)
Infiltration rate incorporat	ing shelter fa	actor							(18) x (2	20) =	0.35	(21)
Infiltration rate modified f	or monthly w	vind speed										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average 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 (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 s	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 effective air char	nge rate for t	he applical	ole case:									_
If mechanical ventilation	n: air change	e rate throu	ıgh system								N/A	(23a)



0.60

0.60

N/A

0.58

0.58

(24d)

(25)

0.58

0.58

0.55

0.55

0.55

0.55

0.55

0.55

0.56

0.56

0.57

0.57

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

0.57

0.57

0.57

0.57

0.59

0.59

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

0.59

0.59

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

3. Heat losses a	and heat loss paramete	r							
Element		Gross area, m²	Openings m ²	Net area A, m²	U-value W/m²K	A x U W/I	K κ-value, kJ/m².K	Ахк, kJ/K	
Window				7.86	x 1.33	= 10.42			(27)
Door				1.80	x 1.00	= 1.80			(26)
External wall				30.82	x 0.18	= 5.55			(29a)
Party wall				34.43	x 0.00	= 0.00			(32)
Roof				50.32	x 0.13	= 6.54			(30)
Total area of ext	ernal elements ∑A, m²			90.80					(31)
Fabric heat loss,	$W/K = \sum (A \times U)$					(26).	(30) + (32) =	24.31	(33)
Heat capacity Cr	m = ∑(A x κ)				(28))(30) + (32) + ((32a)(32e) =	N/A	(34)
Thermal mass pa	arameter (TMP) in kJ/m	² K						250.00	(35)
Thermal bridges	: ∑(L x Ψ) calculated usi	ng Appendix K						9.32	(36)
Total fabric heat	loss						(33) + (36) =	33.62	(37)
	Jan Feb	Mar Apr	May	Jun	Jul Aug	Sep	Oct Nov	Dec	
Ventilation heat	loss calculated monthly	y 0.33 x (25)m x (5)							
	24.83 24.68	24.52 23.79	23.66	23.02 2	3.02 22.90	23.27	23.66 23.93	24.22	(38)
Heat transfer co	efficient, W/K (37)m +	(38)m							
	58.46 58.30	58.15 57.42	57.28	56.65 5	56.53	56.89	57.28 57.56	57.85	
						Average = ∑(3	39)112/12 =	57.42	(39)
Heat loss param	eter (HLP), W/m²K (39)	m ÷ (4)							_
	1.16 1.16	1.16 1.14	1.14	1.13	.13 1.12	1.13	1.14 1.14	1.15	
						Average = ∑(4	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 3	1.00 31.00	30.00	31.00 30.00	31.00	(40)
4. Water heating	ng energy requirement								
Assumed occupa								1.70	(42)
·	hot water usage in litres	s per dav Vd.average	e = (25 x N) + 3	36				74.56	(43)
	Jan Feb	Mar Apr	May		Jul Aug	Sep	Oct Nov	Dec	
Hot water usage	in litres per day for eac	ch month Vd,m = fac	tor from Tabl	e 1c x (43)		-			
	82.02 79.04	76.06 73.07	70.09	67.11 6	7.11 70.09	73.07	76.06 79.04	82.02	7
				•			Σ(44)112 =	894.76	(44)
Energy content of	of hot water used = 4.18	3 x Vd,m x nm x Tm/	3600 kWh/m	onth (see Tabl	es 1b, 1c 1d)				_
	121.63 106.38	109.78 95.71	91.83	79.24 7	3.43 84.26	85.27	99.37 108.47	7 117.80	7
					·		∑(45)112 =	1173.18	(45)
Distribution loss	0.15 x (45)m								_
	18.25 15.96	16.47 14.36	13.77	11.89 1	1.01 12.64	12.79	14.91 16.27	17.67	(46)
Storage volume	(litres) including any sol	lar or WWHRS storag	ge within sam	ne vessel	·			3.00	(47)
Water storage lo	oss:								_
a) If manufactur	er's declared loss factor	is known (kWh/day)					0.26	(48)
Temperature	factor from Table 2b							0.54	(49)
Energy lost fr	om water storage (kWh	n/day) (48) x (49)						0.14	(50)
Enter (50) or (54) in (55)							0.14	(55)
Water storage lo	oss calculated for each r	month (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 con	tains dedicated solar sto	orage or dedicated V	VWHRS (56)m	n 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 eacl	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 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)r	n + (59)m +	+ (61)m				_
	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	t calculated	using Appe	endix G or A	Appendix H	<u> </u>								_
	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	for each mo	onth (kWh/	month) (62	2)m + (63)n	n	•				•	•	
	149.25	131.33	137.39	122.43	119.45	105.97	101.05	111.88	112.00	126.99	135.20	145.41	7
		1		•	'	•	•			∑(64)1	.12 = 1	498.35	(64)
Heat gains from	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. ,			٠, ١
S	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)
			1 22.22			11111			1000			5 2.25	
5. Internal gain	ıs												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	(Table 5)												
	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 (c	alculated ir	n Appendix	L, equation	L9 or L9a),	also see Ta	able 5							
	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	ix L, equatio	on L13 or L	13a), also s	ee 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 (c	alculated in	n Appendix	L, equation	L15 or L15	ia), also see	Table 5				1		1	
	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 ga		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. evap		-	0.00	3.50	0.00	3.00	0.00	1 0.00	1 0.00	0.00	0.00	0.00] (, 0)
	-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		1	07.30	07.50	07.50	07.50	07.50	1 07.50	1 07.50	07.50	07.50	07.50] (/ -/
Water Heating 8	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 ga							02.51	07.33	03.07	74.11	73.73	62.54] (72)
Total internal ga							220.04	224.70	242.69	250.20	276.20	300 50	7 (72)
	297.45	295.72	285.97	270.44	254.97	239.86	229.94	234.79	242.68	258.38	276.38	289.59	(73)
6. Solar gains													
			Access 1	factor	Area	So	ar flux		g	FF		Gains	
			Table	6d	m²	V	V/m²	•	ific data	specific o		W	
									able 6b	or Table			7
West	_		0.7	7 x	7.86	x1	.9.64 x	0.9 x	0.63 x	0.70	=	47.18	(80)
Solar gains in wa												ı	7
	47.18	92.29	151.99	221.67	271.66	278.09	264.76	227.42	176.77	109.51	58.83	38.80	(83)
Total gains - inte	ernal and so	olar (73)m +	(83)m										
	344.63	388.01	437.96	492.11	526.63	517.96	494.69	462.21	419.45	367.89	335.20	328.38	(84)
7. Mean intern	al tempera	iture (bes ti	ng saasan)										
				araa frans		ı(°C)						21.00	(05)
Temperature du	_		_				11	۸۰۰	Sam.	0-4		21.00 Doc	(85)
Halling to the	Jan 	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor	_	_				T =	T ==-	l					7,
	1.00	0.99	0.98	0.94	0.84	0.66	0.50	0.55	0.81	0.96	0.99	1.00	(86)
	ama at livir	ig area T1 (s	steps 3 to 7	in Table 9	C)								

	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 durir	ng heating	g periods in	the rest of	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 fo	or gains f	or rest of d	welling 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 tem	perature	in the rest	of dwelling	T2 (follow	steps 3 to	7 in Table 9	Эс)					•	_
Γ	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	1								Liv	ving area ÷	(4) =	0.55	(91)
Mean internal tem		for the wh	ole dwellin	gfIAxT1+	-(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		l.	I.		l			20.33	20.44	20.03	19.54	13.14	[32]
Apply adjustifierit				1			1	20.52	20.44	20.05	10.54	10.11	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	requirem	ent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor fo	nr gains i	nm		r	•								
	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, ηmG			l	0.92	0.61	0.02	0.43	0.50	0.77	0.93	0.99	1.00] (34)
_			1	45454	426.22	222.00	222.52	222.24	224.06	240.40	224.20	225.04	7 (05)
	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 e			1	1	T	1			<u> </u>	T	1	1	7
	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 r	nean inte	ernal tempe	rature, Lm	, W [(39)m ·	x [(93)m -	(96)m]							_
	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 requ	uirement,	, kWh/mon	th 0.024 x	[(97)m - (9	5)m] x (41)	m							
	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 requ	uirement	kWh/m²/yo	ear							(98)	÷ (4)	38.94	(99)
9a. Energy requir	ements -	individual	heating sy	stems inclu	iding micro	-CHP							
Space heating													_
Fraction of space h	eat from	secondary	/suppleme	ntary syste	m (table 11	.)						0.00	(201)
Fraction of space h	eat from	main syste	em(s)							1 - (20	01) =	1.00	(202)
Fraction of space h	eat from	main syste	em 2									0.00	(202)
Fraction of total sp	ace heat	from main	system 1						(20)2) x [1- (20	3)] =	1.00	(204)
Fraction of total sp	ace heat	from main	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	Vh/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	
L										1)15, 10		2095.50	(211)
Water heating									۷,-1.	,, 10			、/
Efficiency of water	heater												
Emelency of water		07.04	96.43	0F 0C	02 77	70.00	70.00	70.00	70.00	05.13	96.00	07.20	(247)
Water besting for	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			450	4.00.00	40000	400	400	1.0	4.0.0-	4.0:-	4====	400	٦
L	171.02	150.92	158.99	143.93	144.31	132.80	126.63	140.20	140.35	149.18	155.96	166.42	<u></u>
										∑(219a)1	.12 =	1780.70	(219)
Annual totals													_
Space heating fuel	- main sy	stem 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)

10a. Fuel costs - individual heating systems include	ding micro-CHP					
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2095.50	х	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	x	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. CO₂ emissions - individual heating systems i	ncluding micro-CHP					
	Energy kWh/year		Emission factor kg CO₂/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	у
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) + (2	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)



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						La	st modified	d	30/09	9/2020	
Address	2B3P, Kingston	upon Thames,	KT1								
1. Overall dwelling dimensi	ons										
1. Overall dwelling difficus	Olis		A	rea (m²)		Ave	rage storey	•	Vo	olume (m³)	
						he	eight (m)				
Lowest occupied				64.62	(1a) x		2.50	(2a) =		161.55	(3a)
Total floor area	(1a) + (1b)	+ (1c) + (1d)(1n) =	64.62	(4)						
Dwelling volume						(3a) + (3b) + (3	sc) + (3d)(3	n) =	161.55	(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) + (7	a) + (7b) + ((7c) =	20	÷ (5) =		0.12	(8)
If a pressurisation test has be	een carried out o	r is intended, p	roceed to (17), otherw	vise continu	e from (9)	to (16)	_			_
Air permeability value, q50, 6	expressed in cubi	c metres per h	our per squ	are metre	of envelop	e area				5.00	(17)
If based on air permeability v	value, then (18) =	[(17) ÷ 20] + (2	8), otherwis	se (18) = (1	6)					0.37	(18)
Number of sides on which th	e dwelling is shel	tered								2	(19)
Shelter factor							1 ·	- [0.075 x (19	9)] =	0.85	(20)
Infiltration rate incorporating	g shelter factor							(18) x (2	.0) =	0.32	(21)
Infiltration rate modified for	monthly wind sp	eed:									
Jan	Feb Ma	r Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed	l from Table U2										
5.10	5.00 4.90	0 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	3 1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a
Adjusted infiltration rate (all	owing for shelter	and wind fact	or) (21) x (2	22a)m							
0.41	0.40 0.39	9 0.35	0.34	0.30	0.30	0.29	0.32	0.34	0.36	0.37	(22b

Adjusted infiltra	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 effecti	ve air chan	ge rate for t	the applical	ole case:									
If mechanica	l ventilatior	n: air chang	e rate throu	ıgh system								N/A	(23a)
If balanced w	ith heat re	covery: effi	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							
	0.58	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 cha	nge rate - e	nter (24a) (or (24b) or ((24c) or (24	ld) 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)



Element				Gross	Ononings	Not	area	Havalua	A v 11 144	/K	الم	Λν.,	
			;	Gross area, m²	Openings m ²		area m²	U-value W/m²K	AxUW	/K κ-va kJ/n	•	Αxκ, kJ/K	
Window						14	.37 x	1.33	= 19.05				(27)
Door						1.	80 x	1.00	= 1.80				(26)
External wall						54	.23 x	0.18	= 9.76				(29
Party wall						14	.88 x	0.00	= 0.00				(32)
Roof						64	.62 x	0.13	= 8.40				(30)
Total area of exte	ernal eleme	ents ∑A, m²				135	5.02						(31
abric heat loss,	W/K = ∑(A	× U)							(26	5)(30) + (32	() =	39.01	(33
Heat capacity Cm	n = ∑(A x κ)							(28)	(30) + (32) -	+ (32a)(32€) =	N/A	(34
Thermal mass pa	rameter (T	IMP) in kJ/n	1²K									250.00	(35
Thermal bridges:	: ∑(L x Ψ) ca	alculated us	ing Apper	ndix K								17.71	(36
Total fabric heat	loss									(33) + (36	5) =	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 coe		ļ			_								_
	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
		1 37.33					33.33			(39)112/1		86.64	」] (39
Heat loss parame	eter (HIP).	W/m²K (39))m ÷ (4)						Average 2	_(33)112/1		00.01] (33
para	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	1.50	1.55	1.54	1.54	1.55	1.55	_		(40)112/1		1.34	」](40
Number of days	in month (1	Tahle 1al							Average - Z	_(40)112/1		1.54] (40
Number of days	31.00		31.00	30.00	21.00	30.00	21.00	21.00	20.00	21.00	20.00	21.00	7 (40
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40
4. Water heatin	ng energy r	equirement	t										
Assumed occupa	incy, N											2.11	(42
Annual average h	hot water u	usage in litre	es per day	Vd,average	= (25 x N) +	36						84.28	(43
						Jun			6	Oct	Nov		
	Jan	Feb	Mar	Apr	May	Juli	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage								Aug	Sep	Oct	NOV	Dec	
Hot water usage								79.23	Sep 82.60	85.97	89.34	Dec 92.71	1
Hot water usage	in litres pe	er day for ea	ich month	Vd,m = fact	tor from Tab	le 1c x (43)				89.34] (44
ا	in litres pe 92.71	er day for ea	sch month 85.97	Vd,m = fact 82.60	79.23	le 1c x (43 75.86	75.86	79.23		85.97	89.34	92.71]] (44
ا	in litres pe 92.71	er day for ea	sch month 85.97	Vd,m = fact 82.60	79.23	le 1c x (43 75.86	75.86	79.23		85.97	89.34	92.71]] (44
ا	in litres pe	89.34 89.34 er used = 4.1	85.97 8 x Vd,m	x nm x Tm/3	79.23 8600 kWh/m	le 1c x (43 75.86 onth (see	75.86 Tables 1b	79.23	82.60	85.97 ∑(44)11	89.34 2 = 1 122.61	92.71]
Energy content c	92.71 of hot wate 137.49	89.34 er used = 4.1	85.97 8 x Vd,m	x nm x Tm/3	79.23 8600 kWh/m	le 1c x (43 75.86 onth (see	75.86 Tables 1b	79.23	82.60	85.97 ∑(44)11	89.34 2 = 1 122.61	92.71]
Energy content c	92.71 of hot wate 137.49 0.15 x (45)	er day for ea 89.34 er 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 75.86 onth (see	75.86 Tables 1b	79.23 . 1c 1d) 95.25	96.39	85.97 Σ(44)11 112.33 Σ(45)11	89.34 2 = 1 122.61 2 = 1	92.71 1011.41 133.15 1326.12] (45
Energy content c	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 onth (see 89.57	75.86 Tables 1b	79.23	82.60	85.97 ∑(44)11	89.34 2 = 1 122.61	92.71 1011.41 133.15 1326.12] (45] (46
Energy content of the	92.71 of hot wate 137.49 0.15 x (45) 20.62 (litres) includes	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 onth (see 89.57	75.86 Tables 1b	79.23 . 1c 1d) 95.25	96.39	85.97 Σ(44)11 112.33 Σ(45)11	89.34 2 = 1 122.61 2 = 1	92.71 1011.41 133.15 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 VHRS storage	79.23 3600 kWh/m 103.80 15.57	75.86 onth (see 89.57	75.86 Tables 1b	79.23 . 1c 1d) 95.25	96.39	85.97 Σ(44)11 112.33 Σ(45)11	89.34 2 = 1 122.61 2 = 1	92.71 1011.41 133.15 1326.12 19.97 3.00] (45] (46] (47
Energy content of Distribution loss Storage volume (Nater storage lo	of hot wate 137.49 0.15 x (45) 20.62 (litres) incluses: er's declare	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 VHRS storage	79.23 3600 kWh/m 103.80 15.57	75.86 onth (see 89.57	75.86 Tables 1b	79.23 . 1c 1d) 95.25	96.39	85.97 Σ(44)11 112.33 Σ(45)11	89.34 2 = 1 122.61 2 = 1	92.71 1011.41 133.15 1326.12 19.97 3.00	(45) (46) (47) (48)
Energy content of Distribution loss Storage volume (Water storage log) If manufacture Temperature	in litres pe 92.71 of hot wate 137.49 0.15 x (45) 20.62 (litres) incluses: er's declare	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so ed loss facto 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	75.86 onth (see 89.57	75.86 Tables 1b	79.23 . 1c 1d) 95.25	96.39	85.97 Σ(44)11 112.33 Σ(45)11	89.34 2 = 1 122.61 2 = 1	92.71 1011.41 133.15 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 fro	of hot wate 137.49 0.15 x (45) 20.62 (litres) incluses: er's declared factor from om water s	er day for ea 89.34 er used = 4.1 120.25)m 18.04 uding any so ed loss facto 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	75.86 onth (see 89.57	75.86 Tables 1b	79.23 . 1c 1d) 95.25	96.39	85.97 Σ(44)11 112.33 Σ(45)11	89.34 2 = 1 122.61 2 = 1	92.71 1011.41 133.15 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 (Water storage loa) If manufacture Temperature Energy lost from	in litres pe 92.71 of hot wate 137.49 0.15 x (45) 20.62 (litres) incluses: er's declared factor from water so in (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	75.86 onth (see 89.57	75.86 Tables 1b	79.23 . 1c 1d) 95.25	96.39	85.97 Σ(44)11 112.33 Σ(45)11	89.34 2 = 1 122.61 2 = 1	92.71 1011.41 133.15 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 from	of hot wate 137.49 0.15 x (45) 20.62 (litres) incluses: er's declare factor from om water so) in (55) ess calculate	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	85.97 8 x Vd,m 124.09 18.61 blar or WV	108.18 16.23 VHRS storage (kWh/day) (8) x (49)	79.23 3600 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	79.23 .1c 1d) 95.25	96.39	85.97 Σ(44)11 112.33 Σ(45)11 16.85	89.34 2 = 1 122.61 2 = 1 18.39	92.71 1011.41 133.15 1326.12 19.97 3.00 0.26 0.54 0.14 0.14] (45] (46] (46] (47] (48] (49] (50] (55]
Energy lost fro 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 declare factor from water so in (55) oss calculate 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	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 Σ(44)11 112.33 Σ(45)11	89.34 2 = 1 122.61 2 = 1	92.71 1011.41 133.15 1326.12 19.97 3.00 0.26 0.54 0.14] (44] (45] (45] (47] (48] (49] (50] (55
Energy content of Distribution loss Storage volume (Water storage lost) If manufacture Temperature Energy lost from the content of the conte	on litres per 92.71 of hot wate 137.49 0.15 x (45) 20.62 (litres) incluses: er's declare factor from water so in (55) oss calculate 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	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 Σ(44)11 112.33 Σ(45)11 16.85	89.34 2 = 1 122.61 2 = 1 18.39	92.71 1011.41 133.15 1326.12 19.97 3.00 0.26 0.54 0.14 0.14] (45] (46] (47] (48] (49] (50] (55]

Primary circuit lo	oss for each	ı 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	lc									
	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 (calculated f	for each mo	onth 0.85 x	(45)m + (4	6)m + (57)r	n + (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 input	t calculated	using Appe	endix G or A	Appendix H	l								_
	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	or each mo	onth (kWh/	month) (6:	2)m + (63)n	1	•			•		'	
	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	651.29	(64)
Heat gains from	water heat	ing (kWh/n	nonth) 0.2!	5 × [0.85 ×	(45)m + (61	.)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)
] (,
5. Internal gain	ıs												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	(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 (c	alculated in	Appendix I	L, equation	L9 or L9a),	, also see Ta	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 gains	(calculated	in Appendi	x L, equation	on L13 or L	13a), also s	ee 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 (c	alculated ir	Appendix	L, equation	L15 or L15	sa), also see	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 ga	ains (Table !	5a)		•	-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. evap						3.33				0.00		0.00] (/
	-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		•	000	000	1 000	0	05	1 000	000	000	000	000] (, -,
	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 ga							00.75	72.20	74.21	73.30	00.32	05.20] (72)
Total internal ga	349.65	347.78	336.18		298.73		268.53	273.93	283.42	302.26	323.92	340.03	(73)
	349.03	347.76	330.10	317.53	290.75	280.48	200.55	273.93	203.42	302.20	323.92	340.03] (73)
6. Solar gains													
			Access f		Area		ar flux		g	FF		Gains	
			Table	: 6d	m²	V	//m²		ific data able 6b	specific d or Table		W	
					7.00		0.60					25.45	7 (7.4)
North			0.7		7.83				0.63 x		=	25.45	(74)
			_		6.54	x 1	9.64 x	0.9 x	0.63 x	0.70	=	39.26	(76)
East	=/=->	(02)	0.7	7 x	0.54		, , , , , , , , , , , , , , , , , , ,	0.5 x					. ,
East Solar gains in wa													7
Solar gains in wa	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)
	64.70 ernal and so	125.42 plar (73)m +	209.09 (83)m	317.16	404.83	422.79	398.99	331.00				53.49	7
Solar gains in wa	64.70	125.42	209.09						246.43	149.00 451.27	80.34		7
Solar gains in wa	64.70 ernal and so 414.35	125.42 plar (73)m + 473.19	209.09 · (83)m 545.28	317.16	404.83	422.79	398.99	331.00				53.49	(83)
Solar gains in wa	64.70 ernal and so 414.35	125.42 plar (73)m + 473.19 ture (heatin	209.09 · (83)m 545.28	317.16	404.83 703.57	703.27	398.99	331.00				53.49 393.52	(83)
Solar gains in wa	64.70 ernal and so 414.35 nal tempera	125.42 plar (73)m + 473.19 ture (heating periods in	209.09 (83)m 545.28 ng season)	317.16 634.70 area from T	404.83 703.57 Table 9, Th1	422.79 703.27	398.99	331.00	529.85	451.27	404.25	393.52	(83)
Total gains - inte	64.70 ernal and so 414.35 all tempera	125.42 plar (73)m + 473.19 ture (heating periods in Feb	209.09 (83)m 545.28 ng season) n the living a	317.16 634.70 area from 7	404.83 703.57 Table 9, Th1 May	703.27	398.99	331.00				53.49 393.52	(83)
Solar gains in wa	64.70 ernal and so 414.35 hal tempera uring heatin Jan r for gains f	125.42 plar (73)m + 473.19 ture (heating periods in Feb for living are	209.09 (83)m 545.28 ng season) the living a Mar ea n1,m (se	317.16 634.70 area from 7 Apr ee Table 9a	703.57 Table 9, Th1 May	422.79 703.27 .(°C) Jun	398.99 667.52	331.00 604.93	529.85 Sep	451.27 Oct	404.25 Nov	393.52 21.00 Dec] (83)] (84)] (85)
Total gains - inte	64.70 ernal and so 414.35 all tempera	125.42 plar (73)m + 473.19 ture (heating periods in Feb	209.09 (83)m 545.28 ng season) n the living a	317.16 634.70 area from 7	404.83 703.57 Table 9, Th1 May	422.79 703.27	398.99	331.00	529.85	451.27	404.25	393.52	(83)

Mean internal to	emp of livin	g area T1 (s	steps 3 to 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 of	dwelling f	rom Table 9), Th2(°C)		!	!	Į.	!		_ ` `
	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)
Utilisation facto		1	I.	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 to		!			!	ļ	ļ.	0	05	1 0.50	0.00	1 2.00] (00)
	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)
Living area fract		10.00	10.51	13.03	13.33	13.77	13.01	13.01		ving area ÷		0.42] (91)
Mean internal to		for the wh	ole dwellin	σfIΔ v T1 -	⊦(1 - fl Δ\ x ī	Г2				villig area :	(4) -	0.42] (31)
Wicaii internal o	18.55	18.75	19.12	19.63	20.04	20.25	20.30	20.29	20.14	19.60	18.99	18.52	(92)
Apply adjustme		1	l		1	l.		20.23	20.14	13.00	10.55	18.32] (32)
Apply adjustifier	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)
	10.55	16.75	19.12	19.05	20.04	20.23	20.30	20.29	20.14	19.00	10.99	10.52] (93)
8. Space heating	ng requirem	nent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	r for gains,	ηm											
	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, ηπ	nGm, W (94	1)m x (84)m	l										
	412.22	468.65	532.79	592.59	581.71	452.29	311.41	322.74	428.84	433.71	400.42	391.90	(95)
Monthly averag	e 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 fo	or mean inte	ernal tempe	erature, Lm	, W [(39)m	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	(97)
Space heating re	equirement	, 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	
									∑(9	8)15, 10	.12 = 3	3242.41	(98)
Space heating re	equirement	kWh/m²/yo	ear							(98)	÷ (4)	50.18	(99)
9a. Energy req	uirements -	individual	heating sys	stems inclu	iding micro	-CHP							
Space heating													7
Fraction of spac		•		ntary syste	m (table 11	.)						0.00	(201)
Fraction of spac										1 - (20	01) =	1.00	(202)
Fraction of spac	e heat from	main syste	em 2									0.00	(202)
Fraction of total	•		•						(20	02) x [1- (20	3)] =	1.00	(204)
Fraction of total			system 2							(202) x (20	03) =	0.00	(205)
Efficiency of ma	in system 1	(%)										93.50	(206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating for	uel (main sy	stem 1), kV	Vh/month								1		_
	667.08	535.06	454.04	259.25	111.04	0.00	0.00	0.00	0.00	274.52	486.41	680.43	
									∑(21	1)15, 10	.12 =	3467.81	(211)
Water heating													
Efficiency of wa	ter heater												_
	88.03	87.85	87.41	86.36	84.19	79.80	79.80	79.80	79.80	86.41	87.60	88.12	(217)
Water heating f	uel, kWh/m	onth											_
	187.56	165.28	173.55	156.22	156.09	145.74	138.62	153.97	154.28	161.95	170.49	182.45	
										∑(219a)1	.12 =	1946.19	(219)
Annual totals													

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			

Electricity for lighting (Appendix L)					290.39	(232)
Total delivered energy for all uses		(21	11)(221) + (231) + (23	2)(237b) = [5779.39	(238)
10a. Fuel costs - individual heating systems include	ding micro-CHP					
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3467.81	x	3.48	x 0.01 =	120.68	(240)
Water heating	1946.19	x	3.48	x 0.01 =	67.73	(247)
Pumps and fans	75.00	x	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) + (2	45)(254) = [356.60	(255)
11a. SAP rating - individual heating systems inclu	ding micro-CHP					
Energy cost deflator (Table 12)				[0.42	(256)
Energy cost factor (ECF)				[1.37	(257)
SAP value				[80.94	
SAP rating (section 13)				[81	(258)
SAP band				[В	

12a. CO₂ emissions - individual heating systems including mic	ro-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 CO₂, 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)
EI band					В]

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



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

Client								Last modified	d	30/09	9/2020	
Address	2B4P, King	ston upor	Thames, k	KT1								
1. Overall dwelling dime	nsions											
				Α	rea (m²)		Α	verage storey height (m)	,	V	olume (m³)	
Lowest occupied					73.74	(1a) x		2.50	(2a) =		184.35	(3a)
Total floor area	(1a) +	(1b) + (1c) + (1d)(1	Ln) =	73.74	(4)						
Dwelling volume							((3a) + (3b) + (3	c) + (3d)(3	sn) =	184.35	(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 fa	ns							3	x 10 =		30	(7a)
Number of passive vents								0	x 10 =		0	(7b)
Number of flueless gas fire	es							0	x 40 =		0	(7c)
										Air	changes pe hour	r
Infiltration due to chimne	s, flues, fans,	PSVs		(6a)	+ (6b) + (7a	a) + (7b) + ((7c) =	30	÷ (5) =	:	0.16	(8)
If a pressurisation test has	been carried o	out or is ir	ntended, pr	oceed to (17), otherw	ise continu	e from (9) to (16)				
Air permeability value, q5	O, expressed in	cubic me	tres per ho	our per squ	uare metre	of envelop	e area				5.00	(17)
If based on air permeabilit	y value, then (18) = [(17) ÷ 20] + (8), otherwis	se (18) = (16	5)					0.41	(18)
Number of sides on which	the dwelling is	s sheltere	d								2	(19)
Shelter factor								1 -	- [0.075 x (19	9)] =	0.85	(20)
Infiltration rate incorporat	ing shelter fac	tor							(18) x (2	20) =	0.35	(21)
Infiltration rate modified f	or monthly wi	nd speed:										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spe	ed 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 sh	elter and	wind facto	or) (21) x (2	22a)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 cha	nge rate for th	e applicat	ole case:							_		_
If mechanical ventilation	n: air change	rate throu	gh system								N/A	(23a)



0.60

0.60

N/A

0.58

0.58

(24d)

(25)

0.58

0.58

0.56

0.56

0.56

0.56

0.55

0.55

0.56

0.56

0.57

0.57

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

0.57

0.57

0.57

0.57

0.59

0.59

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

0.60

0.60

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

180	Window	(2
180	Door 1.80 x 1.00 $=$ 1.80 External wall 59.21 x 0.18 $=$ 10.66 Party wall 15.83 x 0.00 $=$ 0.00 Total area of external elements ΣA , m^2 76.43 Pabric heat loss, $W/K = \Sigma (A \times U)$ $(26)(30) + (32) =$ 32.90 Heat capacity $Cm = \Sigma (A \times K)$ $(28)(30) + (32) + (32a)(32e) =$ N/A	
Section Sect	External wall 59.21 x 0.18 = 10.66 Party wall 15.83 x 0.00 = 0.00 Total area of external elements ΣA , m^2 76.43 Fabric heat loss, $W/K = \Sigma (A \times U)$ $(26)(30) + (32) = \boxed{32.90}$ Heat capacity $Cm = \Sigma (A \times K)$ $(28)(30) + (32) + (32a)(32e) = \boxed{N/A}$	
the provided in the property of the property o	arty wall	(2
The liter of each clase with \$ 2 \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	otal area of external elements ΣA , m ² abric heat loss, W/K = $\Sigma (A \times U)$ (26)(30) + (32) = 32.90 (28)(30) + (32) + (32a)(32e) = N/A	(2
Section Sect	abric heat loss, W/K = Σ (A × U) (26)(30) + (32) = 32.90 eat capacity Cm = Σ (A × K) (28)(30) + (32) + (32a)(32e) = N/A	(3
Part	eat capacity Cm = $\sum (A \times K)$ (28)(30) + (32) + (32a)(32e) = N/A	(3
Permai mans parameter (TMP) in klym*k		(3
Second S	hermal mass parameter (TMP) in kJ/m ² K 250.00	(3
the property of the property o		(3
Section Sec	hermal bridges: Σ(L x Ψ) calculated using Appendix K	(3
entilation heat loss calculated monthly 0.33 x (z5)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 attainsfer coefficient, W/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 = \(\script{39}\) \cdots \(\script{74.57}\) \cdots \(\scrip	$ \text{fotal fabric heat loss} \qquad $	(3
36.50 36.27 36.04 34.95 34.74 33.80 33.80 33.62 34.16 34.74 35.16 35.59 altertransfer coefficient, W/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 74.37 75.01 Average = ∑(39)112/12 74.37 75.01 Average = ∑(40)112/12 1.03 1.03 1.02 1.01 1.01 0.99 0.99 0.99 1.00 1.01 1.01	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov D	С
eat transfer coefficient, W/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 = \$\frac{2}{3}\$9112/12 = \begin{array}{cccccccccccccccccccccccccccccccccccc	entilation heat loss calculated monthly 0.33 x (25)m x (5)	
T5.92 T5.69 T5.45 T4.37 T4.16 T3.22 T3.24 T3.04 T3.58 T4.16 T4.57 T5.01 Average = \(\frac{1}{2} \) \(1	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
Average = \(\(\frac{1}{3} \) \(\frac{1}	eat transfer coefficient, W/K (37)m + (38)m	
eat loss parameter (HLP), W/m²K (39)m ÷ (4) 1.03 1.03 1.02 1.01 1.01 0.99 0.99 0.99 1.00 1.01 1.01	75.92 75.69 75.45 74.37 74.16 73.22 73.22 73.04 73.58 74.16 74.57 75)1
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 = \(\sqrt{1}\) (112/12 = \(\sqrt{1}\) (1.01 1.02 Average = \(\sqrt{1}\) (112/12 = \(\sqrt{1}\) (1.01 1.01 1.02 Average = \(\sqrt{1}\) (112/12 = \(\sqrt{1}\) (1.01 1.01 1.02 Average = \(\sqrt{1}\) (112/12 = \(\sqrt{1}\) (1.01 1.01 1.02 Average = \(\sqrt{1}\) (112/12 = \(\sqrt{1}\) (1.01 1.01 1.02 Average = \(\sqrt{1}\) (112/12 = \(\sqrt{1}\) (1.01 1.01 1.02 1.03 1.00 28.00 31.00 30.00 31.00 30.00 31.00 30.00 31.00 30.00 31.00 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 30.00 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 30.00 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 30.00 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 30.00 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 30.00 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 30.00 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 30.00 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 30.00 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 30.00 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 30.00 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 30.00 31.00 30.00 31.00 30.00 31.00 30.00 31.00 30.00 31.00 30.00 31.00 31.00 30.00 31.00 30.00 31.00	Average = $\sum (39)112/12 = \boxed{74.37}$	(3
Average = \(\) \(leat loss parameter (HLP), W/m²K (39)m ÷ (4)	
### State St	1.03 1.03 1.02 1.01 1.01 0.99 0.99 1.00 1.01 1.01 1.	2
31.00 28.00 31.00 30.00 30.00 31.00 30.00 31.00 30.00 31.00 30.00 31.00 30.00 30.00 30.00 31.00 30.00	Average = $\sum (40)112/12 = \boxed{1.01}$	(4
### A set of the state of the s	lumber of days in month (Table 1a)	
2.33 19.62 19.00	31.00 28.00 31.00 30.00 31.00 30.00 31.00 31.00 30.00 31.00 30.00 31.00 30.00 31	00 (4
2.33 19.62 19.00	A Water heating energy requirement	
Sample S		(4
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec		(4
the water usage in litres per day for each month Vd,m = factor from Table 1c x (43) 98.58 95.00 91.41 87.83 84.24 80.66 80.66 84.24 87.83 91.41 95.00 98.58 \$\frac{5}{2}(44)112 = \frac{1075.42}{1075.42}\$ the regy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d) \[\frac{146.19}{146.19} \frac{127.86}{131.94} \frac{131.94}{115.03} \frac{110.37}{110.37} \frac{95.24}{95.24} \frac{88.26}{88.26} \frac{101.28}{101.28} \frac{102.49}{119.44} \frac{130.37}{130.37} \frac{141.58}{141.58} \] \$\frac{245}{21.93} \frac{19.18}{19.18} \frac{19.79}{19.72} \frac{16.56}{16.56} \frac{14.29}{14.29} \frac{13.24}{15.19} \frac{15.37}{15.37} \frac{17.92}{17.92} \frac{19.56}{19.56} \frac{21.24}{21.24} \] \$\frac{1410.04}{140.04} \frac{1410.04}{140.04} \		(~
98.58 95.00 91.41 87.83 84.24 80.66 80.66 84.24 87.83 91.41 95.00 98.58 \[\frac{1}{2}\text{(44)112} = \frac{1}{2}\text{1075.42} \] \[\text{nergy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)} \] \[\frac{1}{4}\text{6.19} \] 127.86 131.94 115.03 110.37 95.24 88.26 101.28 102.49 119.44 130.37 141.58 \] \[\frac{1}{2}\text{45}\text{112} = \frac{1}\text{410.04} \] \[\text{istribution loss } 0.15 x (45)m \] \[\frac{2}{2}\text{1.93} \] 19.18 19.79 17.25 16.56 14.29 13.24 15.19 15.37 17.92 19.56 21.24 \] \[\text{torage volume (litres) including any solar or WWHRS storage within same vessel vessel of manufacturer's declared loss factor is known (kWh/day) \] \[\frac{1}{2}\text{1.93} \] 19.18 x (49) \[\frac{1}{2}\text{1.93} \] \[\frac{1}{2}\text{1.94} \] \[\frac{1}{2}\text{1.95}		r
Second content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d) 146.19	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov D	С
nergy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d) 146.19	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Do ot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	
146.19 127.86 131.94 115.03 110.37 95.24 88.26 101.28 102.49 119.44 130.37 141.58 \(\frac{1}{2}(45)\)112 = \frac{1}{2}(410.04) \] istribution loss 0.15 x (45)m \(\frac{2}{1} \) 9.18 19.18 19.79 17.25 16.56 14.29 13.24 15.19 15.37 17.92 19.56 21.24 \] torage volume (litres) including any solar or WWHRS storage within same vessel 3.00 \(\frac{1}{2} \) 16 manufacturer's declared loss factor is known (kWh/day)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Description ot water usage in litres per day for each month Vd,m = factor from Table 1c x (43) 98.58 95.00 91.41 87.83 84.24 80.66 80.66 84.24 87.83 91.41 95.00 98	58
Section Sect	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Description ot water usage in litres per day for each month Vd,m = factor from Table 1c x (43) 98.58 95.00 91.41 87.83 84.24 80.66 80.66 84.24 87.83 91.41 95.00 98 Σ(44)112 = 1075.4	58
istribution loss 0.15 x (45)m 21.93 19.18 19.79 17.25 16.56 14.29 13.24 15.19 15.37 17.92 19.56 21.24 torage volume (litres) including any solar or WWHRS storage within same vessel /ater storage loss: () If manufacturer's declared loss factor is known (kWh/day) Temperature factor from Table 2b Energy lost from water storage (kWh/day) (48) x (49) Inter (50) or (54) in (55) /ater storage loss calculated for each month (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 4.21 4.36 4.21 4.36 the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dependent of water usage in litres per day for each month Vd,m = factor from Table 1c x (43) $ 98.58 95.00 91.41 87.83 84.24 80.66 80.66 84.24 87.83 91.41 95.00 98 $ The proof of water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	58 (4
21.93	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Description of water usage in litres per day for each month Vd,m = factor from Table 1c x (43) 98.58 95.00 91.41 87.83 84.24 80.66 80.66 84.24 87.83 91.41 95.00 98 $\Sigma(44)112 = 1075.44$ The properties of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d) 146.19 127.86 131.94 115.03 110.37 95.24 88.26 101.28 102.49 119.44 130.37 141	58 (4
torage volume (litres) including any solar or WWHRS storage within same vessel // atter storage loss: // atter storage loss factor is known (kWh/day) Temperature factor from Table 2b Energy lost from water storage (kWh/day) (48) x (49) // atter storage loss calculated for each month (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 4.21 4.36 the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Description of water usage in litres per day for each month Vd,m = factor from Table 1c x (43) 98.58 95.00 91.41 87.83 84.24 80.66 80.66 84.24 87.83 91.41 95.00 98 $\Sigma(44)112 = 1075.4$ nergy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d) 146.19 127.86 131.94 115.03 110.37 95.24 88.26 101.28 102.49 119.44 130.37 141 $\Sigma(45)112 = 1410.0$	58 (4
/ater storage loss: () If manufacturer's declared loss factor is known (kWh/day) Temperature factor from Table 2b Energy lost from water storage (kWh/day) (48) x (49) Inter (50) or (54) in (55) /ater storage loss calculated for each month (55) x (41)m 4.36 3.93 4.36 4.21 4.36 4.21 4.36 4.21 4.36 4.21 4.36 4.21 4.36 the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Description of water usage in litres per day for each month Vd,m = factor from Table 1c x (43) 98.58 95.00 91.41 87.83 84.24 80.66 80.66 84.24 87.83 91.41 95.00 98 $\Sigma(44)112 = 1075.44$ nergy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d) 146.19 127.86 131.94 115.03 110.37 95.24 88.26 101.28 102.49 119.44 130.37 141 $\Sigma(45)112 = 1410.06$ istribution loss 0.15 x (45)m	58 (4
Output	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Description ot water usage in litres per day for each month Vd,m = factor from Table 1c x (43) 98.58 95.00 91.41 87.83 84.24 80.66 80.66 84.24 87.83 91.41 95.00 98 5 (44)112 = 1075.4 1075.4	58 2 (4 58 4 (4
Temperature factor from Table 2b Energy lost from water storage (kWh/day) (48) x (49) O.14 Inter (50) or (54) in (55) Vater storage loss calculated for each month (55) x (41)m 4.36 3.93 4.36 4.21 4.36 4.21 4.36 4.21 4.36 4.21 4.36 4.21 4.36 4.21 4.36 the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dot water usage in litres per day for each month Vd,m = factor from Table 1c x (43) $98.58 95.00 91.41 87.83 84.24 80.66 80.66 84.24 87.83 91.41 95.00 98$ $\Sigma(44)112 = 1075.49$ The regy content of hot water used = $4.18 \times Vd$,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d) $146.19 127.86 131.94 115.03 110.37 95.24 88.26 101.28 102.49 119.44 130.37 141$ $\Sigma(45)112 = 1410.09$ This istribution loss $0.15 \times (45)$ m $21.93 19.18 19.79 17.25 16.56 14.29 13.24 15.19 15.37 17.92 19.56 21$ The corage volume (litres) including any solar or WWHRS storage within same vessel 3.00×10^{-1}	58 2 (4 58 4 (4
Energy lost from water storage (kWh/day) (48) x (49) onter (50) or (54) in (55) /ater storage loss calculated for each month (55) x (41)m 4.36 3.93 4.36 4.21 4.36 4.21 4.36 4.21 4.36 4.21 4.36 4.21 4.36 the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dot	58 2 (4 58 4 (4 24 (4
nter (50) or (54) in (55) /ater storage loss calculated for each month (55) x (41)m 4.36 3.93 4.36 4.21 4.21 4.36 4.21 4.21 4.36 4.21 4.21 4.21 4.21 4.21 4.21 4.21 4.21	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dot	58 2 (4 58 4 (4 24 (4 (4
/ater storage loss calculated for each month (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 4.21 4.36 (47) - Vs] ÷ (47), else (56)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dot ot water usage in litres per day for each month Vd,m = factor from Table 1c x (43) 98.58 95.00 91.41 87.83 84.24 80.66 80.66 84.24 87.83 91.41 95.00 98 (44)112 = 1075.4 neergy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d) 146.19 127.86 131.94 115.03 110.37 95.24 88.26 101.28 102.49 119.44 130.37 141 (45)112 = 1410.0 istribution loss 0.15 x (45)m 21.93 19.18 19.79 17.25 16.56 14.29 13.24 15.19 15.37 17.92 19.56 21 torage volume (litres) including any solar or WWHRS storage within same vessel 3.00 // attractor from Table 2b 0.26	58 2 (4 58 4 (4 24 (4 (4 (4 (4
4.36 3.93 4.36 4.21 4.36 4.21 4.36 4.36 4.21 4.36 4.21 4.36 4.21 4.36 4.21 4.36 the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Doctor	58 2 (4 58 4 (4 24 (4 (4 (4 (4
the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dot	58 2 (4 58 4 (4 24 (4 (4 (4 (5)
	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dots	58 2 (4 58 4 (4 24 (4 (4 (4 (5)
436 303 436 434 436 434 436 436 436 436	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dots	58 2 (4 58 4 (4 24 (4 (4 (5) (5)
4.36 3.93 4.36 4.21 4.36 4.21 4.36 4.21 4.36 4.21 4.36 4.21 4.36	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Doctor	58 (4 58 (4 58 (4 58 (4 58 (4 64 (4 65 (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	each month	from Table	3a, 3b or 3	ic									
	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 o	alculated f	or each mo	onth 0.85 x	(45)m + (4	6)m + (57)ı	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
-lBUNA		1	!	!	1	121.97	113.67	120.09	129.21	147.03	137.10	109.20	[(02
olar DHW inpu			1			1	1			1 1		1	7
	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 f	or each mo	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	.)m] + 0.8 ×	[(46)m + (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
	70.70	02		1 33.00	1 33.73	33.03	02	33.7.	33	02.02	0 0	00.27] (00
5. Internal gair	ns												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1etabolic gains	(Table 5)			•	•			•	•				
retabolic gams	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	116.67	166
1				116.67	-	•	110.07	110.07	116.67	110.07	116.67	116.67	J (66
ghting gains (c	calculated in					1					<u> </u>		,
	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	(calculated	in Appendi	x L, equation	on L13 or Lí	13a), also s	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
ooking gains (d	calculated in	Appendix	L, equation	L15 or L15	ia), 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
ump and fan g													_
0	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
			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	,	,						T					, ٦
	-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	gains (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	ains (66)m -	+ (67)m + (6	8)m + (69)	m + (70)m ·	+ (71)m + (72)m							
	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
6. Solar gains													
			Access 1		Area		ar flux		g	FF		Gains	
			Table	∉6d	m²	V	//m²	•	ific data able 6b	specific d or Table		W	
								0	abic ob	or rubic			٦.
						1						65.43	(76
ast			0.7	7 x	10.90	x 1	9.64 x	0.9 x	0.63 ×	0.70	=	03.43	-
			0.7		10.90	-			0.63 ×		=	31.72	(78
outh				7 x		x 4	6.75 x	0.9 x		0.70			J ,
outh /est	atts ∑(74)m	ı(82)m	0.7	7 x	2.22	x 4	6.75 x	0.9 x	0.63 ×	0.70	= [31.72	J ,
outh /est	atts ∑(74)m	ı(82)m	0.7	7 x	2.22	x 4	6.75 x	0.9 x	0.63 ×	0.70	= [31.72	(80
outh /est olar gains in w	110.95	206.94	0.7	7 x 7 x	2.22	x 4	6.75 x 9.64 x	0.9 x (0.63 × 0.63 ×	0.70	= [31.72 13.81	(80
outh /est olar gains in w	110.95 ernal and so	206.94 lar (73)m +	0.7 0.7 321.42 (83)m	7 x 7 x 447.06	2.22 2.30 534.16	x 4 x 1	6.75 x 9.64 x	0.9 x 0.9 x 453.10	0.63 × 0.63 × 365.99	0.70	= 136.39	31.72 13.81 92.56	(80)
outh /est olar gains in w	110.95	206.94	0.7	7 x 7 x	2.22	x 4	6.75 x 9.64 x	0.9 x (0.63 × 0.63 ×	0.70	= [31.72 13.81	(80)
outh Vest olar gains in wa otal gains - inte	110.95 ernal and so 491.25	206.94 slar (73)m + 585.25	0.7 0.7 321.42 (83)m 687.00	7 x 7 x 447.06 792.10	2.22 2.30 534.16	x 4 x 1	6.75 x 9.64 x	0.9 x 0.9 x 453.10	0.63 × 0.63 × 365.99	0.70	= 136.39	31.72 13.81 92.56	(80)
outh Vest Olar gains in want otal gains - inter 7. Mean interr	110.95 ernal and so 491.25 nal tempera	206.94 blar (73)m + 585.25 ture (heati	0.7 0.7 321.42 (83)m 687.00	7 x 7 x 447.06 792.10	2.22 2.30 534.16	x 4 x 1 542.03	6.75 x 9.64 x	0.9 x 0.9 x 453.10	0.63 × 0.63 × 365.99	0.70	= 136.39	31.72 13.81 92.56 462.24	(80) (83) (84)
ast outh Vest olar gains in ward otal gains - into 7. Mean interr emperature du	110.95 ernal and so 491.25 nal tempera	206.94 plar (73)m + 585.25 ture (heating periods in	0.7 0.7 321.42 (83)m 687.00 ng season)	7 x 7 x 447.06 792.10	2.22 2.30 534.16 858.40	x 4 x 1 542.03	6.75 x 9.64 x 517.91	0.9 x 0.9 x 453.10 749.85	0.63 × 0.63 × 365.99	0.70 0.70 239.94 567.94	136.39	31.72 13.81 92.56 462.24 21.00	(80) (83) (84)
outh Vest olar gains in war otal gains - inte	110.95 ernal and so 491.25 nal tempera uring heating	206.94 blar (73)m + 585.25 ture (heating periods in Feb	0.7 0.7 321.42 (83)m 687.00 ng season) the living a	7 x 7 x 7 x 447.06 792.10 Apr	2.22 2.30 534.16 858.40	x 4 x 1 542.03	6.75 x 9.64 x	0.9 x 0.9 x 453.10	0.63 × 0.63 × 365.99	0.70	= 136.39	31.72 13.81 92.56 462.24] (78] (80] (83] (84] (85
outh Vest olar gains in wo otal gains - into	110.95 ernal and so 491.25 nal tempera uring heating	206.94 blar (73)m + 585.25 ture (heating periods in Feb	0.7 0.7 321.42 (83)m 687.00 ng season) the living a	7 x 7 x 7 x 447.06 792.10 Apr	2.22 2.30 534.16 858.40	x 4 x 1 542.03	6.75 x 9.64 x 517.91	0.9 x 0.9 x 453.10 749.85	0.63 × 0.63 × 365.99	0.70 0.70 239.94 567.94	136.39	31.72 13.81 92.56 462.24 21.00	(80) (83) (84)

Mean internal	temp of livir	ng area T1 (s	steps 3 to 7	in Table 90	:)								
	19.99	20.17	20.44	20.75	20.93	20.99	21.00	21.00	20.96	20.69	20.28	19.96	(87)
Temperature d	uring heatin	g periods in	the rest o	f dwelling f	rom Table 9	9, Th2(°C)				•	•	•	_
	20.06	20.06	20.06	20.08	20.08	20.09	20.09	20.09	20.09	20.08	20.07	20.07	(88)
Utilisation factor	or for gains t	for rest of d	welling 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	(89)
Mean internal	temperature	e in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	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	(90)
Living area frac	tion								Li	ving area ÷	(4) =	0.41	(91)
Mean internal	temperature	for the wh	ole dwellin	g fLA x T1 +	-(1 - fLA) x	Т2							
	19.23	19.46	19.81	20.19	20.39	20.45	20.46	20.46	20.42	20.13	19.61	19.20	(92)
Apply adjustme	ent to the m	ean interna	l temperat	ure from Ta	ble 4e whe	ere appropr	riate						
	19.23	19.46	19.81	20.19	20.39	20.45	20.46	20.46	20.42	20.13	19.61	19.20	(93)
8. Space heat	ing roquiron	a a n t											
o. Space near		Feb	Mar	Anr	May	lun	Jul	Aug	Son	Oct	Nov	Dec	
Utilisation factor	Jan or for gains		IVIAI	Apr	May	Jun	Jui	Aug	Sep	Oct	NOV	Dec	
Othisation racti	_		0.06	0.87	0.71	0.50	0.35	0.39	0.66	0.92	0.99	1.00	7 (04)
Useful gains, ղ։	0.99	0.99	0.96	0.87	0.71	0.50	0.35	0.39	0.66	0.92	0.99	1.00	(94)
Oserui gairis, iți	488.43	576.72	657.89	690.53	606.51	423.95	282.07	295.57	445.78	525.00	481.85	460.28	(95)
Monthly averag		-			000.51	423.93	202.07	295.57	443.76	323.00	401.03	400.28] (95)
ivioriting 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 f		1		1			10.00	10.40	14.10	10.00	7.10	4.20] (30)
11041 1033 1410 1	1133.47	1102.02	1004.03	839.47	644.45	428.48	282.54	296.50	465.37	706.46	932.71	1124.82	(97)
Space heating i		!		!	ļ.		202.54	290.50	403.37	700.40	332.71	1124.02] (37)
Space Heating	479.91	353.00	257.53	107.23	28.23	0.00	0.00	0.00	0.00	135.01	324.62	494.42	7
	475.51	333.00	237.33	107.23	20.23	0.00	0.00	0.00		8)15, 10		2179.95	」 │(98)
Space heating i	requirement	· kWh/m²/v	ear						2(3)			29.56	(99)
	equirement		cui							(30)	. (.)	23.30] (33)
9a. Energy red	quirements	- individual	heating sy	stems inclu	ding 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	n main syste	em(s)							1 - (2	01) =	1.00	(202)
Fraction of spa	ce heat fron	n main syste	em 2									0.00	(202)
Fraction of tota	al space heat	t from main	system 1						(20	02) x [1- (20	03)] =	1.00	(204)
Fraction of tota	al space heat	t from main	system 2							(202) x (2	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	vstem 1), kV	Vh/month										
	513.27	377.54	275.44	114.69	30.19	0.00	0.00	0.00	0.00	144.39	347.19	528.79]
									∑(21	1)15, 10	12 = 2	2331.50	(211)
Water heating													
Efficiency of wa	ater heater												_
	87.38	86.98	86.08	84.08	81.44	79.80	79.80	79.80	79.80	84.59	86.71	87.51	(217)
Water heating		nonth											_
	198.90	175.68	185.35	168.59	169.45	152.84	145.21	161.52	161.92	173.85	181.18	193.35	
										∑(219a)1	12 = 2	2067.85	(219)
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		(211)(221) + (231) + (23	32)(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) + (2	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. CO ₂ emissions - individual heating systems includin	g micro-CHP					
	Energy kWh/year		Emission factor kg CO ₂ /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 CO₂, kg/year				(265)(271) =	1157.91	(272)
Dwelling CO₂ emission rate				(272) ÷ (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	r
Space heating - main system 1	2331.50	х	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)



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

Client							Last modified		30/09	/2020	
Address	2B3P, Kingston upo	n Thames, K	T1								
1 Overall dwelling dim	oncione										
1. Overall dwelling dim	ensions		Δ	rea (m²)		Δ	verage storey		Vo	olume (m³)	
			Α.	iea (iii)			height (m)		V	nume (m)	
Lowest occupied				74.00	(1a) x	Г	2.50	(2a) =		185.00	(3a)
Total floor area	(1a) + (1b) + (1	c) + (1d)(1	n) =	74.00	(4)						_
Dwelling volume						((3a) + (3b) + (3	c) + (3d)(3ı	n) =	185.00	(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 f	ans						3	x 10 =		30	(7a)
Number of passive vents							0	x 10 =		0	(7b)
Number of flueless gas fi	res						0	x 40 =		0	(7c)
									Air	changes pe hour	r
Infiltration due to chimne	evs. flues. fans. PSVs		(6a)	+ (6b) + (7a	ı) + (7b) + (7c) =	30	÷ (5) =		0.16	(8)
If a pressurisation test ha		intended, pro] (0)		0.20	_ (0)
Air permeability value, q							, , ,			5.00	(17)
If based on air permeabil	ity value, then (18) = [(1	7) ÷ 20] + (8)), otherwis	se (18) = (16	5)					0.41	(18)
Number of sides on whic	h the dwelling is shelter	ed								2	(19)
Shelter factor							1 -	[0.075 x (19)] =	0.85	(20)
Infiltration rate incorpora	ating shelter factor							(18) x (2	0) =	0.35	(21)
Infiltration rate modified	for monthly wind speed	l:									
Jan	Feb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind sp	peed 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							. 1			T -	7 ,
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 ch										N1/0	(22-)
it mechanicai ventilat	ion: air change rate thro	ugn system								N/A	(23a)



0.60

0.60

N/A

0.58

0.58

0.58

0.58

(23c)

(24d)

(25)

0.56

0.56

0.56

0.56

0.55

0.55

0.56

0.56

0.57

0.57

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

0.57

0.57

0.57

0.57

0.59

0.59

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

0.60

0.60

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

Element				Gross area, m²	Openings m ²	Net :		U-value W/m²K	AxUW		alue, /m².K	Ахк, kJ/K	
Window			c	irea, iii	""	16.		1.33	= 22.15		/III .K	KJ/K	(2
Door						1.8		1.00	= 1.80				(2
External wall						34.		0.18	= 6.18				(2
Party wall						32.		0.00	= 0.00				(3
otal area of exte	ernal elem	ents ΣΑ m²				52.		0.00	0.00				(3
abric heat loss,		_ :				32.	00		(26	5)(30) + (3	32) =	30.13	, (3
leat capacity Cm								(28)	(30) + (32) +			N/A	(:
hermal mass pa			n²K					(20)	(30) (32)	(324)(3		250.00	(:
hermal bridges:				ıdix K								6.08	(3
otal fabric heat		arcaratea as	B , thher	idix it						(33) + (3	36) =	36.21	(:
otal labile fleat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(-
entilation heat				•	,	••••		7.00	334				
	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
ا Jeat transfer coe		-			2 1.03	55.51	33.31	1 33.73	J/	5 1.05	33.27	33.70	\
	72.83	72.59	72.36	71.27	71.07	70.12	70.12	69.94	70.48	71.07	71.48	71.91	٦
	72.00	72.00	72.00	, , , , , ,	72.07	7 0122	70.22		Average = 5			71.27	<u> </u> (3
leat loss parame	eter (HLP),	W/m²K (39))m ÷ (4)						,	_(00),		, _,_,	′′
	0.98	0.98	0.98	0.96	0.96	0.95	0.95	0.95	0.95	0.96	0.97	0.97	٦
	0.50	0.50	0.00	0.00	0.50	0.00	0.50		Average = 5			0.96	<u> </u>
lumber of days	in month (Table 1a)							7.10.000	_(.0,,		0.50	`
	(,											
	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
	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
4. Water heatin	ıg energy r			30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	2.34	(4
ssumed occupa	ng energy r	equiremen	t				31.00	31.00	30.00	31.00	30.00		
ssumed occupa	ng energy r	equiremen	t				31.00 Jul	31.00 Aug	30.00 Sep	31.00 Oct	30.00	2.34	(4
ssumed occupa Innual average h	ng energy r ncy, N not water u Jan	requirement usage in litre Feb	es per day Mar	Vd,average Apr	= (25 x N) + May	36 Jun	Jul					2.34	(4
ssumed occupa Innual average h	ng energy r ncy, N not water u Jan	requirement usage in litre Feb	es per day Mar	Vd,average Apr	= (25 x N) + May	36 Jun	Jul					2.34	(4
ssumed occupa nnual average h	g energy r ncy, 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 95.14	2.34 89.76 Dec	(4 (4
ssumed occupa nnual average h lot water usage	ncy, N not water u Jan in litres pe	requirement usage in litre Feb er day for ea 95.14	es per day Mar ach month 91.55	Vd,average Apr Vd,m = fact 87.96	= (25 x N) + May tor from Table 84.37	36 Jun le 1c x (43 80.78	Jul) 80.78	Aug 84.37	Sep	Oct 91.55	Nov 95.14	2.34 89.76 Dec	(4 (4
issumed occupa innual average h lot water usage	ncy, N not water u Jan in litres pe	requirement usage in litre Feb er day for ea 95.14	es per day Mar ach month 91.55	Vd,average Apr Vd,m = fact 87.96	= (25 x N) + May tor from Table 84.37	36 Jun le 1c x (43 80.78	Jul) 80.78	Aug 84.37	Sep	Oct 91.55	Nov 95.14	2.34 89.76 Dec 98.73	(4
ussumed occupa unnual average h Hot water usage	ncy, N not water u Jan in litres pe 98.73	requirementusage 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 = 130.57	2.34 89.76 Dec 98.73	
Assumed occupa Annual average h Hot water usage Energy content c	ncy, N not water to Jan in litres pe 98.73 of hot wate	requirementusage 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 = 130.57	2.34 89.76 Dec 98.73 1077.07	
Assumed occupa Annual average h Hot water usage Inergy content c	ncy, N not water to Jan in litres pe 98.73 of hot wate	requirementusage 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 = 130.57	2.34 89.76 Dec 98.73 1077.07	(4
issumed occupa innual average h lot water usage nergy content o	ncy, N not water to Jan in litres pe 98.73 of hot wate 146.42 0.15 x (45 21.96	requirement usage in litro Feb er day for ea 95.14 er used = 4.1 128.06	es per day Mar ach month 91.55 8 x Vd,m x 132.14	Vd,average	= (25 x N) + May for from Table 84.37 3600 kWh/m 110.54	36 Jun le 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	
issumed occupa innual average had been declared average. In the content of the co	g energy r ncy, N not water to Jan in litres pe 98.73 of hot wate 146.42 0.15 x (45 21.96	requirement usage in litro Feb er day for ea 95.14 er used = 4.1 128.06	es per day Mar ach month 91.55 8 x Vd,m x 132.14	Vd,average	= (25 x N) + May for from Table 84.37 3600 kWh/m 110.54	36 Jun le 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	
ssumed occupa nnual average h lot water usage nergy content constribution loss vistribution loss torage volume (g energy r ncy, N not water t Jan in litres pe 98.73 If hot wate 146.42 0.15 x (45 21.96 Clitres) incluses:	requirement usage in litre Feb er day for ea 95.14 er used = 4.1 128.06)m 19.21 uding any so	es per day Mar ach month 91.55 8 x Vd,m x 132.14 19.82 blar or WV	Vd,average	= (25 x N) + May for from Table 84.37 8600 kWh/m 110.54 16.58 ge within sam	36 Jun le 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	
ssumed occupa nnual average h lot water usage nergy content constribution loss vistribution loss torage volume (ncy, N not water to Jan in litres pe 98.73 of hot wate 146.42 0.15 x (45 21.96 clitres) incluses:	requirement usage in litre Feb er day for ea 95.14 er used = 4.1 128.06)m 19.21 uding any so	es per day Mar ach month 91.55 8 x Vd,m x 132.14 19.82 blar or WV	Vd,average	= (25 x N) + May for from Table 84.37 8600 kWh/m 110.54 16.58 ge within sam	36 Jun le 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	
ssumed occupa nnual average h lot water usage nergy content o histribution loss torage volume (Vater storage lo) If manufacture	g energy r ncy, N not water t Jan in litres pe 98.73 If hot wate 146.42 0.15 x (45 21.96 litres) incluses: er's declare	requirement usage in litre Feb er day for ea 95.14 er used = 4.1 128.06)m 19.21 uding any so ed loss factor m Table 2b	Mar och month 91.55 8 x Vd,m x 132.14 19.82 blar or WW	Vd,average Apr Vd,m = fact 87.96 x nm x Tm/3 115.21 17.28 VHRS storage n (kWh/day)	= (25 x N) + May for from Table 84.37 8600 kWh/m 110.54 16.58 ge within sam	36 Jun le 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	
dissumed occupa Annual average had been declared average with large volume (Vater storage lo) If manufacture Energy lost fromperature	ncy, N not water to Jan in litres per 98.73 of hot wate 146.42 0.15 x (45 21.96 clitres) incluses: er's declared factor from water services.	requirement usage in litre Feb er day for ea 95.14 er used = 4.1 128.06)m 19.21 uding any so ed loss factor m Table 2b	Mar och month 91.55 8 x Vd,m x 132.14 19.82 blar or WW	Vd,average Apr Vd,m = fact 87.96 x nm x Tm/3 115.21 17.28 VHRS storage n (kWh/day)	= (25 x N) + May for from Table 84.37 8600 kWh/m 110.54 16.58 ge within sam	36 Jun le 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	
Annual average hannual average hannual average had been been been been been been been bee	g energy r ncy, N not water to Jan in litres per 98.73 If hot water 146.42 0.15 x (45) 21.96 litres) incluses: er's declared factor from water so in (55)	requirement usage in litre Feb er day for ea 95.14 er used = 4.1 128.06 199.21 uding any so ed loss factor m Table 2b storage (kW	es per day Mar ach month 91.55 8 x Vd,m x 132.14 19.82 blar or WW	Vd,average	= (25 x N) + May for from Table 84.37 8600 kWh/m 110.54 16.58 ge within sam	36 Jun le 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
innual average had average had average had average in the state of the	g energy r ncy, N not water to Jan in litres per 98.73 If hot water 146.42 0.15 x (45) 21.96 litres) incluses: er's declared factor from water so in (55)	requirement usage in litre Feb er day for ea 95.14 er used = 4.1 128.06 199.21 uding any so ed loss factor m Table 2b storage (kW	es per day Mar ach month 91.55 8 x Vd,m x 132.14 19.82 blar or WW	Vd,average	= (25 x N) + May for from Table 84.37 8600 kWh/m 110.54 16.58 ge within sam	36 Jun le 1c x (43 80.78 onth (see 95.39	Jul 80.78 Tables 1b 88.39	Aug 84.37 , 1c 1d) 101.43	Sep 87.96 102.64 15.40	Oct 91.55 Σ(44)1 119.62 Σ(45)1 17.94	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	
Annual average hannual average hannual average hannual average hannual average hannual average content of the c	g energy r ncy, N not water to Jan in litres per 98.73 of hot water 146.42 0.15 x (45) 21.96 litres) incluses: er's declared factor from water so in (55) ss calculated 4.36	requirement usage in litre Feb er day for ea 95.14 er used = 4.1 128.06)m 19.21 uding any so ed loss factor m Table 2b storage (kW) ed for each 3.93	Mar sch month 91.55 18 x Vd,m x 132.14 19.82 blar or WW 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 ge within sam	36 Jun le 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 15.21	Sep 87.96	Oct 91.55 Σ(44)1 119.62 Σ(45)1	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	(44) (44) (44) (44) (44) (45) (55
Annual average had the water usage sinergy content of the content	g energy r ncy, N not water to Jan in litres per 98.73 of hot water 146.42 0.15 x (45) 21.96 litres) incluses: er's declared factor from water so in (55) ss calculated 4.36	requirement usage in litre Feb er day for ea 95.14 er used = 4.1 128.06)m 19.21 uding any so ed loss factor m Table 2b storage (kW) ed for each 3.93	Mar sch month 91.55 18 x Vd,m x 132.14 19.82 blar or WW 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 ge within sam	36 Jun le 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 15.21	Sep 87.96 102.64 15.40	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	

	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
otal heat requi	ired 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				,
	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
olor DLIM innu					1	122.12	110.01	129.03	129.57	147.24	137.30	109.41] (02
olar DHW inpu													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	iter heater f		nth (kWh/	month) (62	2)m + (63)m 	າ	1						,
	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 from	water heat	ing (kWh/m	nonth) 0.2	5 × [0.85 ×	(45)m + (61	.)m] + 0.8 ×	[(46)m + (57)m + (59))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 gair	ns												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1etabolic 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
ghting gains (c	calculated in	Appendix I	L, equation	L9 or L9a),	also see Ta	able 5						•	_
	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 gains	(calculated	in Appendi	x L. equation	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
ooking goins (v							154.45	132.30	137.70	103.20	103.70	137.54] (00
ooking gains (d			-					T				T	٦,
	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 g													,
	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)											
	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	-93.57	(71
Vater heating g	gains (Table	5)											
	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 ga	ains (66)m +	+ (67)m + (6	68)m + (69)	m + (70)m	+ (71)m + (72)m							
	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
								1	1				, ,
6. Solar gains													
			Access		Area		ar flux		g	FF		Gains	
			Table	6d	m²	V	V/m²	•	ific data able 6b	specific d or Table		W	
								or T			UC		
													٦
orth			0.7	7 x [5.67	x 1	0.63 x		0.63 x		=	18.43	(74
					5.67 2.98	7 =		0.9 x		0.70	= [18.43 10.28	, .
orthEast			0.7	7 x		x 1	1.28 x	0.9 x 0.9 x	0.63 x	0.70	_] (75
orthEast /est	atts ∑(74)m	(82)m	0.7	7 x	2.98	x 1	1.28 x	0.9 x 0.9 x	0.63 x	0.70	= [10.28] (75
orthEast /est	atts ∑(74)m	1(82)m	0.7	7 x	2.98	x 1	1.28 x	0.9 x 0.9 x	0.63 x	0.70	= [10.28	(75 (80
orthEast /est olar gains in w	77.08	150.77	0.7 0.7 0.7 253.38	7 x 7 x 7	2.98	x 1 x 1	1.28 x 9.64 x	0.9 x (0.9 x (0.	0.63 x 0.63 x 0.63 x	0.70 0.70 0.70	= [10.28 48.38	(75 (80
orthEast /est olar gains in w	77.08 ernal and so	150.77 plar (73)m +	0.7 0.7 0.7 253.38 (83)m	7 x 7 x 385.31	2.98 8.06 491.24	x 1 x 1 512.46	1.28 x 9.64 x	0.9 x 0.9 x 0.9 x 402.02	0.63 x 0.63 x 0.63 x	0.70 0.70 0.70	95.98	10.28 48.38 63.54] (75] (80] (83
orthEast /est olar gains in w	77.08	150.77	0.7 0.7 0.7 253.38	7 x 7 x 7	2.98	x 1 x 1	1.28 x 9.64 x	0.9 x (0.9 x (0.	0.63 x 0.63 x 0.63 x	0.70 0.70 0.70	= [10.28 48.38] (75] (80] (83
orthEast /est blar gains in wa btal gains - inte	77.08 ernal and so 458.15	150.77 blar (73)m + 529.85	0.7 0.7 0.7 253.38 (83)m 619.70	7 x 7 x 385.31	2.98 8.06 491.24	x 1 x 1 512.46	1.28 x 9.64 x	0.9 x 0.9 x 0.9 x 402.02	0.63 x 0.63 x 0.63 x	0.70 0.70 0.70	95.98	10.28 48.38 63.54] (75] (80] (83
Jorth JorthEast Vest olar gains in water otal gains - interes T. Mean interes	77.08 ernal and so 458.15 nal tempera	150.77 plar (73)m + 529.85 ture (heatin	0.7 0.7 0.7 253.38 (83)m 619.70	7 x 7 x 385.31 731.06	2.98 8.06 491.24 816.13	x 1 x 1 512.46	1.28 x 9.64 x	0.9 x 0.9 x 0.9 x 402.02	0.63 x 0.63 x 0.63 x	0.70 0.70 0.70	95.98	10.28 48.38 63.54	(75) (80) (83) (84)
IorthEast Vest olar gains in wood otal gains - into	77.08 ernal and so 458.15 nal tempera	150.77 plar (73)m + 529.85 ture (heating periods in	0.7 0.7 0.7 253.38 (83)m 619.70 the living	7 x 7 x 385.31 731.06	2.98 8.06 491.24 816.13	x 1 x 1 512.46 817.20	1.28 x 9.64 x 483.86	0.9 x	0.63 x 0.63 x 0.63 x 299.13	0.70 0.70 0.70 179.77	95.98	10.28 48.38 63.54 433.94	(75) (80) (83) (84)
lorthEast Vest olar gains in wood otal gains - into	77.08 ernal and so 458.15 nal tempera uring heating	150.77 plar (73)m + 529.85 ture (heating periods in Feb	0.7 0.7 0.7 253.38 (83)m 619.70 the living Mar	7 x 7 x 385.31 731.06 Apr	2.98 8.06 491.24 816.13	x 1 x 1 512.46	1.28 x 9.64 x	0.9 x 0.9 x 0.9 x 402.02	0.63 x 0.63 x 0.63 x	0.70 0.70 0.70	95.98	10.28 48.38 63.54 433.94 21.00] (74] (75] (80] (83] (84
orthEast Vest olar gains in want otal gains - inte	77.08 ernal and so 458.15 nal tempera uring heating	150.77 plar (73)m + 529.85 ture (heating periods in Feb	0.7 0.7 0.7 253.38 (83)m 619.70 the living Mar	7 x 7 x 385.31 731.06 Apr	2.98 8.06 491.24 816.13	x 1 x 1 512.46 817.20	1.28 x 9.64 x 483.86	0.9 x	0.63 x 0.63 x 0.63 x 299.13	0.70 0.70 0.70 179.77	95.98	10.28 48.38 63.54 433.94 21.00	(75) (80) (83) (84)

Mean internal	temp of livir	ig area T1 (s	steps 3 to 7	in Table 9	c)								
	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 ir	the rest of	dwelling f	rom 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					-				-	-	_		
	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		!		ļ	!		ļ.	0.07	0.07	1 0.5 .	0.00	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	13.57	13.03	20.00	20.12	20.13	20.13		ving area ÷		0.48	(91)
Mean internal		for the wh	ole dwellin	σfIΔ v T1 -	⊦(1 - fl Δ\ x ī	Т2			L.	ville area :	(4)	0.40] (31)
Wicari internal	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		l .	1			20.55	20.51	20.13	15.71	15.54	[(32)
Apply aujustine	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)
	19.57	19.50	19.00	20.27	20.46	20.54	20.55	20.55	20.51	20.19	19.71	19.54] (93)
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	1										
	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 int	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 - (9	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	7
		•	•						∑(9	8)15, 10	.12 =	2218.74	(98)
Space heating	requirement	: kWh/m²/y	ear									29.98	(99)
	<u>'</u>	,								. ,	. ,		
9a. Energy red	quirements	- individual	heating sy	stems inclu	iding micro	-CHP							
Space heating													
Fraction of spa	ce heat fron	n secondary	/suppleme	ntary syste	m (table 11	.)						0.00	(201)
Fraction of spa	ce heat fron	n main syste	em(s)							1 - (20	01) =	1.00	(202)
Fraction of spa	ce heat fron	n main syste	em 2									0.00	(202)
Fraction of tota	al space heat	t from main	system 1						(20)2) x [1- (20	3)] =	1.00	(204)
Fraction of tota	al space heat	t from main	system 2							(202) x (20	03) =	0.00	(205)
Efficiency of m	ain system 1	(%)										93.50	(206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating	fuel (main sy	vstem 1), kV	Vh/month										
	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 wa	ater heater												
	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	fuel, kWh/m	nonth											
_	199.20	175.79	185.28	168.52	169.75	153.03	145.38	161.72	162.12	173.54	181.35	193.66	7
		•		•		•	•			∑(219a)1		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		(211)(22	1) + (231) + (2	32)(237b) =	4842.30	(238)
10a. Fuel costs - individual heating systems including						
	Fuel kWh/year	F	uel price		Fuel cost £/year	
					-	1
Space heating - main system 1	2372.99	х	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	х	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	324.98	х	13.19	x 0.01 =	42.86	(250)
Additional standing charges					120.00	(251)
Total energy cost		(2	40)(242) + (245)(254) =	327.35	(255)
11a CAD vating individual bacting austrone including	na miana CIID					
11a. SAP rating - individual heating systems including	ng micro-CHP					1
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 including	g micro-CHP					
	Energy kWh/year		Emission factor kg CO₂/kWh		Emissions kg CO₂/year	
Space heating - main system 1	2372.99	x	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	1
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



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

Client								Last modified	d	30/09	9/2020	
Address	3B4P, Kir	ngston upor	n Thames,	KT1								
1. Overall dwelling dimens	sions			_	4 2)						. / 2	
				A	rea (m²)			erage storey height (m)		V	olume (m³)	
Lowest occupied					72.42	(1a) x	Г	2.50	(2a) =		181.05	(3a)
Total floor area	(1a)	+ (1b) + (1d	c) + (1d)(1n) =	72.42	(4)						
Dwelling volume							(3	sa) + (3b) + (3	c) + (3d)(3	3n) =	181.05	(5)
2. Ventilation rate												
										m	1 ³ per hour	
Number of chimneys								0	x 40 =		0	(6a)
Number of open flues								0	x 20 =		0	(6b)
Number of intermittent fans	S							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
. Ch		DC) /		(6.)	(61) (7) . (2 1) . (_ ,	20	7 . (5)		hour	٦ (۵)
Infiltration due to chimneys If a pressurisation test has b			atandad n			a) + (7b) + (30	_ ÷ (5) =		0.17	(8)
Air permeability value, q50,) 10 (10)			5.00	(17)
If based on air permeability							e ai ea				0.42	
Number of sides on which the				s), otherwis	se (10) – (11	0)					2] (18)] (19)
Shelter factor	ne uwening	s is shellere	u					1	- [0.075 x (1	0)] - [0.85	(20)
Infiltration rate incorporating	a chaltar f	actor						1.	18) x (2)		0.35	(20)
Infiltration rate modified for	_								(10) X (2	20) –	0.33	(21)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 infiltration rate (al	lowing 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)
Calculate effective air change	ge rate for t	the applical	ole case:									
If we also also be a selected as											N1 / A	(22-)



If mechanical ventilation: air change rate through system

0.60

0.60

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

0.60

0.60

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

0.58

0.58

0.57

0.57

0.59

0.59

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

N/A

N/A

0.59

0.59

0.58

0.58

(23a)

(24d)

(25)

0.56

0.56

0.56

0.56

0.55

0.55

0.56

0.56

0.57

0.57

Element				Gross	Openings	Net	area	U-value	A x U W	/K κ-val	lie	Ахк,	
			í	area, m²	m ²		m²	W/m ² K	AXOW	kJ/m	,	kJ/K	
Window						15	.02 x	1.33	= 19.91				(27
Door						1.	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	9.70						(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
hermal mass pa	arameter (T	MP) in kJ/m	n²K									250.00	(35
hermal bridges:	: ∑(L x Ѱ) ca	alculated us	ing Apper	ndix K								16.00	(36
otal fabric heat										(33) + (36) =	54.41]] (37
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	٠, ١
/entilation heat	loss calcula	ated month!	lv 0.33 x /	•	•			J	•				
	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				1 31.33	3 1.10	33.21	33.21	33.00	33.00	3 1.10	31.33	33.02] (30
	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
	30.33	30.12		00.00	00.00	07.03	07.03		1	(39)112/12		88.80]] (39
leat loss parame	eter (HI P)	W/m²K (39	1)m ÷ (4)						Average - Z	(33)112/12		88.80] (33
icat ioss paraint	1.25	1.24		1.23	1.22	1 21	1 21	1.21	1.22	1.22	1.23	1 22	1
	1.25	1.24	1.24	1.23	1.22	1.21	1.21	-		-		1.23]]
مريماه عمر مرام مرام	:	Table 1a\							Average = 2	(40)112/12	Z =	1.23	(40
Number of days	,	,		1				1 21 22		21.00		1	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	equirement	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	
	Juli	1 CD											
Hot water usage			ch month	Vd,m = fact	tor from Tab	le 1c x (43	3)						
lot water usage	in litres pe	er day for ea						83.57	87.13	90.68	94.24	97.80]
Hot water usage			90.68	Vd,m = fact 87.13	83.57	le 1c x (43 80.02	80.02	83.57	87.13	90.68 Σ(44)112	94.24	97.80]
	97.80	er day for ea	90.68	87.13	83.57	80.02	80.02		87.13	90.68 Σ(44)112		97.80 1066.87]] (4 4
	97.80	94.24 94.24 er used = 4.1	90.68 8 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)		∑(44)112	2 = 1	1066.87]] (44
	97.80	er day for ea	90.68	87.13	83.57	80.02	80.02		87.13	Σ(44)112 118.49	129.34	140.45	
Energy content o	97.80 97.80 of hot wate	94.24 94.24 er used = 4.1 126.84	90.68 8 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)		∑(44)112	129.34	1066.87] (44] (45
Hot water usage Energy content of	97.80 of hot wate 145.03 0.15 x (45)	94.24 94.24 er used = 4.1 126.84	90.68 .8 x Vd,m 130.89	87.13 x nm x Tm/3	83.57 8600 kWh/m 109.50	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	101.67	Σ(44)112 118.49 Σ(45)112	2 = 1 129.34 2 = 1	140.45 1398.84] (45
inergy content o	97.80 97.80 of hot wate 145.03 0.15 x (45) 21.75	94.24 94.24 er used = 4.1 126.84)m	90.68 .8 x Vd,m 130.89	87.13 x nm x Tm/3 114.11	83.57 8600 kWh/m 109.50	80.02 onth (see 94.49	80.02 Tables 1b	, 1c 1d)		Σ(44)112 118.49	129.34	140.45 1398.84 21.07]] (45
inergy content of the	97.80 of hot wate 145.03 0.15 x (45) 21.75 (litres) include	94.24 94.24 er used = 4.1 126.84)m	90.68 .8 x Vd,m 130.89	87.13 x nm x Tm/3 114.11	83.57 8600 kWh/m 109.50	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	101.67	Σ(44)112 118.49 Σ(45)112	2 = 1 129.34 2 = 1	140.45 1398.84]] (45
inergy content of the	97.80 of hot wate 145.03 0.15 x (45) 21.75 (litres) includes:	er day for ea 94.24 er used = 4.1 126.84)m 19.03 uding any so	90.68 8 x Vd,m 130.89 19.63 blar or WV	87.13 x nm x Tm/3 114.11 17.12 VHRS storage	83.57 8600 kWh/m 109.50 16.42 ge within sam	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	101.67	Σ(44)112 118.49 Σ(45)112	2 = 1 129.34 2 = 1	140.45 1398.84 21.07] (45] (46] (47
inergy content of Distribution loss storage volume (Vater storage lo	of hot wate 145.03 0.15 x (45 21.75 (litres) incluses: er's declare	94.24 94.24 er used = 4.1 126.84)m 19.03 uding any sceed loss facto	90.68 8 x Vd,m 130.89 19.63 blar or WV	87.13 x nm x Tm/3 114.11 17.12 VHRS storage	83.57 8600 kWh/m 109.50 16.42 ge within sam	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	101.67	Σ(44)112 118.49 Σ(45)112	2 = 1 129.34 2 = 1	140.45 1398.84 21.07 3.00] (45] (46] (47
Energy content of Distribution loss Storage volume (Vater storage lo O) If manufacture Temperature	of hot wate 145.03 0.15 x (45) 21.75 (litres) incluses: er's declared factor from	er day for ea 94.24 er used = 4.1 126.84)m 19.03 uding any so ed loss facto m Table 2b	90.68 8 x Vd,m 130.89 19.63 Dlar or WV	87.13 x nm x Tm/3 114.11 17.12 VHRS storagen (kWh/day)	83.57 8600 kWh/m 109.50 16.42 ge within sam	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	101.67	Σ(44)112 118.49 Σ(45)112	2 = 1 129.34 2 = 1	140.45 1398.84 21.07 3.00 0.26 0.54] (45) (45) (45) (45) (45) (45) (45) (45)
Energy content of Distribution loss Storage volume (Nater storage lost) If manufacture Temperature Energy lost fr	of hot wate 145.03 0.15 x (45) 21.75 (litres) incluses: er's declared factor from water serior	er day for ea 94.24 er used = 4.1 126.84)m 19.03 uding any so ed loss facto m Table 2b	90.68 8 x Vd,m 130.89 19.63 Dlar or WV	87.13 x nm x Tm/3 114.11 17.12 VHRS storagen (kWh/day)	83.57 8600 kWh/m 109.50 16.42 ge within sam	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	101.67	Σ(44)112 118.49 Σ(45)112	2 = 1 129.34 2 = 1	140.45 1398.84 21.07 3.00 0.26 0.54	(43) (44) (44) (45) (45) (45) (50)
Energy content of Distribution loss Storage volume (Nater storage lost) If manufacture Temperature Energy lost frenter (50) or (54)	of hot wate 145.03 0.15 x (45) 21.75 (litres) incluses: er's declared factor from water step in (55)	er day for ea 94.24 er used = 4.1 126.84)m 19.03 uding any so ed loss facto m Table 2b storage (kW	90.68 8 x Vd,m 130.89 19.63 blar or WV or is known	87.13 x nm x Tm/3 114.11 17.12 VHRS storage n (kWh/day) 8) x (49)	83.57 8600 kWh/m 109.50 16.42 ge within sam	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	101.67	Σ(44)112 118.49 Σ(45)112	2 = 1 129.34 2 = 1	140.45 1398.84 21.07 3.00 0.26 0.54	(45) (45) (45) (45) (45) (45) (45) (45)
Energy content of Distribution loss Storage volume (Nater storage lost) If manufacture Temperature Energy lost fr	of hot wate 145.03 0.15 x (45) 21.75 (litres) incluses: er's declared factor from water step in (55)	er day for ea 94.24 er used = 4.1 126.84)m 19.03 uding any so ed loss facto m Table 2b storage (kW	90.68 8 x Vd,m 130.89 19.63 blar or WV or is known	87.13 x nm x Tm/3 114.11 17.12 VHRS storage n (kWh/day) 8) x (49)	83.57 8600 kWh/m 109.50 16.42 ge within sam	80.02 onth (see 94.49	80.02 Tables 1b 87.56	, 1c 1d)	101.67	Σ(44)112 118.49 Σ(45)112	2 = 1 129.34 2 = 1	140.45 1398.84 21.07 3.00 0.26 0.54 0.14	(45) (45) (45) (45) (45) (45) (45) (45)
Energy content of Distribution loss Storage volume (Nater storage lost) If manufacture Energy lost frenter (50) or (54) Water storage lost	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	er day for ea 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 8 x Vd,m 130.89 19.63 blar or WV or is known (h/day) (4) month (5) 4.36	87.13 x nm x Tm/3 114.11 17.12 VHRS storage n (kWh/day) 8) x (49) 65) x (41)m 4.21	83.57 8600 kWh/m 109.50 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	101.67	Σ(44)112 118.49 Σ(45)112	2 = 1 129.34 2 = 1	140.45 1398.84 21.07 3.00 0.26 0.54] (45] (45] (45] (45
Energy content of Distribution loss Storage volume (Vater storage lo I) If manufacture Temperature Energy lost fr Enter (50) or (54	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	er day for ea 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 8 x Vd,m 130.89 19.63 blar or WV or is known /h/day) (4 month (5	87.13 x nm x Tm/3 114.11 17.12 VHRS storage n (kWh/day) 8) x (49) 65) x (41)m 4.21	83.57 8600 kWh/m 109.50 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	101.67	Σ(44)112 118.49 Σ(45)112	2 = 1 129.34 2 = 1 19.40	140.45 1398.84 21.07 3.00 0.26 0.54 0.14] (45] (45] (45] (45] (45] (45] (55] (55

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	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	alculated f	or each mo	onth 0.85 >	x (45)m + (4	6)m + (57)ı	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 inp	out 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	vater heater f	or each mo	nth (kWh/i	month) (6	2)m + (63)r	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]
					•	•				∑(64)1	.12 = 1	724.01	(64)
Heat gains fror	m water heat	ing (kWh/m	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)
					<u> </u>						'	'	
5. Internal ga	ains												
Metabolic gain	Jan ns (Table 5)	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	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 (ļ.	, 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 gain			x L, equation		13a), also s	-							_ · /
	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													_ (,
	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			0	002	1 0	002	0	0.102	0	002	7	002] (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. eva			0.00	0.00	0.00	3.55	0.00	1 0.00	0.00	0.00	1 0.00	0.00] (, 0)
	-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		•	02.21	32.2.	32.2.	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	32.2.		32.2.	32.2.	32.2.	32.2.] (* =/
	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 ខ្							00.03	74.00	70.03	02.03	05.45	32.47] (12)
rotal internal g	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	s												
			Access f Table		Area m²		ar flux V/m²	-	g ific data able 6b	FF specific o or Table		Gains 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	7 x	4.48).63 x			64.01	(78)
_	watts ∑(74)m	ı(82)m											
Solar gains in v			337.35	448.18	521.57	524.27	502.91	448.58	376.54	259.92	154.76	107.34	(83)
Solar gains in v	127.27	228.59	337.33									•	- '
-					•	•		•					
-				789.43	842.30	825.15	790.84	742.20	680.53	584.39	502.76	472.94	(84)
-	503.37	olar (73)m + 602.71	(83)m 698.89			825.15	790.84	742.20	680.53	584.39	502.76	472.94	[84]
Total gains - in	503.37	olar (73)m + 602.71 ture (heati	(83)m 698.89 ng season)	789.43	842.30		790.84	742.20	680.53	584.39	502.76	21.00	(84)
Solar gains in v Total gains - in 7. Mean inter Temperature c	503.37	olar (73)m + 602.71 ture (heati	(83)m 698.89 ng season)	789.43	842.30		790.84			584.39 Oct	502.76		, , , ,
Total gains - in 7. Mean inter Temperature o	503.37 rnal tempera during heating	olar (73)m + 602.71 ture (heating periods in	(83)m 698.89 ng season) the living a	789.43 area from Apr	842.30 Table 9, Th	1(°C)		742.20	680.53			21.00	, , , ,
Total gains - in	503.37 rnal tempera during heating	olar (73)m + 602.71 ture (heating periods in	(83)m 698.89 ng season) the living a	789.43 area from Apr	842.30 Table 9, Th	1(°C)						21.00	, , ,

Mean internal te	mp of living	g area T1 (s	teps 3 to 7	in Table 90	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)
Temperature dur	ring heating	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)
Utilisation factor	for gains f	or 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 te	mperature	in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	9c)						
[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 fraction	on								Li	ving area ÷	(4) =	0.38	(91)
Mean internal te	mperature	for the wh	ole dwellin	g fLA x T1 +	-(1 - fLA) x	Γ2							
	18.76	19.01	19.39	19.84	20.15	20.29	20.32	20.31	20.23	19.81	19.21	18.72	(92)
Apply adjustmen	t to the me	an internal	l temperati	ure from Ta	ble 4e whe	re appropr	riate						
	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)
8. Space heating				_		-		_	_			_	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor	_			1	Γ.							1 1	
	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, ηm	-			I	T					T = =	T	T	
[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 average				1			T			T			
[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				1							T	T 1	
[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 red												T 616.15	
L	600.25	456.04	362.08	187.59	71.24	0.00	0.00	0.00	0.00	201.75	418.96	616.45	(00)
Consolination		134/1- / 2 /							∑(98	3)15, 10		2914.36	(98)
Space heating red	quirement	KWN/m²/ye	ear							(98)	÷ (4)	40.24	(99)
9a. Energy requ	irements -	individual	heating sy	stems inclu	ding micro	-СНР							
Space heating													
Fraction of space	heat from	secondary	/suppleme	ntary syste	m (table 11)						0.00	(201
Fraction of space	heat from	main syste	em(s)							1 - (2	01) =	1.00	(202
Fraction of space	heat from	main syste	m 2									0.00	(202
Fraction of total	space heat	from main	system 1						(20)2) x [1- (20	3)] =	1.00	(204
Fraction of total	space heat	from main	system 2							(202) x (2	03) =	0.00	(205
Efficiency of mair	n system 1	(%)										93.50	(206
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fue	el (main sy	stem 1), kW	/h/month										
[641.98	487.74	387.25	200.63	76.19	0.00	0.00	0.00	0.00	215.78	448.09	659.30	
									∑(21:	1)15, 10	.12 = 3	3116.96	(211
Water heating													
Water heating Efficiency of water	er heater												
_	er heater 87.87	87.57	86.95	85.58	83.16	79.80	79.80	79.80	79.80	85.67	87.32	87.97	(217
_	87.87		86.95	85.58	83.16	79.80	79.80	79.80	79.80	85.67	87.32	87.97	(217)
Efficiency of wate	87.87		86.95 182.30	85.58 164.57	83.16	79.80 151.90	79.80	79.80	79.80 160.90	85.67	87.32	87.97	(217)
Efficiency of wate	87.87 el, kWh/m	onth							160.90		178.72		(217)

			_
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			

Liectricity for lighting (Appendix L)			320.39 (232)
Total delivered energy for all uses		(211)(221) + (231) + (232)	(237b) = 5552.07 (238)
10a. Fuel costs - individual heating systems inclu	ıding micro-CHP		
	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	x 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 included	uding micro-CHP		
Energy cost deflator (Table 12)			0.42 (256)
Energy cost factor (ECF)			1.26 (257)
SAP value			82.45
SAP rating (section 13)			82 (258)
SAP band			В

12a. CO ₂ emissions - individual heating systems including mic	ro-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	х	0.519	=	166.39	(268)
Total CO ₂ , 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)
EI band					В]

	Energy kWh/year		Primary factor		Primary Energy kWh/year	,
Space heating - main system 1	3116.96	x	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



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

Client							Last modified	d	30/09	9/2020	
Address	3B5P, Kingston u	pon Thames,	KT1								
1. Overall dwelling dimer	nsions										
			Α	rea (m²)		A	verage storey height (m)	•	Vo	olume (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) + (3	c) + (3d)(3r	n) =	260.18	(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 far	าร						4	x 10 =		40	(7a)
Number of passive vents							0	x 10 =		0	(7b)
Number of flueless gas fire	s						0	x 40 =		0	(7c)
									Air	changes pe hour	r
Infiltration due to chimney	s, flues, fans, PSVs		(6a)	+ (6b) + (7a	a) + (7b) + ((7c) =	40	÷ (5) =		0.15	(8)
If a pressurisation test has	been carried out or	is intended, pi	roceed to (17), otherw	ise continu	e from (9) to (16)				
Air permeability value, q50	, expressed in cubic	metres per h	our per squ	are metre	of envelope	e area				5.00	(17)
If based on air permeability	value, then (18) =	[(17) ÷ 20] + (8	3), otherwis	se (18) = (16	6)					0.40	(18)
Number of sides on which	the dwelling is shelt	ered								2	(19)
Shelter factor							1 -	- [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporati	ng shelter factor							(18) x (20	O) =	0.34	(21)
Infiltration rate modified for	or monthly wind spe	ed:									
Jan	Feb Mar	Apr	May	Jun	Jul	Aug	Sep Sep	Oct	Nov	Dec	
Monthly average wind spec	ed 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 (a	allowing for shelter	and wind facto	or) (21) x (2	2a)m							
0.44	0.43 0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.40	(22b)
Calculate effective air chan	ge rate for the app	icable case:									
If mechanical ventilation	n: air change rate th	rough system								N/A	(23a)



0.60

0.60

N/A

0.58

0.58

0.57

0.57

(23c)

(24d)

(25)

0.55

0.55

0.55

0.55

0.55

0.55

0.56

0.56

0.57

0.57

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

0.57

0.57

0.57

0.57

0.59

0.59

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

0.59

0.59

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

Element				Gross	Openings	No+	area	U-value	AxUW	/K v->**	alue.	Ахк,	
			;	area, m²	m ²		m²	W/m ² K	A X U W		m².K	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	ternal eleme	ents ∑A, m²				189	9.35						(31)
Fabric heat loss,	W/K = ∑(A	× U)							(26	5)(30) + (3	2) =	51.07	(33
Heat capacity Cn	m = ∑(A x κ)							(28)	(30) + (32) +	+ (32a)(32	.e) =	N/A	(34
Thermal mass pa	arameter (T	MP) in kJ/n	1²K									250.00	(35
Thermal bridges	s: Σ(L x Ψ) ca	alculated us	ing Apper	ndix K								10.99	(36
Total fabric heat	loss									(33) + (3	6) =	62.06	(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)									
	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	efficient, W	//K (37)m +	(38)m										
	113.21	112.89	112.58	111.11	110.84	109.56	109.56	109.32	110.05	110.84	111.39	111.97	
									Average = ∑	[(39)112/	12 =	111.11	(39
Heat loss param	eter (HLP),	W/m²K (39)m ÷ (4)										_
	1.09	1.08	1.08	1.07	1.07	1.05	1.05	1.05	1.06	1.07	1.07	1.08	1
				•					Average = ∑	(40)112/	12 =	1.07	- (40
Number of days	in month (Гable 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 [.]	ì										
													,
Assumed occupa	ancy, N											2.77	(42)
•	•	ısage in litre	es per day	Vd,average	= (25 x N) +	36						2.77	_
Annual average	hot water u	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov		_
Annual average	hot water u	Feb	Mar	Apr	May	Jun		Aug	Sep	Oct	Nov	100.09	(42 (43
Annual average	hot water u	Feb	Mar	Apr	May	Jun		Aug 94.08	Sep 98.08	Oct	Nov 106.09	100.09	_
Annual average Hot water usage	Jan e in litres pe	Feb or day for ea 106.09	Mar ch month 102.09	Apr Vd,m = fact 98.08	May tor from Tab 94.08	Jun le 1c x (43 90.08	90.08	94.08	•		106.09	100.09 Dec	_
Annual average Hot water usage	Jan e in litres pe 110.09	Feb r day for ea 106.09 r used = 4.1	Mar ch month 102.09	Apr Vd,m = fact 98.08 x nm x Tm/3	May tor from Tab 94.08	Jun le 1c x (43 90.08 onth (see	90.08	94.08	•	102.09 Σ(44)1	106.09	100.09 Dec	(43
Annual average Hot water usage	Jan e in litres pe	Feb or day for ea 106.09	Mar ch month 102.09	Apr Vd,m = fact 98.08	May tor from Tab 94.08	Jun le 1c x (43 90.08	90.08	94.08	•	102.09	106.09	100.09 Dec	(43
Annual average Hot water usage	Jan e in litres pe 110.09	Feb r day for ea 106.09 r used = 4.1	Mar ch month 102.09	Apr Vd,m = fact 98.08 x nm x Tm/3	May tor from Tab 94.08	Jun le 1c x (43 90.08 onth (see	90.08 Tables 1b,	94.08 1c 1d)	98.08	102.09 Σ(44)1	106.09 12 =	100.09 Dec 110.09 1201.03	(43
Assumed occupa Annual average Hot water usage Energy content of Distribution loss	Jan e in litres pe 110.09 of hot wate 163.27	Feb r day for ea 106.09 r used = 4.1 142.79	Mar ch month 102.09	Apr Vd,m = fact 98.08 x nm x Tm/3	May tor from Tab 94.08	Jun le 1c x (43 90.08 onth (see	90.08 Tables 1b,	94.08 1c 1d)	98.08	102.09 Σ(44)1	106.09 12 =	100.09 Dec 110.09 1201.03	(43
Annual average Hot water usage Energy content of	Jan e in litres pe 110.09 of hot wate 163.27	Feb r day for ea 106.09 r used = 4.1 142.79	Mar ch month 102.09	Apr Vd,m = fact 98.08 x nm x Tm/3	May tor from Tab 94.08	Jun le 1c x (43 90.08 onth (see	90.08 Tables 1b,	94.08 1c 1d)	98.08	102.09 Σ(44)1	106.09 12 =	100.09 Dec 110.09 1201.03	(43
Annual average Hot water usage Energy content of	Jan e in litres pe 110.09 of hot wate 163.27 a 0.15 x (45) 24.49	Feb r day for ear 106.09 r used = 4.1 142.79	Mar ch month 102.09 8 x Vd,m 147.35	Apr Vd,m = fact 98.08 x nm x Tm/3 128.46	May tor from Tab 94.08 8600 kWh/m 123.26	Jun le 1c x (43 90.08 onth (see 106.37	90.08 Tables 1b,	94.08 1c 1d) 113.11	98.08	102.09 Σ(44)1 133.39 Σ(45)1	106.09 12 = 145.60 12 =	100.09 Dec 110.09 1201.03 158.12 1574.74	(43) (43) (44) (45) (46)
Annual average Hot water usage Energy content of Distribution loss Storage volume	Jan e in litres pe 110.09 of hot wate 163.27 c 0.15 x (45) 24.49 (litres) include	Feb r day for ear 106.09 r used = 4.1 142.79	Mar ch month 102.09 8 x Vd,m 147.35	Apr Vd,m = fact 98.08 x nm x Tm/3 128.46	May tor from Tab 94.08 8600 kWh/m 123.26	Jun le 1c x (43 90.08 onth (see 106.37	90.08 Tables 1b,	94.08 1c 1d) 113.11	98.08	102.09 Σ(44)1 133.39 Σ(45)1	106.09 12 = 145.60 12 =	100.09 Dec 110.09 1201.03 158.12 1574.74	(43) (43) (444) (45) (46)
Annual average Hot water usage Energy content of Distribution loss Storage volume Water storage lo	Jan e in litres pe 110.09 of hot wate 163.27 c 0.15 x (45) 24.49 (litres) incluses:	r day for ear 106.09 r used = 4.1 142.79 m 21.42 uding any so	Mar ch month 102.09 8 x Vd,m 147.35 22.10 olar or WV	Apr Vd,m = fact 98.08 x nm x Tm/3 128.46 19.27 VHRS storage	May tor from Tab 94.08 8600 kWh/m 123.26 18.49 ge within sam	Jun le 1c x (43 90.08 onth (see 106.37	90.08 Tables 1b,	94.08 1c 1d) 113.11	98.08	102.09 Σ(44)1 133.39 Σ(45)1	106.09 12 = 145.60 12 =	100.09 Dec 110.09 1201.03 158.12 1574.74	(43) (44) (45) (45) (46)
Annual average Hot water usage Energy content of Distribution loss Storage volume Water storage lo	Jan e in litres pe 110.09 of hot wate 163.27 c 0.15 x (45) 24.49 (litres) includes:	r day for ear 106.09 r used = 4.1 142.79)m 21.42 uding any so	Mar ch month 102.09 8 x Vd,m 147.35 22.10 olar or WV	Apr Vd,m = fact 98.08 x nm x Tm/3 128.46 19.27 VHRS storage	May tor from Tab 94.08 8600 kWh/m 123.26 18.49 ge within sam	Jun le 1c x (43 90.08 onth (see 106.37	90.08 Tables 1b,	94.08 1c 1d) 113.11	98.08	102.09 Σ(44)1 133.39 Σ(45)1	106.09 12 = 145.60 12 =	100.09 Dec 110.09 1201.03 158.12 1574.74 23.72 3.00	(43) (44) (45) (46) (47) (48)
Annual average Hot water usage Energy content of Distribution loss Storage volume Water storage logal of manufacture	Jan e in litres pe 110.09 of hot wate 163.27 c 0.15 x (45) 24.49 (litres) incluoss: er's declare	r day for ear 106.09 r used = 4.1 142.79 m 21.42 uding any so and loss factor Table 2b	Mar ch month 102.09 8 x Vd,m 147.35 22.10 olar or WV	Apr Vd,m = fact 98.08 x nm x Tm/3 128.46 19.27 VHRS storage n (kWh/day)	May tor from Tab 94.08 8600 kWh/m 123.26 18.49 ge within sam	Jun le 1c x (43 90.08 onth (see 106.37	90.08 Tables 1b,	94.08 1c 1d) 113.11	98.08	102.09 Σ(44)1 133.39 Σ(45)1	106.09 12 = 145.60 12 =	100.09 Dec 110.09 1201.03 158.12 1574.74 23.72 3.00 0.26	(43) (43) (444) (45) (45) (46) (47) (48) (49)
Annual average Hot water usage Energy content of Distribution loss Storage volume Water storage lost a) If manufacture Temperature Energy lost fr	Jan in litres pe 110.09 of hot wate 163.27 c 0.15 x (45) 24.49 (litres) incluses: er's declared affector from water services.	r day for ear 106.09 r used = 4.1 142.79 m 21.42 uding any so and loss factor Table 2b	Mar ch month 102.09 8 x Vd,m 147.35 22.10 olar or WV	Apr Vd,m = fact 98.08 x nm x Tm/3 128.46 19.27 VHRS storage n (kWh/day)	May tor from Tab 94.08 8600 kWh/m 123.26 18.49 ge within sam	Jun le 1c x (43 90.08 onth (see 106.37	90.08 Tables 1b,	94.08 1c 1d) 113.11	98.08	102.09 Σ(44)1 133.39 Σ(45)1	106.09 12 = 145.60 12 =	100.09 Dec 110.09 1201.03 158.12 1574.74 23.72 3.00 0.26 0.54	(43) (444) (45) (46) (47) (48) (49) (50
Annual average Hot water usage Energy content of Distribution loss Storage volume Water storage lot a) If manufacture Temperature	Jan e in litres pe 110.09 of hot wate 163.27 c 0.15 x (45) 24.49 (litres) incluses: er's declared factor from water sell in (55)	r day for ear 106.09 r used = 4.1 142.79 m 21.42 uding any so and loss factor Table 2b storage (kW	Mar ch month 102.09 8 x Vd,m 147.35 22.10 blar or WV	Apr Vd,m = fact 98.08 x nm x Tm/3 128.46 19.27 VHRS storage n (kWh/day) 8) x (49)	May tor from Tab 94.08 8600 kWh/m 123.26 18.49 ge within sam	Jun le 1c x (43 90.08 onth (see 106.37	90.08 Tables 1b,	94.08 1c 1d) 113.11	98.08	102.09 Σ(44)1 133.39 Σ(45)1	106.09 12 = 145.60 12 =	100.09 Dec 110.09 1201.03 158.12 1574.74 23.72 3.00 0.26 0.54 0.14	(43) (44) (45) (46) (47) (48) (49) (50)
Annual average Hot water usage Energy content of Distribution loss Storage volume Water storage log a) If manufacture Temperature Energy lost free	Jan e in litres pe 110.09 of hot wate 163.27 c 0.15 x (45) 24.49 (litres) incluses: er's declared factor from water sell in (55)	r day for ear 106.09 r used = 4.1 142.79 m 21.42 uding any so and loss factor Table 2b storage (kW	Mar ch month 102.09 8 x Vd,m 147.35 22.10 blar or WV	Apr Vd,m = fact 98.08 x nm x Tm/3 128.46 19.27 VHRS storage n (kWh/day) 8) x (49)	May tor from Tab 94.08 8600 kWh/m 123.26 18.49 ge within sam	Jun le 1c x (43 90.08 onth (see 106.37	90.08 Tables 1b,	94.08 1c 1d) 113.11	98.08	102.09 Σ(44)1 133.39 Σ(45)1	106.09 12 = 145.60 12 =	100.09 Dec 110.09 1201.03 158.12 1574.74 23.72 3.00 0.26 0.54 0.14	(43) (44) (45
Annual average Hot water usage Energy content of Distribution loss Storage volume Water storage load If manufacture Temperature Energy lost frenter (50) or (54)	Jan e in litres pe 110.09 of hot wate 163.27 c 0.15 x (45) 24.49 (litres) incluses: er's declared factor from water s et factor from water s 1) in (55) coss calculate 4.36	r day for ear 106.09 r used = 4.1 142.79 m 21.42 uding any so and loss factor and Table 2b storage (kW) ed for each 3.93	Mar ch month 102.09 8 x Vd,m 147.35 22.10 blar or WV r is known h/day) (4 month (5 4.36	Apr Vd,m = fact 98.08 x nm x Tm/3 128.46 19.27 VHRS storage n (kWh/day) 8) x (49) 5) x (41)m 4.21	May tor from Tab 94.08 94.08 123.26 18.49 ge within sam	Jun le 1c x (43 90.08 onth (see 106.37 15.96 ne vessel	90.08 Tables 1b, 98.57 14.78	94.08 1c 1d) 113.11 16.97	98.08	102.09 Σ(44)1 133.39 Σ(45)1 20.01	106.09 12 = 145.60 12 =	100.09 Dec 110.09 1201.03 158.12 1574.74 23.72 3.00 0.26 0.54 0.14 0.14	(43) (44) (45) (45) (47) (49) (50) (55

Primary circuit los	s for each	month fro	m Table 3										
Γ	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 eac	ch month f	rom Table	3a, 3b or 3	Sc .		•	•					•	_
Γ	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	r heating c	alculated 1	for each mo	onth 0.85 x	(45)m + (4	l6)m + (57)r	n + (59)m -	+ (61)m		•	-	٠, ١
· 	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 o	!						1 120.20	1 2.0.72	1 2 12 12 0	101.01	172.00	1 200.70] (02)
Г	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	I				1		0.00	0.00	0.00	0.00	0.00	0.00] (03)
	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
L	190.00	107.74	1/4.9/	155.19	150.00	155.09	120.10	140.72	141.10		·	-]] (64)
Heat gains from w	otor booti	n a /l/\\/h /m	onth) 0.3	F v [O 0F v	/45\m + /61	\ml . 0 0 \	· [/46) m · /	57)m . /50°	\m_1	∑(64)1	.12 =	1899.92	(64)
Heat gains from w							1					1	٦,,,,
L	76.38	67.44	71.09	64.10	63.08	56.75	54.87	59.70	59.44	66.45	69.79	74.67	<u>(65)</u>
5. Internal gains													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (T					,			7.4.6	336	- J.			
	138.71	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 (sal						!	130.71	130.71	156.71	156.71	150.71	130.71] (66)
Lighting gains (cal							1 0 07	11.55	15.66	10.00	22.20	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	<u>(67)</u>
Appliance gains (c							1				1		7
L	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 (cal	culated in	Appendix I	L, equation	L15 or L15	ia), also see	Table 5							_
L	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 gair	ns (Table 5	a)											
	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	ation (Tab	le 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 gai	ns (Table 5	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 gain	ıs (66)m +	(67)m + (6	8)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)
								•			•		
6. Solar gains													
			Access		Area		lar flux		g	FF		Gains	
			Table	: 6d	m²	V	V/m²	-	ific data able 6b	specific of Table		W	
Nauth			0.7	- [C 0C	¬ ┌──						22.20	7 (74)
North			0.7		6.86				0.63 x			22.29	」(74) □ (75)
NorthEast			0.7		2.18				0.63 x			7.52	(75)
East			0.7		6.78	-			0.63 x			40.70	_ (76)
SouthEast			0.7	7 x	2.26	x3	36.79 x	0.9 x	0.63 x	0.70	=	25.41	(77)
Solar gains in watt	ts ∑(74)m. 	(82)m											_
L	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 - interr	nal and sol	ar (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)
7.00													
7. Mean internal		·				40-1							7.
Temperature duri			_									21.00	(85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
											DED Cro		

Utilisation facto	or for gains	for living are	ea n1,m (se	e Table 9a)									
	1.00	1.00	0.99	0.97	0.89	0.71	0.54	0.61	0.87	0.98	1.00	1.00	(86)
Mean internal t	emp of livir	g area T1 (s	steps 3 to 7	in Table 9	:)							•	_
	19.78	19.92	20.17	20.51	20.80	20.96	20.99	20.98	20.87	20.49	20.08	19.76	(87)
Temperature di	uring heatin	g periods ir	the rest of	dwelling f	rom Table !	9, Th2(°C)		•			•	•	_
	20.01	20.01	20.02	20.03	20.03	20.04	20.04	20.04	20.04	20.03	20.03	20.02	(88)
Utilisation facto	or for gains	for rest of d	welling n2,	m								•	
	1.00	1.00	0.99	0.96	0.84	0.63	0.43	0.50	0.81	0.98	1.00	1.00	(89)
Mean internal t	emperature	in the rest	of dwelling	T2 (follow	steps 3 to	7 in Table !	9c)					•	_
	18.37	18.58	18.94	19.45	19.83	20.01	20.04	20.04	19.92	19.42	18.82	18.35	(90)
Living area frac	tion					•			Li	ving area ÷	(4) =	0.32	(91)
Mean internal t	emperature	e for the wh	ole dwellin	g fLA x T1 +	+(1 - fLA) x	Т2							_
	18.82	19.01	19.34	19.79	20.14	20.31	20.34	20.34	20.23	19.76	19.22	18.80	(92)
Apply adjustme	nt to the m	ean interna	l temperati	re from Ta	ble 4e whe	re appropi	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	(93)
8. Space heati	ng requiren	nent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	or for gains,	ηm											_
	1.00	1.00	0.99	0.95	0.85	0.65	0.47	0.53	0.82	0.97	1.00	1.00	(94)
Useful gains, ηr	nGm, W (9	4)m x (84)m	1										_
	551.81	632.58	719.53	799.23	782.37	598.20	406.23	423.26	580.28	588.06	537.23	522.94	(95)
Monthly averag	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 for	or mean int	ernal tempe	erature, Lm	, W [(39)m	x [(93)m -	(96)m]							_
	1644.00	1592.61	1445.16	1209.64	935.87	625.90	409.97	430.60	674.14	1015.33	1349.90	1634.71	(97)
Space heating r	equirement	, kWh/mon	th 0.024 x	[(97)m - (9	5)m] x (41)	m							_
	812.59	645.14	539.87	295.49	114.20	0.00	0.00	0.00	0.00	317.88	585.13	827.16	_
									∑(9	8)15, 10		4137.46	(98)
Space heating r	equirement	kWh/m²/y	ear							(98)	÷ (4)	39.76	(99)
9a. Energy req	uirements	- individual	heating sys	stems inclu	iding micro	-CHP							
Space heating													
Fraction of space	e heat from	secondary	/sunnleme	ntary syste	m (table 11)						0.00	(201)
Fraction of space				italy syste	(table 11	-,				1 - (2	01) =	1.00	(202)
Fraction of space										1 (2	O1,	0.00	(202)
Fraction of tota									(20)2) x [1- (20	13)] =	1.00	(204)
Fraction of tota			-						(20	(202) x (20		0.00	(205)
Efficiency of ma			JyJtCili Z							(202) X (2)	-5, -	93.50] (203)] (206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	J (200)
Space heating f													
Space neuting I	869.08	689.99	577.40	316.03	122.14	0.00	0.00	0.00	0.00	339.98	625.80	884.66	٦
	303.08	1 009.99	377.40	310.03	122.14	0.00	1 0.00	1 0.00	1	1)15, 10		1425.09	」 │(211)
Water heating									2(21)	-,J, ±U		. +23.03	J (211)
Efficiency of wa	ter heater												
Efficiency of wa	88.25	88.06	87.62	86.51	84.08	79.80	79.80	79.80	79.80	86.60	87.82	88.33	(217)
Water heating f			07.02	00.31	U4.00	13.00	19.00	19.00	19.00	1 30.00	J 07.02	00.33	J (21/)
rrater neating i	216.30	190.48	199.68	179.40	179.44	166.79	158.12	176.34	176.92	185.93	196.23	210.28	٦
	210.30	190.48	80.661	1/9.40	1/9.44	100.79	158.12	1/0.34	1/0.92	100.93	190.23	210.28	L

	∑(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 includ	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)
112 SAD rating individual heating systems inclu	ding micro CUD					

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 x 0.216 = 482.96 (264) Space and water heating (261) + (262) + (263) + (264) = 1438.78 (265) Pumps and fans 75.00 x 0.519 = 38.93 (267) Electricity for lighting 425.01 x 0.519 = 220.58 (268) Total CO₂, kg/year (265)(271) = 1698.28 (272) Dwelling CO₂ emission rate (272) ÷ (4) = 16.32 (273) El value 84.73 El rating (section 14) 85 (274)	12a. CO₂ emissions - individual heating systems includir	ig micro-CHP					
Water heating 2235.91 x 0.216 = 482.96 (264) Space and water heating $(261) + (262) + (263) + (264) =$ 1438.78 (265) Pumps and fans 75.00 x 0.519 = 38.93 (267) Electricity for lighting 425.01 x 0.519 = 220.58 (268) Total CO ₂ , kg/year $(265)(271) =$ 1698.28 (272) Dwelling CO ₂ emission rate $(272) \div (4) =$ 16.32 (273) El value 84.73 El rating (section 14) 85 (274)		σ,					
Space and water heating $(261) + (262) + (263) + (264) =$ 1438.78 (265) Pumps and fans 75.00 x 0.519 = 38.93 (267) Electricity for lighting 425.01 x 0.519 = 220.58 (268) Total CO ₂ , kg/year (265)(271) = 1698.28 (272) Dwelling CO ₂ emission rate (272) ÷ (4) = 16.32 (273) El value 84.73 El rating (section 14) 85 (274)	Space heating - main system 1	4425.09	x	0.216	= [955.82	(261)
Pumps and fans 75.00 x 0.519 = 38.93 (267) Electricity for lighting 425.01 x 0.519 = 220.58 (268) Total CO2, kg/year (265)(271) = 1698.28 (272) Dwelling CO2 emission rate (272) \div (4) = 16.32 (273) El value 84.73 El rating (section 14) 85 (274)	Water heating	2235.91	x	0.216	= [482.96	(264)
Electricity for lighting 425.01 x 0.519 = 220.58 (268) Total CO_2 , kg/year (265)(271) = 1698.28 (272) Dwelling CO_2 emission rate (272) \div (4) = 16.32 (273) El value 84.73	Space and water heating			(261) + (262) + (263) + (264) =	1438.78	(265)
Total CO ₂ , kg/year (265)(271) = 1698.28 (272) Dwelling CO ₂ emission rate (272) \div (4) = 16.32 (273) El value 84.73 El rating (section 14) 85 (274)	Pumps and fans	75.00	x	0.519	= [38.93	(267)
Dwelling CO_2 emission rate $ (272) \div (4) = $	Electricity for lighting	425.01	x	0.519	= [220.58	(268)
El value 84.73 El rating (section 14) 85 (274)	Total CO ₂ , kg/year			(265	5)(271) =	1698.28	(272)
El rating (section 14)	Dwelling CO₂ emission rate			(2	72) ÷ (4) =	16.32	(273)
	El value					84.73]
El band B	El rating (section 14)					85	(274)
	El band					В]

	Energy kWh/year		Primary factor		Primary Energy kWh/year	y
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	63) + (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

.84 (273)

(272)

SAP version 9.92



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

Client							Last modified	l	30/09	/2020	
Address	3B6P, Kingston up	on Thames, Ki	Γ1								
1. Overall dwelling dimer	nsions										
			Ar	ea (m²)		P	Average storey height (m)		Vo	lume (m³)	
Lowest occupied				94.73] (1a) x		2.50	(2a) =		236.83	(3a)
Total floor area	(1a) + (1b) +	(1c) + (1d)(1r	n) =	94.73	(4)						
Dwelling volume							(3a) + (3b) + (3	c) + (3d)(3r	n) =	236.83	(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 far	าร						3	x 10 =		30	(7a)
Number of passive vents							0	x 10 =		0	(7b)
Number of flueless gas fire	S						0	x 40 =		0	(7c)
									Air	changes pe hour	r
Infiltration due to chimney	s, flues, fans, PSVs		(6a) -	+ (6b) + (7a	a) + (7b) + (7c) = [30	÷ (5) =		0.13	(8)
If a pressurisation test has	been carried out or is	s intended, pro	ceed to (1	7), otherw	ise continu	e from ((9) to (16)				
Air permeability value, q50	, expressed in cubic	metres per hou	ur per squa	are metre o	of envelope	e area				5.00	(17)
If based on air permeability	y value, then (18) = [((17) ÷ 20] + (8),	, otherwis	e (18) = (16	5)					0.38	(18)
Number of sides on which	the dwelling is shelte	ered								2	(19)
Shelter factor							1 -	[0.075 x (19)] =	0.85	(20)
Infiltration rate incorporati	ng shelter factor							(18) x (20	0) =	0.32	(21)
Infiltration rate modified for	or monthly wind spee	ed:									
Jan	Feb Mar	Apr	May	Jun	Jul	Aug	g Sep	Oct	Nov	Dec	
Monthly average wind spec	ed 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	3 1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (a	allowing for shelter a	nd wind factor) (21) x (22	2a)m							
0.41	0.40 0.39	0.35	0.34	0.30	0.30	0.30	0.32	0.34	0.36	0.38	(22b)
Calculate effective air chan	ge rate for the appli	cable case:									
If mechanical ventilation	n: air change rate thr	ough system								N/A	(23a)



0.58

0.58

N/A

0.57

0.57

0.56

0.56

(23c)

(24d)

(25)

0.55

0.55

0.55

0.55

0.54

0.54

0.55

0.55

0.56

0.56

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

0.58

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25) 0.58

3. Heat losses a	and heat loss	paramete	er									
Element				Gross area, m²	Openings m ²		area m²	U-value W/m²K	AxUW	/К к-value, kJ/m².К	Ахк, 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 elemer	nts ∑A, m²				182	2.35					(31)
Fabric heat loss,	$W/K = \sum (A \times$	U)							(26	5)(30) + (32) =	46.59	(33)
Heat capacity Cn	n = ∑(A x κ)							(28)	.(30) + (32) -	- (32a)(32e) =	N/A	(34)
Thermal mass pa	arameter (TN	⁄IP) in kJ/m	² K								250.00	(35)
Thermal bridges	: ∑(L x Ѱ) cal	culated usi	ng Appe	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 calculat	ed monthl	y 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	5 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	108.38	
									Average = 5	[(39)112/12 =	107.69	(39)
Heat loss parame	eter (HLP), W	V/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 = \(\)	[(40)112/12 = _	1.14	(40)
Number of days	in month (Ta	able 1a)						_				_
	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 heatir	ng energy re	quirement										
Assumed occupa		•									2.69	(42)
Annual average I	•	age in litre	s per day	v Vd,average	= (25 x N) +	36					97.97	(43)
_	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct Nov		
Hot water usage	in litres per	day for ea	ch month	vd,m = fac	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	35 107.77	7
									•	Σ(44)112 =	1175.65	(44)
Energy content of	of hot water	used = 4.1	8 x Vd,m	x nm x Tm/3	3600 kWh/m	onth (see	Tables 1b	, 1c 1d)		_		<u> </u>
	159.82	139.78	144.24	125.75	120.66	104.12	96.48	110.72	112.04	130.57 142.5	53 154.77	
										∑(45)112 =	1541.46	(45)
Distribution loss	0.15 x (45)n	n										_
	23.97	20.97	21.64	18.86	18.10	15.62	14.47	16.61	16.81	19.59 21.3	8 23.22	(46)
Storage volume	(litres) includ	ding any so	lar or W\	NHRS storag	ge within san	ne vessel		,	•		3.00	(47)
Water storage lo	oss:									_		
a) If manufacture	er's declared	loss factor	r is know	n (kWh/day))						0.26	(48)
Temperature	factor from	Table 2b									0.54	(49)
Energy lost fr	om water sto	orage (kWl	h/day) (4	18) x (49)						Ī	0.14	(50)
Enter (50) or (54) in (55)									Ī	0.14	(55)
Water storage lo	ss calculated	d for each i	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 dedicat	ed solar st	orage or	dedicated V	VWHRS (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 lo	ss 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 ea	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 requir	ed for wat	er heating c	alculated 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 input	calculated	using Appe	endix G or A	Appendix H	<u>'</u>							•	_
	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	er heater f	or each mo	nth (kWh/ı	month) (62	2)m + (63)n	n						•	_
	187.43	164.72	171.85	152.48	148.28	130.85	124.10	138.33	138.76	158.19	169.25	182.39	7
					•	•				∑(64)1	.12 = 1	1866.64	(64)
Heat gains from v	water heat	ing (kWh/m	nonth) 0.25	5 × [0.85 ×	(45)m + (61	L)m] + 0.8 ×	[(46)m + (57)m + (59)	m]				_
	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)
				•	•	•							
5. Internal gains	S												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains ((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 (ca	alculated in	Appendix I	_, 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 (calculated	in Appendi	x 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 (ca	alculated in	n Appendix I	L, equation	L15 or L15	sa), also see	e 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 ga	ins (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. evapo	oration (Tal	ble 5)											
	-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 ga	ains (Table	5)											
[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 gai	ins (66)m -	+ (67)m + (6	8)m + (69)ı	m + (70)m	+ (71)m + (72)m							
	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)
C Solov going													
6. Solar gains			Access f		Auga	Cal	ar flux		_	FF		Coine	
			Table		Area m²		ar nux //m²	speci	g fic data	specific o	lata	Gains W	
									able 6b	or Table	6c		
East			0.7	7 x	10.44	x 1	9.64 x	0.9 x).63 x	0.70	= [62.66	(76)
South			0.7	7 x	4.42	x 4	6.75 x	0.9 x).63 x	0.70	=	63.15	(78)
Solar gains in wa	tts ∑(74)m	n(82)m									_		
	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 - inte	rnal and so	olar (73)m +	(83)m										
]	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 interna													
Temperature dur	ring heatin	g periods in	the living a	area from T	Table 9, Th	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	a n1,m (se	e Table 9a)								_
	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)

	emp of livir	ng area T1 (s	steps 3 to 7	' in Table 9લ	:)								
	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 du	ıring heatin	g periods in	the rest of	f dwelling f	rom Table 9	9, Th2(°C)							
	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 factor	r for gains f	or rest of d	welling n2,	m									
	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 te	emperature	in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	 Эс)	•	•	•			-
	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 fract	ion								Li	ving area ÷	(4) =	0.33]] (91
Mean internal te	emperature	for the wh	ole dwellin	g fLA x T1 -	+(1 - fLA) x ⁻	Γ2							
	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 adjustmer	nt to the m	ean interna	l temperati	ure from Ta	ble 4e whe	re appropr	iate			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
		,											, , -
8. Space heatir	ng requiren	nent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	r 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, ηm	nGm, W (94	1)m x (84)m	Į										
	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 average	e 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 fo	or mean int	ernal tempe	erature, Lm	, 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 re	equirement	, 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 re	equirement	kWh/m²/ye	ear							(98)	÷ (4)	40.41	(99
9a. Energy requ	uirements ·	individual	heating sy	stems inclu	iding micro	-CHP							
Space heating													,
Fraction of space	e heat from	ı secondary,	/suppleme	ntary syste	m (table 11	.)						0.00	(20
Fraction of space	e heat from	ı main syste	em(s)							1 - (2	01) =	1.00	(20
Fraction of space	e heat fron	ı main syste	em 2									0.00	(20
Fraction of total	space heat	from main	system 1						(20	02) x [1- (20)3)] = [1.00	(20
Fraction of total	space heat	: from main	system 2							(202) x (2	03) =	0.00	(20
- CC: · · · · · ·	in system 1	(%)										93.50	(20
Efficiency of ma				A	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of ma	Jan	Feb	Mar	Apr									
				Apr									
				Apr 292.86	123.04	0.00	0.00	0.00	0.00	299.86	578.42	831.69]
	uel (main sy	stem 1), kW	Vh/month		123.04	0.00	0.00	0.00		299.86 1)15, 10		831.69 4094.13]] (2 1
Space heating fu	uel (main sy	stem 1), kW	Vh/month		123.04	0.00	0.00	0.00		1]] (2:
Space heating for the state of	uel (main sy 812.06	stem 1), kW	Vh/month		123.04	0.00	0.00	0.00		1]] (2:
Space heating fu Water heating Efficiency of wat	uel (main sy 812.06	stem 1), kW	Vh/month		123.04	79.80	79.80	79.80		1			7
Space heating for the street of the street o	10 (main sy 812.06 ster heater 88.16	632.75 87.93	Vh/month 523.46	292.86					Σ(21:	1)15, 10	.12 = 4	1094.13	7
Space heating for water heating Efficiency of water heating	10 (main sy 812.06 ster heater 88.16	632.75 87.93	Vh/month 523.46	292.86					Σ(21:	1)15, 10	.12 = 4	1094.13] (21] (21
Space heating fu Water heating Efficiency of wat	ter heater 88.16 wel, kWh/m	87.93	Vh/month 523.46 87.45	292.86	84.15	79.80	79.80	79.80	∑(21 79.80	86.32	87.70 193.00	88.25	7

			_
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			

Liectricity 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 inclu	iding micro-CHP		
	Fuel kWh/year	Fuel price	Fuel cost £/year
Space heating - main system 1	4094.13	x 3.48 x 0	0.01 = 142.48 (240)
Water heating	2198.86	x 3.48 x 0	0.01 = 76.52 (247)
Pumps and fans	75.00	x 13.19 x 0	0.01 = 9.89 (249)
Electricity for lighting	408.17	x 13.19 x 0	0.01 = 53.84 (250)
Additional standing charges			120.00 (251)
Total energy cost		(240)(242) + (245)	(254) = 402.73 (255)
11a. SAP rating - individual heating systems included	uding micro-CHP		
Energy cost deflator (Table 12)			0.42 (256)
Energy cost factor (ECF)			1.21 (257)
SAP value			83.11
SAP rating (section 13)			83 (258)
SAP band			В

12a. CO ₂ emissions - individual heating systems including mi	cro-CHP					
	Energy kWh/year		Emission factor kg CO₂/kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	4094.13	x	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 CO₂, kg/year				(265)(271) =	1610.05	(272)
Dwelling CO₂ 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	x	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



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

		Area (m²)		Average storey height (m)	Volume (m³)
Lowest occupied		72.24	(1a) x	2.50 (2a) =	180.60 (3a
+1		57.20	(1b) x	2.50 (2b) =	143.00 (3t
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) =	129.44	(4)		
Dwelling volume				(3a) + (3b) + (3c) + (3d)	(3n) = 323.60 (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	4	x 10 =	40	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)
			Air changes pe	r
			hour	

Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	40 ÷ (5) =	0.12	(8
If a pressurisation test has been carried out or is intend	ded, 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		5.00	(1

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

Shelter factor

Infiltration rate incorporating shelter factor

Infiltration rate n	nodified fo	r monthly v	vind speed										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 infiltration rate (allowing for shelter and wind factor) (21) x (22a)m													
	0.40	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 air change rate for the applicable case:

If mechanical ventilation: air change rate through system

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

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

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

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



N/A

0.37

2

0.85

0.32

1 - [0.075 x (19)] =

 $(18) \times (20) =$

(19)

(20)

(23a)

(23c)

				Gross	Openings	Net are			A x U W/I		alue,	Ахк,	
			а	rea, m²	m²	A, m²	W/n	n²K		kJ/	m².K	kJ/K	
Vindow						23.72	x1.3	3 = [31.45	_			(
Door						1.80	x1.0	00 = [1.80				(
Ground floor						72.24	x0.1	.3 =	9.39				(
External wall						64.31	x0.1	.8 =	11.58				(
Party wall						79.95	x0.0	00 = [0.00				(
Roof						17.62	x0.1	.3 =	2.29				(
Total area of ext	ternal eleme	ents ∑A, m²	2			179.69)						_ (
abric heat loss,	, W/K = ∑(A	× U)							(26).	(30) + (3	32) =	56.50	(
Heat capacity Cr	m = ∑(A x κ)							(28)(30)	+ (32) + (32a)(32	e) =	N/A	
Thermal mass p	arameter (T	MP) in kJ/n	n²K									250.00	
Thermal bridges	s: Σ(L x Ψ) ca	alculated us	sing Appen	dix K								9.46	
Total fabric heat	t loss									(33) + (3	66) =	65.96	
	Jan	Feb	Mar	Apr	May	Jun	Jul A	ug	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	3.00	8.78	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	.24.22 12	3.96 1	24.74	125.58	126.17	126.79	
								Ave	rage = ∑(3	39)112/	12 =	125.87	
Heat loss param	eter (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	
								Ave	rage = ∑(4	10)112/	12 =	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	0.00	31.00	30.00	31.00	(
1 Water heati													
4. Water Heati	na onorav r	aquiraman	*										
		equiremen	t									2 90	7,
Assumed occup	ancy, N			Vd avorago	2= (2E v N) + 3	26						2.89	
Assumed occup	ancy, N hot water u	ısage in litro	es per day				lul A	uσ	San	Oct	Nov	102.92	
Assumed occupa Annual average	ancy, N hot water u Jan	usage in litro Feb	es per day Mar	Apr	May	Jun	Jul A	ug	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 Table	Jun e 1c x (43)						102.92 Dec	
Assumed occup: Annual average	ancy, N hot water u Jan	usage in litro Feb	es per day Mar	Apr	May	Jun e 1c x (43)				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	es per day Mar ach month 104.98	Apr Vd,m = fac 100.86	May tor from Table 96.75	Jun e 1c x (43) 92.63	92.63 96	5.75 1			109.10	102.92 Dec	
Assumed occup Annual average Hot water usage	hot water u Jan e in litres pe 113.21 of hot wate	r used = 4.1	es per day Mar ach month 104.98	Apr Vd,m = fact 100.86	May tor from Table 96.75	Jun e 1c x (43) 92.63 onth (see Ta	92.63 96 oles 1b, 1c 1c	5.75 1 H)	00.86	104.98 ∑(44)1	109.10 12 =	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	es per day Mar ach month 104.98	Apr Vd,m = fac 100.86	May tor from Table 96.75	Jun e 1c x (43) 92.63 onth (see Ta	92.63 96 oles 1b, 1c 1c	5.75 1 H)	00.86	104.98 Σ(44)1 137.17	109.10 12 = 149.73	102.92 Dec 113.21 1235.05	
Assumed occupa Annual average Hot water usage Energy content	ancy, N hot water u Jan e in litres pe 113.21 of hot wate	r used = 4.1	es per day Mar ach month 104.98	Apr Vd,m = fact 100.86	May tor from Table 96.75	Jun e 1c x (43) 92.63 onth (see Ta	92.63 96 oles 1b, 1c 1c	5.75 1 H)	00.86	104.98 ∑(44)1	109.10 12 = 149.73	102.92 Dec 113.21 1235.05	
Assumed occupa 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	es per day Mar ach month 104.98 18 x Vd,m x 151.53	Apr Vd,m = fac 100.86 x nm x Tm/3 132.10	May tor from Table 96.75 3600 kWh/ma 126.76	92.63 onth (see Ta	92.63 96 ples 1b, 1c 1c 01.36 11	5.75 1 d) 6.31 1	17.70	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 occupa Annual average Hot water usage Energy content	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 used = 4.1 146.84 22.03	es per day Mar ach month 104.98 18 x Vd,m x 151.53	Apr Vd,m = fact 100.86 s nm x Tm/3 132.10	May tor from Table 96.75 3600 kWh/mo 126.76	Jun e 1c x (43) 92.63 onth (see Ta 109.38	92.63 96 ples 1b, 1c 1c 01.36 11	5.75 1 d) 6.31 1	00.86	104.98 Σ(44)1 137.17	109.10 12 = 149.73	102.92 Dec 113.21 1235.05 162.59 1619.35	
Assumed occupa 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 used = 4.1 146.84 22.03	es per day Mar ach month 104.98 18 x Vd,m x 151.53	Apr Vd,m = fact 100.86 s nm x Tm/3 132.10	May tor from Table 96.75 3600 kWh/mo 126.76	Jun e 1c x (43) 92.63 onth (see Ta 109.38	92.63 96 ples 1b, 1c 1c 01.36 11	5.75 1 d) 6.31 1	17.70	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 occupa Annual average Hot water usage Energy content Distribution loss Storage volume Water storage lo	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 used = 4.1 146.84 22.03 uding any so	es per day Mar ach month 104.98 18 x Vd,m x 151.53 22.73 olar or WW	Apr Vd,m = fact 100.86 s nm x Tm/3 132.10 19.82 /HRS storage	May tor from Table 96.75 3600 kWh/mo 126.76 19.01 ge within sam	Jun e 1c x (43) 92.63 onth (see Ta 109.38	92.63 96 ples 1b, 1c 1c 01.36 11	5.75 1 d) 6.31 1	17.70	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	
Assumed occupa Annual average Hot water usage Energy content Distribution loss Storage volume Water storage lo	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 used = 4.3 146.84 22.03 uding any solutions and sed loss factors	es per day Mar ach month 104.98 18 x Vd,m x 151.53 22.73 olar or WW	Apr Vd,m = fact 100.86 s nm x Tm/3 132.10 19.82 /HRS storage	May tor from Table 96.75 3600 kWh/mo 126.76 19.01 ge within sam	Jun e 1c x (43) 92.63 onth (see Ta 109.38	92.63 96 ples 1b, 1c 1c 01.36 11	5.75 1 d) 6.31 1	17.70	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 occupa Annual average Hot water usage Energy content Distribution loss Storage volume Water storage loss 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 declare	r used = 4.1 146.84 m 22.03 uding any solution Table 2b	es per day Mar ach month 104.98 18 x Vd,m x 151.53 22.73 olar or WW	Apr Vd,m = fact 100.86 a nm x Tm/3 132.10 19.82 /HRS storage (kWh/day)	May tor from Table 96.75 3600 kWh/mo 126.76 19.01 ge within sam	Jun e 1c x (43) 92.63 onth (see Ta 109.38	92.63 96 ples 1b, 1c 1c 01.36 11	5.75 1 d) 6.31 1	17.70	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 occupation occ	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 used = 4.1 146.84 m 22.03 uding any solution Table 2b	es per day Mar ach month 104.98 18 x Vd,m x 151.53 22.73 olar or WW	Apr Vd,m = fact 100.86 a nm x Tm/3 132.10 19.82 /HRS storage (kWh/day)	May tor from Table 96.75 3600 kWh/mo 126.76 19.01 ge within sam	Jun e 1c x (43) 92.63 onth (see Ta 109.38	92.63 96 ples 1b, 1c 1c 01.36 11	5.75 1 d) 6.31 1	17.70	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	
Assumed occupa Annual average Hot water usage Energy content Distribution loss Storage volume Water storage loa a) If manufactur Temperature Energy lost fi Enter (50) or (54	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 4) in (55)	r used = 4.1 146.84 m 22.03 uding any solution Table 2b storage (kW	es per day Mar ach month 104.98 18 x Vd,m x 151.53 22.73 olar or WW or is known /h/day) (48	Apr Vd,m = fact 100.86 a nm x Tm/3 132.10 19.82 /HRS storage (kWh/day)	May tor from Table 96.75 3600 kWh/mo 126.76 19.01 ge within sam	Jun e 1c x (43) 92.63 onth (see Ta 109.38	92.63 96 ples 1b, 1c 1c 01.36 11	5.75 1 d) 6.31 1	17.70	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 occupation occ	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 4) in (55)	r used = 4.1 146.84 m 22.03 uding any solution Table 2b storage (kW	es per day Mar ach month 104.98 18 x Vd,m x 151.53 22.73 olar or WW or is known /h/day) (48	Apr Vd,m = fact 100.86 a nm x Tm/3 132.10 19.82 /HRS storage (kWh/day)	May tor from Table 96.75 3600 kWh/mo 126.76 19.01 ge within sam	Jun e 1c x (43) 92.63 onth (see Ta 109.38	92.63 96 ples 1b, 1c 1c 01.36 11 15.20 17	6.75 1 6.31 1	17.70	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	

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If the contact courts	د داد ما د ما			- d:+- d \A	(MALLIDE (EC)		\/a] • /47\	-l (FC)					
If the vessel contain							1		4.24	4.06	1.24	T 426	7 (57)
Daine and a locality land	4.36	3.93	4.36	4.21	4.36	4.21	4.36	4.36	4.21	4.36	4.21	4.36	<u>(57)</u>
Primary circuit loss							T	1	1				٦
L	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 eac		from Table	3a, 3b or 3	C	i .		i	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 required	d for wate	er heating c	alculated for	or each mo	onth 0.85 x	(45)m + (4	6)m + (57)ı 	n + (59)m +	- (61)m				_
	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 c	alculated	using Appe	ndix G or A	ppendix 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 water	r heater f	or each mo	nth (kWh/r	month) (62	2)m + (63)m	1							
	195.51	171.78	179.14	158.83	154.37	136.11	128.98	143.93	144.43	164.78	176.45	190.21	
										∑(64)1	.12 = 1	1944.53	(64)
Heat gains from w	ater heati	ing (kWh/m	onth) 0.25	5 × [0.85 × ((45)m + (61)m] + 0.8 ×	[(46)m + (57)m + (59)	m]				
	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)
_		•											_
5. Internal gains													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (T	able 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 (calc	culated in	Appendix L	, equation	L9 or L9a),	also see Ta	ble 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 (ca	alculated	in Appendi	ι L, equatio	n L13 or L1	L3a), also se	ee Table 5							
	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 (cald	culated in	Appendix I	, equation	L15 or L15	a), also see	Table 5							
	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 gain	ns (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. evapora	ation (Tab	ole 5)											_ ` `
	-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 gair		!										1	(/
	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 gain:							74.55	01.00	04.03	31.00	30.04	102.50	(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)
L	496.15	495.64	478.00	450.06	421.72	394.23	370.08	303.29	397.91	420.13	436.37	403.42	(/3)
6. Solar gains													
			Access f	actor	Area	Sol	ar flux		g	FF		Gains	
			Table	6d	m²	W	//m²	-	ific data	specific o		W	
									able 6b	or Table	өс		7
South			0.77	7 x [9.04	_ x _ 4			0.63 x	0.70	=	129.16	<u> </u> (78)
East			0.77	7 x	10.68	_ x _ 1	9.64 x	0.9 x	0.63 x	0.70	=	64.10	<u>(76)</u>
SouthEast			0.77	7 x	4.00	x 3	6.79 x	0.9 x	0.63 x	0.70	=	44.98	(77)
Solar gains in watt	:s ∑(74)m	(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 - intern	nal 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. Mean internal													
Temperature durir	ng heating	g periods in	the living a	rea from T	able 9, Th1	(°C)						21.00	(85)
											LIDNI, ADOL	D. Dunlay	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor	for gains fo	or living are	a n1,m (see	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	mp 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 dur	ing 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 fo	or rest of d	welling n2,r	n									
	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	mperature	in the rest	of dwelling	T2 (follow	steps 3 to 7	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 fraction	on								Li	ving area ÷	(4) =	0.30	(91)
Mean internal te	mperature	for the wh	ole dwelling	g fLA x T1 +	(1 - fLA) x T	2							
	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 adjustmen	t to the me	ean internal	temperatu	re from Tal	ble 4e whe	re appropi	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 heating	g requirem	ent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor	for gains, r	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)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	external to	emperature	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 inte	rnal 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	n						•	_
	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	irements -	individual	heating sys	tems includ	ding micro-	-СНР							
Space heating													7
Fraction of space				ntary systen	n (table 11))						0.00	(201)
Fraction of space										1 - (20	01) = [1.00	(202)
Fraction of space												0.00	(202)
Fraction of total									(20)2) x [1- (20		1.00	(204)
Fraction of total			system 2							(202) x (20	03) = [0.00	(205)
Efficiency of mair	•											93.50	(206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fu							 			1 -	1	1	7
	920.84	676.02	514.39	245.06	78.24	0.00	0.00	0.00	0.00	272.78	630.82	950.88]
Water besting									∑(21	1)15, 10	.12 =	4289.02	(211)
Water heating Efficiency of water	ar heater												
Linciency of wate		07.00	07 22	0F 70 T	02.05	70.00	70.00	70.00	70.00	05.00	07.70	00 44	(247)
 Water heating fu	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 neating lu	CI, KVVII/III	Ontil											

221.39 195.26 205.15 18	5.14 186.10 170.56 1	61.62 180.	36 180.98 191.66	5 201.00 215.15	
			∑(219a):	112 = 2294.37	(219)
Annual totals					
Space heating fuel - main system 1				4289.02	
Water heating fuel				2294.37	
Electricity for pumps, fans and electric keep-hot (Table	e 4f)				
central heating pump or water pump within warm	air heating unit	Γ	30.00		(230c)
boiler flue fan	-	Ī	45.00		(230e)
Total electricity for the above, kWh/year					(231)
Electricity for lighting (Appendix L)					(232)
Total delivered energy for all uses		(211)	.(221) + (231) + (232)(2		(238)
		` '	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		/
10a. Fuel costs - individual heating systems including	g micro-CHP				
	Fuel kWh/year		Fuel price	Fuel cost £/year	
Space heating - main system 1	4289.02	x	3.48 x 0.0	01 = 149.26	(240)
Water heating	2294.37	x	3.48 x 0.0	01 = 79.84	(247)
Pumps and fans	75.00	x	13.19 x 0.0	9.89	(249)
Electricity for lighting	476.33	x	13.19 x 0.0	01 = 62.83	(250)
Additional standing charges				120.00	(251)
Total energy cost			(240)(242) + (245)	(254) = 421.82	(255)
11a. SAP rating - individual heating systems including	g micro-CHP				
Energy cost deflator (Table 12)				0.42	(256)
Energy cost factor (ECF)				1.02	(257)
SAP value				85.83	
SAP rating (section 13)				86	(258)
SAP rating (section 13) SAP band				86 B	(258)
	uding micro-CHP				(258)
SAP band	uding micro-CHP Energy kWh/year	ı	Emission factor kg CO₂/kWh		(258)
SAP band	Energy	x [Emissions kg CO ₂ /year	(258)
SAP band 12a. CO ₂ emissions - individual heating systems included in the system in the system included in the system in the system included in the system in the system included in the system in t	Energy kWh/year		kg CO₂/kWh	Emissions kg CO ₂ /year	
SAP band 12a. CO ₂ emissions - individual heating systems inclu Space heating - main system 1	Energy kWh/year 4289.02	х [kg CO₂/kWh 0.216 =	Emissions kg CO ₂ /year = 926.43 = 495.58	(261)
SAP band 12a. CO ₂ emissions - individual heating systems inclu Space heating - main system 1 Water heating	Energy kWh/year 4289.02	х [0.216 = 0.216	Emissions kg CO ₂ /year = 926.43 = 495.58 (264) = 1422.01	(261) (264)
SAP band 12a. CO ₂ emissions - individual heating systems inclu Space heating - main system 1 Water heating Space and water heating	Energy kWh/year 4289.02 2294.37	x [x [0.216 = 0.216 = (261) + (262) + (263) +	Emissions kg CO ₂ /year = 926.43 = 495.58 (264) = 1422.01 = 38.93	(261) (264) (265)
SAP band 12a. CO ₂ emissions - individual heating systems included syste	Energy kWh/year 4289.02 2294.37	x [x [0.216 = 0.216 = (261) + (262) + (263) + 0.519 = 0.519	Emissions kg CO ₂ /year = 926.43 = 495.58 (264) = 1422.01 = 38.93 = 247.22	(261) (264) (265) (267)
SAP band 12a. CO ₂ emissions - individual heating systems included a system system 1 Water heating Space and water heating Pumps and fans Electricity for lighting	Energy kWh/year 4289.02 2294.37	x [x [kg CO ₂ /kWh 0.216 = 0.216 = (261) + (262) + (263) + 0.519 = 0.519 = (265)	Emissions kg CO ₂ /year = 926.43 = 495.58 (264) = 1422.01 = 38.93 = 247.22 (271) = 1708.16	(261) (264) (265) (267) (268)
SAP band 12a. CO ₂ emissions - individual heating systems included a system system 1 Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year	Energy kWh/year 4289.02 2294.37	x [x [kg CO ₂ /kWh 0.216 = 0.216 = (261) + (262) + (263) + 0.519 = 0.519 = (265)	Emissions kg CO ₂ /year 926.43 495.58 (264) = 1422.01 38.93 247.22 (271) = 1708.16	(261) (264) (265) (267) (268) (272)
SAP band 12a. CO ₂ emissions - individual heating systems included and systems included are systems included. Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate	Energy kWh/year 4289.02 2294.37	x [x [kg CO ₂ /kWh 0.216 = 0.216 = (261) + (262) + (263) + 0.519 = 0.519 = (265)	Emissions kg CO ₂ /year = 926.43 = 495.58 (264) = 1422.01 = 38.93 = 247.22 (271) = 1708.16 ÷ (4) = 13.20 86.88	(261) (264) (265) (267) (268) (272)
SAP band 12a. CO ₂ emissions - individual heating systems included and system 1 Space heating - main system 1 Water heating Space and water heating Pumps and fans Electricity for lighting Total CO ₂ , kg/year Dwelling CO ₂ emission rate El value	Energy kWh/year 4289.02 2294.37	x [x [kg CO ₂ /kWh 0.216 = 0.216 = (261) + (262) + (263) + 0.519 = 0.519 = (265)	Emissions kg CO ₂ /year = 926.43 = 495.58 (264) = 1422.01 = 38.93 = 247.22 (271) = 1708.16 ÷ (4) = 13.20 86.88	(261) (264) (265) (267) (268) (272) (273)
SAP band 12a. CO ₂ emissions - individual heating systems included and system 1 Space heating - main system 1 Water heating 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	Energy kWh/year 4289.02 2294.37 75.00 476.33	x [x [kg CO ₂ /kWh 0.216 = 0.216 = (261) + (262) + (263) + 0.519 = 0.519 = (265)	Emissions kg CO ₂ /year 926.43 495.58 (264) = 1422.01 38.93 247.22 (271) = 1708.16 ÷ (4) = 13.20 86.88 87	(261) (264) (265) (267) (268) (272) (273)
SAP band 12a. CO ₂ emissions - individual heating systems included and systems included are systems included as a system 1 Water heating 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)	Energy kWh/year 4289.02 2294.37 75.00 476.33	x	kg CO ₂ /kWh 0.216 = 0.216 = (261) + (262) + (263) + 0.519 = (265) (272)	Emissions kg CO ₂ /year = 926.43 = 495.58 (264) = 1422.01 = 38.93 = 247.22 (271) = 1708.16 ÷ (4) = 13.20 86.88 87 B	(261) (264) (265) (267) (268) (272) (273)
SAP band 12a. CO ₂ emissions - individual heating systems included and system 1 Space heating - main system 1 Water heating 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	Energy kWh/year 4289.02 2294.37 75.00 476.33	x	kg CO ₂ /kWh 0.216 = 0.216 = (261) + (262) + (263) + 0.519 = 0.519 = (265)	Emissions kg CO ₂ /year 926.43 495.58 (264) = 1422.01 38.93 247.22 (271) = 1708.16 ÷ (4) = 13.20 86.88 87	(261) (264) (265) (267) (268) (272) (273)
SAP band 12a. CO ₂ emissions - individual heating systems included and system 1 Space heating - main system 1 Water heating 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	Energy kWh/year 4289.02 2294.37 75.00 476.33	x	kg CO ₂ /kWh 0.216 = 0.216 = (261) + (262) + (263) + 0.519 = (265) (272)	Emissions kg CO ₂ /year = 926.43 = 495.58 (264) = 1422.01 = 38.93 = 247.22 (271) = 1708.16 = ÷ (4) = 13.20 86.88 87 B Primary Energy kWh/year	(261) (264) (265) (267) (268) (272) (273)
SAP band 12a. CO ₂ emissions - individual heating systems included and system 1 Water heating 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 13a. Primary energy - individual heating systems included.	Energy kWh/year 4289.02 2294.37 75.00 476.33 luding micro-CHP Energy kWh/year	x	kg CO ₂ /kWh 0.216 = 0.216 = (261) + (262) + (263) + 0.519 = (265) (272) Primary factor	Emissions kg CO ₂ /year = 926.43 = 495.58 (264) = 1422.01 = 38.93 = 247.22 (271) = 1708.16 ÷ (4) = 13.20 86.88 87 B Primary Energy kWh/year = 5232.61	(261) (264) (265) (267) (268) (272) (273) (274)
SAP band 12a. CO ₂ emissions - individual heating systems included and system 1 Water heating 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 13a. Primary energy - individual heating systems included and systems in	Energy kWh/year 4289.02 2294.37 75.00 476.33 luding micro-CHP Energy kWh/year 4289.02	x [x	kg CO ₂ /kWh 0.216 = 0.216 = (261) + (262) + (263) + 0.519 = (265) (272) Primary factor = =	Emissions kg CO ₂ /year = 926.43 = 495.58 (264) = 1422.01 = 38.93 = 247.22 (271) = 1708.16 = ÷ (4) = 13.20 86.88 87 B Primary Energy kWh/year = 5232.61 = 2799.13	(261) (264) (265) (267) (268) (272) (273) (274)
SAP band 12a. CO ₂ emissions - individual heating systems included and	Energy kWh/year 4289.02 2294.37 75.00 476.33 luding micro-CHP Energy kWh/year 4289.02	x [x	kg CO ₂ /kWh 0.216 = 0.216 = (261) + (262) + (263) + 0.519 = (265) (272) Primary factor 1.22 = 1.22 =	Emissions kg CO ₂ /year = 926.43 = 495.58 (264) = 1422.01 = 38.93 = 247.22 (271) = 1708.16 ÷ (4) = 13.20 86.88 87 B Primary Energy kWh/year = 5232.61 = 2799.13 (264) = 8031.74	(261) (264) (265) (267) (268) (272) (273) (274)
SAP band 12a. CO ₂ emissions - individual heating systems included and system 1 Water heating 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 13a. Primary energy - individual heating systems included and systems in	Energy kWh/year 4289.02 2294.37 75.00 476.33 luding micro-CHP Energy kWh/year 4289.02 2294.37	x	kg CO ₂ /kWh 0.216 = 0.216 = 0.216 = (261) + (262) + (263) + 0.519 = (265) (272) Primary factor 1.22 = 1.22 = (261) + (262) + (263) +	Emissions kg CO ₂ /year = 926.43 = 495.58 (264) = 1422.01 = 38.93 = 247.22 (271) = 1708.16 ÷ (4) = 13.20 86.88 87 B Primary Energy kWh/year = 5232.61 = 2799.13 (264) = 8031.74	(261) (264) (265) (267) (268) (272) (273) (274) (261) (264) (265)

Page 5

Electricity for lighting

Primary energy kWh/year

Dwelling primary energy rate kWh/m2/year

476.33

7

3 07

1462.34

9724.33 (272

(268)

75.13 (273)

SAP version 9.92

Appendix C DER Worksheets – Be Lean



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

Client						Last modified	d	30/09	30/09/2020			
Address	1B2P, Kin	gston upor	n Thames, I	KT1								
1. Overall dwelling dime	nsions											
				А	rea (m²)		Α	verage storey height (m)	•	Vo	olume (m³)	
Lowest occupied					51.12	(1a) x		2.50	(2a) =		127.80	(3a)
Total floor area	(1a) ·	+ (1b) + (1d	c) + (1d)(2	1n) =	51.12	(4)						
Dwelling volume							((3a) + (3b) + (3	c) + (3d)(3	(n) =	127.80	(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 fa	ins							0	x 10 =		0	(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, fans	, PSVs		(6a)	+ (6b) + (7a	a) + (7b) + ((7c) =	0	÷ (5) =	:	0.00	(8)
If a pressurisation test has	s been carried	out or is in	ntended, pr	roceed to (17), otherw	ise continu	e from (9) to (16)				
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 $(18) = (16)$										0.15	(18)	
Number of sides on which the dwelling is sheltered										1	(19)	
Shelter factor						1	- [0.075 x (19	9)] =	0.93	(20)		
Infiltration rate incorporating shelter factor							(18) x (2	20) =	0.14	(21)		
Infiltration rate modified	or monthly w	ind speed										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spe	eed from Tabl	e 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 s	helter and	wind facto	or) (21) x (2	22a)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 air cha	_											_
If mechanical ventilation: air change rate through system 0.50 (23a							(23a)					



0.30

0.30

0.30

0.30

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

75.65

0.28

0.28

(24a)

(25)

0.28

0.28

0.25

0.25

0.25

0.25

0.25

0.25

0.26

0.26

0.27

0.27

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

0.29

0.29

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

0.27

0.27

0.27

0.27

3. Heat losses and h	eat loss parameter										
Element			Gross ea, m²	Openings m ²		t area , m²	U-value W/m²K	A x U W/	K κ-value kJ/m².	, ,	
Window					8	3.18 x	1.24	= 10.11			(27)
Door					1	.80 x	0.60	= 1.08			(26)
Ground floor					51	1.12 x	0.10	= 5.11			(28a)
External wall					18	8.25 x	0.17	= 3.10			(29a)
Party wall					17	7.80 x	0.00	= 0.00			(32)
External wall					25	5.45 x	0.15	= 3.82			(29a)
External wall					2	.70 x	0.20	= 0.54			(29a)
Total area of external	elements ∑A, m²				10	7.50					(31)
Fabric heat loss, W/K	= ∑(A × U)							(26)	(30) + (32) =	23.76	(33)
Heat capacity Cm = ∑(Ахк)						(28)	.(30) + (32) +	(32a)(32e) =	N/A	(34)
Thermal mass parame	eter (TMP) in kJ/m²	K								250.00	(35)
Thermal bridges: ∑(L	«Ψ) calculated usin	ig Append	ix K							8.51	(36)
Total fabric heat loss									(33) + (36) =	32.27	(37)
J.	an Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct I	Nov Dec	
Ventilation heat loss	calculated monthly	0.33 x (2	5)m x (5)								
12	.60 12.45	12.30	11.57	11.43	10.69	10.69	10.55	10.99	11.43 1	1.72 12.01	(38)
Heat transfer coefficie	ent, W/K (37)m + (3	38)m									
44	.86 44.72	44.57	43.84	43.69	42.96	42.96	42.82	43.26	43.69 43	3.99 44.28	
								Average = ∑(39)112/12 =	43.80	(39)
Heat loss parameter (HLP), W/m²K (39)r	n ÷ (4)									
0.	88 0.87	0.87	0.86	0.85	0.84	0.84	0.84	0.85		0.86 0.87	
								Average = ∑(40)112/12 =	0.86	(40)
Number of days in mo								1			
31	.00 28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00 3	0.00 31.00	(40)
4. Water heating en	ergy requirement										
Assumed occupancy,	N						,			1.72	(42)
Annual average hot w	ater usage in litres	per day V	d,average	= (25 x N) +	36					75.12	(43)
J	an Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct N	Nov Dec	
Hot water usage in lit	res per day for each	n month V	d,m = fact	tor from Tab	le 1c x (43	3)					
82	.64 79.63	76.63	73.62	70.62	67.61	67.61	70.62	73.62	76.63 7	9.63 82.64	
									∑(44)112 =	901.49	(44)
Energy content of hot	water used = 4.18	x Vd,m x	nm x Tm/3	3600 kWh/m	onth (see	e Tables 1	b, 1c 1d)				
12	2.55 107.18	110.60	96.42	92.52	79.84	73.98	84.90	85.91	100.12 10	9.29 118.68	
									∑(45)112 =	1181.99	(45)
Distribution loss 0.15	x (45)m										
18	16.08	16.59	14.46	13.88	11.98	11.10	12.73	12.89	15.02 1	6.39 17.80	(46)
Storage volume (litres	s) including any sola	ar or WWI	HRS storag	ge within san	ne vessel					3.00	(47)
Water storage loss:											
b) Manufacturer's dec	clared loss factor is	not know	n								
Hot water storage	loss factor from Ta	ble 2 (kW	h/litre/day	y)						0.02	(51)
Volume factor from	n Table 2a									3.42	(52)
Temperature facto	or from Table 2b									0.60	(53)
Energy lost from w	ater storage (kWh,	/day) (47)	x (51) x (5	52) x (53)						0.13	(54)
Enter (50) or (54) in (5	55)									0.13	(55)

Water storage l	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 con	ntains dedic	ated solar st	torage or d	ledicated 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	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 e	each month	from Table	3a, 3b or 3	Sc .	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	alculated f	or 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	ıt calculated												_ ` '
·	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			!								
	149.85	131.84	137.90	122.85	119.83	106.26	101.29	112.20	112.33	127.42	135.71	145.98	7
	2.5.65	102.01	207.50	1 111.00	1 110.00	200.20	101.15	1 111.110	111.00	Σ(64)1		1503.47	」 (64)
Heat gains from	n water heat	ting (kWh/m	nonth) 0.2	5 × [0.85 ×	(45)m + (61)ml + 0.8 ×	((46)m + (57)m + (59)ml	2(01)1		1303.17	(0.)
a. gama mam	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	10.44	30.07	43.70	33.13	37.40	01.30	_ (03)
5. Internal gair	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 (c	calculated in	n Appendix l	_, equation	L9 or L9a)	, also see Ta	ıble 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	l in Appendi	x L, equation	on L13 or L	13a) also se	o Tabla F							
					13aj, aiso si	e rabie 5							
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 (c		151.70	147.77	139.42	128.87	118.95	112.32	110.77	114.69	123.05	133.60	143.52	(68)
		151.70	147.77	139.42	128.87	118.95	31.62	31.62	31.62	123.05 31.62	133.60 31.62	31.62	(68)
	31.62	151.70 n Appendix I 31.62	147.77 L, equation	139.42 L15 or L15	128.87 5a), also see	118.95 Table 5					ı		J
Cooking gains (c	31.62	151.70 n Appendix I 31.62	147.77 L, equation	139.42 L15 or L15	128.87 5a), also see	118.95 Table 5					ı		J
Cooking gains (c	31.62 sains (Table 0.00	151.70 n Appendix I 31.62 5a)	147.77 L, equation 31.62	139.42 L15 or L15 31.62	128.87 5a), also see 31.62	118.95 Table 5 31.62	31.62	31.62	31.62	31.62	31.62	31.62] (69)
Cooking gains (o	31.62 sains (Table 0.00 coration (Ta	151.70 n Appendix I 31.62 5a) 0.00 able 5)	147.77 L, equation 31.62	139.42 L15 or L15 31.62	128.87 5a), also see 31.62 0.00	118.95 Table 5 31.62	31.62	31.62	31.62	31.62	31.62	31.62	(69)
Cooking gains (or Pump and fan g	31.62 sains (Table 0.00 poration (Ta	151.70 n Appendix I 31.62 5a) 0.00 able 5) -68.92	147.77 L, equation 31.62	139.42 L15 or L15 31.62	128.87 5a), also see 31.62	118.95 Table 5 31.62	31.62	31.62	31.62	31.62	31.62	31.62] (69)
Cooking gains (o	31.62 sains (Table 0.00 poration (Ta -68.92 gains (Table	151.70 n Appendix I 31.62 5a) 0.00 able 5) -68.92	147.77 L, equation 31.62 0.00	139.42 L15 or L15 31.62 0.00	128.87 5a), also see 31.62 0.00 -68.92	118.95 Table 5 31.62 0.00 -68.92	0.00	0.00	0.00	31.62 0.00 -68.92	31.62 0.00 -68.92	0.00	(69) (70) (71)
Cooking gains (or Pump and fan go Losses e.g. evap	31.62 sains (Table 0.00 poration (Ta -68.92 gains (Table	151.70 n Appendix I 31.62 5a) 0.00 able 5) -68.92	147.77 L, equation 31.62 0.00 -68.92	139.42 L15 or L15 31.62 0.00 -68.92	128.87 5a), also see 31.62 0.00 -68.92	118.95 Table 5 31.62 0.00 -68.92	31.62	31.62	31.62	31.62	31.62	31.62	(69)
Cooking gains (or Pump and fan g	alculated in 31.62 sains (Table 0.00 coration (Ta -68.92 gains (Table 84.13 ains (66)m	151.70 n Appendix I 31.62 5a) 0.00 able 5) -68.92 55) 82.39 + (67)m + (6	147.77 L, equation 31.62 0.00 -68.92 78.79 8)m + (69)	139.42 L15 or L15 31.62 0.00 -68.92 73.89 m + (70)m	128.87 5a), also see 31.62 0.00 -68.92 70.71 + (71)m + (72)	118.95 Table 5 31.62 0.00 -68.92 66.23 72)m	31.62 0.00 -68.92	31.62 0.00 -68.92	31.62 0.00 -68.92 69.03	31.62 0.00 -68.92 74.10	31.62 0.00 -68.92 79.83	31.62 0.00 -68.92	(69) (70) (71) (72)
Cooking gains (or Pump and fan go Losses e.g. evap	31.62 sains (Table 0.00 poration (Ta -68.92 gains (Table	151.70 n Appendix I 31.62 5a) 0.00 able 5) -68.92	147.77 L, equation 31.62 0.00 -68.92	139.42 L15 or L15 31.62 0.00 -68.92	128.87 5a), also see 31.62 0.00 -68.92	118.95 Table 5 31.62 0.00 -68.92	0.00	0.00	0.00	31.62 0.00 -68.92	31.62 0.00 -68.92	0.00	(69) (70) (71)
Cooking gains (or Pump and fan go Losses e.g. evap	alculated in 31.62 sains (Table 0.00 coration (Ta -68.92 gains (Table 84.13 ains (66)m	151.70 n Appendix I 31.62 5a) 0.00 able 5) -68.92 55) 82.39 + (67)m + (6	147.77 L, equation 31.62 0.00 -68.92 78.79 8)m + (69)	139.42 L15 or L15 31.62 0.00 -68.92 73.89 m + (70)m	128.87 5a), also see 31.62 0.00 -68.92 70.71 + (71)m + (72)	118.95 Table 5 31.62 0.00 -68.92 66.23 72)m	31.62 0.00 -68.92	31.62 0.00 -68.92	31.62 0.00 -68.92 69.03	31.62 0.00 -68.92 74.10	31.62 0.00 -68.92 79.83	31.62 0.00 -68.92	(69) (70) (71) (72)
Cooking gains (of Pump and fan good Losses e.g. evap Water heating good Total internal ga	alculated in 31.62 sains (Table 0.00 coration (Ta -68.92 gains (Table 84.13 ains (66)m	151.70 n Appendix I 31.62 5a) 0.00 able 5) -68.92 55) 82.39 + (67)m + (6	147.77 L, equation 31.62 0.00 -68.92 78.79 8)m + (69)	139.42 115 or L15 31.62 0.00 -68.92 73.89 m + (70)m 269.79	128.87 5a), also see 31.62 0.00 -68.92 70.71 + (71)m + (72)	118.95 Table 5 31.62 0.00 -68.92 66.23 72)m 238.84	31.62 0.00 -68.92	31.62 0.00 -68.92 67.30	31.62 0.00 -68.92 69.03 241.66	31.62 0.00 -68.92 74.10 257.54	31.62 0.00 -68.92 79.83 275.74	31.62 0.00 -68.92	(69) (70) (71) (72)
Cooking gains (of Pump and fan good Losses e.g. evap Water heating good Total internal ga	alculated in 31.62 sains (Table 0.00 coration (Ta -68.92 gains (Table 84.13 ains (66)m	151.70 n Appendix I 31.62 5a) 0.00 able 5) -68.92 55) 82.39 + (67)m + (6	147.77 L, equation 31.62 0.00 -68.92 78.79 8)m + (69) 285.49	139.42 115 or L15 31.62 0.00 -68.92 73.89 m + (70)m 269.79	128.87 5a), also see 31.62 0.00 -68.92 70.71 + (71)m + (72)m + (73)m + (74)m + (74)	118.95 Table 5 31.62 0.00 -68.92 66.23 72)m 238.84	31.62 0.00 -68.92 62.42 228.80	31.62 0.00 -68.92 67.30	31.62 0.00 -68.92 69.03	31.62 0.00 -68.92 74.10	31.62 0.00 -68.92 79.83 275.74	31.62 0.00 -68.92 82.40 289.11	(69) (70) (71) (72)
Cooking gains (of Pump and fan good Losses e.g. evap Water heating good Total internal ga	alculated in 31.62 sains (Table 0.00 coration (Ta -68.92 gains (Table 84.13 ains (66)m	151.70 n Appendix I 31.62 5a) 0.00 able 5) -68.92 55) 82.39 + (67)m + (6	147.77 L, equation 31.62 0.00 -68.92 78.79 8)m + (69) 285.49	139.42 1.15 or l.15 31.62 0.00 -68.92 73.89 m + (70)m 269.79	128.87 5a), also see 31.62 0.00 -68.92 70.71 + (71)m + (72)m + (73)m + (74)m + (74)	118.95 Table 5 31.62 0.00 -68.92 66.23 72)m 238.84 Sol	31.62 0.00 -68.92 62.42 228.80	31.62 0.00 -68.92 67.30 233.68	31.62 0.00 -68.92 69.03 241.66	31.62 0.00 -68.92 74.10 257.54 FF specific c or Table	31.62 0.00 -68.92 79.83 275.74	31.62 0.00 -68.92 82.40 289.11	(69) (70) (71) (72)
Cooking gains (of Pump and fan geleger) Losses e.g. evap Water heating geleger Total internal ga	calculated in 31.62 sains (Table 0.00 coration (Ta -68.92 gains (Table 84.13 ains (66)m 297.08	151.70 n Appendix I 31.62 5a) 0.00 able 5) -68.92 55) 82.39 + (67)m + (6	147.77 L, equation 31.62 0.00 -68.92 78.79 -8)m + (69) 285.49 Access 1 Table	139.42 115 or L15 31.62 0.00 -68.92 73.89 m + (70)m 269.79	128.87 5a), also see 31.62 0.00 -68.92 70.71 + (71)m + (71)	118.95 Table 5 31.62 0.00 -68.92 66.23 72)m 238.84 Sol	31.62 0.00 -68.92 62.42 228.80	31.62 0.00 -68.92 67.30 233.68	31.62 0.00 -68.92 69.03 241.66 g cific data Table 6b	31.62 0.00 -68.92 74.10 257.54 FF specific c or Table	31.62 0.00 -68.92 79.83 275.74	31.62 0.00 -68.92 82.40 289.11 Gains W	(69) (70) (71) (72) (73)
Cooking gains (cooking gains) Pump and fan g Losses e.g. evap Water heating g Total internal ga 6. Solar gains	calculated in 31.62 sains (Table 0.00 coration (Ta -68.92 gains (Table 84.13 ains (66)m 297.08	151.70 n Appendix I 31.62 5a) 0.00 able 5) -68.92 55) 82.39 + (67)m + (6	147.77 L, equation 31.62 0.00 -68.92 78.79 -8)m + (69) 285.49 Access 1 Table	139.42 115 or L15 31.62 0.00 -68.92 73.89 m + (70)m 269.79	128.87 5a), also see 31.62 0.00 -68.92 70.71 + (71)m + (71)	118.95 Table 5 31.62 0.00 -68.92 66.23 72)m 238.84 Sol	31.62 0.00 -68.92 62.42 228.80	31.62 0.00 -68.92 67.30 233.68	31.62 0.00 -68.92 69.03 241.66 g cific data Table 6b	31.62 0.00 -68.92 74.10 257.54 FF specific c or Table	31.62 0.00 -68.92 79.83 275.74	31.62 0.00 -68.92 82.40 289.11 Gains W	(69) (70) (71) (72) (73)
Cooking gains (cooking gains) Pump and fan g Losses e.g. evap Water heating g Total internal ga 6. Solar gains	alculated in 31.62 ains (Table 0.00 coration (Ta -68.92 gains (Table 84.13 ains (66)m 297.08 atts Σ(74)n 35.07	151.70 n Appendix I 31.62 5a) 0.00 nble 5) -68.92 55) 82.39 + (67)m + (6 295.34	147.77 L, equation 31.62 0.00 -68.92 78.79 88)m + (69) 285.49 Access 1 Table 0.7	139.42 115 or L15 31.62 0.00 -68.92 73.89 m + (70)m 269.79 factor 6d	128.87 5a), also see 31.62 0.00 -68.92 70.71 + (71)m + (71)	118.95 Table 5 31.62 0.00 -68.92 66.23 72)m 238.84 Sol	31.62 0.00 -68.92 62.42 228.80 ar flux V/m² 9.64 x	31.62 0.00 -68.92 67.30 233.68 spec or 1	31.62 0.00 -68.92 69.03 241.66 g cific data Table 6b 0.45 x	31.62 0.00 -68.92 74.10 257.54 FF specific c or Table 0.70	31.62 0.00 -68.92 79.83 275.74	31.62 0.00 -68.92 82.40 289.11 Gains W 35.07	(69) (70) (71) (72) (73)
Cooking gains (cooking gains) Pump and fan g Losses e.g. evap Water heating g Total internal ga 6. Solar gains West Solar gains in wa	alculated in 31.62 ains (Table 0.00 coration (Ta -68.92 gains (Table 84.13 ains (66)m 297.08 atts Σ(74)n 35.07	151.70 n Appendix I 31.62 5a) 0.00 nble 5) -68.92 55) 82.39 + (67)m + (6 295.34	147.77 L, equation 31.62 0.00 -68.92 78.79 88)m + (69) 285.49 Access 1 Table 0.7	139.42 115 or L15 31.62 0.00 -68.92 73.89 m + (70)m 269.79 factor 6d	128.87 5a), also see 31.62 0.00 -68.92 70.71 + (71)m + (71)	118.95 Table 5 31.62 0.00 -68.92 66.23 72)m 238.84 Sol	31.62 0.00 -68.92 62.42 228.80 ar flux V/m² 9.64 x	31.62 0.00 -68.92 67.30 233.68 spec or 1	31.62 0.00 -68.92 69.03 241.66 g cific data Table 6b 0.45 x	31.62 0.00 -68.92 74.10 257.54 FF specific c or Table 0.70	31.62 0.00 -68.92 79.83 275.74	31.62 0.00 -68.92 82.40 289.11 Gains W 35.07	(69) (70) (71) (72) (73)
Cooking gains (cooking gains) Pump and fan g Losses e.g. evap Water heating g Total internal ga 6. Solar gains West Solar gains in wa Total gains - internal gains	atts Σ(74)m 35.07 at S 2 (74)m 35.07	151.70 n Appendix I 31.62 5a) 0.00 nble 5) -68.92 55) 82.39 + (67)m + (6 295.34 n(82)m 68.61 plar (73)m + 363.95	147.77 L, equation 31.62 0.00 -68.92 78.79 8)m + (69) 285.49 Access 1 Table 0.7 112.98 (83)m 398.48	139.42 115 or L15 31.62 0.00 -68.92 73.89 m + (70)m 269.79 factor 6d x [164.78	128.87 5a), also see 31.62 0.00 -68.92 70.71 + (71)m + (72)m + (73)m + (73)	118.95 Table 5 31.62 0.00 -68.92 66.23 72)m 238.84 Sol W 206.73	31.62 0.00 -68.92 62.42 228.80 ar flux V/m² 9.64 x 196.81	31.62 0.00 -68.92 67.30 233.68 spec or 7 0.9 x 169.06	31.62 0.00 -68.92 69.03 241.66 g cific data Table 6b 0.45 x	31.62 0.00 -68.92 74.10 257.54 FF specific c or Table 0.70 81.41	31.62 0.00 -68.92 79.83 275.74 data 6c = [43.73	31.62 0.00 -68.92 82.40 289.11 Gains W 35.07	(69) (70) (71) (72) (73) (80) (83)
Cooking gains (cooking gains) Pump and fan g Losses e.g. evap Water heating g Total internal ga 6. Solar gains West Solar gains in wa Total gains - internal gains - internal gains - internal gains	atts Σ(74)n 35.07 and tempera	151.70 n Appendix I 31.62 5a) 0.00 able 5) -68.92 55) 82.39 + (67)m + (6 295.34 n(82)m 68.61 blar (73)m + 363.95 ature (heating)	147.77 L, equation 31.62 0.00 -68.92 78.79 8)m + (69) 285.49 Access (Table 0.7 112.98 (83)m 398.48	139.42 115 or L15 31.62 0.00 -68.92 73.89 m + (70)m 269.79 factor 6d x [164.78]	128.87 5a), also see 31.62 0.00 -68.92 70.71 + (71)m + (71)	118.95 Table 5 31.62 0.00 -68.92 66.23 72)m 238.84 Sol W 206.73	31.62 0.00 -68.92 62.42 228.80 ar flux V/m² 9.64 x 196.81	31.62 0.00 -68.92 67.30 233.68 spec or 7 0.9 x 169.06	31.62 0.00 -68.92 69.03 241.66 g cific data Table 6b 0.45 x	31.62 0.00 -68.92 74.10 257.54 FF specific c or Table 0.70 81.41	31.62 0.00 -68.92 79.83 275.74 data 6c = [43.73	31.62 0.00 -68.92 82.40 289.11 Gains W 35.07	(69) (70) (71) (72) (73) (80) (83) (84)
Cooking gains (cooking gains) Pump and fan g Losses e.g. evap Water heating g Total internal ga 6. Solar gains West Solar gains in wa Total gains - internal gains	atts Σ(74)n 35.07 and tempera	151.70 n Appendix I 31.62 5a) 0.00 able 5) -68.92 55) 82.39 + (67)m + (6 295.34 n(82)m 68.61 blar (73)m + 363.95 ature (heating)	147.77 L, equation 31.62 0.00 -68.92 78.79 8)m + (69) 285.49 Access (Table 0.7 112.98 (83)m 398.48	139.42 115 or L15 31.62 0.00 -68.92 73.89 m + (70)m 269.79 factor 6d x [164.78]	128.87 5a), also see 31.62 0.00 -68.92 70.71 + (71)m + (71)	118.95 Table 5 31.62 0.00 -68.92 66.23 72)m 238.84 Sol W 206.73	31.62 0.00 -68.92 62.42 228.80 ar flux V/m² 9.64 x 196.81	31.62 0.00 -68.92 67.30 233.68 spec or 7 0.9 x 169.06	31.62 0.00 -68.92 69.03 241.66 g cific data Table 6b 0.45 x	31.62 0.00 -68.92 74.10 257.54 FF specific c or Table 0.70 81.41	31.62 0.00 -68.92 79.83 275.74 data 6c = [43.73	31.62 0.00 -68.92 82.40 289.11 Gains W 35.07	(69) (70) (71) (72) (73) (80) (83)

Annual space heating requirement 1251.99 (98) Space heat from boilers (98) x (304a) x (305) x (306) = 1314.59 (307a)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temper at 12 (steps 3 to 7 in Table 9c) 20.19 20.31 20.51 20.56 20.93 20.99 21.00 21.00 20.07 20.75 20.43 20.17 [87] Temperature during heating periods: the rest of dwelling from Table 9c) 20.19 20.19 20.19 20.19 20.10 20.10 20.21 20.22 20.22 20.22 20.21 20.21 20.20 20.20 [88] Utilisation factor for gains for rest of dwelling sprom Table 9c) 20.10 0.09 0.99 0.99 0.91 0.01 0.76 0.54 0.35 0.41 0.68 0.94 0.99 1.00 [89] Mean internal temperature in the rest of dwelling r12 (follow steps 3 to 7 in Table 9c) 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] We internal temperature for the whole dwelling ft As T1 + (1 - ft.A) x T2 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 mean internal temperature from Table 4e where appropriate 19.62 19.76 20.01 20.32 20.51 20.58 20.39 20.99 20.55 20.31 19.92 19.60 [93] 8. Space heating requirement 19.62 19.76 20.01 20.32 20.51 20.58 20.39 20.99 20.55 20.31 19.92 19.60 [93] 8. Space heating requirement 19.62 19.76 80.01 30.80 388.81 356.69 253.79 170.95 178.73 267.01 319.02 315.72 316.61 [95] When the mean internal temperature, from Table 4e where appropriate 20.99	Utilisation factor	r for gains fo	or living are	ea n1,m (se	e Table 9a)									
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]		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)
Temperature during heating periods in the rest of dwelling from Table 9, Th2/CV 20.19 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 for rest of dwelling n2 / (follow steps 3 to 7 in Table 9c) 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 temperature in the rest of dwelling n2 / (follow steps 3 to 7 in Table 9c) 1.00 19.27 19.56 19.92 20.14 20.21 20.22 20.22 20.19 19.92 19.46 19.09 (90) Itiving area fraction	Mean internal te	emp of living	g area T1 (s	teps 3 to 7	in Table 9c)							_	_
20.19 20.19 20.19 20.20 20.21 20.22 20.22 20.22 20.21 20.21 20.20 20.20 28.8								21.00	21.00	20.97	20.75	20.43	20.17	(87)
Utilisation factor for gains for rest of dwelling n2, m 1.00	Temperature du									T			1	1
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9). 19.10 19.27 19.56 19.92 20.14 20.21 20.22 20.12 20.19 19.92 19.46 19.09 30)	Utilisation factor			l .	l I	20.21	20.22	20.22	20.22	20.21	20.21	20.20	20.20] (88)
Mean intermal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) 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 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. Mean intermal temperature for the whole dwelling fLAx T1 +(1 - fLA) x T2 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 mean internal temperature from Table 4e where appropriate 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 requirement Isan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, nm 4.99 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, nmGm, W (94)m x (84)m 30.35 36.01.7 388.00 398.81 356.69 253.79 170.95 178.73 267.01 319.02 315.72 316.61 95. Monthly average external temperature 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, ln, W (139)m x (193)m x (193)	Othisation factor	_		_		0.76	0.54	0.26	0.41	0.69	0.04	0.00	1.00	7 (90)
19.10 19.27 19.56 19.92 20.14 20.21 20.22 20.29 19.92 19.46 19.09 19.00 19.0	Mean internal te			<u> </u>				Į	0.41	0.08	0.54	0.55	1.00] (63)
Living area fraction Living area fraction					· ·		1	·	20.22	20.19	19.92	19.46	19.09	(90)
19.62 19.76 20.01 20.32 20.51 20.58 20.59 20.55 20.31 19.92 19.60 92) Apply adjustment to the mean internal temperature from Table 4e where appropriate 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 Sepace heating requirement 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 Sepace heating requirement 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 Sepace heating requirement 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 Sepace heating requirement 19.62 19	Living area fracti	ion			l l						l.	(4) =	1] ' '
Apply adjustment to the mean internal temperature from Table 4e where appropriate 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 requirement Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, m 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, mpGm, W (94)mx (84)m 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 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)mx (193)mx (193)m	Mean internal te	emperature	for the wh	ole dwellin	g fLA x T1 +	(1 - fLA) x	Т2							
8. Space heating requirement Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec		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)
8. Space heating requirement Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Apply adjustmen	nt to the me	an internal	temperati	ure from Ta	ble 4e whe	ere appropr	iate						
Utilisation factor for gains, n/m 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)		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)
Useful gains, nmGm, W (94)m x (84)m 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 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)] 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 requirement, kWh/month 0.024 x ([97]m - (95)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) Space heating requirement kWh/m²/year (98)m (120)m (120)	8. Space heatin	ng requirem	ent											
Useful gains, ηmGm, W (94)m x (84)m 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 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 ([39]m - (96)m)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains, ηmGm, W (94)m x (84)m 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 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 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 requirement, kWh/month 0.024 x [(97)m - (95)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 Space heating requirement kWh/m²/year (98) ÷ (4) 24.49 (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 community heat from boilers (302) x (303a) = 1.00 (303a) Fraction of total space heat from community boilers (302) x (303a) = 1.00 (305) 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 (305) Space heating Annual space heating requirement 1.251.99 (98) Space heating Annual space heating requirement 1.251.99 (98) Water heating	Utilisation factor	r for gains, r	ηm											
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 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] (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 requirement, kWh/month 0.024 x [(97)m - (95)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) ÷ (4) 24.49 (99) Space heating requirement kWh/m²/year (98) ÷ (4) 24.49 (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 community heat from boilers (302) x (303a) = 1.00 (303a) Fraction of total space heat from community boilers (302) x (303a) = 1.00 (305a) Distribution loss factor (Table 4c(3)) for community water heating Annual space heating requirement 1251.99 (98) x (304a) x (305) x (306) = 1314.59 (307a) Water heating		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)
Monthly average external temperature from Table U1 4.30	Useful gains, ηm	nGm, W (94)m x (84)m											
4.30		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)
Heat loss rate for mean internal temperature, 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 requirement, kWh/month 0.024 x [(97)m - (95)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 Space heating requirement kWh/m²/year (98) ÷ (4) 24.49 (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 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 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 1.251.99 (98) Space heating Annual space heating requirement (98) x (304a) x (305) x (306) = 1314.59 (307a) Water heating	Monthly average	e external to	emperature	from Tabl	e U1							_		
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)		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 265.46	Heat loss rate fo	or mean inte	rnal tempe	rature, Lm	, W [(39)m	x [(93)m -	(96)m]			.			.	-
265.46 204.51 159.24 73.24 21.03 0.00 0.00 0.00 78.23 178.60 271.69 \[\frac{1}{2}(98)15, 1012 = 1251.99 \] (98) \[\frac{1}{2}(98) \times \times \frac{1}{2}(151.99) \] (98) \[\frac{1}{2}(98) \times \frac{1}{2}(151.99) \] (98) \[\frac{1}{2}(151.99) \] (98)								171.22	179.23	279.17	424.16	563.78	681.78	(97)
Space heating requirement kWh/m²/year $(98) \pm (4) = 1251.99$ (98) 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 (0.00) (302) Fraction of community heat from boilers (0.00) (303a) Fraction of total space heat from community boilers (0.00) (303a) Fraction of total space heat from community boilers (0.00) (303a) 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 (0.00) (305a) Space heat from boilers (0.00) (305b) (306) Space heat from boilers (0.00) (305a)	Space heating re								Г	1	Г	1		٦
Space heating requirement kWh/m²/year (98) ÷ (4) 24.49 (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 community heat from boilers (302) x (303a) = 1.00 (304a) 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 (98) x (304a) x (305) x (306) = 1314.59 (307a) Water heating		265.46	204.51	159.24	73.24	21.03	0.00	0.00	0.00		l .] (00)
9b. Energy requirements - community heating scheme Fraction of space heat from secondary/supplementary system (table 11) Fraction of space heat from secondary/supplementary system (table 11) Fraction of space heat from community system Fraction of community heat from boilers Fraction of total space heat from community boilers Fractor 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 1251.99 (98) Space heat from boilers (98) x (304a) x (305) x (306) = 1314.59 (307a)	Constitution		LAA/I- /2 /							∑(98				7
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 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 (98) x (304a) x (305) x (306) = 1314.59 (307a) Water heating	Space neating re	equirement	kwn/m²/ye	ear							(98)	÷ (4)	24.49] (99)
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 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 1251.99 (98) Space heat from boilers (98) x (304a) x (305) x (306) = 1314.59 (307a) Water heating	9b. Energy requ	uirements -	communit	y 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 1251.99 (98) Space heat from boilers (98) x (304a) x (305) x (306) = 1314.59 (307a)	Fraction of space	e heat from	secondary,	/suppleme	ntary syster	n (table 11	.)				'0' if	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 Space heat from boilers (302) x (303a) = 1.00 (305a) 1.00 (305a) 1.05 (306) Space heating (98) x (304a) x (305) x (306) = 1314.59 (307a)	Fraction of space	e heat from	community	y system							1 - (3	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) = 1314.59 Water heating	Fraction of comm	munity heat	from boile	rs									1.00	(303a)
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) = 1314.59 Water heating	Fraction of total	space heat	from comn	nunity boil	ers						(302) x (30	3a) =	1.00	(304a)
Distribution loss factor (Table 12c) for community heating system 1.05 (306) Space heating Annual space heating requirement Space heat from boilers (98) x (304a) x (305) x (306) = 1314.59 (307a) Water heating	Factor for contro	ol and charg	ing method	d (Table 4c	(3)) for com	munity spa	ace heating						1.00	(305)
Space heating 1251.99 (98) Annual space heating requirement (98) x (304a) x (305) x (306) = 1314.59 (307a) Water heating (98) x (304a) x (305) x (306) = 1314.59 (307a)	Factor for chargi	_				_							1.00	(305a)
Annual space heating requirement 1251.99 (98) Space heat from boilers (98) x (304a) x (305) x (306) = 1314.59 (307a) Water heating		· /- /-	lo 12c) for			stem							1.05	(306)
Annual space heating requirement	Distribution loss	factor (Tab	12 12 101 (community	neating sys									
Space heat from boilers $(98) \times (304a) \times (305) \times (306) = 1314.59$ (307a) Water heating	Distribution loss Space heating	factor (Tab	ie 120,101 (community	neating sys									
	Space heating			community	neating sys				1	251.99				(98)
	Space heating Annual space he	eating requi		community	neating sy:] < (305) x (3	06) =		7
	Space heating Annual space heat from	eating requi		community	neating sy] (305) x (3	06) =		7
Water heat from boilers $(64) \times (303a) \times (305a) \times (306) = \boxed{1578.64}$ (310a)	Space heating Annual space he Space heat from Water heating	eating requin	rement	community	neating sys				(98	3) x (304a) >] ((305) x (3)	06) =		(307a)

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

103.29 (330a)

Total electricity for the above, kWh/year

103.29 (331)

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 - commur	ity heatin	ng 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]

12	b. (CO	2 emiss	ions -	communi	ity	heati	ng sc	heme

12b. CO₂ emissions - community heating scheme											
		Energy kWh/year	Emissions (kg/year)								
Emissions from other sources (space heating)										
Efficiency of boilers		89.50					(367a)				
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) = [3232.66	x	0.216	= [698.25	(367)				
Electrical energy for community	y heat distribution	28.93	x	0.519	= [15.02	(372)				
Total CO2 associated with com	munity systems					713.27	(373)				
Total CO2 associated with space	e 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 CO ₂ , 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)				
EI 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	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

4032.67 (376)

317.11 (378)

(379)

757.11 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



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

Client							L	ast modified		30/09	/2020	
Address	1B2P, Kir	ngston upoi	n Thames, I	KT1								
1. Overall dwelling dimen	sions											
				Aı	rea (m²)			rage storey eight (m)		Vo	olume (m³)	
Lowest occupied					50.88] (1a) x		2.50] (2a) =		127.20	(3a)
Total floor area	(1a)	+ (1b) + (1	c) + (1d)(1	1n) =	50.88	(4)						
Dwelling volume							(3a) + (3b) + (3	c) + (3d)(3n)	=	127.20	(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 fan	ıs							0	x 10 =		0	(7a)
Number of passive vents								0	x 10 =		0	(7b)
Number of flueless gas fires	5							0	x 40 =		0	(7c)
										Air	changes pe hour	er
Infiltration due to chimneys	s, flues, fan	s, PSVs		(6a)	+ (6b) + (7a	a) + (7b) + (7	/c) =	0	÷ (5) =		0.00	(8)
If a pressurisation test has	been carrie	d out or is i	ntended, pr	roceed to (1	17), otherw	ise continue	from (9)	to (16)				
Air permeability value, q50	, expressed	in cubic m	etres per h	our per squ	are metre	of envelope	area				3.00	(17)
If based on air permeability	value, the	n (18) = [(17	7) ÷ 20] + (8	3), otherwis	se (18) = (16	5)					0.15	(18)
Number of sides on which t	the dwelling	g is sheltere	ed								3	(19)
Shelter factor								1 -	[0.075 x (19)]	=	0.78	(20)
Infiltration rate incorporati	ng shelter f	actor							(18) x (20)	=	0.12	(21)
Infiltration rate modified fo	r 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							
0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14	(22b
Calculate effective air chan	ge rate for	the applica	ble case:									
If mechanical ventilation	n: air chang	e rate thro	ugh system								0.50	(23a
If balanced with heat re	covery: effi	ciency in %	allowing fo	or in-use fac	ctor from T	able 4h					75.65	(23c

Calculate effective	ve air chang	ge rate for t	the applical	ole case:									
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	a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)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	ffective air change rate - enter (24a) or (24b) or (24c) or (24d) 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)



	nd heat lo	ss parameto	51									
Element			;	Gross area, m²	Openings m ²		area m²	U-value W/m²K	AxUW	//K κ-valu kJ/m²		
Window						7.	76 x	1.24	= 9.59			(27)
Door						1.3	80 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 exte	ernal eleme	ents ∑A, m²				61	.01					(31)
Fabric heat loss, \	W/K = ∑(A	× U)							(26	5)(30) + (32)	= 20.28	(33)
Heat capacity Cm	n = ∑(A x κ)							(28)	(30) + (32) -	+ (32a)(32e) :	= N/A	(34)
Thermal mass par	rameter (T	MP) in kJ/m	1 ² K								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		Nov Dec	
Ventilation heat I	loss calcula	ited monthl	v 0.33 x (25)m x (5)	•			J	·			
Γ	11.33	11.21	11.09	10.48	10.36	9.75	9.75	9.62	9.99	10.36	10.60 10.84	(38)
Heat transfer coe												
Γ	38.81	38.69	38.57	37.96	37.84	37.23	37.23	37.11	37.47	37.84	38.08 38.33	
L		00.00		7.50	07.0.	07.20	07.120			(39)112/12		(39)
Heat loss parame	oter (HIP)	W/m²K (39)m ÷ (4)						Average - Z	<u>(</u> (33)112/12	37.33	(33)
	0.76	0.76	0.76	0.75	0.74	0.73	0.73	0.73	0.74	0.74	0.75 0.75	7
L	0.76	0.76	0.76	0.75	0.74	0.73	0.73			(40)112/12		 (40)
Number of days i	in month /	Fable 1a)							Average – 2	(40)112/12	- 0.75	(40)
Number of days f	•	,	24.00	30.00	21.00	20.00	21.00	21.00	20.00	21.00	21.00	7 (40)
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										1.72	(42)
Annual average h	not water u	sage in litre	es per day	Vd,average	= (25 x N) +	36					74.96	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov Dec	
Hot water usage i	in litres pe	r day for ea	ch month	Vd,m = fact	or from Tab	le 1c x (43)					
	82.45	79.45	76.45	73.46	70.46	67.46	67.46	70.46	73.46	76.45	79.45 82.45	
L								•	•	Σ(44)112	<u> </u>	(44)
Energy content o	f hot wate	r used = 4.1	8 x Vd.m	x nm x Tm/3	8600 kWh/m	onth (see	Tables 1b.	1c 1d)		2()		` '
[122.27	106.94	110.35	96.21	92.31	79.66	73.82	84.71	85.72	99.90 1	09.04 118.41	
L		100.01	110.00	30.22	32.02	75.00	70.02	1 0 2	1 00.72	Σ(45)112		(45)
										2(13)112	1175.55	(.5)
Distribution loss	0.15 x (45)	lm										
Distribution loss			16 55	1/1/13	12 95	11 05	11 07	12 71	12.86	1/1 08 1	16.36 17.76	7 (46)
[18.34	16.04	16.55	14.43	13.85	11.95	11.07	12.71	12.86	14.98 1	16.36 17.76	(46)
[Storage volume (18.34 litres) inclu	16.04			-		11.07	12.71	12.86	14.98 1	3.00	(46) (47)
Storage volume (I	18.34 litres) inclu	16.04 uding any sc	olar or WV	VHRS storag	-		11.07	12.71	12.86	14.98 1	_	= -
Storage volume (I Water storage los b) Manufacturer's	18.34 litres) incluss: s declared	16.04 uding any so	olar or WV	VHRS storag	e within sam		11.07	12.71	12.86	14.98	3.00	(47)
Storage volume (I Water storage los b) Manufacturer's Hot water stor	18.34 litres) incluss: s declared rage loss fa	16.04 uding any so	olar or WV	VHRS storag	e within sam		11.07	12.71	12.86	14.98 1	0.02	(47)
Storage volume (I Water storage los b) Manufacturer's Hot water stor Volume factor	18.34 litres) incluses: s declared rage loss for from Table	16.04 uding any so loss factor actor from The 2a	olar or WV	VHRS storag	e within sam		11.07	12.71	12.86	14.98 1	0.02 3.42	(47) (51) (52)
Storage volume (I Water storage los b) Manufacturer's Hot water stor Volume factor Temperature	18.34 litres) incluses: s declared rage loss for from Table factor from	16.04 Juding any so loss factor from Table 2b	olar or WV is not kno Fable 2 (k	VHRS storag	e within sam		11.07	12.71	12.86	14.98	0.02 3.42 0.60	(47) (51) (52) (53)
Storage volume (I Water storage los b) Manufacturer's Hot water stor Volume factor Temperature storage	18.34 litres) incluses: s declared rage loss for from Table factor from the point water s	16.04 Juding any so loss factor from Table 2b	olar or WV is not kno Fable 2 (k	VHRS storag	e within sam		11.07	12.71	12.86	14.98	0.02 3.42 0.60 0.13	(47) (51) (52) (53) (54)
Storage volume (I Water storage los b) Manufacturer's Hot water stor Volume factor Temperature store Energy lost from	18.34 litres) incluses: s declared rage loss for from Table factor from water so in (55)	16.04 loss factor actor from Table 2a n Table 2b storage (kW	olar or WV is not kno Fable 2 (k¹ h/day) (4	WHRS storag	e within sam		11.07	12.71	12.86	14.98	0.02 3.42 0.60	(47) (51) (52) (53)
Storage volume (I Water storage los b) Manufacturer's Hot water stor Volume factor Temperature storage	18.34 litres) incluses: s declared rage loss for from Table factor from water so in (55)	16.04 loss factor actor from Table 2a n Table 2b storage (kW	olar or WV is not kno Fable 2 (k¹ h/day) (4	WHRS storag	e within sam		11.07	12.71	12.86	14.98	0.02 3.42 0.60 0.13	(47) (51) (52) (53) (54)

If the vessel con	stains dodis	atad calar c	torago or d	ladicated M	WALLDE (EE)	m v [(47)	Vcl · (47)	olso (E6)				
If the vessel con		1	-			1	1		2.01	4.04	2.01	101
Drimon, aircuit l	4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04 (
Primary circuit l			1	22.54	22.25	22.54	22.26	22.25	22.54	22.26	22.54	22.25
	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26 (
Combi loss for e						T	1		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
Total heat requi		er heating o	calculated f	or each mo	onth 0.85 x	(45)m + (4	6)m + (57)r -	n + (59)m - ·	+ (61)m			
	149.58	131.60	137.66	122.63	119.62	106.08	101.12	112.01	112.14	127.20	135.47	145.72 (
Solar DHW inpu	t calculated	l 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
Output from wa	ater heater	for each mo	onth (kWh/	month) (62	2)m + (63)m	1						
	149.58	131.60	137.66	122.63	119.62	106.08	101.12	112.01	112.14	127.20	135.47	145.72
										∑(64)1	.12 = 🔃	1500.82 (
Heat gains from	water heat	ting (kWh/n	nonth) 0.2	5 × [0.85 ×	(45)m + (61)m] + 0.8 ×	: [(46)m + (5	57)m + (59))m]			
	62.50	55.29	58.54	53.13	52.54	47.63	46.39	50.01	49.64	55.06	57.40	61.22
5. Internal gair	ns											
	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 (
Lighting gains (c	calculated in	n Appendix I	L, equation	L9 or L9a),	also see Ta	ıble 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
Appliance gains	(calculated	in Appendi	x L, equatio	on L13 or L	13a), also se	ee Table 5						
	149.52	151.07	147.16	138.84	128.33	118.46	111.86	110.31	114.22	122.54	133.05	142.92 (
Cooking gains (c	calculated in	n Appendix	L, equation	L15 or L15	ia), also see	Table 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 (
Pump and fan g		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 (
Losses e.g. evap		1								1 2.22		, 5.55
	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64	-68.64 (
Water heating g		!	00.04	00.04	00.04	00.04	00.04	00.04	00.04	00.04	00.04	(00.04
vvater meating g	84.00		70.60	72.70	70.61	66.15	62.25	67.21	68.04	74.00	70.72	02.20 /
Total internal ar		82.27	78.68	73.79	70.61	66.15	62.35	67.21	68.94	74.00	79.72	82.28 (
Total internal ga							222.42	222.07		256.00	275.04	200.27
	296.31	294.56	284.72	269.05	253.43	238.19	228.18	233.07	241.04	256.88	275.04	288.37 (
6. Solar gains												
			Access 1	factor	Area	Sol	ar flux		g	FF		Gains
			Table	6d	m²	V	V/m²	-	ific data	specific o		W
						_		or T	able 6b	or Table	e 6c 	
North			0.7	7 x	4.56	x 1	.0.63 x	0.9 x	0.45 x	0.70	=	10.58 (
East			0.7	7 x	3.20	x1	.9.64 x	0.9 x	0.45 x	0.70	=	13.72
Calam aatma tia	atts ∑(74)m	n(82)m										
Solar gains in w		47.07	78.57	119.67	153.37	160.49	151.33	125.11	92.73	55.92	30.16	20.11
Solar gains in w	24.30	17.07										
			(83)m									
			(83)m 363.29	388.72	406.80	398.68	379.51	358.18	333.77	312.81	305.21	308.48 (
Total gains - into	ernal and so	olar (73)m + 341.62	363.29	388.72	406.80	398.68	379.51	358.18	333.77	312.81	305.21	308.48 (
	ernal and so	olar (73)m + 341.62	363.29	388.72	406.80	398.68	379.51	358.18	333.77	312.81	305.21	308.48 (
Total gains - into	320.61	341.62 sture (heating	363.29 ng season)				379.51	358.18	333.77	312.81	305.21	21.00
Total gains - into	320.61	341.62 sture (heating	363.29 ng season)				379.51 Jul	358.18 Aug	333.77 Sep	312.81 Oct	305.21 Nov	`

	or tor gains t	or living are	ea 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	teps 3 to 7	in Table 9c	:)								
	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	uring heating	g periods in	the rest of	f dwelling fi	rom Table	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	9c)	•		•		•	_
	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	tion					•			Li	ving area ÷	(4) =	0.45	(91)
Mean internal t	temperature	for the wh	ole dwellin	ıg fLA x T1 +	-(1 - fLA) x	T2							_
	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 temperati	ure from Ta	ble 4e wh	ere appropr	riate				•	•	
	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 requirem												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	or for gains,									,			_
	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			1	1	1	_
	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										T	T	1	٦
	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								T		T	1	1	7 ()
	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								1	1		1 400 4=	1 0400=	7
	211.40	163.90	127.72	56.33	13.73	0.00	0.00	0.00	0.00	57.63 8)15, 10	139.17	216.85	
Cara a la cationa										217 5 771	1/=		
Space neating r	requirement	114/1/2/							∑(98	•		986.74	(98)
		kWh/m²/ye	ear						∑(9	•	÷ (4)	19.39	(98) (99)
9b. Energy red				scheme					<u>Σ</u> (9	•			=
•	quirements -	- communit	ty heating s		m (table 1:	1)			Σ(a ₂	(98)			(99)
Fraction of spa	quirements - ce heat from	- communit	ty heating s		m (table 1	1)			∑(∂:	(98)	÷ (4)	19.39	(99)
Fraction of space	quirements - ce heat from ce heat from	community	ty heating s /suppleme y system		m (table 1	1)			∑(∂:	(98)	÷ (4)	19.39	(301)
Fraction of space Fraction of space Fraction of com	quirements - ce heat from ce heat from nmunity hear	community a secondary, a community t from boile	y heating s /suppleme y system ers	ntary systei	m (table 1	1)				(98)	÷ (4)	0.00 1.00	(99) (301 (302 (303
Fraction of space Fraction of space Fraction of com Fraction of tota	quirements - ce heat from ce heat from nmunity heat al space heat	secondary, community t from boile	y heating s /supplement y system ers munity boild	ntary syster						'0' if i	÷ (4)	0.00 1.00 1.00	(99) (301 (302 (303 (304
Fraction of space Fraction of space Fraction of com Fraction of tota Factor for conti	quirements - ce heat from ce heat from nmunity head al space heat rol and charg	community a secondary, a community t from boile from community	y heating s /supplement y system ers munity boild d (Table 4c)	ers (3)) for com	nmunity sp	pace heating				'0' if i	÷ (4)	0.00 1.00 1.00 1.00	(301 (302 (303 (304 (305
Fraction of space Fraction of space Fraction of com Fraction of tota Fractor for conti	quirements - ce heat from ce heat from nmunity head al space heat rol and charg ging method	community a secondary, a community t from boile from comm ging method (Table 4c(3	y heating s /supplement y system ers munity boiled d (Table 4c) 3)) for comm	ers (3)) for com	nmunity sp er heating	pace heating				'0' if i	÷ (4)	0.00 1.00 1.00 1.00 1.00	(301 (302 (303 (304 (305 (305
Fraction of space Fraction of space Fraction of com Fraction of tota Fractor for conti	quirements - ce heat from ce heat from nmunity head al space heat rol and charg ging method	community a secondary, a community t from boile from comm ging method (Table 4c(3	y heating s /supplement y system ers munity boiled d (Table 4c) 3)) for comm	ers (3)) for com	nmunity sp er heating	pace heating				'0' if i	÷ (4)	0.00 1.00 1.00 1.00 1.00 1.00	(301 (302 (303 (304 (305 (305
Fraction of space Fraction of space Fraction of com Fraction of tota Factor for conte Factor for charg Distribution los	quirements - ce heat from ce heat from nmunity head al space heat rol and charg ging method	community a secondary, a community t from boile from comm ging method (Table 4c(3	y heating s /supplement y system ers munity boiled d (Table 4c) 3)) for comm	ers (3)) for com	nmunity sp er heating	pace heating				'0' if i	÷ (4)	0.00 1.00 1.00 1.00 1.00 1.00	(301 (302 (303 (304 (305 (305
Fraction of space Fraction of space Fraction of come Fraction of tota Factor for conte Factor for charge Distribution los Space heating	quirements - ce heat from new new theat al space heat rol and charg ging method as factor (Tab	community a secondary, a community t from boile from comn ging method (Table 4c(3	y heating s /supplement y system ers munity boiled d (Table 4c) 3)) for comm	ers (3)) for com	nmunity sp er heating	pace heating				'0' if i	÷ (4)	0.00 1.00 1.00 1.00 1.00 1.00	(301 (302 (303 (304 (305 (305 (306
Fraction of space Fraction of space Fraction of come Fraction of total Factor for control Factor for charge Distribution los Space heating Annual space h	quirements - ce heat from nee heat from nmunity head al space heat rol and charg ging method as factor (Tab	community a secondary, a community t from boile from comn ging method (Table 4c(3	y heating s /supplement y system ers munity boiled d (Table 4c) 3)) for comm	ers (3)) for com	nmunity sp er heating	pace heating		(5		(98) '0' if 1 - (30) (302) x (30)	÷ (4)	0.00 1.00 1.00 1.00 1.00 1.00	(99) (301 (302 (303 (304 (305 (305 (306
Fraction of space Fraction of space Fraction of come Fraction of total Factor for control Factor for charge Distribution lose Space heating Annual space heat	quirements - ce heat from new name of the second se	community a secondary, a community t from boile from comn ging method (Table 4c(3	y heating s /supplement y system ers munity boiled d (Table 4c) 3)) for comm	ers (3)) for com	nmunity sp er heating	pace heating		(5	986.74	(98) '0' if 1 - (30) (302) x (30)	÷ (4)	0.00 1.00 1.00 1.00 1.00 1.00 1.05	(99) (301 (302 (303 (304 (305 (305 (306
Fraction of space Fraction of space Fraction of total Fraction of total Fractor for charge Distribution loss Space heating Annual space heat from Water heating	quirements - ce heat from ce heat from nmunity head al space heat rol and charg ging method as factor (Tab	communition secondary, a community of from boile of from committed	y heating s /supplement y system ers munity boiled d (Table 4c) 3)) for comm	ers (3)) for com	nmunity sp er heating	pace heating			986.74	(98) '0' if 1 - (30) (302) x (30)	÷ (4)	0.00 1.00 1.00 1.00 1.00 1.00 1.05	(99) (301 (302 (303 (304 (305 (305 (306 (98)
9b. Energy recommendation of space fraction of commendation of total fraction of total fraction for control fractor for charged bistribution loss. Space heating Annual space heat from the space heat from t	quirements - ce heat from the heat th	communition secondary, a community of from boile of from committed	y heating s /supplement y system ers munity boiled d (Table 4c) 3)) for comm	ers (3)) for com	nmunity sp er heating	pace heating			986.74 98) x (304a) :	(98) '0' if if if 1 - (3i) (302) x (30) x (305) x (3i)	÷ (4)	0.00 1.00 1.00 1.00 1.00 1.00 1.05	=

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)

В

(338)

Total delivered energy for all uses

(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =2962.74

10b. Fue	I costs -	communit	y 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

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) = [2918.37	x	0.216	= [630.37	(367)
Electrical energy for communit	y heat distribution	26.12	x	0.519	= [13.56	(372)
Total CO2 associated with com	munity systems					643.92	(373)
Total CO2 associated with space	ee 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)	•
Primary energy from other sou	rces (space heating)						
Efficiency of boilers		89.50					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	2918.37	x	1.22	=	3560.41	(367)
Electrical energy for communit	y heat distribution	26.12	x	3.07	=	80.19	(372)
Total primary energy associate	d with community systems					3640.60	(373)
Total primary energy associate	d with space and water heating					3640.60	(376)

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)

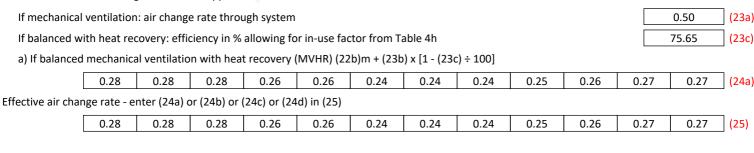
(378)

92.72 (384)



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

Client							La	st modified	d	30/09/2020		
Address	1B2P, Kings	ston upor	Thames, k	KT1								
1. Overall dwelling dime	ensions											
				Ar	ea (m²)			rage storey eight (m)	'	V	olume (m³)	
Lowest occupied				Ţ.	50.32] (1a) x		2.50	(2a) =		125.80	(3a
Total floor area	(1a) +	(1b) + (1c	c) + (1d)(1	Ln) = 5	50.32	(4)						
Dwelling volume							(3a) + (3b) + (3	sc) + (3d)(3i	า) =	125.80	(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 fa	ans							0	x 10 =		0	(7a
Number of passive vents								0	x 10 =		0	(7k
Number of flueless gas fir	es							0	x 40 =		0	(70
										Air	changes pe	er
nfiltration due to chimne	eys, flues, fans, l	PSVs		(6a) +	+ (6b) + (7a	a) + (7b) + (7c) =	0	÷ (5) =		0.00	(8)
f a pressurisation test ha	s been carried o	out or is ir	ntended, pr	oceed to (1	7), otherw	ise continu	e from (9)	to (16)	_			_
Air permeability value, q5	0, expressed in	cubic me	etres per ho	our per squa	are metre	of envelope	e area				3.00	(17
f based on air permeabili	ty value, then (18) = [(17	') ÷ 20] + (8	s), otherwise	e (18) = (16	6)					0.15	(18
Number of sides on which	n the dwelling is	sheltere	d								2	(19
Shelter factor								1 -	- [0.075 x (19)] =	0.85	(20
nfiltration rate incorpora	ting shelter fac	tor							(18) x (20	O) =	0.13	(21
nfiltration rate modified	for monthly wi	nd speed:										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind sp	eed 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	(22
Adjusted infiltration rate	(allowing for sh	elter and	wind facto	or) (21) x (22	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	(22
Calculate effective air cha	inge rate for the	e applicat	ole case:									
If mechanical ventilati	on: air change i	ate throu	ıgh system								0.50	(23





3. Heat losses and heat loss parameter									
Element	Gross area, m²	Openings m ²	Net ar		U-value W/m²K	A x U W/	К к-value, kJ/m².К	Αxκ, kJ/K	
Window			7.86	x	1.24	= 9.71			(27)
Door			1.80	x	0.60	= 1.08			(26)
External wall			14.32	2 x	0.17	= 2.43			(29a)
Party wall			34.43	3 x	0.00	= 0.00			(32)
External wall			16.50) x	0.20	= 3.30			(29a)
Roof			50.32	2 x	0.13	= 6.54			(30)
Total area of external elements ΣA , m^2			90.80)					(31)
Fabric heat loss, W/K = \sum (A × U)						(26)	(30) + (32) =	23.07	(33)
Heat capacity Cm = \sum (A x κ)					(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 App	endix K							6.77	(36)
Total fabric heat loss							(33) + (36) =	29.84	(37)
Jan Feb Mar	Apr	May	Jun	Jul	Aug	Sep	Oct Nov	Dec	
Ventilation heat loss calculated monthly 0.33	x (25)m x (5)								
11.80 11.67 11.5	4 10.88	10.74	10.08	10.08	9.95	10.35	10.74 11.01	11.27	(38)
Heat transfer coefficient, W/K (37)m + (38)m									
41.64 41.51 41.3	8 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)
Heat loss parameter (HLP), W/m ² K (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	0.82	
						Average = ∑(40)112/12 =	0.81	(40)
Number of days in month (Table 1a)									
31.00 28.00 31.00	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								1.70	7 (10)
Assumed occupancy, N								1.70	(42)
Annual average hot water usage in litres per d								74.56	(43)
Jan Feb Mar		May	Jun	Jul	Aug	Sep	Oct Nov	Dec	
Hot water usage in litres per day for each mor							ı	1	7
82.02 79.04 76.00	6 73.07	70.09	67.11	67.11	70.09	73.07	76.06 79.04	!]
							∑(44)112 =	894.76	(44)
Energy content of hot water used = 4.18 x Vd,		1			1		ŀ		7
121.63 106.38 109.7	8 95.71	91.83	79.24	73.43	84.26	85.27	99.37 108.4	7 117.80	
Distribution loss 0.15 x (45)m							∑(45)112 =	1173.18	(45)
18.25 15.96 16.4	7 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 \	WHRS storag	ge within same	e vessel		•		. [3.00	(47)
Water storage loss:									. ,
b) Manufacturer's declared loss factor is not k	nown								
Hot water storage loss factor from Table 2		v)						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)
Enter (50) or (54) in (55)	(±1) V (JI) V (J2, A (JJ)						0.13	(55)
Water storage loss calculated for each month								0.13	7 (22)

Water storage loss calculated for each month (55) x (41)m

		T '				T			1				7 ()
1 6 th a	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			T	7 ,,
	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			1	T	1	T	I	I	T		I	T	7
	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		from Table	3a, 3b or 3	1	1		1				1		7
	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		. (45)m + (4	1	1			ı		7
	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 input	t 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 wa	ter heater f	or each mo	nth (kWh/	month) (62	2)m + (63)n	1							_
	148.94	131.04	137.08	122.13	119.14	105.67	100.73	111.57	111.69	126.68	134.90	145.10	
										∑(64)1	.12 = 1	1494.66	(64)
Heat gains from	water heat	ing (kWh/m	nonth) 0.2!	5 × [0.85 ×	(45)m + (61	l)m] + 0.8 ×	[(46)m + (!	57)m + (59)m]				_
	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 gain	15												
J. Internal gall	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains		165	IVIGI	Aþi	iviay	Juli	Jui	Aug	Зер	Oct	NOV	Dec	
Wietabolic 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)
Lighting gains (c				!	·		04.90	04.90	04.90	04.90	04.90	04.90] (66)
Lighting gams (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	7 (67)
Appliance gains							5.10	0.71	9.00	11.43	13.34	14.22	(67)
Appliance gains	148.07		-	1			110.77	100.22	112.11	121.25	121 75	141.52	7 (60)
Cooking gains (s		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		1	-				21.50	21.50	21.50	24.50	21.50	24.50	7 (60)
Pump and fan ga	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)
Pullip allu lali go	,	,	0.00	0.00	0.00	1 0 00	0.00	0.00	0.00	0.00	0.00	0.00	7 (70)
	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	,	,							1 ====				7 (-4)
	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	-67.98	<u> </u> (71)
Water heating g	` ` ` ` ` ` ` ` ` ` ` ` ` ` ` ` ` ` ` `	,				T		I	T		I		7 ()
	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							Г				Г		٦
	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)
6. Solar gains													
			Access f	actor	Area	Sol	ar flux		g	FF		Gains	
				6d	m²	W	//m²	•	ific data	specific c		W	
			Table										
									able 6b	or Table			_
West			Table		7.86	x 1	9.64 x		0.45 x			33.70	(80)
	atts ∑(74)m	ı(82)m			7.86	x1	9.64 x					33.70	(80)
	atts ∑(74)m 33.70	n(82)m 65.92			7.86	x 1	9.64 x					33.70	(80)
Solar gains in wa	33.70	65.92	0.7	7 x				0.9 x	0.45 x	0.70	= [1	_
Solar gains in wa	33.70	65.92	0.7	7 x				0.9 x	0.45 x	0.70	= [1	_
Solar gains in wa	33.70 ernal and so 327.81	65.92 blar (73)m + 358.30	0.7 108.56 (83)m 391.20	7 x [194.04	198.64	189.11	0.9 x	0.45 x	78.22	42.02	27.71	(83)
Solar gains in wa Total gains - inte 7. Mean intern	33.70 ernal and so 327.81	65.92 blar (73)m + 358.30 sture (heatin	0.7 108.56 (83)m 391.20	7 x [158.33	194.04	198.64	189.11	0.9 x	0.45 x	78.22	42.02	27.71	(83)
Solar gains in wa	33.70 ernal and so 327.81	65.92 blar (73)m + 358.30 sture (heatin	0.7 108.56 (83)m 391.20	7 x [158.33	194.04	198.64	189.11	0.9 x	0.45 x	78.22	42.02	27.71	(83)

Utilisation facto	or for gains	for 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			!	!	!								(/
	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)
Temperature d		1		1									
•	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)
Utilisation facto									1 20.20				_ (00)
	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		1	l	1	!		1	1 0.00	0.00	1 0.50	0.55	1 2.00	_ (00)
	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)
Living area frac		13.11	13.03	20.02	20.20	20.20	20.20	20.20		ving area ÷		0.55	(91)
Mean internal t		e for the wh	ole dwellin	ng fLA x T1 +	-(1 - fLA) x	Т2				ville area v	(.,	0.33] (31)
cancomar	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				1	l			20.00	20.04	20.43	20.00	15.75	(32)
rippiy dajastine	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)
	15.61	13.34	20.17	20.43	20.01	20.00	20.00	20.00	20.04	20.43	20.08	19.79	(33)
8. Space heati	ng requiren	nent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	or for gains,	ηm											
	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)
Useful gains, ηr	mGm, W (9	4)m x (84)m											_
	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	ge external t	temperature	e from Tabl	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	or mean int	ernal tempe	erature, Lm	, W [(39)m	x [(93)m -	(96)m]							
	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 r	equirement	t, kWh/mon	th 0.024 x	[(97)m - (9	5)m] x (41)	m							_
	237.88	181.41	138.01	59.85	15.45	0.00	0.00	0.00	0.00	65.12	157.77	244.18	
									∑(9	8)15, 10	.12 = 1	.099.65	(98)
Space heating r	equirement	t kWh/m²/yo	ear							(98)	÷ (4)	21.85	(99)
9b. Energy red													7
Fraction of space				ntary syste	m (table 11	.)				'0' if ı		0.00	(301)
Fraction of space	ce heat fron	n communit	y system							1 - (30	01) =	1.00	(302)
Fraction of com	munity hea	t from boile	ers									1.00	(303a)
Fraction of tota	I space hear	t from comr	nunity boil	ers						(302) x (30	3a) =	1.00	(304a)
Factor for contr	rol and char	ging metho	d (Table 4c	(3)) for com	nmunity spa	ace heating	5					1.00	(305)
Factor for charg	ging method	d (Table 4c(3	3)) for com	munity wat	er heating							1.00	(305a)
Distribution los	s factor (Tal	ble 12c) for	community	y heating sy	stem							1.05	(306)
Space heating										7			
Annual space h	eating requ	irement							1099.65	_			(98)
Space heat from	n boilers							(9	8) x (304a)	x (305) x (30	06) =1	154.64	(307a)
Water heating													
Annual water h	eating requ	irement							1494.66				(64)
Water heat from	m boilers							(64	l) x (303a) x	- (305a) x (30	06) = 1	.569.39	(310a)
Electricity used	for heat dis	stribution					0.01	L× [(307a).	(307e) + (310a)(310	e)] =	27.24	(313)
													-

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)

В

(338)

Total delivered energy for all uses

3070.08 (307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =

10b. Fu	el costs -	communit	y heating s	cheme

	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 schem

110. 3AF Taking - Community hearing scheme		
Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.24	(357)
SAP value	82.72	
SAP rating (section 13)	83	(358)

SAP band

12b. CO ₂ emissions - commun	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) = [3043.60	x	0.216	= [657.42	(367)
Electrical energy for communit	y heat distribution	27.24	x	0.519	= [14.14	(372)
Total CO2 associated with com	munity systems					671.56	(373)
Total CO2 associated with space	ee 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 CO₂, kg/year					(376)(382) = [851.16	(383)
Dwelling CO₂ emission rate					(383) ÷ (4) = [16.91	(384)
El value						88.03	
El rating (section 14)						88	(385)
EI band						В	

13b. Primary energy - commu	inity 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) =	3043.60	x	1.22	=	3713.20	(367)
Electrical energy for communit	y heat distribution	27.24	x	3.07	=	83.63	(372)
Total primary energy associate	d with community systems					3796.82	(373)
Total primary energy associate	d with space and water heating					3796.82	(376)

Pumps and fans
Electricity for lighting
Primary energy kWh/year

Dwelling primary energy rate kWh/m2/year

101.68 244.38

X

3.07 3.07 =

312.15

750.24 (379)

(378)

4859.22 (383)

96.57 (384)



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

Client								Last modified		30/09	/2020	
Address	2B3P, Kin	gston upo	n Thames,	KT1								
1. Overall dwelling din	noncions											
1. Overall dwelling din	iensions			Δ	rea (m²)		Δ	verage storey		Vo	lume (m³)	
				^	.cu (<i>)</i>			height (m)		•	nume (m)	
Lowest occupied					64.62	(1a) x	Г	2.50	(2a) =		161.55	(3a)
Total floor area	(1a)	+ (1b) + (1e	c) + (1d)(1n) =	64.62	(4)						_
Dwelling volume							(3	3a) + (3b) + (3	c) + (3d)(3ı	n) =	161.55	(5)
2. Ventilation rate												
2. Ventuation rate										m	³ per hour	
Number of chimneys								0	x 40 =		0	(6a)
Number of open flues							\ <u> </u>	0	x 20 =		0] (6b)
Number of intermittent	fans							0	x 10 =		0] (7a)
Number of passive vent								0	x 10 =		0	(7b)
Number of flueless gas f								0	x 40 =		0	(7c)
									-	Air	changes pe	r
									1		hour	7
Infiltration due to chimr	-				+ (6b) + (7a			0	÷ (5) =		0.00	(8)
If a pressurisation test h								9) to (16)				7
Air permeability value, o							e area				3.00	(17) (10)
If based on air permeab				3), otherwis	se (18) = (16	o)					0.15	(18) (10)
Number of sides on whi Shelter factor	ch the aweiling	s is shellere	eu					1 -	[0.075 x (19)1 – <u> </u>	0.85] (19)] (20)
Infiltration rate incorpor	rating shelter fa	actor						1-	(18) x (20		0.13	(21)
Infiltration rate modifie	_		:						(10) // (2)	o,	0.13	(==)
Jan		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind s	peed 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	3 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	e (allowing for	shelter and	d wind facto	or) (21) x (2	22a)m							
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 cl	•											7
If mechanical ventila	tion: air change	e rate thro	ugh system								0.50	(23a)



0.29

0.29

0.29

0.29

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

74.80

0.28

0.28

0.27

0.27

(23c)

(24a)

(25)

0.25

0.25

0.25

0.25

0.24

0.24

0.25

0.25

0.26

0.26

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

0.28

0.28

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

0.27

0.27

0.26

0.26

	and near io	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						15	.04 x	1.24	= 18.59				(27)
Door						1.	80 x	0.60	= 1.08				(26)
External wall						31	.51 x	0.17	= 5.36				(29
Party wall						14	.88 x	0.00	= 0.00				(32)
External wall						22	.05 x	0.20	= 4.41				(29
Roof						64	.62 x	0.13	= 8.40				(30)
Total area of ex	ternal elem	ents ∑A, m²	:			135	5.02						(31)
Fabric heat loss,	, W/K = ∑(A	× U)							(26)(30) + (3	2) =	37.83	(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 bridges	s: ∑(L x Ѱ) c	alculated us	sing Apper	ndix K								15.57	(36)
Total fabric hear	t loss									(33) + (3	6) =	53.41	(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)									
	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	V/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)112/2	12 =	67.56	(39)
Heat loss param	neter (HLP),	W/m ² K (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)112/2	12 =	1.05	(40)
Number of days	in month (Table 1a)							Average = ∑	(40)112/2	12 =	1.05	(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	1.05	J ` '
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					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					31.00	(40)
4. Water heati	ancy, N hot water to	28.00 requirementusage in litre	t es per day Mar	Vd,average Apr	= (25 x N) + May	36 Jun	Jul	31.00	30.00	31.00	30.00	31.00 2.11 84.28	(40)
4. Water heati Assumed occup Annual average	ancy, N hot water to Jan e in litres pe	28.00 requirementusage in litre	es per day Mar ach month	Vd,average Apr Vd,m = fact	= (25 x N) + May tor from Tabl	36 Jun le 1c x (43	Jul)	31.00 Aug	30.00 Sep	31.00 Oct	30.00	2.11 84.28 Dec	(40)
4. Water heati Assumed occup Annual average	ancy, N hot water to	28.00 requiremen usage in litre 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	31.00 2.11 84.28	(40) (42) (43)
4. Water heati Assumed occup Annual average	ancy, N hot water to Jan e in litres pe	28.00 requirementusage in litro Feb er day for ea	es per day Mar ach month	Vd,average Apr Vd,m = fact 82.60	= (25 x N) +	36 Jun le 1c x (43 75.86	Jul) 75.86	31.00 Aug 79.23	30.00 Sep	31.00 Oct	30.00 Nov	2.11 84.28 Dec	(40) (42) (43)
4. Water heati Assumed occup Annual average Hot water usage	ancy, N hot water to Jan e in litres pe	28.00 requirementusage in litro Feb er day for ea	es per day Mar ach month	Vd,average Apr Vd,m = fact 82.60	= (25 x N) +	36 Jun le 1c x (43 75.86	Jul) 75.86	31.00 Aug 79.23	30.00 Sep	31.00 Oct	30.00 Nov	2.11 84.28 Dec	(40) (42) (43)
4. Water heati Assumed occup Annual average Hot water usage	ancy, N hot water to Jan e in litres pe 92.71 of hot wate	zequirement usage in litro Feb er day for ea 89.34	es per day Mar ach month 85.97	Vd,average Apr Vd,m = fact 82.60 x nm x Tm/3	= (25 x N) +	36 Jun le 1c x (43 75.86 onth (see	Jul) 75.86 Tables 1b	Aug 79.23	\$ep 82.60	31.00 Oct 85.97 Σ(44)1	30.00 Nov 89.34 12 = 122.61	2.11 84.28 Dec 92.71 1011.41	(40) (42) (43) (43)
4. Water heati Assumed occup. Annual average Hot water usage Energy content	ancy, N hot water to Jan e in litres pe 92.71 of hot wate 137.49	zequirement usage in litre Feb er day for eat 89.34 er used = 4.1	es per day Mar ach month 85.97	Vd,average Apr Vd,m = fact 82.60 x nm x Tm/3	= (25 x N) +	36 Jun le 1c x (43 75.86 onth (see	Jul) 75.86 Tables 1b	Aug 79.23	\$ep 82.60	31.00 Oct 85.97 Σ(44)1	30.00 Nov 89.34 12 = 122.61	2.11 84.28 Dec 92.71	(42) (42) (43)
4. Water heati Assumed occup Annual average Hot water usage	31.00 Ing energy r ancy, N hot water to Jan e in litres per 92.71 of hot water 137.49	zequirement usage in litre Feb er day for eat 89.34 er used = 4.1	es per day Mar ach month 85.97 18 x Vd,m 124.09	Vd,average	= (25 x N) + May tor from Tabl 79.23 3600 kWh/m 103.80	36 Jun le 1c x (43 75.86 onth (see 89.57	Jul) 75.86 Tables 1b 83.00	Aug 79.23 , 1c 1d) 95.25	\$ep 82.60 96.39	31.00 Oct 85.97 Σ(44)1 112.33 Σ(45)1	30.00 Nov 89.34 12 = 122.61 12 =	2.11 84.28 Dec 92.71 1011.41 133.15 1326.12	(42) (42) (43) (44)
4. Water heati Assumed occup Annual average Hot water usage Energy content Distribution loss	ancy, N hot water to Jan e in litres per 92.71 of hot wate 137.49 s 0.15 x (45)	28.00 requirement usage in litro Feb er day for eat 89.34 er used = 4.1 120.25 6)m 18.04	es per day Mar ach month 85.97 18 x Vd,m 124.09	Vd,average	= (25 x N) + May tor from Tabl 79.23 3600 kWh/m 103.80	36 Jun le 1c x (43 75.86 onth (see 89.57	Jul) 75.86 Tables 1b	Aug 79.23	\$ep 82.60	31.00 Oct 85.97 Σ(44)1	30.00 Nov 89.34 12 = 122.61	2.11 84.28 Dec 92.71 1011.41 133.15 1326.12	(40) (42) (43) (44) (45)
4. Water heati Assumed occup. Annual average Hot water usage Energy content Distribution loss Storage volume	ancy, N hot water to Jan e in litres per 92.71 of hot water 137.49 s 0.15 x (45) 20.62 (litres) inclination	28.00 requirement usage in litro Feb er day for eat 89.34 er used = 4.1 120.25 6)m 18.04	es per day Mar ach month 85.97 18 x Vd,m 124.09	Vd,average	= (25 x N) + May tor from Tabl 79.23 3600 kWh/m 103.80	36 Jun le 1c x (43 75.86 onth (see 89.57	Jul) 75.86 Tables 1b 83.00	Aug 79.23 , 1c 1d) 95.25	\$ep 82.60 96.39	31.00 Oct 85.97 Σ(44)1 112.33 Σ(45)1	30.00 Nov 89.34 12 = 122.61 12 =	2.11 84.28 Dec 92.71 1011.41 133.15 1326.12	(40) (42) (43) (44) (45)
4. Water heati Assumed occup. Annual average Hot water usage Energy content Distribution loss Storage volume	ancy, N hot water to Jan e in litres per 92.71 of hot wate 137.49 s 0.15 x (45) 20.62 (litres) incluses:	z8.00 requirement usage in litro Feb er day for ea 89.34 er used = 4.1 120.25 f)m 18.04 uding any so	es per day Mar ach month 85.97 18 x Vd,m 124.09 18.61 olar or WV	Vd,average	= (25 x N) + May tor from Tabl 79.23 3600 kWh/m 103.80	36 Jun le 1c x (43 75.86 onth (see 89.57	Jul) 75.86 Tables 1b 83.00	Aug 79.23 , 1c 1d) 95.25	\$ep 82.60 96.39	31.00 Oct 85.97 Σ(44)1 112.33 Σ(45)1	30.00 Nov 89.34 12 = 122.61 12 =	2.11 84.28 Dec 92.71 1011.41 133.15 1326.12	(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	ancy, N hot water to Jan e in litres per 92.71 of hot water 137.49 s 0.15 x (45 20.62 (litres) incloses: r's declared	z8.00 requirement usage in litro Feb er day for eat 89.34 er used = 4.1 120.25 s)m 18.04 uding any so	es per day Mar ech month 85.97 18 x Vd,m 124.09 18.61 olar or WV	Vd,average	= (25 x N) + May tor from Tabl 79.23 3600 kWh/m 103.80 15.57 ge within sam	36 Jun le 1c x (43 75.86 onth (see 89.57	Jul) 75.86 Tables 1b 83.00	Aug 79.23 , 1c 1d) 95.25	\$ep 82.60 96.39	31.00 Oct 85.97 Σ(44)1 112.33 Σ(45)1	30.00 Nov 89.34 12 = 122.61 12 =	2.11 84.28 Dec 92.71 1011.41 133.15 1326.12	(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 r ancy, N hot water to Jan e in litres per 92.71 of hot water 137.49 s 0.15 x (45 20.62 (litres) inchors: r's declared orage loss f	z8.00 requiremen usage in litre Feb er day for ea 89.34 er used = 4.1 120.25 6)m 18.04 uding any so	es per day Mar ech month 85.97 18 x Vd,m 124.09 18.61 olar or WV	Vd,average	= (25 x N) + May tor from Tabl 79.23 3600 kWh/m 103.80 15.57 ge within sam	36 Jun le 1c x (43 75.86 onth (see 89.57	Jul) 75.86 Tables 1b 83.00	Aug 79.23 , 1c 1d) 95.25	\$ep 82.60 96.39	31.00 Oct 85.97 Σ(44)1 112.33 Σ(45)1	30.00 Nov 89.34 12 = 122.61 12 =	2.11 84.28 Dec 92.71 1011.41 133.15 1326.12 19.97 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	ancy, N hot water to Jan e in litres per 92.71 of hot water to 137.49 s 0.15 x (45 20.62 (litres) inclusors: r's declared orage loss for from Tab	z8.00 requirement usage in litro Feb er day for eat 89.34 er used = 4.1 120.25 s)m 18.04 uding any so d loss factor factor from ole 2a	es per day Mar ech month 85.97 18 x Vd,m 124.09 18.61 olar or WV	Vd,average	= (25 x N) + May tor from Tabl 79.23 3600 kWh/m 103.80 15.57 ge within sam	36 Jun le 1c x (43 75.86 onth (see 89.57	Jul) 75.86 Tables 1b 83.00	Aug 79.23 , 1c 1d) 95.25	\$ep 82.60 96.39	31.00 Oct 85.97 Σ(44)1 112.33 Σ(45)1	30.00 Nov 89.34 12 = 122.61 12 =	2.11 84.28 Dec 92.71 1011.41 133.15 1326.12 19.97 3.00 0.02 3.42	(40) (42) (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 r ancy, N hot water to Jan e in litres per 92.71 of hot water 137.49 s 0.15 x (45 20.62 (litres) inclusors: r's declared orage loss for from Table e factor from	z8.00 requirement usage in litro Feb er day for eat 89.34 er used = 4.1 120.25 f)m 18.04 uding any so d loss factor factor from factor fro	es per day Mar ach month 85.97 18 x Vd,m 124.09 18.61 olar or WV is not kno	Vd,average Apr Vd,m = fact 82.60 x nm x Tm/3 108.18 16.23 VHRS storage	= (25 x N) + May tor from Tabl 79.23 3600 kWh/m 103.80 15.57 ge within sam	36 Jun le 1c x (43 75.86 onth (see 89.57	Jul) 75.86 Tables 1b 83.00	Aug 79.23 , 1c 1d) 95.25	\$ep 82.60 96.39	31.00 Oct 85.97 Σ(44)1 112.33 Σ(45)1	30.00 Nov 89.34 12 = 122.61 12 =	2.11 84.28 Dec 92.71 1011.41 133.15 1326.12 19.97 3.00 0.02 3.42 0.60	(40) (40) (40) (42) (43) (44) (45) (46) (47) (51) (52) (53) (54)
4. Water heati Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage le b) Manufacture Hot water st	31.00 Ing energy r ancy, N hot water to Jan e in litres per 92.71 of hot water 137.49 s 0.15 x (45 20.62 (litres) includes: r's declared orage loss from Table e factor from water strom water strong strom water strong	z8.00 requirement usage in litro Feb er day for eat 89.34 er used = 4.1 120.25 f)m 18.04 uding any so d loss factor factor from factor fro	es per day Mar ach month 85.97 18 x Vd,m 124.09 18.61 olar or WV is not kno	Vd,average Apr Vd,m = fact 82.60 x nm x Tm/3 108.18 16.23 VHRS storage	= (25 x N) + May tor from Tabl 79.23 3600 kWh/m 103.80 15.57 ge within sam	36 Jun le 1c x (43 75.86 onth (see 89.57	Jul) 75.86 Tables 1b 83.00	Aug 79.23 , 1c 1d) 95.25	\$ep 82.60 96.39	31.00 Oct 85.97 Σ(44)1 112.33 Σ(45)1	30.00 Nov 89.34 12 = 122.61 12 =	2.11 84.28 Dec 92.71 1011.41 133.15 1326.12 19.97 3.00 0.02 3.42	(40) (42) (43) (44) (44) (45) (46) (47)

	4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04
If the vessel con	tains dedic	ated solar s	torage or d	edicated W	/WHRS (56)	m x [(47) -	Vs] ÷ (47),	else (56)	1	ı		
	4.04	3.65	4.04	3.91	4.04	3.91	4.04	4.04	3.91	4.04	3.91	4.04
Primary circuit lo			1		r				_			
	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
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
Total heat requi	red for wat	er heating o	alculated f	or each mo	onth 0.85 x	(45)m + (4	6)m + (57)r	n + (59)m -	+ (61)m	_		
	164.79	144.91	151.39	134.60	131.11	116.00	110.31	122.55	122.81	139.63	149.04	160.46
Solar DHW input	t 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
Output from wa	ter heater 1	for each mo	nth (kWh/ı	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 =	1647.59 (6
Heat gains from	water heat	ing (kWh/n	nonth) 0.25	5 × [0.85 ×	(45)m + (61)m] + 0.8 ×	((46)m + (!	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
5. Internal gain	ıs											
3. memar gam	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Metabolic gains		100	IVIUI	Aþi	way	Jun	, a,	Aug	ЭСР	Oct	1404	Dec
Wictabolic 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
Lighting gains (ca			l .				105.44	105.44	103.44	103.44	103.44	103.44
Lighting gams (C	16.44	14.60	11.88	8.99	6.72	5.67	6.13	7.97	10.70	13.58	15.85	16.90 (6
Appliance gains		1	I.				0.13	7.57	10.70	13.36	15.85	10.30
Appliance gains				1					140.00	151.15	164.11	476.20
					1 1 5 0 2 0	11611	12700					
Cooking gains (s	184.43	186.34	181.52	171.25	158.29	146.11	137.98	136.06	140.88	151.15	164.11	176.29 (6
Cooking gains (c	alculated ir	Appendix	L, equation	L15 or L15	a), also see	Table 5					1	
	alculated ir	Appendix 33.54					33.54	33.54	33.54	33.54	33.54	33.54
Cooking gains (c	alculated ir 33.54 ains (Table	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 (6
Pump and fan ga	alculated ir 33.54 ains (Table	33.54 5a) 0.00	L, equation	L15 or L15	a), also see	Table 5					1	
	alculated in 33.54 ains (Table 0.00 oration (Ta	33.54 33.54 5a) 0.00 ble 5)	L, equation 33.54 0.00	L15 or L15 33.54	a), also see 33.54	Table 5 33.54 0.00	33.54	33.54	33.54	33.54	33.54	33.54 (6
Pump and fan ga Losses e.g. evap	alculated ir 33.54 ains (Table 0.00 oration (Ta	33.54 5a) 0.00 ble 5) -84.35	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 (6
Pump and fan ga	alculated ir 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table	33.54 5a) 0.00 ble 5) -84.35	0.00 -84.35	15 or L15 33.54 0.00	a), also see 33.54 0.00 -84.35	Table 5 33.54 0.00 -84.35	0.00	0.00	0.00	0.00	0.00	33.54 (6 0.00 (7 -84.35 (7
Pump and fan ga Losses e.g. evap Water heating g	alculated ir 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table	1 Appendix 33.54 5a) 0.00 ble 5) -84.35 5)	0.00 -84.35	L15 or L15 33.54 0.00 -84.35	a), also see 33.54 0.00 -84.35	Table 5 33.54 0.00 -84.35	33.54	33.54	33.54	33.54	33.54	33.54 (6
Pump and fan ga Losses e.g. evap	alculated ir 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table 90.80 ins (66)m	n Appendix 33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6	0.00 -84.35 84.81 -68)m + (69)	15 or L15 33.54 0.00 -84.35 79.32 m + (70)m	a), also see 33.54 0.00 -84.35 75.75 + (71)m + (7	Table 5 33.54 0.00 -84.35 70.72 72)m	33.54 0.00 -84.35	33.54 0.00 -84.35	33.54 0.00 -84.35	33.54 0.00 -84.35	33.54 0.00 -84.35 85.98	33.54 (6 0.00 (7 -84.35 (7
Pump and fan ga Losses e.g. evap Water heating g	alculated ir 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table	1 Appendix 33.54 5a) 0.00 ble 5) -84.35 5)	0.00 -84.35	L15 or L15 33.54 0.00 -84.35	a), also see 33.54 0.00 -84.35	Table 5 33.54 0.00 -84.35	0.00	0.00	0.00	0.00	0.00	33.54 (6 0.00 (7 -84.35 (7
Pump and fan ga Losses e.g. evap Water heating g	alculated ir 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table 90.80 ins (66)m	n Appendix 33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6	0.00 -84.35 84.81 -68)m + (69)	15 or L15 33.54 0.00 -84.35 79.32 m + (70)m	a), also see 33.54 0.00 -84.35 75.75 + (71)m + (7	Table 5 33.54 0.00 -84.35 70.72 72)m	33.54 0.00 -84.35	33.54 0.00 -84.35	33.54 0.00 -84.35	33.54 0.00 -84.35	33.54 0.00 -84.35 85.98	33.54 (6 0.00 (7 -84.35 (7
Pump and fan ga Losses e.g. evap Water heating g Total internal ga	alculated ir 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table 90.80 ins (66)m	n Appendix 33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6	0.00 -84.35 84.81 68)m + (69) 332.84	115 or L15 33.54 0.00 -84.35 79.32 m + (70)m 314.20	a), also see 33.54 0.00 -84.35 75.75 + (71)m + (7295.40	Table 5 33.54 0.00 -84.35 70.72 72)m 277.14	33.54 0.00 -84.35 66.45 265.19	33.54 0.00 -84.35 71.93	33.54 0.00 -84.35 73.87 280.08	33.54 0.00 -84.35 79.56 298.93	33.54 0.00 -84.35 85.98	33.54 (6 0.00 (7 -84.35 (7 88.87 (7 336.69 (7
Pump and fan ga Losses e.g. evap Water heating g Total internal ga	alculated ir 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table 90.80 ins (66)m	n Appendix 33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6	0.00 -84.35 84.81 68)m + (69)	115 or L15 33.54 0.00 -84.35 79.32 m + (70)m 314.20	a), also see 33.54 0.00 -84.35 75.75 + (71)m + (72)	Table 5 33.54 0.00 -84.35 70.72 72)m 277.14	33.54 0.00 -84.35 66.45	33.54 0.00 -84.35 71.93 270.59	33.54 0.00 -84.35 73.87 280.08	33.54 0.00 -84.35 79.56 298.93	33.54 0.00 -84.35 85.98 320.58	33.54 (6 0.00 (7 -84.35 (7 88.87 (7 336.69 (7
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains	alculated ir 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table 90.80 ins (66)m	n Appendix 33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6	0.00 -84.35 84.81 68)m + (69) 332.84	0.00 -84.35 79.32 m + (70)m 314.20 ractor 6d	a), also see 33.54 0.00 -84.35 75.75 + (71)m + (71)m + (71)m + (72)m + (72	Table 5 33.54 0.00 -84.35 70.72 72)m 277.14 Sol	33.54 0.00 -84.35 66.45 265.19	33.54 0.00 -84.35 71.93 270.59 spec	33.54 0.00 -84.35 73.87 280.08 g iffic data cable 6b	33.54 0.00 -84.35 79.56 298.93 FF specific c or Table	33.54 0.00 -84.35 85.98 320.58	33.54 (6 0.00 (7 -84.35 (7 88.87 (7 336.69 (7
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains	alculated ir 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table 90.80 ins (66)m	n Appendix 33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6	2. equation 2. 33.54 0.00 -84.35 84.81 68)m + (69) 332.84 Access f Table	15 or L15 33.54 0.00 -84.35 79.32 m + (70)m 314.20 6d 7 x	a), also see 33.54 0.00 -84.35 75.75 + (71)m + (72) 295.40 Area m² 8.20	Table 5 33.54 0.00 -84.35 70.72 72)m 277.14 Sol	33.54 0.00 -84.35 66.45 265.19 ar flux v/m² 0.63 x	33.54 0.00 -84.35 71.93 270.59 spec or T	33.54 0.00 -84.35 73.87 280.08 g iffic data rable 6b 0.45 x	33.54 0.00 -84.35 79.56 298.93 FF specific c or Table 0.70	33.54 0.00 -84.35 85.98 320.58	33.54 (6 0.00 (7 -84.35 (7 88.87 (7 336.69 (7 Gains W
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains North East	alculated ir 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table 90.80 ins (66)m 346.31	n Appendix 33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6	0.00 -84.35 84.81 68)m + (69) 332.84	115 or L15 33.54 0.00 -84.35 79.32 m + (70)m 314.20 factor 6d	a), also see 33.54 0.00 -84.35 75.75 + (71)m + (71)m + (71)m + (72)m + (72	Table 5 33.54 0.00 -84.35 70.72 72)m 277.14 Sol	33.54 0.00 -84.35 66.45 265.19 ar flux v/m² 0.63 x	33.54 0.00 -84.35 71.93 270.59 spec or T	33.54 0.00 -84.35 73.87 280.08 g iffic data cable 6b	33.54 0.00 -84.35 79.56 298.93 FF specific cor Table 0.70	33.54 0.00 -84.35 85.98 320.58	33.54 (6 0.00 (7 -84.35 (7 88.87 (7 336.69 (7
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains	alculated ir 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table 90.80 ins (66)m 346.31	Appendix 33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6 344.44	L, equation 33.54 0.00 -84.35 84.81 68)m + (69) 332.84 Access f Table 0.7	115 or L15 33.54 0.00 -84.35 79.32 m + (70)m 314.20 factor 6d 7 x [7 x [a), also see 33.54 0.00 -84.35 75.75 + (71)m + (71	Table 5 33.54 0.00 -84.35 70.72 72)m 277.14 Sol V x 1 x 1	33.54 0.00 -84.35 66.45 265.19 ar flux V/m² 0.63 x 9.64 x	33.54 0.00 -84.35 71.93 270.59 spec or T 0.9 x	33.54 0.00 -84.35 73.87 280.08 g iffic data rable 6b 0.45 0.45 x	33.54 0.00 -84.35 79.56 298.93 FF specific c or Table 0.70 0.70	33.54 0.00 -84.35 85.98 320.58	33.54 (6 0.00 (7 -84.35 (7 88.87 (7 336.69 (7 Gains W
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains North East Solar gains in wa	alculated ir 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table 90.80 ins (66)m 346.31	33.54 33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6 344.44	0.00 -84.35 84.81 68)m + (69) 332.84 Access f Table 0.7	115 or L15 33.54 0.00 -84.35 79.32 m + (70)m 314.20 factor 6d	a), also see 33.54 0.00 -84.35 75.75 + (71)m + (72) 295.40 Area m² 8.20	Table 5 33.54 0.00 -84.35 70.72 72)m 277.14 Sol	33.54 0.00 -84.35 66.45 265.19 ar flux v/m² 0.63 x	33.54 0.00 -84.35 71.93 270.59 spec or T	33.54 0.00 -84.35 73.87 280.08 g iffic data rable 6b 0.45 x	33.54 0.00 -84.35 79.56 298.93 FF specific c or Table 0.70	33.54 0.00 -84.35 85.98 320.58	33.54 (6 0.00 (7 -84.35 (7 88.87 (7 336.69 (7 Gains W
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains North East	alculated in 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table 90.80 ins (66)m 346.31 atts ∑(74)m 48.36 ernal and so	Appendix 33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6 344.44	L, equation 33.54 0.00 -84.35 84.81 68)m + (69) 332.84 Access f Table 0.7 0.7	15 or L15 33.54 0.00 -84.35 79.32 m + (70)m 314.20 6 7 x 237.07	a), also see 33.54 0.00 -84.35 75.75 + (71)m + (71	Table 5 33.54 0.00 -84.35 70.72 72)m 277.14 Sol V x 1 x 1 316.04	33.54 0.00 -84.35 66.45 265.19 ar flux V/m² 0.63 x 9.64 x	33.54 0.00 -84.35 71.93 270.59 spec or T 0.9 x 0.9 x	33.54 0.00 -84.35 73.87 280.08 g ific data able 6b 0.45 0.45 x 184.19	33.54 0.00 -84.35 79.56 298.93 FF specific c or Table 0.70 0.70 111.37	33.54 0.00 -84.35 85.98 320.58 data 66c = [33.54 (6 0.00 (7 -84.35 (7) 88.87 (7) 336.69 (7) Gains W 19.03 (7) 29.33 (7)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains North East Solar gains in wa	alculated ir 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table 90.80 ins (66)m 346.31	33.54 33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6 344.44	0.00 -84.35 84.81 68)m + (69) 332.84 Access f Table 0.7	115 or L15 33.54 0.00 -84.35 79.32 m + (70)m 314.20 factor 6d 7 x [7 x [a), also see 33.54 0.00 -84.35 75.75 + (71)m + (71	Table 5 33.54 0.00 -84.35 70.72 72)m 277.14 Sol V x 1 x 1	33.54 0.00 -84.35 66.45 265.19 ar flux V/m² 0.63 x 9.64 x	33.54 0.00 -84.35 71.93 270.59 spec or T 0.9 x	33.54 0.00 -84.35 73.87 280.08 g iffic data rable 6b 0.45 0.45 x	33.54 0.00 -84.35 79.56 298.93 FF specific c or Table 0.70 0.70	33.54 0.00 -84.35 85.98 320.58	33.54 (6 0.00 (7 -84.35 (7 88.87 (7 336.69 (7 Gains W
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains North East Solar gains in wa	alculated ir 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table 90.80 ins (66)m 346.31 atts ∑(74)m 48.36 ernal and so 394.67	1 Appendix 33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6 344.44 344.44 1	Access f Table 0.77 156.29 (83)m 489.13	15 or L15 33.54 0.00 -84.35 79.32 m + (70)m 314.20 6 7 x 237.07	a), also see 33.54 0.00 -84.35 75.75 + (71)m + (71	Table 5 33.54 0.00 -84.35 70.72 72)m 277.14 Sol V x 1 x 1 316.04	33.54 0.00 -84.35 66.45 265.19 ar flux V/m² 0.63 x 9.64 x	33.54 0.00 -84.35 71.93 270.59 spec or T 0.9 x 0.9 x	33.54 0.00 -84.35 73.87 280.08 g ific data able 6b 0.45 0.45 x 184.19	33.54 0.00 -84.35 79.56 298.93 FF specific c or Table 0.70 0.70 111.37	33.54 0.00 -84.35 85.98 320.58 data 66c = [33.54 (6 0.00 (7 -84.35 (7) 88.87 (7) 336.69 (7) Gains W 19.03 (7) 29.33 (7)
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	alculated in 33.54 ains (Table 0.00 oration (Ta -84.35 ains (Table 90.80 ins (66)m 346.31 atts Σ(74)m 48.36 arnal and so	1 Appendix 33.54 5a) 0.00 ble 5) -84.35 5) 88.86 + (67)m + (6 344.44 344.44 1 al(82)m 93.74 blar (73)m + 438.18 ture (heati	L, equation 33.54 0.00 -84.35 84.81 68)m + (69) 332.84 Access f Table 0.7 0.7 156.29 (83)m 489.13	115 or L15 33.54 0.00 -84.35 79.32 m + (70)m 314.20 factor 6d 7 x 237.07	a), also see 33.54 0.00 -84.35 75.75 + (71)m + (71	Table 5 33.54 0.00 -84.35 70.72 72)m 277.14 Solution x	33.54 0.00 -84.35 66.45 265.19 ar flux V/m² 0.63 x 9.64 x	33.54 0.00 -84.35 71.93 270.59 spec or T 0.9 x 0.9 x	33.54 0.00 -84.35 73.87 280.08 g ific data able 6b 0.45 0.45 x 184.19	33.54 0.00 -84.35 79.56 298.93 FF specific c or Table 0.70 0.70 111.37	33.54 0.00 -84.35 85.98 320.58 data 66c = [33.54 (6 0.00 (7 -84.35 (7) 88.87 (7) 336.69 (7) Gains W 19.03 (7) 29.33 (7)

Mean internal temperature for the whole whole willing function for gains for living area function for gains for living area function for gains for rest of dwelling function function function for gains for rest of dwelling function func		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temp of living area *11 (steps* 31 o / 1n Table 9c) Temperature during hosting periods the reset of dwelling from Table 9c) Temperature during hosting periods the reset of dwelling from Table 9c) Utilisation factor for gains for rest of dwelling 7t2 (follow steps 31 o 7 in Table 9c) Utilisation factor for gains for rest of dwelling 7t2 (follow steps 31 o 7 in Table 9c) Mean internal temperature in the rest of dwelling 7t2 (follow steps 31 o 7 in Table 9c) Mean internal temperature in the rest of dwelling 7t2 (follow steps 31 o 7 in Table 9c) Ling area fraction 19.10 19.93 19.55 19.56 19.97 20.28 20.42 20.45 20.44 19.36 19.99 19.45 19.08 19.50 19.98 (92) Mean internal temperature for the whole dwelling fl.4 x 7t1 + (f.1.4) x T Living area fraction Mean internal temperature for the whole dwelling fl.4 x 7t1 + (f.1.4) x T Living area fraction Mean internal temperature for the whole dwelling fl.4 x 7t1 + (f.1.4) x T Living area fraction Mean internal temperature for the whole dwelling fl.4 x 7t1 + (f.1.4) x T Mean internal temperature for the whole dwelling fl.4 x 7t1 + (f.1.4) x T Living area fraction Mean internal temperature for the whole dwelling fl.4 x 7t1 + (f.1.4) x T Mean internal temperature for the whole dwelling fl.4 x 7t1 + (f.1.4) x T Mean internal temperature for the whole dwelling fl.4 x 7t1 + (f.1.4) x T Mean internal temperature for the whole dwelling fl.4 x 7t1 + (f.1.4) x T Mean internal temperature for the whole dwelling fl.4 x 7t1 + (f.1.4) x T Mean internal temperature for the whole dwelling fl.4 x 7t1 + (f.1.4) x T Mean internal temperature flow flow fl.4 x Mean internal temperature flow flow fl.4 x Mean internal temperature flow flow fl.4 x Mean internal temperature flow flow flow fl.4 x Mean internal temperature flow flow fl.4 x Mean internal temperature flow flow flow flow flow flow flow flow	Utilisation fac	tor for gains f	or living are	ea n1,m (se	e Table 9a)									
19.89 20.01 20.25 20.57 20.84 20.97 20.99 20.99 20.90 20.50 20.05 20.04 20.04 1885 1870 20.05 20.03 20.03 20.03 20.03 20.05 20.05 20.05 20.05 20.05 20.04 20.04 1885 1870 20.05 20.05 20.05 20.05 20.05 20.05 20.05 20.05 20.04 20.04 1885 20.05 2		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)
The persisting during heating periods in the rest of dwelling from Table 9, This IC	Mean interna	temp of livin	g area T1 (s	steps 3 to 7	in Table 9c	:)								
Utilisation factor for gains for rest of welling regular properties. 20.03 20.03 20.03 20.03 20.05 20.05 20.06 20.06 20.05 20.05 20.05 20.04 20.04 (8)		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)
Utilisation factor for gains for rest of dwelling n2.m 1.00 0.99 0.98 0.94 0.82 0.60 0.41 0.47 0.77 0.97 0.99 0.99 1.00 (89) Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) 18.54 18.73 19.07 19.54 19.89 20.04 12.06 19.97 19.52 18.96 18.52 (90) Living area fraction Mean internal temperature for the whole dwelling fl.x x 11 +11 - fl.A) x 12 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 adjustment to the mean internal temperature from Table 4e where appropriate 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 heating requirement 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 heating requirement 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 heating requirement 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 heating requirement 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 heating requirement 10.00 0.99 0.98 0.94 0.83 0.63 0.63 0.45 0.51 0.80 0.96 0.99 1.00 (94) 10.86 19.99 19.98 19.99	Temperature	during heatin	g periods in	the rest o	f dwelling fr	rom Table	9, Th2(°C)							
1.00		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)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c) 18.54 18.73 19.07 19.54 19.89 20.04 20.06 20.06 19.97 19.52 18.96 18.52 19.10 19.26 19.56 19.97 20.28 20.42 20.45 20.44 20.36 19.95 19.46 19.08 19.20 19.10 19.26 19.56 19.97 20.28 20.42 20.45 20.44 20.36 19.95 19.46 19.08 19.20 19.10 19.26 19.56 19.97 20.28 20.42 20.45 20.44 20.36 19.95 19.46 19.08 19.20 19.10 19.26 19.56 19.97 20.28 20.42 20.45 20.44 20.36 19.95 19.46 19.08 19.20 19.20 19.56 19.97 20.28 20.42 20.45 20.44 20.36 19.95 19.46 19.08 19.20	Utilisation fac	tor for gains f	or rest of d	welling n2,	m									
18.54 18.73 19.07 19.54 19.89 20.04 20.06 20.06 19.97 19.52 18.96 18.52 19.30 19.3		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)
Living area fraction	Mean interna	temperature	e in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	9c)						
Mean internal temperature for the whole dwelling fl.A x T1 + (1 - TLA) x T2 19.10 19.26 19.96 19.97 20.28 20.42 20.45 20.44 20.36 19.95 19.46 19.08 92) Apply adjustment to the mean internal temperature from Table 4e whole appropriate 19.10 19.26 19.96 19.97 20.28 20.42 20.45 20.44 20.36 19.95 19.46 19.08 93) Apply adjustment to the mean internal temperature from Table 4e whole appropriate whole and the region of the following flow of the following flow and the region of the following flow and the region of the following flow and the region of the flow of the flow and the region of		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)
19.10 19.26 19.56 19.97 20.28 20.42 20.45 20.44 20.36 19.95 19.46 19.08 19.08 19.00 19.10 19.26 19.56 19.97 20.28 20.42 20.45 20.44 20.36 19.95 19.46 19.08 19.30 19.30 19.30 19.30 19.30 19.40 19.08 19.30 19.30 19.40 19.08 19.30 19.30 19.40 19.08 19.30 19.40 19.08 19.30 19.40 19.08 19.30 19.40 19.08 19.30 19.30 19.40 19.08 19.30 19.40 19.08 19.30 19.40 19.08 19.30 19.40 19.08 19.30 19.40 19.30 19.30 19.40 19.30 19.40 19.30 19.40 19.30 19.40 19.30 19.40 19.30 19.40 19.30 19.40 19.30 19.40 19.30 19.40 19.30 19.40 19.30 19.40 19.30 19.40 19.30 19.40 19.30 19.40 19.30 19.4	Living area fra	ction								Liv	ving area ÷	(4) =	0.42	(91)
Apply adjustment to the main internal temperature from Table 4e where appropriate 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) Same part of the part o	Mean interna	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 (93)		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)
Section Sect	Apply adjustm	ent to the m	ean interna	l temperati	ure from Ta	ble 4e whe	ere appropr	riate						
Utilisation factor for gains, nm Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec		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)
Utilisation factor for gains, nm Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	8. Snace hea	ting requires	nent											
Utilisation factor for gains, nm 1.00	o. Space nea			Mar	Apr	Mav	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1.00	Utilisation fac					,								
Useful gains, nmGm, W (94)m x (84)m 393.15				0.98	0 94	0.83	0.63	0.45	0.51	0.80	0.96	0.99	1 00	(94)
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 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)	Useful gains, r		!	l .	0.5 .	0.03	0.03	0.15	0.51	0.00	0.50	0.55	1.00] (3.)
Monthly average external temperature from Table U1 4.30	0001u. gao, .		1		519.08	196.62	373 90	25/1.27	265.09	370.74	395 52	377 71	375 53	(95)
4.30	Monthly avera		-	I.		430.02	373.50	254.27	203.03	370.74	333.32	377.71	373.33	_ (55)
Heat loss rate for mean intermal temperature, Lm, W [(39)m x [(93)m - (96)m)] 1018.15 985.60 894.04 748.23 578.72 387.77 256.12 268.62 418.59 630.70 837.84 1013.28 97) Space heating requirement, kWh/month	worthly aver	_				11 70	14 60	16.60	16.40	14.10	10.60	7 10	4.20	(96)
1018.15 985.60 894.04 748.23 578.72 387.77 256.12 268.62 418.59 630.70 837.84 1013.28 97) Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m 465.01 370.00 307.86 164.98 61.08 0.00 0.00 0.00 0.00 174.97 331.30 474.48 5 Space heating requirement kWh/m²/year (98) ÷ (4) 36.36 (99) 9 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 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 (305a) Factor for control and charging method (Table 4c(3)) for community water heating 1.00 (305a) Factor for control and charging method (Table 4c(3)) for community water heating 1.00 (305a) Space heating 1.00 (305a) Spa	Heat loss rate					l		10.00	10.40	14.10	10.00	7.10	4.20	_ (30)
Space heating requirement, kWh/month 0.024 x [[97]m - (95)m] x (41]m 465.01 370.00 307.86 164.98 61.08 0.00 0.00 0.00 174.97 331.30 474.48 [98] Space heating requirement kWh/m²/year	ricat 1033 rate							256.12	269.62	/10 EQ	620.70	027 04	1012 20	(07)
465.01 370.00 307.86 164.98 61.08 0.00 0.00 0.00 174.97 331.30 474.48	Snace heating		!					230.12	208.02	410.33	030.70	037.84	1013.28	(57)
Space heating requirement kWh/m²/year $(98)^{\pm}5$, $1012 = 2349.68$ $(98)^{\pm}5$ $(99)^{\pm}5$ $(99)^$	Space nearing						1	0.00	0.00	0.00	174.07	221 20	171 10	٦
Space heating requirement kWh/m²/year (98) ÷ (4) 36.36 (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 community heat from boilers 1.00 (303a) Fraction of total space heat from community boilers (302) x (303a) = 1.00 (304a) Fraction of total space heat from community boilers (302) x (303a) = 1.00 (305a) 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 1.05 (306a) Space heating Annual space heating requirement 2349.68 (98) Water heating Annual water heating requirement 1647.59 (64)		405.01	370.00	307.80	104.96	01.08	0.00	0.00	0.00	1				_ ☐ (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 Factor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system 1.05 (306) Space heating Annual space heating requirement 2349.68 (98) Space heat from boilers (98) x (304a) x (305) x (306) = 2467.16 (307a) Water heating Annual water heating requirement 1647.59 (64)	Cnaco hoating	roquiromont	101/h/m²/v	nar						7(30				_ ` <i>'</i>
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 Water heating Annual water heating requirement 1647.59 (64)	Space neating	requirement	. KVVII/III / y	eai							(96)	÷ (4)	30.30] (99)
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 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 Page 4.08 Space heat from boilers Page 4.08 Space heating Annual water heating requirement Annual water heating requirement Fraction of community heat from boilers 1.00 (302) x (303a) = 1.00 (304a) 1.00 (305a) 1.00 (305a) 1.00 (305a) 1.00 (305a) 1.00 (305a) 2.00 (305a) 2.00 (305a) Space heating Annual space heating requirement (98) x (304a) x (305) x (306) = 2467.16 (307a)	9b. Energy re	equirements	- communit	y 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 Water heating Annual water heating requirement Mater heating Annual water heating requirement 1.00 (305a) 1.05 (306) 1.05 (306) 1.05 (306)	Fraction of spa	ace heat from	secondary	/suppleme	ntary systei	m (table 11	1)				'0' if	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 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 2349.68 (98) Space heat from boilers (98) x (304a) x (305) x (306) = 2467.16 (307a) Water heating Annual water heating requirement 1647.59 (64)	Fraction of spa	ace heat from	n communit	y system							1 - (3	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) = 2467.16 (307a) Water heating Annual water heating requirement 1647.59 (64)	Fraction of co	mmunity hea	t from boile	ers									1.00	(303a)
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 Water heating Annual water heating requirement 1.00 (305a) 1.05 (306) (98) Space heating (98) (98) (98) (98) (98) (1047.16 (307a)	Fraction of to	tal space heat	from comr	nunity boil	ers						(302) x (30	3a) =	1.00	(304a)
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) = 2467.16 (307a) Water heating Annual water heating requirement 1647.59 (64)	Factor for con	trol and char	ging metho	d (Table 4c	(3)) for com	nmunity sp	ace heating						1.00	(305)
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) = 2467.16 (307a) Water heating Annual water heating requirement 1647.59 (64)							_						1.00	= -
Space heating Annual space heating requirement Space heat from boilers (98) x (304a) x (305) x (306) = 2467.16 (307a) Water heating Annual water heating requirement 1647.59 (64)													1.05	
Annual space heating requirement Space heat from boilers (98) x (304a) x (305) x (306) = 2467.16 (307a) Water heating Annual water heating requirement 1647.59 (64)														_
Annual space heating requirement Space heat from boilers (98) x (304a) x (305) x (306) = 2467.16 (307a) Water heating Annual water heating requirement 1647.59 (64)	Space heating	5												
Space heat from boilers (98) x (304a) x (305) x (306) = 2467.16 (307a) Water heating Annual water heating requirement 1647.59 (64)			rement							2349.68]			(98)
Water heating Annual water heating requirement 1647.59 (64)											< (305) x (3	06) =	2467.16	_
Annual water heating requirement 1647.59 (64)	,								,,,,	, (/,	, -,,0	,		
	Water heating	g												
Water heat from boilers (64) x (303a) x (305a) x (306) = 1729.97 (310a)	Annual water	heating requi	irement							1647.59]			(64)
	Water heat fro	om boilers							(64) x (303a) x	(305a) x (3	06) =	1729.97	(310a)

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

147.82 (330a) 147.82 (331)

Total electricity for the above, kWh/year

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 - co	mmunity	heating 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 band	В]

12b. CO₂ emissions - communi	ity	heati	ing sc	heme
------------------------------	-----	-------	--------	------

12b. CO₂ emissions - commun	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) = [4689.54	x	0.216	= [1012.94	(367)
Electrical energy for community	y heat distribution	41.97	x	0.519	= [21.78	(372)
Total CO2 associated with com	munity systems					1034.72	(373)
Total CO2 associated with space	e 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 CO ₂ , kg/year					(376)(382) = [1262.14	(383)
Dwelling CO₂ emission rate					(383) ÷ (4) = [19.53	(384)
El value						84.57	
EI rating (section 14)						85	(385)
EI band						В	

13b. Primary energy - commu	nity 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) =	4689.54	x	1.22	=	5721.23	(367)
Electrical energy for communit	y heat distribution	41.97	x	3.07	=	128.85	(372)
Total primary energy associated	d with community systems					5850.08	(373)

Pumps and fans

Electricity for lighting

147.82 290.37 3.

3.07

3.07 =

5850.08 (376)

453.80 (378)

891.45 (379)

7195.33 (383)

111.35 (384)

Primary energy kWh/year

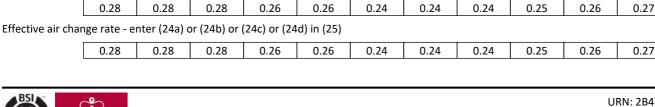
Dwelling primary energy rate kWh/m2/year

URN: 2B3P - Top Floor BC version 1 NHER Plan Assessor version 6.3.9



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

Client							L	ast modified	t	30/0	9/2020	
Address	2B4P, Kin	gston upor	Thames,	KT1								
1 Overall develling dimon	oio no											
1. Overall dwelling dimen	sions			A	rea (m²)		Ave	erage storey	•	,	/olume (m³)	
				7.0	,			neight (m)		•	rotuine (iii)	
Lowest occupied					73.74	(1a) x		2.50	(2a) =		184.35	(3a)
Total floor area	(1a) -	+ (1b) + (1d	c) + (1d)(1n) =	73.74	(4)						
Dwelling volume							(3a	a) + (3b) + (3	sc) + (3d)(3	n) =	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 fan	S							0	x 10 =		0	(7a)
Number of passive vents								0	x 10 =		0	(7b)
Number of flueless gas fires	;							0	x 40 =		0	(7c)
										Ai	r changes pe hour	er
Infiltration due to chimneys	s, flues, fans	, PSVs		(6a)	+ (6b) + (7a	a) + (7b) + (7	7c) =	0	÷ (5) =		0.00	(8)
If a pressurisation test has l	been carried	out or is in	ntended, pi	roceed to (1	17), otherw	vise continue	e from (9)	to (16)				
Air permeability value, q50,	expressed i	n cubic me	etres per h	our per squ	are metre	of envelope	area				3.00	(17)
If based on air permeability	value, then	(18) = [(17	') ÷ 20] + (8	3), otherwis	se (18) = (1	6)					0.15	(18)
Number of sides on which t	he dwelling	is sheltere	d								2	(19)
Shelter factor								1 -	- [0.075 x (19	9)] = [0.85	(20)
Infiltration rate incorporation	-								(18) x (2	0) =	0.13	(21)
Infiltration rate modified fo			_								_	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spee			4.40	4.30	2.00	2.00	2.70	1.00	4.30	4.50	4.70	(22)
5.10 Wind factor (22)m ÷ 4	5.00	4.90	4.40	4.50	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
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						1 2.55	2.50					(/
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 chang	ge rate for t	he applical	ole case:	· · · · · ·	· · · · · ·							•
If mechanical ventilation	n: air change	rate throu	ıgh system								0.50	(23a)
												7 (00)



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

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

75.65

0.27

0.27

(23c)

(24a)

(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							80 x	0.70	= 1.26				(26
External wall							.58 x	0.17	= 5.03	=			(29
Party wall							.83 x	0.00	= 0.00	\exists			(32
External wall							.63 x	0.20	= 5.93	\dashv			(29
Total area of exte	ernal eleme	ents ∇Δ m²					.43	0.20	3.33				(31
Fabric heat loss, '		_				_ 70	.43		(2)	5)(30) + (32) -	31.27	(31
Heat capacity Cm		•						(20)	(30) + (32)			N/A] (33] (34
Thermal mass pa			o²V					(20)	(30) + (32)	r (32a)(3	Ze)	250.00	٦.
·	-			adiv V] (35] (36
Thermal bridges:		aiculateu us	ing Apper	IUIX K						(22) . (26)	9.45] (36
Total fabric heat		F-1-					11	A	6	(33) + (40.72	[37
	Jan 	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
ا entilation heat! ا					г			T	1				٦.
_	17.30	17.10	16.91	15.94	15.74	14.78	14.78	14.58	15.16	15.74	16.13	16.52	(38
leat transfer coe										I			,
	58.02	57.82	57.63	56.66	56.47	55.50	55.50	55.30	55.88	56.47	56.85	57.24	_
									Average = 2	(39)112,	/12 =	56.61	(39
leat loss parame	eter (HLP),	W/m²K (39)m ÷ (4)										_
	0.79	0.78	0.78	0.77	0.77	0.75	0.75	0.75	0.76	0.77	0.77	0.78	_
									Average = 2	(40)112,	/12 =	0.77	(40
Number of days i	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 heatin	ag oporgy r	oquiromoni											
	<u> </u>	equirement										2 22	7 (42
Assumed occupa	•			. Mala a company	(25 · · N) ·	26						2.33	∫ (42
Annual average h		-					Lul	A	Çan.	Oct	Nov	89.62	(43
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
latatauaaaa	:		ماخم ممر مام	Value foot	au fuana Tabi	1 - 1 / 12	,						
Hot water usage	·							04.24	07.00	04.44	1 05 00	1 00 50	7
ot water usage	in litres pe 98.58	95.00	91.41	87.83	or from Tab	le 1c x (43 80.66	80.66	84.24	87.83	91.41	95.00	98.58]
[98.58	95.00	91.41	87.83	84.24	80.66	80.66		87.83	91.41 ∑(44)1		98.58]] (44
[98.58	95.00 r used = 4.1	91.41 8 x Vd,m	87.83 x nm x Tm/3	84.24 600 kWh/m	80.66 onth (see	80.66 Tables 1b,	1c 1d)		∑(44)1	.12 =	1075.42]] (44
[98.58	95.00	91.41	87.83	84.24	80.66	80.66		87.83	∑(44)1 119.44	.12 =	1075.42	
Hot water usage [Energy content o	98.58 of hot wate 146.19	95.00 r used = 4.1 127.86	91.41 8 x Vd,m	87.83 x nm x Tm/3	84.24 600 kWh/m	80.66 onth (see	80.66 Tables 1b,	1c 1d)		∑(44)1	.12 =	1075.42	
Energy content o	98.58 of hot wate 146.19	95.00 r used = 4.1 127.86	91.41 8 x Vd,m	87.83 x nm x Tm/3	84.24 600 kWh/m	80.66 onth (see	80.66 Tables 1b,	1c 1d)		∑(44)1 119.44	.12 =	1075.42	
Energy content o	98.58 of hot wate 146.19	95.00 r used = 4.1 127.86	91.41 8 x Vd,m	87.83 x nm x Tm/3	84.24 600 kWh/m	80.66 onth (see	80.66 Tables 1b,	1c 1d)		∑(44)1 119.44	.12 =	1075.42] (45
Energy content o	98.58 of hot wate 146.19 0.15 x (45) 21.93	95.00 r used = 4.1 127.86)m	91.41 .8 x Vd,m 131.94	87.83 x nm x Tm/3 115.03	84.24 6600 kWh/m 110.37	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d)	102.49	Σ(44)1 119.44 Σ(45)1	.12 =	1075.42 141.58 1410.04]] (4!] (4!
Energy content o Distribution loss Storage volume (98.58 of hot wate 146.19 0.15 x (45) 21.93 (litres) inclu	95.00 r used = 4.1 127.86)m	91.41 .8 x Vd,m 131.94	87.83 x nm x Tm/3 115.03	84.24 6600 kWh/m 110.37	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d)	102.49	Σ(44)1 119.44 Σ(45)1	.12 =	1075.42 141.58 1410.04 21.24]] (4!] (4!
Energy content o Distribution loss Storage volume (Water storage lo	98.58 of 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 blar or WV	87.83 x nm x Tm/3 115.03 17.25 WHRS storag	84.24 6600 kWh/m 110.37	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d)	102.49	Σ(44)1 119.44 Σ(45)1	.12 =	1075.42 141.58 1410.04 21.24]] (45
Energy content o Distribution loss Storage volume (Water storage lo	98.58 of 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 scools factor	91.41 .8 x Vd,m 131.94 19.79 blar or WV	87.83 x nm x Tm/3 115.03 17.25 WHRS storag	84.24 6600 kWh/m 110.37 16.56 e within sam	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d)	102.49	Σ(44)1 119.44 Σ(45)1	.12 =	1075.42 141.58 1410.04 21.24	(44)
Energy content o Distribution loss Storage volume (Water storage lo	98.58 of hot wate 146.19 0.15 x (45) 21.93 (litres) incluses: 's declared orage loss fa	95.00 r used = 4.1 127.86 m 19.18 uding any so	91.41 .8 x Vd,m 131.94 19.79 blar or WV	87.83 x nm x Tm/3 115.03 17.25 WHRS storag	84.24 6600 kWh/m 110.37 16.56 e within sam	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d)	102.49	Σ(44)1 119.44 Σ(45)1	.12 =	1075.42 141.58 1410.04 21.24 3.00	(45)
Energy content o Distribution loss Storage volume (Water storage lo) Manufacturer Hot water sto	98.58 of hot wate 146.19 0.15 x (45) 21.93 (litres) incluses: 's declared orage loss for from Table	95.00 r used = 4.1 127.86)m 19.18 uding any so	91.41 .8 x Vd,m 131.94 19.79 blar or WV	87.83 x nm x Tm/3 115.03 17.25 WHRS storag	84.24 6600 kWh/m 110.37 16.56 e within sam	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d)	102.49	Σ(44)1 119.44 Σ(45)1	.12 =	1075.42 141.58 1410.04 21.24 3.00	(4:1) (4:1) (4:1) (5:1) (5:1) (5:1)
Energy content o Distribution loss Storage volume (Water storage lo) Manufacturer Hot water sto	98.58 of hot wate 146.19 0.15 x (45) 21.93 (litres) incluses: 's declared orage loss for from Table factor from	95.00 r used = 4.1 127.86 m 19.18 uding any solutions factor actor from Table 2b	91.41 8 x Vd,m 131.94 19.79 Dlar or WV is not kno	x nm x Tm/3 115.03 17.25 WHRS storagown Wh/litre/day	84.24 6600 kWh/m 110.37 16.56 e within sam	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d)	102.49	Σ(44)1 119.44 Σ(45)1	.12 =	1075.42 141.58 1410.04 21.24 3.00 0.02 3.42] (45] (46] (47
Energy content o Distribution loss Storage volume (Water storage lo) Manufacturer Hot water sto Volume factor Temperature	98.58 of hot wate 146.19 0.15 x (45) 21.93 (litres) incluses: 's declared orage loss for from Table factor from om water s	95.00 r used = 4.1 127.86 m 19.18 uding any solutions factor actor from Table 2b	91.41 8 x Vd,m 131.94 19.79 Dlar or WV is not kno	x nm x Tm/3 115.03 17.25 WHRS storagown Wh/litre/day	84.24 6600 kWh/m 110.37 16.56 e within sam	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d)	102.49	Σ(44)1 119.44 Σ(45)1	.12 =	1075.42 141.58 1410.04 21.24 3.00 0.02 3.42 0.60	(45) (45) (45) (45) (47) (51) (52) (53) (53)
Energy content of Cont	98.58 of hot wate 146.19 0.15 x (45) 21.93 (litres) incluses: 's declared orage loss far from Table factor from om water selections) in (55)	95.00 r used = 4.1 127.86 m 19.18 uding any solutions factor from Tactor from Table 2b storage (kW	91.41 8 x Vd,m 131.94 19.79 blar or WV is not kno Table 2 (k'	87.83 x nm x Tm/3 115.03 17.25 WHRS storag wh Wh/litre/day	84.24 6600 kWh/m 110.37 16.56 e within sam	80.66 onth (see 95.24	80.66 Tables 1b,	1c 1d)	102.49	Σ(44)1 119.44 Σ(45)1	.12 =	1075.42 141.58 1410.04 21.24 3.00 0.02 3.42 0.60 0.13	(4!) (4!) (4!) (5:) (5:) (5:) (5:) (5:4)

If the vessel cont	ains dedica	ited solar st	orage or d	edicated 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 lo	ss for each	month from	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	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)
otal heat requir	ed for wate	er heating c	alculated fo	or each mo	onth 0.85 x	(45)m + (4	6)m + (57)	m + (59)m ·	+ (61)m				_ ` `
[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)
ا Solar DHW input						121.07	113.30	120.30	120.51	210.71	130.00	100.00	(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	162
Lutnut from wat							0.00	0.00	0.00	0.00	0.00	0.00	(63)
Dutput from wat ۱					1		445.56	122.50	120.01	446 74	456.00	160.00	7
	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 v	water heat	ing (kWh/m	onth) 0.25	5 × [0.85 ×	(45)m + (61)m] + 0.8 ×	[(46)m + ((57)m + (59)m]				_
l	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)
5. Internal gains													
J. Internal gams		Feb	Mar	Anr	May	lum	10.1	Διια	Con	Oct	Nov	Doc	
	Jan	reb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	NOV	Dec	
) Metabolic gains ا									1				٦ ,
	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 (ca.	Iculated in		., equation	L9 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	on 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 (ca	lculated in	Appendix L	_, equation	L15 or L15	sa), 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)
oump and fan ga	ins (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)
ا Losses e.g. evapo									1 0.00				(, ,
	-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)
Nator boating ga			-93.34	-33.34	-93.34	-33.34	-33.34	-93.34	-33.34	-93.34	-33.34	-93.34	(/ 1)
Rater heating ga ۱			22.22	22.12	=0.00	====		1	T =0.00				7 (-0)
L	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)
Fotal internal gai					+ (71)m + (7	-	i			i		1	_
L	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. Joiai gains			Access f	actor	Area	Sal	ar flux		a	FF		Gains	
			Table		m²		V/m²	spec	g cific data	specific	data	W	
								or T	Table 6b	or Table	e 6c		
East			0.77	7 x	10.90	x 1	9.64 x	0.9 x	0.45 x	0.70	= [46.73	(76)
South			0.77	7 x	2.22	x 4	6.75 x	0.9 x	0.45 x	0.70		22.66	(78)
West			0.77	7 x	2.30	x 1	9.64 x	0.9 x	0.45 x	0.70	=	9.86	(80
Solar gains in wat	tts Σ(74)m	(82)m											` `
]	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)
ا Fotal gains - inter				313.33	301.34	337.17	1 303.34	1 323.04	201.42	1/1.55	J J J J - + Z	1 00.12	(00)
i otai gairis - IIILEI 1				664.00	702 :-	607.00	657.51	647.55	F.C. 0.	400.00	445.00	422.5	7 (0.0
	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 interna	ıl te <u>mpera</u>	ture (heatir	ng season)										
Геmperature dur		•	,	area from 3	Tahle 0 Th1	(°C)						21.00	(85)
emperature uur	B HEALIH	perious III	and livilig o	Ca 11 UIII	1 abic 3, 1111	()						21.00	(00)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains					I -				1			7
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 livir 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 heatin						21.00	21.00	20.99	20.65	20.52	20.28] (07)
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	1		1	20.20	20.23	20.23	1 20.30	1 20.23	20.20		20.27] (00)
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		of dwelling		steps 3 to	7 in Table 9	1				1		_ ` .
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	e for the wh	ole dwellin	g fLA x T1 +	(1 - fLA) x 7	Г2							
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 m	ean internal	l temperati	ure from Tal	ble 4e whe	re appropr	riate						
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 requiren	nent											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains,			•	•								
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 (9-	4)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 t	emperature	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	ernal 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/mon	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	.12 = 🗀	1415.77	(98)
Space heating requirement	kWh/m²/ye	ear							(98)	÷ (4)	19.20	(99)
9b. Energy requirements	- communit	v heating s	cheme									
Fraction of space heat from				n (table 11	<u> </u>				'0' if	none	0.00	(301)
Fraction of space heat from			ilital y Systel	II (table 11	.,				1 - (3		1.00	(302)
Fraction of community hea									- (0	o_,	1.00	(303a)
Fraction of total space hear			ers						(302) x (30	3a) =	1.00	(304a)
Factor for control and char		-		munity spa	ace heating						1.00	(305)
Factor for charging method											1.00	(305a)
Distribution loss factor (Tal	ole 12c) for	community	heating sys	stem							1.05	(306)
Space heating												
Annual space heating requ	irement						1	1415.77]			(98)
Space heat from boilers							(98	8) x (304a) x	x (305) x (3	06) = [1486.56	(307a)
Water house												
Water heating								1724 52	1			(C 4)
Annual water heating requ	irement							1731.52	 205-\ : (2	06)	1010 10	(64)
Water heat from boilers							(64)) x (303a) x	(305a) x (3	Ub) = [1818.10	(310a)

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

149.00 (330a)

Total electricity for the above, kWh/year

149.00 (331)

Electricity for lighting (Appendix L)

325.11 (332)

Total delivered energy for all uses

(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) = 3778.76 (338)

10b. Fue	l costs -	communit	ty I	heat	ing 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	х	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		
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	e and water heating					814.70	(376)
Pumps and fans		149.00	x	0.519	= [77.33	(378)
Electricity for lighting		325.11	x	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	

13h Primary energy - community heating scheme

13b. Primary energy - commu	nity heating scheme							
		Energy kWh/year				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) =	3692.35	x	1.22	=	4504.67	(367)	
Electrical energy for community	y heat distribution	33.05	x	3.07	=	101.45	(372)	
Total primary energy associated	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

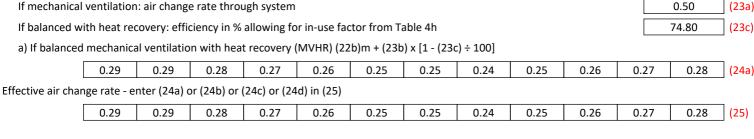
Dwelling primary energy rate kWh/m2/year

URN: 2B4P - Mid Floor version 1 NHER Plan Assessor version 6.3.9 SAP version 9.92



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

Client								Last modified	ł	30/0	9/2020	
Address	2B3P, Kir	ngston upo	n Thames,	KT1								
1. Overall dwelling dime	nsions											
				A	rea (m²)		A	erage storey height (m)	,	V	/olume (m³)	
Lowest occupied					74.00	(1a) x		2.50	(2a) =		185.00	(3a
Total floor area	(1a)	+ (1b) + (1	c) + (1d)(1n) =	74.00	(4)						
Dwelling volume							(3	3a) + (3b) + (3	c) + (3d)(3i	1) =	185.00	(5)
2. Ventilation rate												
									_	_ r	m³ per hour	_
Number of chimneys								0	x 40 =	L	0	(6a
Number of open flues								0	x 20 =		0	(6b
Number of intermittent fa	ns							0	x 10 =		0	(7a
Number of passive vents								0	x 10 =		0	(7k
Number of flueless gas fire	es							0	x 40 =		0	(70
										Aiı	r changes pe hour	er
Infiltration due to chimne	s, flues, fans	s, PSVs		(6a)	+ (6b) + (7	a) + (7b) + (7c) =	0	÷ (5) =		0.00	(8)
lf a pressurisation test has	been carried	d out or is i	ntended, pi	roceed to (17), otherw	ise continu	e from (9)) to (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	3), otherwis	se (18) = (1	6)					0.15	(18
Number of sides on which	the dwelling	g is sheltere	ed								2	(19
Shelter factor								1 -	- [0.075 x (19)] =	0.85	(20
Infiltration rate incorporat	ing shelter f	actor							(18) x (20	0) = [0.13	(21
nfiltration rate modified f	or monthly v	wind speed										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average 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 (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
Adjusted infiltration rate (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	(22
Calculate effective air cha	nge rate for t	the applica	ble case:				*	•			.	_
If mechanical ventilation	n: air chang	e rate thro	ugh system								0.50	(23
	o o o o o o o o o o o o o o o o o o o		-		atar frans T	abla 45					74.00	_ ·





				Gross area, m²	Openings m ²		area m²	U-value W/m²K	AxUW		/alue, /m².K	Ахк, kJ/K	
Window				,			.96 x	1.24	= 22.19		•	•	(27
Door							80 x	0.70	= 1.26	=			(26
External wall							.44 x	0.17	= 5.17	=			(29
Party wall							.15 x	0.00	= 0.00	\exists			(32)
External wall							65 x	0.20	= 0.53	\exists			(29
Fotal area of exte	ernal elemi	ents $\nabla \Delta$ m²					.85	0.20	0.55				(31
abric heat loss,		_				52	.83		(2)	5)(30) + (32) -	29.16	(33
Heat capacity Cm								(20)	(30) + (32)			N/A] (34] (34
hermal mass pa			^2 <i>l</i> ∕					(20)	(30) + (32)	r (32a)(3	Ze)	250.00	_ ` _
•				adiv V] (35
hermal bridges:		aicuiateu us	ang Appei	IUIX K						(22) . (26)	7.34] (36] (3-
otal fabric heat		Fala	N/a		Mari	1	11	A	Cara	(33) + (36.49	[37
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
ا entilation heat/ آ			-					1	T			1	٦,.
	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
leat transfer coe													_
	54.11	53.92	53.72	52.75	52.55	51.58	51.58	51.39	51.97	52.55	52.94	53.33	_
									Average = 2	(39)112,	/12 =	52.70	(39
leat loss parame	eter (HLP),	W/m²K (39)m ÷ (4)	_									_
	0.73	0.73	0.73	0.71	0.71	0.70	0.70	0.69	0.70	0.71	0.72	0.72	_
									Average = 2	(40)112,	/12 =	0.71	(40
Number of days i	in month (7	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 heatin	ag oporgy r	oquiromoni											
	<i>.</i>	equirement										2.24	7 (45
Assumed occupa	•			. Mala a company	(25 · N) ·	26						2.34	∫ (42
Annual average h	iot water u	isage in litre	es per day		= (25 x N) + May		11	A	Sep	Oct	Nov	89.76	(43
	lan	Fala	N/10 H			Jun	Jul	Aug		Oct	INOV		
latatauaaaa	Jan	Feb	Mar	Apr		1-1(42		J	ЗСР			Dec	
Hot water usage	in litres pe	r day for ea	ich month	Vd,m = fact	or from Tab)			04.55	,		٦
Hot water usage						le 1c x (43 80.78		84.37	87.96	91.55	95.14	98.73]
[in litres pe 98.73	er day for ea	91.55	87.96	sor from Tab	80.78	80.78	84.37		91.55 ∑(44)1	95.14]] (44
[in litres pe 98.73 of hot wate	95.14 r used = 4.1	91.55 8 x Vd,m	87.96 x nm x Tm/3	or from Tabl 84.37	80.78 onth (see	80.78 Tables 1b,	84.37 1c 1d)	87.96	∑(44)1	95.14	98.73]] (44
[in litres pe 98.73	er day for ea	91.55	87.96	sor from Tab	80.78	80.78	84.37		∑(44)1 119.62	95.14 .12 =	98.73 1077.07 141.80	
Energy content o	98.73 of hot wate	95.14 95.14 r used = 4.1	91.55 8 x Vd,m	87.96 x nm x Tm/3	or from Tabl 84.37	80.78 onth (see	80.78 Tables 1b,	84.37 1c 1d)	87.96	∑(44)1	95.14 .12 =	98.73	
Energy content o	98.73 of hot wate	95.14 95.14 r used = 4.1	91.55 8 x Vd,m	87.96 x nm x Tm/3	or from Tabl 84.37	80.78 onth (see	80.78 Tables 1b,	84.37 1c 1d)	87.96	∑(44)1 119.62	95.14 .12 =	98.73 1077.07 141.80	
Energy content o	98.73 of hot wate	95.14 95.14 r used = 4.1	91.55 8 x Vd,m	87.96 x nm x Tm/3	or from Tabl 84.37	80.78 onth (see	80.78 Tables 1b,	84.37 1c 1d)	87.96	∑(44)1 119.62	95.14	98.73 1077.07 141.80] (4!
Energy content o	98.73 of hot wate 146.42 0.15 x (45) 21.96	95.14 95.14 r used = 4.1 128.06)m	91.55 8 x Vd,m 132.14	x nm x Tm/3 115.21	84.37 8600 kWh/m 110.54	80.78 onth (see 95.39	80.78 Tables 1b,	1c 1d) 101.43	87.96	Σ(44)1 119.62 Σ(45)1	95.14 .12 =	98.73 1077.07 141.80 1412.21]] (4!] (4!
Energy content o Distribution loss Storage volume (98.73 of hot wate 146.42 0.15 x (45) 21.96 (litres) inclu	95.14 95.14 r used = 4.1 128.06)m	91.55 8 x Vd,m 132.14	x nm x Tm/3 115.21	84.37 8600 kWh/m 110.54	80.78 onth (see 95.39	80.78 Tables 1b,	1c 1d) 101.43	87.96	Σ(44)1 119.62 Σ(45)1	95.14 .12 =	98.73 1077.07 141.80 1412.21 21.27]] (45
Energy content o Distribution loss Storage volume (Water storage lo	98.73 of hot wate 146.42 0.15 x (45) 21.96 (litres) incluses:	r day for ea 95.14 r used = 4.1 128.06)m 19.21 uding any so	91.55 .8 x Vd,m 132.14 19.82 blar or WV	x nm x Tm/3 175.21 17.28 WHRS storag	84.37 8600 kWh/m 110.54	80.78 onth (see 95.39	80.78 Tables 1b,	1c 1d) 101.43	87.96	Σ(44)1 119.62 Σ(45)1	95.14 .12 =	98.73 1077.07 141.80 1412.21 21.27]] (45
Energy content o Distribution loss Storage volume (Water storage lo	98.73 of hot wate 146.42 0.15 x (45) 21.96 (litres) incluses:	95.14 r used = 4.1 128.06 m 19.21 uding any so	91.55 .8 x Vd,m 132.14 19.82 olar or WV	x nm x Tm/3 115.21 17.28 WHRS storag	84.37 8600 kWh/m 110.54 16.58 e within sam	80.78 onth (see 95.39	80.78 Tables 1b,	1c 1d) 101.43	87.96	Σ(44)1 119.62 Σ(45)1	95.14 .12 =	98.73 1077.07 141.80 1412.21 21.27] (4!] (4!] (4:
Energy content o Distribution loss Storage volume (Water storage lo	98.73 of hot wate 146.42 0.15 x (45) 21.96 (litres) incluses:	r day for ea 95.14 r used = 4.1 128.06)m 19.21 uding any so loss factor actor from T	91.55 .8 x Vd,m 132.14 19.82 olar or WV	x nm x Tm/3 115.21 17.28 WHRS storag	84.37 8600 kWh/m 110.54 16.58 e within sam	80.78 onth (see 95.39	80.78 Tables 1b,	1c 1d) 101.43	87.96	Σ(44)1 119.62 Σ(45)1	95.14 .12 =	98.73 1077.07 141.80 1412.21 21.27 3.00	(4:
Energy content o Distribution loss Storage volume (Water storage lo) Manufacturer' Hot water sto	98.73 of hot wate 146.42 0.15 x (45) 21.96 (litres) incluses: 's declared orage loss for from Table	r day for ea 95.14 r used = 4.1 128.06)m 19.21 uding any so loss factor actor from Tele 2a	91.55 .8 x Vd,m 132.14 19.82 olar or WV	x nm x Tm/3 115.21 17.28 WHRS storag	84.37 8600 kWh/m 110.54 16.58 e within sam	80.78 onth (see 95.39	80.78 Tables 1b,	1c 1d) 101.43	87.96	Σ(44)1 119.62 Σ(45)1	95.14 .12 =	98.73 1077.07 141.80 1412.21 21.27 3.00	(4:1) (4:1) (4:1) (5:1) (5:1) (5:1)
Energy content o Distribution loss Storage volume (Water storage lo b) Manufacturer Hot water sto	98.73 of hot wate 146.42 0.15 x (45) 21.96 (litres) incluses: 's declared orage loss for from Table factor from	r day for ea 95.14 r used = 4.1 128.06)m 19.21 uding any so loss factor actor from Table 2b	91.55 8 x Vd,m 132.14 19.82 blar or WV	x nm x Tm/3 115.21 17.28 WHRS storag	84.37 8600 kWh/m 110.54 16.58 e within sam	80.78 onth (see 95.39	80.78 Tables 1b,	1c 1d) 101.43	87.96	Σ(44)1 119.62 Σ(45)1	95.14 .12 =	98.73 1077.07 141.80 1412.21 21.27 3.00 0.02 3.42	(44) (45) (46) (47) (51) (52) (53) (53)
Energy content o Distribution loss Storage volume (Water storage lo) Manufacturer Hot water sto Volume factor Temperature	98.73 of hot wate 146.42 0.15 x (45) 21.96 (litres) incluses: 's declared orage loss for from Table factor from water s	r day for ea 95.14 r used = 4.1 128.06)m 19.21 uding any so loss factor actor from Table 2b	91.55 8 x Vd,m 132.14 19.82 blar or WV	x nm x Tm/3 115.21 17.28 WHRS storag	84.37 8600 kWh/m 110.54 16.58 e within sam	80.78 onth (see 95.39	80.78 Tables 1b,	1c 1d) 101.43	87.96	Σ(44)1 119.62 Σ(45)1	95.14 .12 =	98.73 1077.07 141.80 1412.21 21.27 3.00 0.02 3.42 0.60	(4:) (4:) (4:) (5:) (5:) (5:
Energy content of Cont	98.73 of hot wate 146.42 0.15 x (45) 21.96 (litres) incluses: 's declared orage loss for from Table factor from om water selections) in (55)	r day for ea 95.14 r used = 4.1 128.06)m 19.21 uding any so loss factor actor from Table 2a n Table 2b storage (kW	19.82 Diar or WV is not kno Table 2 (k	17.28 WHRS storag Wh/litre/day	84.37 8600 kWh/m 110.54 16.58 e within sam	80.78 onth (see 95.39	80.78 Tables 1b,	1c 1d) 101.43	87.96	Σ(44)1 119.62 Σ(45)1	95.14 .12 =	98.73 1077.07 141.80 1412.21 21.27 3.00 0.02 3.42 0.60 0.13	(4!) (4!) (4!) (5:) (5:) (5:) (5:)

	ntains dedica	ated solar st	torage or d	ledicated 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 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 e	ach month	from Table	3a, 3b or 3	ic					•				_
	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 wate	er heating c	alculated f	for each mo	onth 0.85 x	(45)m + (4	6)m + (57)ı	m + (59)m	+ (61)m				_
	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 inpu	t 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 wa	iter heater f	or each mo	nth (kWh/	month) (62	2)m + (63)m	1					•	1	
	173.72	152.72	159.45	141.63	137.85	121.81	115.70	128.74	129.07	146.92	157.00	169.10	
				•	!	Į.	Į.			∑(64)1	.12 = 1	1733.69	 (64)
Heat gains from	water heat	ing (kWh/m	nonth) 0.2!	5 × [0.85 ×	(45)m + (61	.)m] + 0.8 ×	: [(46)m + (57)m + (59))m]	2(1)			(- ,
Ü	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)
					1 20.00			1	1 00:2:		1 0	1 00.00	
5. Internal gair	ns												
	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 (c	calculated in	Appendix I	_, equation	L9 or L9a),	also see Ta	able 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 Appendi:	x L, equation	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	calculated in	Appendix I	L, equation	L15 or L15	ia), 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	ole 5)						1		1		1	_ ` `
	-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													
00	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)
Гotal internal ga							00.00	74.03	70.70	02.02	05.00	32.73	(/ _/
rotar internal ga	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)
	377.73	373.74	302.99	342.41	321.50	301.41	288.20	294.00	304.32	323.31	349.19	307.07	(/3)
6. Solar gains													
			Access f		Area		ar flux		g	FF		Gains	
			Table	: 6d	m²	V	V/m²	-	cific data Table 6b	specific of Table		W	
													7 (- 0
North			0.7		6.10				0.45 x			14.16	_] (74) □
NorthEast			0.7		3.20	-		0.9 x	0.45 x			7.88	(75)
West	_, ,		0.7	7 x	8.66	x 1	9.64 x	0.9 x	0.45 x	0.70	=	37.13	(80)
folar gains in w	atts ∑(74)m					1	ı			ı			7
Joiai gains in we		115.73	194.50	295.78	377.09	393.39	371.44	308.60	229.62	138.00	73.68	48.77	(83)
-	59.17												
-			(83)m	1									_
Total gains - inte			(83)m 557.49	638.19	698.66	694.80	659.70	602.61	534.14	463.31	422.87	415.84	(84)
Total gains - inte	ernal and so 436.90	lar (73)m + 491.48	557.49	1	698.66	694.80	659.70	602.61	534.14	463.31	422.87	415.84	(84)
Total gains - inte	436.90	lar (73)m + 491.48 ture (heatin	557.49 ng season)	1			659.70	602.61	534.14	463.31	422.87		
otal gains - inte	436.90	lar (73)m + 491.48 ture (heatin	557.49 ng season)	1			659.70	602.61	534.14	463.31	422.87	21.00	(84)

Ministrion factor for gains for leving area n1, m (see Table 9) 0.89 0.8	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temp of living area Ta (steps 3 to 7 in Table 9-1 Temperature during betang periods in the rest of dwelling from Table 9-1 Temperature during betang periods in the rest of dwelling from Table 9-1 Temperature during betang periods in the rest of dwelling 12-4 (aligned betang 12-4 (align	Utilisation factor for gains	or living are	ea n1,m (se	e Table 9a)									
The presentation 10	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 persuant of wing head in persival in the result of the line in the line i	Mean internal temp of livir	g area T1 (s	steps 3 to 7	in Table 9c)	_		_		_	_	_	_
Mathematics		!				1	21.00	21.00	20.99	20.85	20.56	20.34	(87)
Main internal temperature the rest of dwelling n2,			1			1	ı			1		1	7
1.00 0.99 0.97 0.86 0.64 0.43 0.29 0.34 0.60 0.92 0.99 1.00 0.99 0.00 0.90 0.00 0.90 0.00 0.90 0.00 0.90 0.00 0.90 0.00 0.90 0.90 0.00 0.90		1		1	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 SU- 19.45 19.62 19.91 20.21 20.32 20.34 20.35 20.33 20.16 19.76 19.49 90) Living area fraction					0.64	0.42	0.20	0.24	0.60	0.02	0.00	1.00	7 (00)
1945 1962 1991 2021 2032 2034 2036 2035 2033 2016 1976 1948 1991 2048 1991 2048 1991 2048 1991 2048 1991 2048 1991 2048 1991 2048 2048 2048 2048 2048 2048 2048 2048 2048 2048 2048 2048 2048 2048 2049 2015 1987 2024 2049 2015 1987 2024 2049 2015 2049		ļ.					Į	0.34	0.60	0.92	0.99	1.00] (89)
Living area fraction Living area a fraction of total pace heating requirement by the whole dwelling ILA x T1 + (1-1LA) x T2				1		1	1	20.35	20.33	20.16	19.76	19.43	(90)
Mean internal temperature for the whole dwelling [fLa x T1 + [1 - fLa] x T2 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) 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 20.65 20.49 20.15 19.87 (93) 8. Space heating requirement summarized programment summarized programma										1		<u> </u>	_ ` <i>'</i>
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 20.65 20.49 20.15 19.87 (93) 8. Space heating requirement Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Utilisation factor for gains, mm 100 0.99 0.97 0.86 0.66 0.45 0.32 0.36 0.63 0.93 0.99 1.00 (94) Useful gains, nmGm, 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 (95) Monthly average external temperature from Table U1 436.20 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, m, W (193)m x (193)m (1	_	for the wh	ole dwellin	g fLA x T1 +	(1 - fLA) x	T2					` '		_ ` '
S. Space heating requirement Substitution Sub	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)
Same	Apply adjustment to the m	ean interna	l temperati	ure from Tal	ble 4e whe	ere appropr	iate						
Utilisation factor for gains, nm 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) Useful gains, nmGm, 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 (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 x (193)m - (96)m) 883.43 816.12 740.27 614.24 469.92 312.61 209.48 219.02 340.50 519.94 690.86 835.56 (97) Space heating requirement, kWh/month 0.024 x (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 **Praction of space heat from secondary/supplementary system (table 11) Fraction of space heat from community heating scheme 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 Back charging method (Table 4c(3)) for community system Space heating requirement **Total fine fine fine fine fine fine fine fine	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, npm 1.00	8. Space heating requiren	nent											
1.00	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains, nmGm, 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 (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 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 (97) Space heating requirement, kWh/month 0.024 x (197)m - (95)m] x (41)m 303.72 213.61 149.93 44.92 6.01 0.00 0.00 0.00 0.00 67.35 196.02 313.15 Space heating requirement kWh/m²/year	Utilisation factor for gains,	ηm											
Monthly average external temperature from Table U1 Marked Ma	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, nmGm, W (9	4)m x (84)m	1										
Haat loss rate for mean internal temperature, Lm, W [(39)m × (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 (97) 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 (98) Space heating requirement kWh/m²/year (98) ± (41)m (17.60) (99)	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 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 (98) ÷ (4) 17.60 (99) [95] 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 (303a) Fraction of total space heat from community boilers (302) x (303a) = 1.00 (304a) Factor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community water heating Annual space heating requirement Water heating Annual water heating requirement [1302.45] (98) x (304a) x (305) x (306) = 1367.57 (307a)	Monthly average external t	emperature	e 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		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 303.72 221.36 149.93 44.92 6.01 0.00 0.00 0.00 0.00 67.35 196.02 313.15 Σ(98)15, 1012 = 1302.45 (98) 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 1 - (301) = 1.00 (302) Fraction of community heat from 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 (98) x (304a) x (305) x (306) = 1367.57 (307a) Water heating Annual water heating requirement (733.69) (64)			1		x [(93)m -					,		1	7
303.72 221.36 149.93 44.92 6.01 0.00 0.00 0.00 0.00 67.35 196.02 313.15 ∑(98)15, 1012 = 1302.45 (98) 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 1 - (301) = 1.00 (302) 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 (305a) Factor for control and charging method (Table 4c(3)) for community space heating 1.00 (305a) Distribution loss factor (Table 12c) for community heating system 1.05 (306) Space heating Annual space heating requirement 1302.45 (98) Water heating Annual water heating requirement 1733.69 (64)		!					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 $(98) \pm (4)$ 17.60 (99) Space heating requirements - community heating scheme						1	0.00	1 0 00		67.05	405.00	242.45	٦
Space heating requirement kWh/m²/year (98) ÷ (4) 17.60 (99) Phone	303.72	221.36	149.93	44.92	6.01	0.00	0.00	0.00	1]] (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 Factor for charging method (Table 4c(3)) for community water heating Distribution loss factor (Table 12c) for community heating system 1.05 (306) 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)	Snace heating requirement	k\\\h/m²/\\	ear						7(30				_
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) Fraction of total space heat from community boilers 1.00 (305b) Fraction of total space heating method (Table 4c(3)) for community space heating 1.00 (305c) 1.00	Space nearing requirement	. KVVII/III / y	cai							(38)	. (4)	17.00	(99)
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 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 method (Table 4c(3)) for community space heating Fraction of total space heating Fractio	9b. Energy requirements	- communit	y 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 To (303a) 1.00 (305a) 1.00 (305a) 1.00 (305a) 1.05 (306b) Space heating (98) x (304a) x (305) x (306) = 1367.57 (307a)	Fraction of space heat from	secondary	/suppleme	ntary systen	n (table 11	1)				'0' if	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 1302.45 (98) x (304a) x (305) x (306) = 1367.57 (307a) Water heating Annual water heating requirement 1733.69 (64)	•									1 - (3	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) = 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 1302.45 (98) x (304a) x (305) x (306) = 1367.57 (307a) Water heating Annual water heating requirement 1733.69 (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) (98) (98) (98) (98) × (304a) × (305) × (306) = 1367.57 (307a) (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	Distribution loss factor (Tal	ne 12C) for	community	neating sys	stem							1.05	J (306)
Annual space heating requirement	Snace heating												
Space heat from boilers (98) x (304a) x (305) x (306) = 1367.57 (307a) Water heating 1733.69 (64)		rement						<u> </u>	1302.45]			(98)
Water heating Annual water heating requirement 1733.69 (64)		2								ч х (305) х (3	06) =	1367.57	_
Annual water heating requirement 1733.69 (64)	,							(5.	, (== .5)	(= >= / (0	-,		_ (2 4)
	Water heating												
(64) (992.) (995.) (995.) (995.)	Annual water heating requ	irement						1	1733.69]			(64)
Water heat from boilers $(64) \times (303a) \times (305a) \times (306) = 1820.37$ $(310a)$	Water heat from 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)

Total electricity for the above, kWh/year

169.28 (331)

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

	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] x	4.24	x 0.01 =	77.18	(342a)
Pumps and fans	169.28] x	13.19	x 0.01 =	22.33	(349)
Electricity for lighting	325.04	x	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		
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 heat	ing)						
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 community heat distr	ibution	31.88	x	0.519	= [16.55	(372)
Total CO2 associated with community syst	tems					785.93	(373)
Total CO2 associated with space and water	r heating					785.93	(376)
Pumps and fans		169.28	X	0.519	= [87.85	(378)
Electricity for lighting		325.04	x	0.519	= [168.69	(379)
Total CO₂, kg/year					(376)(382) = [1042.47	(383)
Dwelling CO₂ emission rate					(383) ÷ (4) = [14.09	(384)
El value						88.26	
El rating (section 14)						88	(385)
El 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 (376)

519.67 (378)

997.86 (379)

5960.98 (383)

80.55 (384)

Primary energy kWh/year

Dwelling primary energy rate kWh/m2/year



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

Client						L	ast modified	t	30/09	30/09/2020		
Address	3B4P, King	3B4P, Kingston upon Thames, KT1										
1. Overall dwelling dimen	sions											
				Α	rea (m²)			erage storey neight (m)	•	Vo	olume (m³)	
Laurant annual ad					72.42] (4-)			7 (2-)		404.05	7 (2-)
Lowest occupied Total floor area	(10)	· /1b\ · /1	o) , (1 d) (1		72.42	(1a) x		2.50	」(2a) =		181.05	(3a)
Dwelling volume	(1a) 1	+ (10) + (10	c) + (1d)(III) = [72.42	(4)	(2	a) + (3b) + (3	(a)	n) - [181.05	(5)
Dweiling volume							(3	a) + (5b) + (5	c) + (3u)(3	11) –	161.05	_] (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 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	changes pe	r
In City and the second second	- fl f	DC) /-		(6-)	. (Ch) . (7.	.) . (71-) . (7 -\	0	7 . (5)		hour	7 (0)
Infiltration due to chimneys If a pressurisation test has			atandad n		+ (6b) + (7a			0) to (14)	_ ÷ (5) =		0.00	(8)
Air permeability value, q50								10 (10)			3.00	(17)
							e al ea				0.15	(18)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)										2	(19)	
Number of sides on which the dwelling is sheltered Shelter factor $1 - [0.075 \times (19)] =$									9)] = -	0.85	(20)	
Infiltration rate incorporating shelter factor (18) \times (20) =									0.13	(21)		
Infiltration rate modified for monthly wind speed:												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spee	ed from Table	e 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												
0.16	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:												
If mechanical ventilation: air change rate through system 0.50 (23a)											(23a)	



0.28

0.28

0.28

0.28

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

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

0.28

0.28

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

0.26

0.26

0.26

0.26

75.65

0.27

0.27

0.27

0.27

(23c)

(24a)

(25)

0.24

0.24

0.24

0.24

0.24

0.24

0.25

0.25

0.26

0.26

	and near io	ss paramet	er										
Element			i	Gross area, m²	Openings m ²	Net A,	area m²	U-value W/m²K	A x U W		/alue, /m².K	Αxκ, kJ/K	
Window						15	.02 x	1.24	= 18.56				(27)
Door						1.	80 x	0.70	= 1.26				(26)
External wall						30	.08 x	0.17	= 5.11				(29
Party wall						32	.93 x	0.00	= 0.00				(32)
External wall						10	.38 x	0.20	= 2.08				(29
Roof						72	.42 x	0.13	= 9.41				(30)
Total area of ex	ternal elem	ents ∑A, m²	:			129).70						(31)
Fabric heat loss,	, W/K = ∑(A	× U)							(26	i)(30) + (32) =	36.43	(33)
Heat capacity C	m = ∑(A x κ))						(28)	(30) + (32) +	· (32a)(3	2e) =	N/A	(34)
Thermal mass p	arameter (٦	TMP) 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 hea	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	efficient, 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	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	_ ` · ·
	31.00	28.00		30.00	31.00	30.00	31.00						_ ` · ·
4. Water heati	31.00	28.00		30.00	31.00	30.00	31.00					31.00	(40)
4. Water heati	31.00 ng energy r ancy, N	28.00 requiremen	t				31.00					31.00 2.30	(40)
4. Water heati	31.00 ng energy r ancy, N	28.00 requiremen	t				31.00					31.00	(40)
4. Water heati Assumed occup Annual average	ng energy r ancy, N hot water t	28.00 requirementusage in litre	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	ancy, N hot water to Jan e in litres pe	28.00 requirementusage in litre	t es per day Mar ach month	Vd,average Apr Vd,m = fact	= (25 x N) + May tor from Tabl	36 Jun e 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	ng energy r ancy, N hot water t	28.00 requiremen usage in litre 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)
4. Water heati Assumed occup Annual average Hot water usage	ng energy rancy, N hot water to Jan e in litres pe	28.00 requirementusage in litro Feb er day for ea	es per day Mar ach month	Vd,average Apr Vd,m = fact 87.13	= (25 x N) + May tor from Tabl	36 Jun e 1c x (43 80.02	Jul) 80.02	31.00 Aug 83.57	30.00 Sep	31.00 Oct	30.00 Nov	2.30 88.91 Dec	(40)
4. Water heati Assumed occup Annual average Hot water usage	ng energy rancy, N hot water to Jan e in litres pe	28.00 requirementusage in litro Feb er day for ea	es per day Mar ach month	Vd,average Apr Vd,m = fact 87.13	= (25 x N) + May tor from Tabl	36 Jun e 1c x (43 80.02	Jul) 80.02	31.00 Aug 83.57	30.00 Sep	31.00 Oct	30.00 Nov	2.30 88.91 Dec 97.80	(40)
4. Water heati Assumed occup Annual average Hot water usage	ng energy rancy, N hot water to Jan e in litres pe 97.80	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 e 1c x (43 80.02 onth (see	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	(40)
4. Water heati Assumed occup Annual average Hot water usage Energy content	ng energy rancy, 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	Vd,average Apr Vd,m = fact 87.13 x nm x Tm/3	= (25 x N) +	36 Jun e 1c x (43 80.02 onth (see	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 Energy content	ancy, N hot water to Jan e in litres per 97.80 of hot wates 145.03	28.00 requirement usage in litre Feb er day for ear 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 e 1c x (43 80.02 onth (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 =	2.30 88.91 Dec 97.80 1066.87 140.45 1398.84	(40 (42 (43 (44) (44
4. Water heati Assumed occup Annual average Hot water usage Energy content Distribution loss	ancy, 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) + May tor from Tabl 83.57 3600 kWh/m 109.50	36 Jun e 1c x (43 80.02 onth (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 Distribution loss	31.00 ng energy r ancy, N hot water to Jan e in litres pe 97.80 of hot wate 145.03 s 0.15 x (45 21.75 (litres) inclination	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) + May tor from Tabl 83.57 3600 kWh/m 109.50	36 Jun e 1c x (43 80.02 onth (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 =	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	31.00 ng energy r ancy, N hot water t Jan e in litres pe 97.80 of hot wate 145.03 s 0.15 x (45 21.75 (litres) incluses:	28.00 requirement usage in litre Feb er day for eat 94.24 er used = 4.1 126.84 f)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 Tabl 83.57 3600 kWh/m 109.50	36 Jun e 1c x (43 80.02 onth (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 =	2.30 88.91 Dec 97.80 1066.87 140.45 1398.84	(40) (42) (43) (44) (44)
4. Water heati Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage le b) Manufacture	31.00 ng energy r ancy, N hot water to Jan e in litres pe 97.80 of hot wate 145.03 s 0.15 x (45 21.75 (litres) inch oss: r's declared	zequirement usage in litro Feb er day for eat 94.24 er used = 4.1 126.84 f)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 Tabl 83.57 3600 kWh/m 109.50 16.42 ge within sam	36 Jun e 1c x (43 80.02 onth (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 =	2.30 88.91 Dec 97.80 1066.87 140.45 1398.84	(40) (42) (43) (44) (44) (45) (46)
4. Water heati Assumed occup Annual average Hot water usage Energy content Distribution loss Storage volume Water storage le	31.00 ng energy r ancy, N hot water to Jan e in litres per 97.80 of hot water 145.03 s 0.15 x (45 21.75 (litres) inchors: r's declared orage loss f	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 Tabl 83.57 3600 kWh/m 109.50 16.42 ge within sam	36 Jun e 1c x (43 80.02 onth (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 =	2.30 88.91 Dec 97.80 1066.87 140.45 1398.84 21.07 3.00	(40 (42 (43 (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	31.00 ng energy r ancy, N hot water to Jan e in litres per 97.80 of hot water 145.03 s 0.15 x (45 21.75 (litres) inclusors: r's declared orage loss for from Tab	28.00 requirement usage in litro Feb er day for eat 94.24 er used = 4.1 126.84 f)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 Tabl 83.57 3600 kWh/m 109.50 16.42 ge within sam	36 Jun e 1c x (43 80.02 onth (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 =	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	31.00 ng energy r ancy, N hot water to Jan e in litres per 97.80 of hot water 145.03 s 0.15 x (45 21.75 (litres) incheoss: r's declared orage loss for from Table e factor from	28.00 requirement usage in litro Feb er day for ear 94.24 er used = 4.1 126.84 i)m 19.03 uding any so 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 storag wn Wh/litre/da	= (25 x N) + May tor from Tabl 83.57 3600 kWh/m 109.50 16.42 ge within sam	36 Jun e 1c x (43 80.02 onth (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 =	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	31.00 ng energy r ancy, N hot water to Jan e in litres per 97.80 of hot water to 145.03 s 0.15 x (45 21.75 (litres) inclusors: r's declared orage loss from Table e factor from rom water s	28.00 requirement usage in litro Feb er day for ear 94.24 er used = 4.1 126.84 i)m 19.03 uding any so 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 storag wn Wh/litre/da	= (25 x N) + May tor from Tabl 83.57 3600 kWh/m 109.50 16.42 ge within sam	36 Jun e 1c x (43 80.02 onth (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 =	2.30 88.91 Dec 97.80 1066.87 140.45 1398.84 21.07 3.00 0.02 3.42	(40) (42) (42) (43) (43) (44) (45) (46) (47)

	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 s	torage or d	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 I	oss 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 e	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 requi	ired for wat	er heating o	calculated f	or each mo	onth 0.85 x	(45)m + (4	6)m + (57)r	n + (59)m +	+ (61)m				
	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)
Solar DHW inpu	t calculated	l 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 wa	iter heater	for each mo	onth (kWh/i	month) (62	2)m + (63)m	ı							
	172.33	151.51	158.20	140.54	136.80	120.91	114.86	127.77	128.09	145.79	155.76	167.76	
										∑(64)1	.12 = 1	720.32	(64)
Heat gains from	water heat	ting (kWh/n	nonth) 0.25	5 × [0.85 ×	(45)m + (61	.)m] + 0.8 ×	: [(46)m + (5	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)
5. Internal gain	ns												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	(Table 5)	_		_		•							
	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 (d	alculated ir	n Appendix I	L, equation	L9 or L9a),	also see Ta	ble 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	(calculated	in Appendi	x L, equatio	on L13 or L	L3a), also se	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 (d	calculated in	n Appendix	L, equation	L15 or L15	a), 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	(69)
Pump and fan g	ains (Table	5a)											
	0.00	1					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)
Losses e.g. evap		1	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	(70)
Losses e.g. evap		1	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14		(70)
Losses e.g. evap	oration (Ta	ble 5) -92.14						1	1	İ			. ,
	oration (Ta	ble 5) -92.14						1	1	İ		-92.14	` ,
	oration (Ta -92.14 gains (Table 94.17	ble 5) -92.14 5) 92.12	-92.14 87.86	-92.14 82.06	-92.14 78.29	-92.14 72.99	-92.14	-92.14	-92.14	-92.14	-92.14	-92.14	(71)
Water heating g	oration (Ta -92.14 gains (Table 94.17	ble 5) -92.14 5) 92.12	-92.14 87.86	-92.14 82.06	-92.14 78.29	-92.14 72.99	-92.14	-92.14	-92.14	-92.14	-92.14	92.13	(71)
Water heating g	-92.14 gains (Table 94.17 ains (66)m	ble 5) -92.14 5) 92.12 + (67)m + (6	-92.14 87.86 68)m + (69)	-92.14 82.06 m + (70)m	-92.14 78.29 + (71)m + (7	-92.14 72.99 72)m	-92.14 68.49	-92.14 74.26	-92.14 76.31	-92.14 82.31	-92.14 89.09	92.13	(71) (72)
Water heating g	-92.14 gains (Table 94.17 ains (66)m	ble 5) -92.14 5) 92.12 + (67)m + (6	-92.14 87.86 68)m + (69) 358.20	-92.14 82.06 m + (70)m - 337.92	-92.14 78.29 + (71)m + (7	-92.14 72.99 72)m 297.54	-92.14 68.49 284.59	-92.14 74.26	-92.14 76.31	-92.14 82.31 321.13	-92.14 89.09	92.13	(71) (72)
Water heating g	-92.14 gains (Table 94.17 ains (66)m	ble 5) -92.14 5) 92.12 + (67)m + (6	-92.14 87.86 68)m + (69) 358.20	-92.14 82.06 m + (70)m - 337.92	-92.14 78.29 + (71)m + (7 317.39	-92.14 72.99 72)m 297.54 Sol	-92.14 68.49 284.59	-92.14 74.26 290.28	-92.14 76.31 300.65	-92.14 82.31 321.13	-92.14 89.09 344.67	-92.14 92.13 362.26 Gains	(71) (72)
Water heating g	-92.14 gains (Table 94.17 ains (66)m	ble 5) -92.14 5) 92.12 + (67)m + (6	-92.14 87.86 68)m + (69) 358.20	-92.14 82.06 m + (70)m - 337.92	-92.14 78.29 + (71)m + (7 317.39	-92.14 72.99 72)m 297.54 Sol	-92.14 68.49 284.59	-92.14 74.26 290.28	-92.14 76.31 300.65	-92.14 82.31 321.13	-92.14 89.09 344.67	92.13	(71) (72)
Water heating g	-92.14 gains (Table 94.17 ains (66)m	ble 5) -92.14 5) 92.12 + (67)m + (6	-92.14 87.86 68)m + (69) 358.20	-92.14 82.06 m + (70)m 337.92 Factor 6d	-92.14 78.29 + (71)m + (7 317.39	-92.14 72.99 72)m 297.54 Sol	-92.14 68.49 284.59 ar flux V/m²	-92.14 74.26 290.28 spec	-92.14 76.31 300.65	-92.14 82.31 321.13 FF specific c or Table	-92.14 89.09 344.67	-92.14 92.13 362.26 Gains W	(71) (72) (73)
Water heating garden for the state of the st	-92.14 gains (Table 94.17 ains (66)m	ble 5) -92.14 5) 92.12 + (67)m + (6	-92.14 87.86 68)m + (69) 358.20 Access f Table	-92.14 82.06 m + (70)m 337.92 Factor 6d	-92.14 78.29 + (71)m + (7 317.39 Area m ²	-92.14 72.99 72)m 297.54 Sol	-92.14 68.49 284.59 ar flux V/m²	-92.14 74.26 290.28 spec or T	-92.14 76.31 300.65 g ific data able 6b	-92.14 82.31 321.13 FF specific c or Table 0.70	-92.14 89.09 344.67	-92.14 92.13 362.26 Gains W	(71) (72) (73)
Water heating garage Total internal garage 6. Solar gains West South	oration (Ta -92.14 gains (Table 94.17 ains (66)m 372.76	ble 5) -92.14 5) 92.12 + (67)m + (6) 370.78	-92.14 87.86 68)m + (69) 358.20 Access f Table	-92.14 82.06 m + (70)m 337.92 Factor 6d	-92.14 78.29 + (71)m	-92.14 72.99 72)m 297.54 Sol	-92.14 68.49 284.59 ar flux V/m²	-92.14 74.26 290.28 spec or T	-92.14 76.31 300.65 g ific data able 6b 0.45 x	-92.14 82.31 321.13 FF specific c or Table 0.70	-92.14 89.09 344.67	-92.14 92.13 362.26 Gains W	(71) (72) (73)
Water heating garage Total internal garage. 6. Solar gains West	oration (Ta -92.14 gains (Table 94.17 ains (66)m 372.76	ble 5) -92.14 5) 92.12 + (67)m + (6) 370.78	-92.14 87.86 68)m + (69) 358.20 Access f Table	-92.14 82.06 m + (70)m 337.92 Factor 6d 7 x [7 x [-92.14 78.29 + (71)m	-92.14 72.99 72)m 297.54 Sol	-92.14 68.49 284.59 ar flux V/m² 9.64 x 6.75 x	-92.14 74.26 290.28 spec or T	-92.14 76.31 300.65 g ific data able 6b 0.45 x	-92.14 82.31 82.31 FF specific c or Table 0.70 0.70	-92.14 89.09 344.67	-92.14 92.13 362.26 Gains W 45.19 45.72	(71) (72) (73) (80) (78)
Water heating garden for the state of the st	oration (Ta -92.14 gains (Table 94.17 ains (66)m 372.76 atts ∑(74)m 90.91	ble 5) -92.14 5) 92.12 + (67)m + (6) 370.78 n(82)m 163.28	-92.14 87.86 88)m + (69) 358.20 Access f Table 0.7 0.7	-92.14 82.06 m + (70)m 337.92 Factor 6d	-92.14 78.29 + (71)m	-92.14 72.99 72)m 297.54 Sol W x 1 x 4	-92.14 68.49 284.59 ar flux V/m²	-92.14 74.26 290.28 spec or T 0.9 x 0.9 x	-92.14 76.31 300.65 g ific data able 6b 0.45 x 0.45 x	-92.14 82.31 321.13 FF specific c or Table 0.70	-92.14 89.09 344.67	-92.14 92.13 362.26 Gains W 45.19 45.72	(71) (72) (73)
Water heating garage Total internal garage 6. Solar gains West South	oration (Ta -92.14 gains (Table 94.17 ains (66)m 372.76 372.76	ble 5) -92.14 5) 92.12 + (67)m + (6 370.78 n(82)m 163.28 plar (73)m +	-92.14 87.86 68)m + (69) 358.20 Access f Table 0.7 0.7	-92.14 82.06 m + (70)m 337.92 Factor 6d 7	-92.14 78.29 + (71)m	-92.14 72.99 72)m 297.54 Sol W x 1 x 4 374.48	-92.14 68.49 284.59 ar flux V/m² 9.64 x 6.75 x	-92.14 74.26 290.28 spec or T 0.9 x 0.9 x 320.42	-92.14 76.31 300.65 g ific data able 6b 0.45 x 0.45 x 268.96	-92.14 82.31 82.31 FF specific c or Table 0.70 0.70 185.66	-92.14 89.09 344.67 data 6c = [-92.14 92.13 362.26 Gains W 45.19 45.72	(71) (72) (73) (80) (78) (83)
Water heating garden for the state of the st	oration (Ta -92.14 gains (Table 94.17 ains (66)m 372.76 atts ∑(74)m 90.91	ble 5) -92.14 5) 92.12 + (67)m + (6) 370.78 n(82)m 163.28	-92.14 87.86 88)m + (69) 358.20 Access f Table 0.7 0.7	-92.14 82.06 m + (70)m 337.92 Factor 6d 7 x [7 x [-92.14 78.29 + (71)m	-92.14 72.99 72)m 297.54 Sol W x 1 x 4	-92.14 68.49 284.59 ar flux V/m² 9.64 x 6.75 x	-92.14 74.26 290.28 spec or T 0.9 x 0.9 x	-92.14 76.31 300.65 g ific data able 6b 0.45 x 0.45 x	-92.14 82.31 82.31 FF specific c or Table 0.70 0.70	-92.14 89.09 344.67	-92.14 92.13 362.26 Gains W 45.19 45.72	(71) (72) (73) (80) (78)
Water heating garden for the state of the st	oration (Ta -92.14 gains (Table 94.17 ains (66)m 372.76 atts ∑(74)m 90.91 ernal and so 463.67	ble 5) -92.14 5) 92.12 + (67)m + (6) 370.78 n(82)m 163.28 blar (73)m + 534.06	-92.14 87.86 88)m + (69) 358.20 Access f Table 0.7 0.7 240.97 (83)m 599.16	-92.14 82.06 m + (70)m 337.92 Factor 6d 7	-92.14 78.29 + (71)m	-92.14 72.99 72)m 297.54 Sol W x 1 x 4 374.48	-92.14 68.49 284.59 ar flux V/m² 9.64 x 6.75 x	-92.14 74.26 290.28 spec or T 0.9 x 0.9 x 320.42	-92.14 76.31 300.65 g ific data able 6b 0.45 x 0.45 x 268.96	-92.14 82.31 82.31 FF specific c or Table 0.70 0.70 185.66	-92.14 89.09 344.67 data 6c = [-92.14 92.13 362.26 Gains W 45.19 45.72	(71) (72) (73) (80) (78) (83)
Water heating garden for the state of the st	atts ∑(74)m 90.91 ernal and so 463.67	ble 5) -92.14 5) 92.12 + (67)m + (6) 370.78 n(82)m 163.28 blar (73)m + 534.06	-92.14 87.86 68)m + (69)i 358.20 Access f Table 0.7 0.7 240.97 (83)m 599.16	-92.14 82.06 m + (70)m 337.92 Factor 6d 7	-92.14 78.29 + (71)m	-92.14 72.99 72)m 297.54 Sol W x 1 x 4 374.48	-92.14 68.49 284.59 ar flux V/m² 9.64 x 6.75 x	-92.14 74.26 290.28 spec or T 0.9 x 0.9 x 320.42	-92.14 76.31 300.65 g ific data able 6b 0.45 x 0.45 x 268.96	-92.14 82.31 82.31 FF specific c or Table 0.70 0.70 185.66	-92.14 89.09 344.67 data 6c = [-92.14 92.13 362.26 Gains W 45.19 45.72 76.67	(71) (72) (73) (80) (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	0.99	0.98	0.92	0.79	0.59	0.43	0.47	0.73	0.95	0.99	1.00	(86)
Mean internal te	mp of livin	g area T1 (s	teps 3 to 7	in Table 9c)							_	_
	20.14	20.28	20.51	20.76	20.93	20.99	21.00	21.00	20.97	20.74	20.39	20.11	(87)
Temperature dur							I	T	T		T	T	7 (2.5)
Utilisation factor	20.16	20.16	20.16	20.18	20.18	20.19	20.19	20.19	20.18	20.18	20.17	20.17	(88)
Utilisation factor	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 te						1	!	0.39	0.00	0.93	0.55	1.00] (03)
	19.00	19.22	19.54	19.91	20.11	20.18	20.19	20.19	20.16	19.89	19.39	18.97	(90)
Living area fraction	on			l l						ving area ÷	(4) =	0.38	(91)
Mean internal te	mperature	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	(92)
Apply adjustmen	t to the me	ean internal	l temperati	ure from Tal	ble 4e whe	ere appropr	iate						
	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)
8. Space heating	g requirem	ent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor	for gains, i	ηm											
	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)
Useful gains, ηmo	Gm, 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 to	emperature	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 inte	rnal tempe	rature, Lm	, W [(39)m	x [(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)
Space heating red								1	1	1		1	7
	397.94	294.98	221.73	98.90	27.82	0.00	0.00	0.00	0.00	108.86	266.12	410.65]] (00)
		1341 / 2/							∑(98	8)15, 10		1827.00	∫ (98)
Space heating red	quirement	KWn/m²/ye	ear							(98)	÷ (4)	25.23	(99)
9b. Energy requ	irements -	communit	y heating s	cheme									
Fraction of space	heat from	secondary	/suppleme	ntary syster	n (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	from boile	rs									1.00	(303a)
Fraction of total s	space heat	from comm	nunity boil	ers						(302) x (30	3a) =	1.00	(304a)
Factor for contro	l and charg	ging method	d (Table 4c	(3)) for com	munity spa	ace heating						1.00	(305)
Factor for charging	ng method	(Table 4c(3	3)) for com	munity wate	er heating							1.00	(305a)
Distribution loss	factor (Tab	le 12c) for	community	heating sys	stem							1.05	(306)
Cuase backing													
Space heating	nting room	roment						1	.827.00	1			(98)
Annual space hea Space heat from		ement							3) x (304a) :) v (305) v (2	06) = -	1918.35	(98) (307a)
Space neat HOM	טווכו ז							(90	J, ∧ (3U4a))	√ (202) X (3		1310.33	_ (3U/a)
Water heating													
Annual water hea	ating requi	rement						1	720.32]			(64)
Water heat from													7,
	boilers							(64)	x (303a) x	(305a) x (3	06) =	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

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

10b. Fue	l costs - co	mmunity	heating 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	х	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 - commun	ity 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 community	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	e 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 CO₂, 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	nity 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) =	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

146.33 320.59 x

3.07

3.07

5191.56 (376)

449.24 (378)

(0.0)

984.22 (379)

6625.03 (383)

Primary energy kWh/year

Electricity for lighting

Dwelling primary energy rate kWh/m2/year

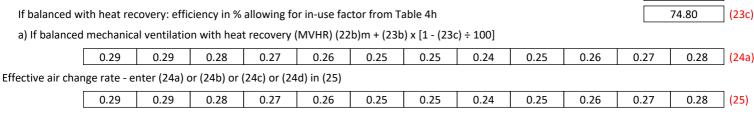
91.48 (384)



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							I	Last modified	l	30/0	9/2020	
Address	3B5P, Kir	ngston upoi	n Thames,	KT1								
1. Overall dwelling dimer	nsions											
				А	rea (m²)			erage storey height (m)	,	V	olume (m³)	
Lowest occupied					104.07	(1a) x		2.50	(2a) =		260.18	(3a
Total floor area	(1a)	+ (1b) + (1c	c) + (1d)(1n) =	104.07	(4)						
Owelling volume							(3	a) + (3b) + (3	c) + (3d)(3	n) =	260.18	(5)
2. Ventilation rate												
										n	n³ per hour	
lumber of chimneys								0	x 40 =		0	(6a
lumber of open flues								0	x 20 =		0	(6k
lumber of intermittent far	ns							0	x 10 =		0	(78
lumber of passive vents								0	x 10 =		0	(71
lumber of flueless gas fire	s							0	x 40 =		0	(70
										Air	changes pe	er
nfiltration 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 i	ntended, pi	roceed to (17), otherw	ise continu	e from (9,) to (16)				
ir permeability value, q50), expressed	in cubic me	etres per h	our per squ	uare metre	of envelope	e area				3.00	(17
based on air permeabilit	y value, the	n (18) = [(17	7) ÷ 20] + (8	3), otherwi	se (18) = (16	6)					0.15	(18
lumber of sides on which	the dwelling	g is sheltere	ed								2	(19
helter factor								1 -	· [0.075 x (19)] =	0.85	(20
nfiltration rate incorporati	ing shelter f	actor							(18) x (2	0) =	0.13	(2:
nfiltration rate modified fo	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
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
djusted infiltration rate (a	allowing for	shelter and	wind facto	or) (21) x (2	22a)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	(22
Calculate effective air char	nge rate for	the applical	ble case:									
If mechanical ventilatio	n: air chang	e rate thro	ugh system								0.50	(2:
If balanced with heat re	covery: effi	ciency in %	allowing fo	or in-use fa	ctor from T	able 4h					74.80	(23





3. Heat losses a	and heat lo	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						18	.08 x	1.24	= 22.34				(27)
Door						1.	80 x	1.30	= 2.34				(26)
Ground floor						104	.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 ext	ernal elem	ents ∑A, m²				189	.35						(31)
Fabric heat loss,	W/K = ∑(A	× U)							(26	5)(30) + (3	32) =	47.00	(33)
Heat capacity Cn	n = ∑(A x к)							(28)	(30) + (32) +	+ (32a)(32	2e) =	N/A	(34)
Thermal mass pa	arameter (1	MP) in kJ/n	n²K									250.00	(35)
Thermal bridges	: ∑(L x Ѱ) c	alculated us	ing Appe	ndix K								13.64	(36)
Total fabric heat	loss									(33) + (3	36) =	60.64	(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)									
	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	efficient, 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 parame	eter (HLP),	W/m²K (39)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	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	t										
Assumed occupa		- q										2.77	(42)
Annual average I	-	ısage in litre	es ner dav	√Vd average	= (25 x N) +	36						100.09	(12) (43)
/imaar average i	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	_ (43)
Hot water usage								71005	306			200	
Thot water asage	110.09	106.09	102.09	_	94.08	90.08	90.08	94.08	98.08	102.09	106.09	110.09	7
	110.03	100.03	102.03	30.00	34.00	30.00	30.00	34.00	30.00	Σ(44)1		1201.03	_ ☐ (44)
Energy content of	of hot wate	rused = 4.1	2 v Vd m	v nm v Tm/3	8600 kWh/m	onth (see	Tahles 1h	1c 1d)		∠(44)1	12	1201.03	(44)
Lifer by content c	163.27	142.79	147.35		123.26	106.37	98.57	113.11	114.46	133.39	145.60	158.12	
	103.27	142.79	147.33	120.40	123.20	100.57	30.37	113.11	114.40	∑(45)1		1574.74	」 │(45)
Distribution loss	0 15 v (45	lm								2(43)1	12	1374.74	(43)
Distribution 1033	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)
Storago volumo							14.70	10.57	17.17	20.01	21.04	-	=
Storage volume		aunig atty St	olai Ol W	sviino stoidg	c within Sdff	ic vessel						3.00	(47)
	,,,,												
Water storage lo	's declared	loss factor	is not kno	own									
b) Manufacturer					.v)							0.02	/[1\
b) Manufacturer Hot water sto	orage loss f	actor from ⁻			y)							0.02	= '
b) Manufacturer Hot water sto Volume facto	orage loss f or from Tab	actor from ⁻ le 2a			у)							3.42	(52)
b) Manufacturer Hot water sto Volume facto Temperature	orage loss f or from Tab e factor fror	actor from Tele 2a	Table 2 (k	Wh/litre/da								3.42 0.60	(51) (52) (53)
b) Manufacturer Hot water sto Volume facto Temperature Energy lost fr	orage loss for from Tab efactor fror om water s	actor from Tele 2a	Table 2 (k	Wh/litre/da								3.42 0.60 0.13	(52) (53) (54)
b) Manufacturer Hot water sto Volume facto Temperature	orage loss for from Tabes factor from water solution (55)	actor from [*] le 2a n Table 2b storage (kW	Table 2 (k 'h/day) (4	Wh/litre/da 47) x (51) x (5								3.42 0.60	(52) (53)

	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	tains dedica	ated solar st	torage or de	edicated W	/WHRS (56)	m x [(47) -	Vs] ÷ (47),	else (56)					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 l													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			3a, 3b or 30	1									7
	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				1	1				1
	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 inpu										2.22			1 (60)
Outrout from a	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							105.05	T	1,10,00	152.52	.=	1 105 10	1
	190.57	167.46	174.65	154.89	150.57	132.79	125.87	140.41	140.88	160.69	172.03	185.42]
			th\ 0.25	[O OF	(45) : (61	\1 . O.O	. [(46) (1	F7\ (F0	\	∑(64)11	.2 = [1896.22	(64)
Heat gains from				1						66.40	CO 55	74.42	1 (65)
	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 gair	าร												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	(Table 5)												
	138.71	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 (c	alculated in	Appendix I	., 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	(calculated	in Appendi	x L, equatio	on L13 or L:	13a), also se	e Table 5							
	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 (c	calculated in	Appendix I	L, equation	L15 or L15	a), 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 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	ole 5)											
	-110.97	-110.97	44007					1				_	1
Water heating g			-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	-110.97	(71)
		5)											1
	102.32	5)	95.21	88.68	84.45	78.48	73.41	79.91	-110.97 82.22	-110.97 88.97	-110.97 96.60	-110.97] (71)] (72)
Total internal ga	102.32 ains (66)m	5) 100.01 + (67)m + (6	95.21 68)m + (69)r	88.68 m + (70)m -	84.45 + (71)m + (7	78.48 72)m	73.41	79.91	82.22	88.97	96.60	100.02] (72)
Total internal ga	102.32	5)	95.21	88.68	84.45	78.48							1
Total internal ga	102.32 ains (66)m	5) 100.01 + (67)m + (6	95.21 68)m + (69)r	88.68 m + (70)m -	84.45 + (71)m + (7	78.48 72)m	73.41	79.91	82.22	88.97	96.60	100.02] (72)
	102.32 ains (66)m	5) 100.01 + (67)m + (6	95.21 68)m + (69)r	88.68 m + (70)m · 410.43	84.45 + (71)m + (7 384.41	78.48 72)m 359.55	73.41 343.56 ar flux	79.91	82.22 363.19	88.97	96.60	100.02 440.52] (72)
	102.32 ains (66)m	5) 100.01 + (67)m + (6	95.21 :8)m + (69)r 435.81	88.68 m + (70)m - 410.43	84.45 + (71)m + (7 384.41	78.48 72)m 359.55	73.41	79.91 350.02	82.22 363.19 g cific data	88.97 388.80 FF specific da	96.60 418.21	100.02] (72)
6. Solar gains	102.32 ains (66)m	5) 100.01 + (67)m + (6	95.21 (8)m + (69)r 435.81 Access fa Table	88.68 m + (70)m - 410.43	84.45 + (71)m + (7 384.41 Area m²	78.48 72)m 359.55 Sol a W	73.41 343.56 ar flux V/m²	79.91 350.02 spec or 1	82.22 363.19 g cific data Table 6b	88.97 388.80 FF specific do or Table	96.60 418.21	100.02 440.52 Gains W] (72)] (73)
6. Solar gains North	102.32 ains (66)m	5) 100.01 + (67)m + (6	95.21 68)m + (69)r 435.81 Access fa Table	88.68 m + (70)m - 410.43 Factor 6d	84.45 + (71)m + (7 384.41 Area m²	78.48 72)m 359.55 Sola W	73.41 343.56 ar flux V/m²	79.91 350.02 spec or 1	82.22 363.19 g cific data Table 6b 0.45 x	88.97 388.80 FF specific do or Table 0.70	96.60 418.21 ata 6c = [100.02 440.52 Gains W] (72)] (73)
6. Solar gains North NorthEast	102.32 ains (66)m	5) 100.01 + (67)m + (6	95.21 88)m + (69)r 435.81 Access frable 0.77	88.68 m + (70)m · 410.43 factor 6d 7 x [84.45 + (71)m + (7 384.41 Area m ² 6.86 2.18	78.48 72)m 359.55 Sol: W x 1 x 1	73.41 343.56 ar flux V/m² 0.63 x 1.28 x	79.91 350.02 spec or T 0.9 x	82.22 363.19 g cific data Table 6b 0.45 x 0.45 x	88.97 388.80 FF specific do or Table 0.70 0.70	96.60 418.21 ata 6c = = = =	100.02 440.52 Gains W 15.92 5.37] (72)] (73)] (74)] (75)
6. Solar gains North NorthEast East	102.32 ains (66)m	5) 100.01 + (67)m + (6	95.21 68)m + (69)r 435.81 Access fa Table 0.77 0.77	88.68 m + (70)m + 410.43 Factor 6d 7 x 7 7 x 7	84.45 + (71)m + (7 384.41 Area m ² 6.86 2.18 6.78	78.48 72)m 359.55 Soli X 1 X 1 X 1 X 1	73.41 343.56 ar flux V/m² 0.63 x 1.28 x 9.64 x	79.91 350.02 spec or 1 0.9 x 0.9 x	82.22 g cific data rable 6b 0.45 x 0.45 x 0.45 x	88.97 388.80 FF specific do or Table 0.70 0.70 0.70	96.60 418.21 ata 6c = = = = = = = = = = = = = = = = = = =	100.02 440.52 Gains W 15.92 5.37 29.07] (72)] (73)] (74)] (75)] (76)
6. Solar gains North NorthEast East SouthEast	102.32 ains (66)m - 453.75	5) 100.01 + (67)m + (6 451.47	95.21 88)m + (69)r 435.81 Access frable 0.77	88.68 m + (70)m + 410.43 Factor 6d 7 x 7 7 x 7	84.45 + (71)m + (7 384.41 Area m ² 6.86 2.18	78.48 72)m 359.55 Soli X 1 X 1 X 1 X 1	73.41 343.56 ar flux V/m² 0.63 x 1.28 x 9.64 x	79.91 350.02 spec or 1 0.9 x	82.22 363.19 g cific data Table 6b 0.45 x 0.45 x	88.97 388.80 FF specific do or Table 0.70 0.70 0.70	96.60 418.21 ata 6c = = = =	100.02 440.52 Gains W 15.92 5.37] (72)] (73)] (74)] (75)
6. Solar gains North NorthEast East	102.32 ains (66)m - 453.75 atts ∑(74)m	5) 100.01 + (67)m + (6 451.47	95.21 68)m + (69)r 435.81 Access fa Table 0.77 0.77 0.77	88.68 m + (70)m + 410.43 Factor 6d 7	84.45 + (71)m + (7 384.41 Area m² 6.86 2.18 6.78 2.26	78.48 72)m 359.55 Soli X 1 X 1 X 1 X 3	73.41 343.56 ar flux V/m² 0.63 x 1.28 x 9.64 x 6.79 x	79.91 350.02 spec or 1 0.9 x 0.9 x 0.9 x 0.9 x	82.22 g cific data rable 6b 0.45 x 0.45 x 0.45 x	88.97 Second Sec	96.60 418.21 ata 6c = = = = = = = = = = = = = = = = = = =	100.02 440.52 Gains W 15.92 5.37 29.07 18.15] (72)] (73)] (74)] (75)] (76)
North NorthEast East SouthEast Solar gains in wa	102.32 ains (66)m - 453.75 atts ∑(74)m 68.51	5) 100.01 + (67)m + (6 451.47 1(82)m 129.14	95.21 68)m + (69)r 435.81 Access fa Table 0.77 0.77 0.77	88.68 m + (70)m + 410.43 Factor 6d 7 x 7 7 x 7	84.45 + (71)m + (7 384.41 Area m ² 6.86 2.18 6.78	78.48 72)m 359.55 Soli X 1 X 1 X 1 X 1	73.41 343.56 ar flux V/m² 0.63 x 1.28 x 9.64 x	79.91 350.02 spec or 1 0.9 x 0.9 x	82.22 g cific data rable 6b 0.45 x 0.45 x 0.45 x	88.97 388.80 FF specific do or Table 0.70 0.70 0.70	96.60 418.21 ata 6c = = = = = = = = = = = = = = = = = = =	100.02 440.52 Gains W 15.92 5.37 29.07] (72)] (73)] (74)] (75)] (76)
6. Solar gains North NorthEast East SouthEast	102.32 ains (66)m - 453.75 atts ∑(74)m 68.51	5) 100.01 + (67)m + (6 451.47 1(82)m 129.14	95.21 68)m + (69)r 435.81 Access fa Table 0.77 0.77 0.77	88.68 m + (70)m + 410.43 Factor 6d 7	84.45 + (71)m + (7 384.41 Area m² 6.86 2.18 6.78 2.26	78.48 72)m 359.55 Soli X 1 X 1 X 1 X 3	73.41 343.56 ar flux V/m² 0.63 x 1.28 x 9.64 x 6.79 x	79.91 350.02 spec or 1 0.9 x 0.9 x 0.9 x 0.9 x	82.22 g cific data rable 6b 0.45 x 0.45 x 0.45 x	88.97 Second Sec	96.60 418.21 ata 6c = = = = = = = = = = = = = = = = = = =	100.02 440.52 Gains W 15.92 5.37 29.07 18.15] (72)] (73)] (74)] (75)] (76)

7. Mean intern	al tempe <u>ra</u>	iture (h <u>eatii</u>	ng season)										
Temperature du				area from T	Table 9. Th	1(°C)						21.00	(85
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	_ (
Utilisation factor				•	•			6	3.5%				
	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 te			l .		1	0.00	0.50	0.50	0.04	0.50	1.00	1.00] (00
	20.13	20.24	20.43	20.69	20.90	20.99	21.00	21.00	20.94	20.68	20.36	20.12	(87
Temperature du			l .	l .	1		1 21.00	1 21.00	20.51	20.00	20.50	20.12] (0,
Temperature au	20.24	20.24	20.24	20.25	20.25	20.26	20.26	20.27	20.26	20.25	20.25	20.24	(88
Utilisation factor					20.23	20.20	20.20	20.27	20.20	20.23	20.23	20.24] (00
otinsation ractor	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 te					1	1		0.47	0.79	0.96	1.00	1.00] (0:
iviean internal te				1		1		20.27	20.21	10.00	10.40	10.04	7 (0)
	19.06	19.22	19.50	19.88	20.15	20.26	20.26	20.27	20.21	19.86	19.40	19.04] (90] (01
Living area fracti		. f t la la	ala dall:a	- fi A T1 .	./1 fl A\	тэ			Li	ving area ÷	(4) =	0.32	(9:
Mean internal to				-				1 00 50			10.71	1000	٦,,
	19.40	19.54	19.80	20.14	20.39	20.49	20.50	20.50	20.45	20.12	19.71	19.38	(9:
Apply adjustmer										T a= -	1	1	٦,,
	19.40	19.54	19.80	20.14	20.39	20.49	20.50	20.50	20.45	20.12	19.71	19.38	(9
8. Space heatin	ng requiren	nent											
•	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor					,								
	1.00	1.00	0.99	0.96	0.85	0.63	0.44	0.50	0.80	0.98	1.00	1.00	(9
Useful gains, ηm			l .	0.50	1 0.03	1 0.03	0.11	0.50	0.00	0.50	1.00	1.00	(5
oscial gains, ifin	521.49	578.70	636.59	684.18	647.54	473.96	318.52	333.02	484.39	526.64	500.84	497.08	(9!
Monthly average				!	047.54	473.90	318.32	333.02	464.53	320.04	300.84	437.08	(೨.
ivioritiny average					11.70	14.60	16.60	16.40	1410	10.60	7.10	4.20	٦ ,
	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)
Heat loss rate fo								1	l	l	1	1	٦,.
	1289.74	1246.75	1128.37	938.66	723.49	482.13	319.18	334.48	523.04	792.69	1056.33	1280.28	(9
Space heating re									1			1	,
	571.57	448.93	365.88	183.23	56.51	0.00	0.00	0.00	0.00	197.94	399.95	582.70	_
									∑(98	8)15, 10		2806.71	<u> </u> (9
Space heating re	equirement	: kWh/m²/ye	ear							(98)	÷ (4)	26.97	(99
9b. Energy req	uirements	- communit	v heating s	cheme									
			-		m /table 11	1)				'0' if	nono	0.00	7 /2
Fraction of space				iitary syste	ın (table 11	1 J					none	0.00	」(3 ີ (ລ
Fraction of space										1 - (3	01) = [1.00	່ (3 ໄ (3
Fraction of comr	•									(202) (= =	a \	1.00] (3] (3
Fraction of total	·									(302) x (30	3a) = [1.00] (3] (3
Factor for contro						ace heating	;					1.00] (3]
Factor for chargi	ing method	d (Table 4c(3	()) for com	munity wat	er heating							1.00	(3
Distribution loss	factor (Tal	ole 12c) for	community	heating sy	/stem							1.05	(30
Space heating													
Annual space he	eating requi	irement						2	806.71]			(9
C	. In a 11 a ma							101	(224)	(0.0=) (0	26)		٦,,

2947.05

(98) x (304a) x (305) x (306) =

Space heat from boilers

Water heating

(307a)

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	0.0	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 input	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) + (310) +	(312) + (315) + (331) + (332)	.(337b) = 5601.15 (338)
10b. Fuel costs - community heating scheme			
	Fuel kWh/year	Fuel price	Fuel cost £/year
Space heating from boilers	2947.05 x	4.24 x 0	0.01 = 124.95 (340a)
Water heating from boilers			0.01 = 84.42 (342a)
Pumps and fans	1991.03 x 238.06 x		0.01 = 31.40 (349)
Electricity for lighting	425.01 x		0.01 = 56.06 (350)
Additional standing charges	423.01 X	13.19 X C	120.00 (351)
Total energy cost		(340a)(342e) + (345).	
Total energy cost		(340a)(342e) + (343).	(334) - 410.83 (333)
11b. SAP rating - community heating scheme			
Energy cost deflator (Table 12)			0.42 (356)
Energy cost factor (ECF)			1.17 (357)
SAP value			83.62
SAP rating (section 13)			84 (358)
SAP band			В
12h CO emissions community heating scheme			
12b. CO ₂ emissions - community heating scheme	Energy	Emission factor	Emissions
12b. CO₂ emissions - community heating scheme	Energy kWh/year	Emission factor	Emissions (kg/year)
12b. CO₂ emissions - community heating scheme Emissions from other sources (space heating)		Emission factor	
		Emission factor	
Emissions from other sources (space heating)	kWh/year	Emission factor 0.216	(kg/year)
Emissions from other sources (space heating) Efficiency of boilers	kWh/year 89.50		(kg/year) (367a)
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	(kg/year) (367a) = 1191.76 (367)
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 5517.40 x	0.216	(kg/year) (367a) = 1191.76 (367) = 25.63 (372)
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	89.50 5517.40 x	0.216	(kg/year) (367a) = 1191.76 (367) = 25.63 (372) 1217.39 (373)
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 x 49.38 x	0.216	(kg/year) (367a) = 1191.76 (367) = 25.63 (372) 1217.39 (373) 1217.39 (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 5517.40 x 49.38 x	0.216 0.519 0.519 0.519	(kg/year) (367a) = 1191.76 (367) = 25.63 (372) 1217.39 (373) 1217.39 (376) = 123.55 (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 x 49.38 x	0.216 0.519 0.519 0.519	(kg/year) (367a) = 1191.76 (367) = 25.63 (372) 1217.39 (373) 1217.39 (376) = 123.55 (378) = 220.58 (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 x 49.38 x	0.216 0.519 0.519 0.519	(kg/year) (367a) = 1191.76 (367) = 25.63 (372) 1217.39 (373) 1217.39 (376) = 123.55 (378) = 220.58 (379))(382) = 1561.52 (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 x 49.38 x	0.216 0.519 0.519 0.519	(kg/year) (367a) = 1191.76 (367) = 25.63 (372) 1217.39 (373) 1217.39 (376) = 123.55 (378) = 220.58 (379) 0(382) = 1561.52 (383) 3) ÷ (4) = 15.00 (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	89.50 5517.40 x 49.38 x	0.216 0.519 0.519 0.519	(kg/year) (367a) = 1191.76 (367) = 25.63 (372) 1217.39 (373) 1217.39 (376) = 123.55 (378) = 220.58 (379) 0(382) = 1561.52 (383) 3) ÷ (4) = 15.00 (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 CO2, kg/year Dwelling CO2 emission rate El value El rating (section 14) El band	89.50 5517.40 x 49.38 x	0.216 0.519 0.519 0.519	(kg/year) (367a) = 1191.76 (367) = 25.63 (372) 1217.39 (373) 1217.39 (376) = 123.55 (378) = 220.58 (379) 0(382) = 1561.52 (383) 3) ÷ (4) = 15.00 (384) 85.96 86 (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)	89.50 5517.40 x 49.38 x 238.06 x 425.01 x	0.216 0.519 0.519 0.519 (376) (38.	(kg/year) (367a) = 1191.76 (367) = 25.63 (372) 1217.39 (373) 1217.39 (376) = 123.55 (378) = 220.58 (379) 0(382) = 1561.52 (383) 3) ÷ (4) = 15.00 (384) 85.96 86 (385) B
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	89.50 5517.40 x 49.38 x	0.216 0.519 0.519 0.519	(kg/year) (367a) = 1191.76 (367) = 25.63 (372) 1217.39 (373) 1217.39 (376) = 123.55 (378) = 220.58 (379) 0(382) = 1561.52 (383) 3) ÷ (4) = 15.00 (384) 85.96 86 (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 13b. Primary energy - community heating scheme	89.50 5517.40 x 49.38 x 238.06 x 425.01 x	0.216 0.519 0.519 0.519 (376) (38.	(kg/year) (367a) = 1191.76 (367) = 25.63 (372) 1217.39 (373) 1217.39 (376) = 123.55 (378) = 220.58 (379) 0(382) = 1561.52 (383) 3) ÷ (4) = 15.00 (384) 85.96 86 (385) B Primary energy
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 x 49.38 x 238.06 x 425.01 x	0.216 0.519 0.519 0.519 (376) (38.	(kg/year) (367a) = 1191.76 (367) = 25.63 (372) 1217.39 (373) 1217.39 (376) = 123.55 (378) = 220.58 (379))(382) = 1561.52 (383) 3) ÷ (4) = 15.00 (384) 85.96 86 (385) B Primary energy (kWh/year)
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 5517.40	0.216 0.519 0.519 0.519 (376) (38.	(kg/year) (367a) = 1191.76 (367) = 25.63 (372) 1217.39 (373) 1217.39 (376) = 123.55 (378) = 220.58 (379) 0(382) = 1561.52 (383) 3) ÷ (4) = 15.00 (384) 85.96 86 (385) B Primary energy (kWh/year) (367a)
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 x 49.38 x 238.06 x 425.01 x	0.216 0.519 0.519 0.519 (376) (38.	(kg/year) (367a) = 1191.76 (367) = 25.63 (372) 1217.39 (373) 1217.39 (376) = 123.55 (378) = 220.58 (379) 0(382) = 1561.52 (383) 3) ÷ (4) = 15.00 (384) 85.96 86 (385) B Primary energy (kWh/year) (367a)

Electrical energy for community heat distribution	49.38	x	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	x	3.07	=	730.84	(378)
Electricity for lighting	425.01	x	3.07	=	1304.79	(379)
Primary energy kWh/year					8918.46	(383)
Dwelling primary energy rate kWh/m2/year					85.70	(384)



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							Last modified	d	30/09	9/2020	
Address	3B6P, Kingston upo	n Thames, K	T1								
1. Overall dwelling dimen	sions		_	4 2							
			Ai	rea (m²)		Д	verage storey height (m)	1	V	olume (m³)	
Lowest occupied				94.73	(1a) x	Г	2.50	(2a) =		236.83	(3a)
Total floor area	(1a) + (1b) + (1	c) + (1d)(1		94.73	(4)] (==)			
Dwelling volume	(=2) (=3) (=	(,		1 ()		(3a) + (3b) + (3	sc) + (3d)(3i	n) =	236.83	(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 fan	ns						0	x 10 =		0	(7a)
Number of passive vents							0	x 10 =		0	(7b)
Number of flueless gas fires	s						0	x 40 =		0	(7c)
									Air	changes pe hour	er
Infiltration due to chimneys	s, flues, fans, PSVs		(6a)	+ (6b) + (7a	a) + (7b) + ((7c) =	0	÷ (5) =		0.00	(8)
If a pressurisation test has	been carried out or is	intended, pr	oceed to (1	17), otherw	ise continu	e from ((9) to (16)	_			_
Air permeability value, q50	, expressed in cubic m	etres per ho	ur per squ	are metre	of envelop	e area				3.00	(17)
If based on air permeability	value, then (18) = [(1	7) ÷ 20] + (8), otherwis	se (18) = (16	5)					0.15	(18)
Number of sides on which t	the dwelling is shelter	ed								2	(19)
Shelter factor							1 -	- [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporati	ng shelter factor							(18) x (20	0) =	0.13	(21)
Infiltration rate modified fo	or monthly wind speed	l:									
Jan	Feb Mar	Apr	May	Jun	Jul	Aug	g Sep	Oct	Nov	Dec	
Monthly average wind spee	ed 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	3 1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (a	llowing for shelter and	d wind facto	r) (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 chan	ge rate for the applica	ble case:									
If mechanical ventilation	n: air change rate thro	ugh system								0.50	(23a)



0.29

0.29

0.29

0.29

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

74.80

0.28

0.28

0.27

0.27

(23c)

(24a)

(25)

0.25

0.25

0.25

0.25

0.24

0.24

0.25

0.25

0.26

0.26

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

0.28

0.28

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

0.27

0.27

0.26

0.26

-51 TICUL 1035C3	and neat io	ss paramet	er										
Element				Gross area, m²	Openings m ²	Net a	_	U-value W/m²K	AxUW		/alue, /m².K	Αxκ, kJ/K	
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				(29
Party wall						15.	15 x	0.00	= 0.00				(32)
External wall						34.	68 x	0.20	= 6.94				(29
Roof						94.	73 x	0.13	= 12.31				(30)
Total area of ex	ternal elem	ents ∑A, m²				182	.35						(31)
Fabric heat loss	s, W/K = ∑(A	× U)							(26	5)(30) + (32) =	44.86	(33)
Heat capacity C	m = ∑(A x κ)							(28)	(30) + (32) +	- (32a)(3	2e) =	N/A	(34)
Thermal mass p	oarameter (1	MP) in kJ/n	n²K									250.00	(35)
Thermal bridge	s: ∑(L x Ψ) c	alculated us	ing Appe	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	
									Average = ∑	(39)112,	/12 =	79.63	(39)
Heat loss paran	neter (HLP),	W/m²K (39)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	equiremen	t										
Assumed occup												2.69	(42)
Annual average	•	usage in litre	es per day	Vd.average	= (25 x N) +	36						97.97	_ (43)
	Jan	Feb	Mar										
Hot water usag				Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	ב ווו וונו כא טכ	er dav for ea		Apr Vd.m = fact	May or from Tabl	Jun e 1c x (43	Jul)	Aug	Sep	Oct	Nov	Dec	
			ich month	Vd,m = fact	or from Tabl	e 1c x (43)						7
	107.77	er day for ea						Aug 92.09	Sep 96.01	99.93	103.85	107.77]] (44)
Energy content	107.77	103.85	99.93	96.01	or from Tabl	e 1c x (43 88.17	88.17	92.09			103.85]] (44)
Energy content	107.77	103.85 er used = 4.1	99.93 8 x Vd,m	96.01 x nm x Tm/3	92.09 S600 kWh/m	e 1c x (43 88.17 onth (see	88.17 Tables 1b	92.09 , 1c 1d)	96.01	99.93 ∑(44)1	103.85	107.77 1175.65]] (44)
Energy content	107.77	103.85	99.93	96.01	or from Tabl	e 1c x (43 88.17	88.17	92.09		99.93 ∑(44)1 130.57	103.85 .12 =	107.77 1175.65 154.77	
	107.77 of hot wate	103.85 er used = 4.1 139.78	99.93 8 x Vd,m	96.01 x nm x Tm/3	92.09 S600 kWh/m	e 1c x (43 88.17 onth (see	88.17 Tables 1b	92.09 , 1c 1d)	96.01	99.93 ∑(44)1	103.85 .12 =	107.77 1175.65	
Energy content Distribution los	107.77 of hot wate 159.82 s 0.15 x (45	103.85 r used = 4.1 139.78	99.93 .8 x Vd,m 144.24	y Nd,m = fact 96.01 x nm x Tm/3 125.75	92.09 9600 kWh/me	88.17 onth (see	88.17 Tables 1b	92.09 , 1c 1d) 110.72	96.01	99.93 Σ(44)1 130.57 Σ(45)1	103.85 .12 =	107.77 1175.65 154.77 1541.46	(45)
Distribution los	107.77 of hot wate 159.82 s 0.15 x (45) 23.97	103.85 r used = 4.1 139.78)m 20.97	99.93 8 x Vd,m 144.24 21.64	y Nd,m = fact 96.01 x nm x Tm/3 125.75	92.09 92.09 6600 kWh/me 120.66	88.17 onth (see 104.12	88.17 Tables 1b	92.09 , 1c 1d)	96.01	99.93 ∑(44)1 130.57	103.85 .12 =	107.77 1175.65 154.77 1541.46	(45)
Distribution los Storage volume	107.77 of hot wate 159.82 s 0.15 x (45) 23.97 e (litres) include	103.85 r used = 4.1 139.78)m 20.97	99.93 8 x Vd,m 144.24 21.64	y Nd,m = fact 96.01 x nm x Tm/3 125.75	92.09 92.09 6600 kWh/me 120.66	88.17 onth (see 104.12	88.17 Tables 1b	92.09 , 1c 1d) 110.72	96.01	99.93 Σ(44)1 130.57 Σ(45)1	103.85 .12 =	107.77 1175.65 154.77 1541.46	(45)
Distribution los Storage volume Water storage I	107.77 of hot wate 159.82 s 0.15 x (45) 23.97 e (litres) includes:	103.85 er used = 4.1 139.78)m 20.97 uding any so	99.93 8 x Vd,m 144.24 21.64	y vd,m = fact 96.01 x nm x Tm/3 125.75 18.86 WHRS storage	92.09 92.09 6600 kWh/me 120.66	88.17 onth (see 104.12	88.17 Tables 1b	92.09 , 1c 1d) 110.72	96.01	99.93 Σ(44)1 130.57 Σ(45)1	103.85 .12 =	107.77 1175.65 154.77 1541.46	(45)
Distribution los Storage volume Water storage l b) Manufacture	of hot water 159.82 s 0.15 x (45 23.97 e (litres) includoss:	103.85 r used = 4.1 139.78)m 20.97 uding any so	99.93 8 x Vd,m 144.24 21.64 blar or WV	y vd,m = fact 96.01 x nm x Tm/3 125.75 18.86 WHRS storage	92.09 92.09 6600 kWh/me 120.66 18.10 e within sam	88.17 onth (see 104.12	88.17 Tables 1b	92.09 , 1c 1d) 110.72	96.01	99.93 Σ(44)1 130.57 Σ(45)1	103.85 .12 =	107.77 1175.65 154.77 1541.46 23.22 3.00	(44) (45) (46) (47)
Distribution los Storage volume Water storage I b) Manufacture Hot water st	of hot water 159.82 s 0.15 x (45 23.97 et (litres) includoss: er's declared torage loss f	103.85 or used = 4.1 139.78)m 20.97 uding any so loss factor actor from	99.93 8 x Vd,m 144.24 21.64 blar or WV	y vd,m = fact 96.01 x nm x Tm/3 125.75 18.86 WHRS storage	92.09 92.09 6600 kWh/me 120.66 18.10 e within sam	88.17 onth (see 104.12	88.17 Tables 1b	92.09 , 1c 1d) 110.72	96.01	99.93 Σ(44)1 130.57 Σ(45)1	103.85 .12 =	107.77 1175.65 154.77 1541.46 23.22 3.00	(45) (46) (47)
Distribution los Storage volume Water storage I b) Manufacture Hot water st	of hot water 159.82 s 0.15 x (45 23.97 e (litres) includoss: er's declared torage loss from Tab	103.85 r used = 4.1 139.78)m 20.97 uding any so loss factor actor from	99.93 8 x Vd,m 144.24 21.64 blar or WV	y vd,m = fact 96.01 x nm x Tm/3 125.75 18.86 WHRS storage	92.09 92.09 6600 kWh/me 120.66 18.10 e within sam	88.17 onth (see 104.12	88.17 Tables 1b	92.09 , 1c 1d) 110.72	96.01	99.93 Σ(44)1 130.57 Σ(45)1	103.85 .12 =	107.77 1175.65 154.77 1541.46 23.22 3.00	(45) (46) (47) (51)
Distribution los Storage volume Water storage I b) Manufacture Hot water st Volume fact Temperatur	of hot water 159.82 s 0.15 x (45) 23.97 e (litres) includes: er's declared torage loss from Table e factor from	103.85 r used = 4.1 139.78)m 20.97 uding any so loss factor actor from le 2a n Table 2b	99.93 8 x Vd,m 144.24 21.64 blar or WV	1 Vd,m = fact 96.01 x nm x Tm/3 125.75 18.86 WHRS storage	92.09 3600 kWh/ma 120.66 18.10 e within sam	88.17 onth (see 104.12	88.17 Tables 1b	92.09 , 1c 1d) 110.72	96.01	99.93 Σ(44)1 130.57 Σ(45)1	103.85 .12 =	107.77 1175.65 154.77 1541.46 23.22 3.00 0.02 3.42 0.60	(45) (46) (47) (51) (52) (53)
Distribution los Storage volume Water storage I b) Manufacture Hot water st Volume fact Temperatur Energy lost f	of hot water 159.82 s 0.15 x (45 23.97 e (litres) includes: er's declared torage loss for from Table e factor from water s	103.85 r used = 4.1 139.78)m 20.97 uding any so loss factor actor from le 2a n Table 2b	99.93 8 x Vd,m 144.24 21.64 blar or WV	1 Vd,m = fact 96.01 x nm x Tm/3 125.75 18.86 WHRS storage	92.09 3600 kWh/ma 120.66 18.10 e within sam	88.17 onth (see 104.12	88.17 Tables 1b	92.09 , 1c 1d) 110.72	96.01	99.93 Σ(44)1 130.57 Σ(45)1	103.85 .12 =	107.77 1175.65 154.77 1541.46 23.22 3.00 0.02 3.42 0.60 0.13	(45) (46) (47) (51) (52) (53) (54)
Distribution los Storage volume Water storage l b) Manufacture Hot water st Volume fact Temperatur	of hot water 159.82 s 0.15 x (45) 23.97 e (litres) includes: er's declared torage loss from Table factor from water set 4) in (55)	103.85 or used = 4.1 139.78)m 20.97 uding any so loss factor actor from actor from le 2a n Table 2b storage (kW	21.64 blar or WV is not kno Table 2 (k	1 Vd,m = fact 96.01 x nm x Tm/3 125.75 18.86 WHRS storage wm Wh/litre/date	92.09 3600 kWh/ma 120.66 18.10 e within sam	88.17 onth (see 104.12	88.17 Tables 1b	92.09 , 1c 1d) 110.72	96.01	99.93 Σ(44)1 130.57 Σ(45)1	103.85 .12 =	107.77 1175.65 154.77 1541.46 23.22 3.00 0.02 3.42 0.60	(45) (46) (47) (51) (52) (53)

	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			1	3.51	4.04	3.31	1.04] (30)
	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	oss for each	n month fro	m Table 3	•				•				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	from Table	3a, 3b or 3	Bc									
	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 1	for each mo	onth 0.85 x	(45)m + (4	6)m + (57)r	n + (59)m ·	+ (61)m				
	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 input	t calculated	d 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 wa	ter heater	for each mo	onth (kWh/	month) (62	2)m + (63)m	า							
	187.12	164.44	171.54	152.17	147.96	130.54	123.79	138.02	138.46	157.87	168.95	182.08	
										∑(64)1	.12 = 1	862.94	(64)
Heat gains from	water heat	ting (kWh/n	nonth) 0.2	5 × [0.85 ×	(45)m + (61	.)m] + 0.8 ×	: [(46)m + (!	57)m + (59)m]				
	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)
E Internal acid													
5. Internal gain		Fah	Max	Δ	Mar	1	Ind	Aug	Com	Oct	Nov	Doo	
Natabalia saina	Jan (Table 5)	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	. ,	124.25	42425	124.25	424.25	424.25	424.25	424.25	124.25	42425	424.25	12425	1 (66)
Liebtine esine (s	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				_			0.62	14.00	15.04	10.00	22.20	22.75	7 (67)
Annliance gains	23.11	20.53	16.69	12.64	9.45	7.98	8.62	11.20	15.04	19.09	22.28	23.75	<u> </u> (67)
Appliance gains	247.52	250.08	243.61		212.44	196.09	105.47	402.50	100.00	202.05	222.25	226.50	7 (60)
		1 7501 OX	1 1/12 61	229.83	1 111 44	196 119	185.17	182.60	189.08	202.85	220.25	236.59	(68)
Caalina asino (a				1	1							1] (00)
Cooking gains (c	alculated in	n Appendix	L, equation	L15 or L15	a), also see	Table 5		26.42	26.42	26.42	26.42		7
	alculated in 36.43	36.43		1	1		36.43	36.43	36.43	36.43	36.43	36.43	(69)
Cooking gains (c	36.43 ains (Table	Appendix 36.43 5a)	L, equation 36.43	36.43	36.43	Table 5 36.43	36.43		1		1	36.43	(69)
Pump and fan ga	alculated in 36.43 ains (Table 0.00	36.43 5a) 0.00	L, equation	L15 or L15	a), also see	Table 5		36.43	36.43	36.43	36.43		7
	alculated in 36.43 ains (Table 0.00 oration (Ta	36.43 5a) 0.00 ble 5)	L, equation 36.43	36.43 0.00	36.43	Table 5 36.43 0.00	36.43	0.00	0.00	0.00	0.00	36.43] (69)] (70)
Pump and fan ga Losses e.g. evap	alculated in 36.43 ains (Table 0.00 oration (Ta	36.43 5a) 0.00 ble 5)	L, equation 36.43	36.43	36.43	Table 5 36.43	36.43		1		1	36.43	(69)
Pump and fan ga	alculated in 36.43 ains (Table 0.00 oration (Ta -107.40 ains (Table	1 Appendix 36.43 5a) 0.00 ble 5) -107.40	L, equation 36.43 0.00 -107.40	36.43 0.00	36.43 0.00	Table 5 36.43 0.00 -107.40	36.43 0.00 -107.40	0.00	0.00	0.00	0.00	0.00] (69)] (70)] (71)
Pump and fan ga Losses e.g. evap Water heating g	alculated in 36.43 ains (Table 0.00 oration (Ta -107.40 ains (Table 100.78	1 Appendix 36.43 5a) 0.00 ble 5) -107.40 5) 98.52	L, equation 36.43 0.00 -107.40	1.15 or L15 36.43 0.00 -107.40	36.43 36.43 0.00 -107.40	Table 5 36.43 0.00 -107.40	36.43	0.00	0.00	0.00	0.00	36.43] (69)] (70)
Pump and fan ga Losses e.g. evap	alculated in 36.43 ains (Table 0.00 oration (Ta -107.40 ains (Table 100.78 ins (66)m	1 Appendix 36.43 5a) 0.00 ble 5) -107.40 5) 98.52 + (67)m + (6	L, equation 36.43 0.00 -107.40 93.82 68)m + (69)	0.00 -107.40 87.43 m + (70)m	36.43 0.00 -107.40 83.28 + (71)m + (7	Table 5 36.43 0.00 -107.40 77.44 72)m	36.43 0.00 -107.40 72.48	0.00 -107.40 78.84	0.00	0.00 -107.40 87.71	0.00 -107.40 95.18	36.43 0.00 -107.40 98.53] (69)] (70)] (71)] (72)
Pump and fan ga Losses e.g. evap Water heating g	alculated in 36.43 ains (Table 0.00 oration (Ta -107.40 ains (Table 100.78	1 Appendix 36.43 5a) 0.00 ble 5) -107.40 5) 98.52	L, equation 36.43 0.00 -107.40	1.15 or L15 36.43 0.00 -107.40	36.43 36.43 0.00 -107.40	Table 5 36.43 0.00 -107.40	36.43 0.00 -107.40	0.00	0.00	0.00	0.00	0.00] (69)] (70)] (71)
Pump and fan ga Losses e.g. evap Water heating g	alculated in 36.43 ains (Table 0.00 oration (Ta -107.40 ains (Table 100.78 ins (66)m	1 Appendix 36.43 5a) 0.00 ble 5) -107.40 5) 98.52 + (67)m + (6	L, equation 36.43 0.00 -107.40 93.82 68)m + (69)	0.00 -107.40 87.43 m + (70)m	36.43 0.00 -107.40 83.28 + (71)m + (7	Table 5 36.43 0.00 -107.40 77.44 72)m	36.43 0.00 -107.40 72.48	0.00 -107.40 78.84	0.00	0.00 -107.40 87.71	0.00 -107.40 95.18	36.43 0.00 -107.40 98.53] (69)] (70)] (71)] (72)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga	alculated in 36.43 ains (Table 0.00 oration (Ta -107.40 ains (Table 100.78 ins (66)m	1 Appendix 36.43 5a) 0.00 ble 5) -107.40 5) 98.52 + (67)m + (6	L, equation 36.43 0.00 -107.40 93.82 68)m + (69)	0.00 -107.40 87.43 m + (70)m 393.18	36.43 0.00 -107.40 83.28 + (71)m + (72) 368.45	Table 5 36.43 0.00 -107.40 77.44 72)m 344.79	36.43 0.00 -107.40 72.48 329.54 ar flux	0.00 -107.40 78.84	0.00	0.00 -107.40 87.71	0.00 -107.40 95.18	36.43 0.00 -107.40 98.53] (69)] (70)] (71)] (72)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga	alculated in 36.43 ains (Table 0.00 oration (Ta -107.40 ains (Table 100.78 ins (66)m	1 Appendix 36.43 5a) 0.00 ble 5) -107.40 5) 98.52 + (67)m + (6	0.00 -107.40 93.82 68)m + (69)	0.00 -107.40 87.43 m + (70)m 393.18	36.43 0.00 -107.40 83.28 + (71)m + (73) 368.45	Table 5 36.43 0.00 -107.40 77.44 72)m 344.79	36.43 0.00 -107.40 72.48 329.54	0.00 -107.40 78.84 335.92	0.00 -107.40 81.10 348.49 g g cific data	0.00 -107.40 87.71 372.93	95.18 400.98	36.43 0.00 -107.40 98.53] (69)] (70)] (71)] (72)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains	alculated in 36.43 ains (Table 0.00 oration (Ta -107.40 ains (Table 100.78 ins (66)m	1 Appendix 36.43 5a) 0.00 ble 5) -107.40 5) 98.52 + (67)m + (6	1. equation 36.43 0.00 0.00 -107.40 93.82 08)m + (69) 417.40 Access Table	0.00 -107.40 87.43 m + (70)m 393.18	36.43 0.00 -107.40 83.28 + (71)m + (71)m + (71)m + (72) Area m ²	77.44 72)m 344.79 Sol	36.43 0.00 -107.40 72.48 329.54 ar flux	0.00 -107.40 78.84 335.92 spec	0.00 -107.40 81.10 348.49 g cific data Table 6b	0.00 -107.40 87.71 372.93 FF specific c or Table	95.18 400.98	36.43 0.00 -107.40 98.53 422.15 Gains W] (69)] (70)] (71)] (72)] (73)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains	alculated in 36.43 ains (Table 0.00 oration (Ta -107.40 ains (Table 100.78 ins (66)m	1 Appendix 36.43 5a) 0.00 ble 5) -107.40 5) 98.52 + (67)m + (6	L, equation 36.43 0.00 -107.40 93.82 58)m + (69) 417.40 Access Table	1.15 or L15 36.43 0.00 -107.40 87.43 m + (70)m 393.18 factor 6d	36.43 0.00 -107.40 83.28 + (71)m +	Table 5 36.43 0.00 -107.40 77.44 72)m 344.79 Sol	36.43 0.00 -107.40 72.48 329.54 ar flux v/m² 9.64 x	0.00 -107.40 78.84 335.92 spec or 1 0.9 x	0.00 -107.40 81.10 348.49 g cific data Table 6b 0.45 x	0.00 -107.40 87.71 372.93 FF specific c or Table 0.70	95.18 400.98 data 66c	36.43 0.00 -107.40 98.53 422.15 Gains W] (69)] (70)] (71)] (72)] (73)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains East South	alculated in 36.43 ains (Table 0.00 oration (Ta 107.40 ains (Table 100.78 ins (66)m 434.69	1 Appendix 36.43 5a) 0.00 ble 5) -107.40 5) 98.52 + (67)m + (64) 432.41	1. equation 36.43 0.00 0.00 -107.40 93.82 08)m + (69) 417.40 Access Table	1.15 or L15 36.43 0.00 -107.40 87.43 m + (70)m 393.18 factor 6d	36.43 0.00 -107.40 83.28 + (71)m + (71)m + (71)m + (72) Area m ²	Table 5 36.43 0.00 -107.40 77.44 72)m 344.79 Sol	36.43 0.00 -107.40 72.48 329.54 ar flux v/m² 9.64 x	0.00 -107.40 78.84 335.92 spec or 1 0.9 x	0.00 -107.40 81.10 348.49 g cific data Table 6b	0.00 -107.40 87.71 372.93 FF specific cor Table 0.70	95.18 400.98 data 66c	36.43 0.00 -107.40 98.53 422.15 Gains W] (69)] (70)] (71)] (72)] (73)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains	alculated in 36.43 ains (Table 0.00 oration (Ta -107.40 ains (Table 100.78 ins (66)m 434.69	n Appendix 36.43 5a) 0.00 ble 5) -107.40 5) 98.52 + (67)m + (64) 432.41	L, equation 36.43 0.00 -107.40 93.82 58)m + (69) 417.40 Access Table 0.7	1.15 or L15 36.43 0.00 -107.40 87.43 m + (70)m 393.18 factor 6 d	36.43 0.00 -107.40 83.28 + (71)m +	Table 5 36.43 0.00 -107.40 77.44 72)m 344.79 Sol W	36.43 0.00 -107.40 72.48 329.54 ar flux V/m² 9.64 x 6.75 x	0.00 -107.40 78.84 335.92 spec or 1 0.9 x 0.9 x	0.00 -107.40 81.10 348.49 g cific data Fable 6b 0.45 x 0.45 x	0.00 -107.40 87.71 372.93 FF specific c or Table 0.70 0.70	0.00 -107.40 95.18 400.98 data e 6c = [36.43 0.00 -107.40 98.53 422.15 Gains W 44.76 45.11] (69)] (70)] (71)] (72)] (73)] (76)] (78)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains East South Solar gains in wa	alculated in 36.43 ains (Table 0.00 oration (Ta	1 Appendix 36.43 5a) 0.00 ble 5) -107.40 5) 98.52 + (67)m + (64) 432.41	L, equation 36.43 0.00 -107.40 93.82 68)m + (69) 417.40 Access Table 0.7 0.7	1.15 or L15 36.43 0.00 -107.40 87.43 m + (70)m 393.18 factor 6d	36.43 0.00 -107.40 83.28 + (71)m +	Table 5 36.43 0.00 -107.40 77.44 72)m 344.79 Sol	36.43 0.00 -107.40 72.48 329.54 ar flux v/m² 9.64 x	0.00 -107.40 78.84 335.92 spec or 1 0.9 x	0.00 -107.40 81.10 348.49 g cific data Table 6b 0.45 x	0.00 -107.40 87.71 372.93 FF specific c or Table 0.70	95.18 400.98 data 66c	36.43 0.00 -107.40 98.53 422.15 Gains W] (69)] (70)] (71)] (72)] (73)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains East South	alculated in 36.43 ains (Table 0.00 oration (Ta 107.40 ains (Table 100.78 ins (66)m 434.69 atts ∑(74)m 89.87 ernal and so	1 Appendix 36.43 5a) 0.00 ble 5) -107.40 5) 98.52 + (67)m + (6 432.41 161.44 blar (73)m +	L, equation 36.43 0.00 -107.40 93.82 58)m + (69) 417.40 Access Table 0.7 0.7 238.31 (83)m	1.15 or L15 36.43 0.00 -107.40 87.43 m + (70)m 393.18 factor 6 dd 7 x [7 x [316.67	a), also see 36.43 0.00 -107.40 83.28 + (71)m + (7	Table 5 36.43 0.00 -107.40 77.44 72)m 344.79 Sol X 1 X 4	36.43 0.00 -107.40 72.48 329.54 ar flux V/m² 9.64 x 6.75 x	0.00 -107.40 78.84 335.92 spec or 1 0.9 x 0.9 x 316.98	0.00 -107.40 81.10 348.49 g g ific data Table 6b 0.45 x 266.02	0.00 -107.40 87.71 372.93 FF specific c or Table 0.70 0.70 183.58	0.00 -107.40 95.18 400.98 data 66c = [36.43 0.00 -107.40 98.53 422.15 Gains W 44.76 45.11 75.79] (69)] (70)] (71)] (72)] (73)] (76)] (78)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains East South Solar gains in wa	alculated in 36.43 ains (Table 0.00 oration (Ta	1 Appendix 36.43 5a) 0.00 ble 5) -107.40 5) 98.52 + (67)m + (64) 432.41	L, equation 36.43 0.00 -107.40 93.82 68)m + (69) 417.40 Access Table 0.7 0.7	1.15 or L15 36.43 0.00 -107.40 87.43 m + (70)m 393.18 factor 6 d	36.43 0.00 -107.40 83.28 + (71)m +	Table 5 36.43 0.00 -107.40 77.44 72)m 344.79 Sol W	36.43 0.00 -107.40 72.48 329.54 ar flux V/m² 9.64 x 6.75 x	0.00 -107.40 78.84 335.92 spec or 1 0.9 x 0.9 x	0.00 -107.40 81.10 348.49 g cific data Fable 6b 0.45 x 0.45 x	0.00 -107.40 87.71 372.93 FF specific c or Table 0.70 0.70	0.00 -107.40 95.18 400.98 data e 6c = [36.43 0.00 -107.40 98.53 422.15 Gains W 44.76 45.11] (69)] (70)] (71)] (72)] (73)] (76)] (78)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains East South Solar gains in wa	alculated in 36.43 ains (Table 0.00 oration (Ta	1 Appendix 36.43 5a) 0.00 ble 5) -107.40 5) 98.52 + (67)m + (64) 432.41 1(82)m 161.44 blar (73)m + 593.85	L, equation 36.43 0.00 -107.40 93.82 68)m + (69) 417.40 Access Table 0.7 0.7 238.31 (83)m 655.71	36.43 36.43 0.00 -107.40 87.43 m + (70)m 393.18 6d 7	a), also see 36.43 0.00 -107.40 83.28 + (71)m + (7	Table 5 36.43 0.00 -107.40 77.44 72)m 344.79 Sol X 1 X 4	36.43 0.00 -107.40 72.48 329.54 ar flux V/m² 9.64 x 6.75 x	0.00 -107.40 78.84 335.92 spec or 1 0.9 x 0.9 x 316.98	0.00 -107.40 81.10 348.49 g g ific data Table 6b 0.45 x 266.02	0.00 -107.40 87.71 372.93 FF specific c or Table 0.70 0.70 183.58	0.00 -107.40 95.18 400.98 data 66c = [36.43 0.00 -107.40 98.53 422.15 Gains W 44.76 45.11 75.79] (69)] (70)] (71)] (72)] (73)] (76)] (78)
Pump and fan ga Losses e.g. evap Water heating g Total internal ga 6. Solar gains East South Solar gains in wa Total gains - internal	alculated in 36.43 ains (Table 0.00 oration (Ta -107.40 ains (Table 100.78 ins (66)m 434.69 atts Σ(74)m 89.87 ernal and so 524.56 al tempera	1 Appendix 36.43 5a) 0.00 ble 5) -107.40 5) 98.52 + (67)m + (6 432.41 1(82)m 161.44 blar (73)m + 593.85	L, equation 36.43 0.00 -107.40 93.82 58)m + (69) 417.40 Access Table 0.7 0.7 238.31 (83)m 655.71	1.15 or L15 36.43 0.00 -107.40 87.43 m + (70)m 393.18 factor 6d 7 x [7 x [316.67	36.43 0.00 -107.40 83.28 + (71)m + (7) 368.45 Area m² 10.44 4.42 368.57	Table 5 36.43 0.00 -107.40 77.44 72)m 344.79 Solution X	36.43 0.00 -107.40 72.48 329.54 ar flux V/m² 9.64 x 6.75 x	0.00 -107.40 78.84 335.92 spec or 1 0.9 x 0.9 x 316.98	0.00 -107.40 81.10 348.49 g g ific data Table 6b 0.45 x 266.02	0.00 -107.40 87.71 372.93 FF specific c or Table 0.70 0.70 183.58	0.00 -107.40 95.18 400.98 data 66c = [109.28	36.43 0.00 -107.40 98.53 422.15 Gains W 44.76 45.11 75.79] (69)] (70)] (71)] (72)] (73)] (76)] (78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	or for gains	for 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 t	emp of livir	ng area T1 (s	steps 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 du	uring heatin	g periods ir	the rest of	f dwelling fi	rom Table	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 facto	or for gains	for 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 t	emperature	e in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	9c)						_
	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 fract	tion								Li	ving area ÷	(4) =	0.33	(91)
Mean internal t	emperature	e for the wh	ole dwellin	g fLA x T1 +	-(1 - fLA) x	T2						_	_
	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 adjustme	nt to the m	ean interna	l temperati	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 heati	ng requiren	nent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	or for gains,	ηm		•	•								
	1.00	0.99	0.98	0.94	0.84	0.63	0.44	0.49	0.76	0.96	0.99	1.00	(94)
Useful gains, ηn	nGm, W (9	4)m x (84)m)								1	· ·	_ ` ′
	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 averag		1		1			00000	1 2 2 3 3 3				1	
,	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				1	l								
	1228.32	1189.33	1077.28	895.73	689.03	459.16	303.66	318.33	498.88	758.06	1007.88	1219.55	(97)
Space heating r		1					303.00	1 310.33	130.00	730.00	1007.00	1213.33	(37)
- Para	524.58	402.52	321.74	162.15	54.16	0.00	0.00	0.00	0.00	166.21	360.49	537.56	٦
	324.30	402.32	321.74	102.13	34.10	0.00	0.00	0.00	1	8)15, 10		2529.40	 (98)
Space heating r	equirement	· kWh/m²/v	ear						2(3)	•	÷ (4)	26.70	(99)
Space nearing i	equirement		cui							(30)	. (-)	20.70	(55)
9b. Energy req	uirements	- communit	ty heating s	cheme									
Fraction of space	e heat fron	n secondary	/suppleme	ntary syste	m (table 11	1)				'0' if	none	0.00	(301)
Fraction of space	e heat fron	n communit	y system							1 - (3	01) =	1.00	(302)
Fraction of com	munity hea	t from boile	ers									1.00	(303a)
Fraction of tota	I space hea	t from comr	munity boil	ers						(302) x (30	3a) =	1.00	(304a)
Factor for contr	ol and char	ging metho	d (Table 4c	(3)) for com	nmunity sp	ace heating						1.00	(305)
Factor for charg	ging method	d (Table 4c(3	3)) for com	munity wat	er heating							1.00	(305a)
Distribution los	s factor (Tal	ole 12c) for	community	heating sy	stem							1.05	(306)
Space heating										,			
Annual space he	eating requ	irement						2	2529.40]			(98)
Space heat fron	n boilers							(98	8) x (304a) :	x (305) x (3	06) =	2655.87	(307a)
Water heating													
Annual water h	eating requ	irement						1	1862.94	1			(64)
Water heat from	• .) x (303a) x	์ (305a) x (3	06) =	1956.09	(310a)
Tatal Heat Hol	5511615							(04)	, (303a) X	,5550, 7 (5	,		(5100)

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

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

216.69 (330a) (331)

Total electricity for the above, kWh/year

216.69

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. Fue	costs -	community	heating sc	heme
----------	---------	-----------	------------	------

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	2655.87	x	4.24	x 0.01 =	112.61	(340a)
Water heating from boilers	1956.09	x	4.24	x 0.01 =	82.94	(342a)
Pumps and fans	216.69	x	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 heating 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 h	eating)								
Efficiency of boilers		89.50					(367a)		
CO2 emissions from boilers [(307	a)+(310a)] x 100 ÷ (367a) = [5153.03	x	0.216	= [1113.05	(367)		
Electrical energy for community heat of	listribution	46.12	x	0.519	= [23.94	(372)		
Total CO2 associated with community	systems					1136.99	(373)		
Total CO2 associated with space and w	ater 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 CO ₂ , 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 - 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) =	5153.03	x	1.22	=	6286.70	(367)
Electrical energy for community	y heat distribution	46.12	x	3.07	=	141.59	(372)
Total primary energy associated	d with community systems					6428.28	(373)
Electrical energy for community	y heat distribution]			141.59	(372)

Total primary energy associated with space and water heating

Pumps and fans

Electricity for lighting

216.69 408.17 3.07

3.07

6428.28 (376)

665.25 (378)

1253.08 (379)

(384)

(383)

8346.62

88.11

Primary energy kWh/year

Dwelling primary energy rate kWh/m2/year



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 dimens	ions			
		Area (m²)	Average storey height (m)	Volume (m³)
Lowest occupied		72.24 (1a) x	2.50 (2a) =	180.60 (3a)
+1		57.20 (1b) x	2.50 (2b) =	143.00 (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)(1n) =	129.44 (4)		
Dwelling volume			(3a) + (3b) + (3c) + (3d)	(3n) = 323.60 (5)
2. Ventilation rate				
				m³ per hour
Number of chimneys			0 x 40	= 0 (6a)
Number of open flues			0 x 20	= 0 (6b)

0 x 10 = 0 (7a) Number of intermittent fans Number of passive vents 0 x 10 = 0 Number of flueless gas fires 0 x 40 = 0

Air changes per hour 0.00

3.00

0.15

(8)

(17)

(18)

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

Infiltration due to chimneys, flues, fans, PSVs

Infiltration rate modified for monthly wind speed:

	2	(19)
1 - [0.075 x (19)] =	0.85	(20)

0.13 $(18) \times (20) =$

 \div (5) =

Jan Feb Apr May Jul Oct Nov Dec Aug Sep

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)
or (22)	m ÷ 4												_
	1 20	1 25	1 22	1 10	1.00	0.05	0.05	0.02	1.00	1 00	1 12	1 10	(222)

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

Shelter factor

Wind factor

	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	l 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 change rate for the applicable case:

If mechanical ventilation: air change rate through system

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

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100] 0.30 0.29 0.29 0.27 0.26 0.26 0.25 0.26 0.27 0.28 0.27 0.28 (24a)

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



0.50

73.10

(23a)

(23c)

Element				Gross	Openings		area	U-value	A x U W		alue,	Αхκ,	
ACI			а	area, m²	m²		m²	W/m²K	22.2:	_ '	m².K	kJ/K	,
Window							.72 x	1.24	= 29.31				(2
Door						1.		1.30	= 2.34	\exists			(2
Ground floor						72		0.10	= 7.22				(2
External wall						64		0.17	= 10.93				(2
Party wall						79		0.00	= 0.00				(3
Roof							.04 x	0.13	= 1.96				(3
Roof						2.		0.16	= 0.41				(3
Total area of ex	ternal elem	ents ∑A, m²				179	0.69						_ (3 _
Fabric heat loss	, W/K = ∑(A	× U)								5)(30) + (3		52.18	(3
Heat capacity C	m = ∑(A x к)							(28)	.(30) + (32) -	+ (32a)(32	e) =	N/A	(3
Thermal mass p	arameter (T	TMP) in kJ/n	n²K									250.00	(3
Thermal bridge:	s: Σ(L x Ψ) c	alculated us	ing Appen	ıdix K								14.96	(3
Total fabric hea	t loss									(33) + (3	6) =	67.14	(3
	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)									
	31.72	31.38	31.04	29.34	29.00	27.30	27.30	26.96	27.98	29.00	29.68	30.36	(3
Heat transfer co	oefficient, W	J/K (37)m +	- (38)m										
	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 = 2	(39)112/	12 =	96.39	(3
Heat loss param	neter (HLP),	W/m ² K (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 =	0.74	(4
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
4 Water beati	ing operav d	oguiromon											
4. Water heati		equiremen	L									2.00	7,
Assumed occup	•			v. 1	(25 N)	26						2.89	(4 (4
Annual average							11	A	Com	0-4	No.	102.92	(4
	Jan	Feb	Mar	Apr	May	Jun	Jul 、	Aug	Sep	Oct	Nov	Dec	
Hot water usage							_	1	1			1	_
	113.21	109.10	104.98	100.86	96.75	92.63	92.63	96.75	100.86	104.98	109.10	113.21	<u>.</u>
_										∑(44)1:	12 =	1235.05	(2
Energy content									T				_
	167.89	146.84	151.53	132.10	126.76	109.38	101.36	116.31	117.70	137.17	149.73	162.59	_
										∑(45)1:	12 =	1619.35	(4
Distribution los	s 0.15 x (45)m						_					_
	25.18	22.03	22.73	19.82	19.01	16.41	15.20	17.45	17.65	20.57	22.46	24.39	(4
		uding any so	olar or WW	VHRS storag	ge within san	ne vessel						3.00	(4
_	oss:												
_											_		_
Water storage I	r's declared	loss factor	is not kno	wn									10
Water storage I					y)							0.02] (;
Storage volume Water storage I b) Manufacture Hot water st Volume fact	torage loss f	actor from			y)							0.02 3.42	=
Water storage l b) Manufacture Hot water st	torage loss for from Tab	actor from			y)								(5 (5 (5

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)

6. Solar gains																
			Access f Table		Area m²		Solar flux W/m²		•	g ific data able 6b		FF specific d or Table			Gains W	
South			0.7	7 x	9.04	_ x	46.75	x 0.9	x C	0.50	X	0.70		=	102.51	(78)
East			0.7	7 x	10.68	x	19.64	x 0.9	x	0.45	X	0.70		=	45.79	(76)
SouthEast			0.7	7 x	4.00	x	36.79	x 0.9	х	0.50	X	0.70		=	35.70	(77)
Solar gains in wa	tts ∑(74)m	(82)m														
	184.00	318.27	444.57	559.93	631.00	626	604.	31 5	52.00	485.05	5	354.57	22:	1.36	156.78	(83)
Total gains - inte	rnal and so	lar (73)m +	(83)m													
	678.81	810.77	919.89	1007.27	1049.38	101	7.84 977.	55 9	31.96	879.62	2	777.36	67	6.59	636.87	(84)

	ii tempera	iture (heatir	ng season)										
emperature dur	ing heatin	g periods in	the living	area from	Table 9, Th	1(°C)						21.00	(8
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Itilisation factor	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 ter	mp 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 dur	ing heatin	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
Itilisation factor	for gains f	or rest of d	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 ter	mperature	in the rest	of dwelling	g 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
iving area fractio	on								Li	ving area ÷	(4) =	0.30	(9
/lean internal ter	mperature	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
apply adjustment	t to the m	ean internal	temperati	ure 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
8. Space heating	g requiren	nent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tilisation factor	for gains,	ηm											_
	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
Iseful gains, ηm(Gm, W (94	4)m x (84)m											
	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
Nonthly average	external t	emperature	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	(9
leat loss rate for	mean inte	ernal tempe	rature, Lm	, W [(39)n	n x [(93)m -	(96)m]							
	1507.74	1463.21	1327.29	1101.17	843.21	558.90	370.32	387.94	609.16	931.85	1236.13	1494.12	2 (9
pace heating red	quirement	, kWh/mont	th 0.024 x	[(97)m - (9	5)m] x (41)	m							
	617.72	442.19	319.47	130.26	30.34	0.00	0.00	0.00	0.00	148.28	405.78	638.41	
									∑(9	8)15, 10	.12 =	2732.45	(9
pace heating red	quirement	kWh/m²/ye	ear							(98)	÷ (4)	21.11	(9
Oh Engravers	ivovaovata	- community	v booting c	chomo									
9b. Energy requ					/: 11 4					lol :r		0.00	7 (2
raction of space			• •	ntary syste	m (table 11	L)					none	0.00	(3 (3
raction of space										1 - (3	01) = [1.00	(3 (3
raction of comm										(0.05)		1.00	(3 (3
raction of total s										(302) x (30	за) = [1.00	(3 (3
actor for control						ace heating						1.00	(3 (3
actor for chargin	_				_							1.00	(3
istribution loss f	factor (Tak	ole 12c) for o	community	heating sy	/stem							1.05	(3
pace heating										7			
nnual space hea		rement							2732.45]	. —		(<u>9</u>
pace heat from l								/01	8) x (304a) :	(205) (2	061	2869.07	(3

Water heating

Annual water heating requirement			1940.83		(64)
Water heat from boilers			(64) x (303a) x (305a) x (306		(310a)
Electricity used for heat distribution		0.01 × [(3	307a)(307e) + (310a)(310e)		(313)
·					
Electricity for pumps, fans and electric keep-hot (Table 4f)					
mechanical ventilation fans - balanced, extract or positive inpu	t 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) + (3	10) + (312)	+ (315) + (331) + (332)(337b)	5733.65	(338)
10b. Fuel costs - community heating scheme	F I		Full order	Final	
	Fuel kWh/year		Fuel price	Fuel cost £/year	
Space heating from boilers	2869.07	x	4.24 x 0.01 =		(340a)
Water heating from boilers	2037.87	X	4.24 × 0.01 =		(342a)
Pumps and fans	350.38	X	13.19 × 0.01 =		(349)
Electricity for lighting	476.33	x	13.19 × 0.01 =		(350)
Additional standing charges	470.33	^	13.13 × 0.01 =		(351)
Total energy cost			(340a)(342e) + (345)(354		(355)
- Total chergy cost			(5450)(5420) * (543)(554)	7 - 437.10	(333)
11b. SAP rating - community heating scheme					
Energy cost deflator (Table 12)				0.42	(356)
Energy cost factor (ECF)				1.05	(357)
SAP value				85.32	
SAP rating (section 13)				85	(358)
SAP band				В	
12h CO. emissions - community heating scheme					
12b. CO ₂ emissions - community heating scheme	Fnergy		Emission factor	Fmissions	
12b. CO ₂ emissions - community heating scheme	Energy kWh/year		Emission factor	Emissions (kg/year)	
12b. CO₂ emissions - community heating scheme Emissions from other sources (space heating)			Emission factor		
			Emission factor	(kg/year)	(367a)
Emissions from other sources (space heating)	kWh/year	x	Emission factor 0.216 =	(kg/year)	(367a) (367)
Emissions from other sources (space heating) Efficiency of boilers	kWh/year 89.50	x x		(kg/year)	
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	89.50 5482.61		0.216 =	(kg/year) 1184.24 25.47	(367)
Emissions from other sources (space heating) Efficiency of boilers CO2 emissions from boilers [(307a)+(310a)] \times 100 \div (367a) = Electrical energy for community heat distribution	89.50 5482.61		0.216 =	(kg/year) 1184.24 25.47 1209.71	(367) (372)
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	89.50 5482.61		0.216 =	(kg/year) 1184.24 25.47 1209.71 1209.71	(367) (372) (373)
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 =	1184.24 25.47 1209.71 1209.71 181.85	(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	0.216 = 0.519 = 0.519	(kg/year) 1184.24 25.47 1209.71 1209.71 181.85 247.22	(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	0.216 = 0.519 = 0.519 = 0.519 =	(kg/year) 1184.24 25.47 1209.71 1209.71 181.85 247.22 1638.77	(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	0.216 = 0.519 = 0.519 = (376)(382	(kg/year) 1184.24 25.47 1209.71 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	0.216 = 0.519 = 0.519 = (376)(382	1184.24 25.47 1209.71 1209.71 181.85 247.22) = 1638.77) = 12.66 87.41	(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	0.216 = 0.519 = 0.519 = (376)(382	1184.24 25.47 1209.71 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 CO2, kg/year Dwelling CO2 emission rate El value El rating (section 14) El band	89.50 5482.61 49.07	x	0.216 = 0.519 = 0.519 = (376)(382	(kg/year) 1184.24 25.47 1209.71 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)	89.50 5482.61 49.07 350.38 476.33	x	0.216 = 0.519 = (376)(382 (383) ÷ (4	1184.24 25.47 1209.71 1209.71 181.85 247.22 1 = 1638.77 1 = 12.66 87.41 87 B	(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 CO2, kg/year Dwelling CO2 emission rate El value El rating (section 14) El band	89.50 5482.61 49.07	x	0.216 = 0.519 = 0.519 = (376)(382	(kg/year) 1184.24 25.47 1209.71 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 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 = (376)(382 (383) ÷ (4	(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)
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 = (376)(382 (383) ÷ (4	(kg/year) 1184.24 25.47 1209.71 1209.71 181.85 247.22) = 1638.77) = 12.66 87.41 87 B Primary energy (kWh/year)	(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 Energy kWh/year	x x x	0.216 = 0.519 = 0.519 = (376)(382 (383) ÷ (4	1184.24 25.47 1209.71 1209.71 181.85 247.22 1 638.77 1 = 12.66 87.41 87 B Primary energy (kWh/year)	(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 = (376)(382 (383) ÷ (4	1184.24 25.47 1209.71 1209.71 181.85 247.22 1 638.77 1 = 12.66 87.41 87 B Primary energy (kWh/year)	(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	х	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 waighted average II values [M	1//21/\1			

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
Е	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
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(I/s)]							LID officionav			
ID of system type	Α	В	С	D	E	F	G	Н	I	HR 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	acy [lm/W]	
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?	NO
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

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

Building Use

% Area	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

Residential spaces

Others: Miscellaneous 24hr activities

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 & CO, 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.

F	HVAC Systems Performance									
Sys	System Type Heat dem MJ/m2									
[ST	[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
	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

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

Cool gen SSEER = Cooling generator seasonal energy efficiency ratio

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

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-Тур	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))]		U _{i-Min} = Minimum individual element U-values [W/(m²K)]
* There might be more than one surface where the minimum U-value occurs.			

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

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

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		
	Highly efficient building fabric and air tightness standards.	As per Energy Statement		
1. Reduce the amount of heat entering the building	Solar control glazing with g-value of	A low G-value reduces the solar gains,		
near circums are surrains	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 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 assum will help reduce the risk of overheating	ed between dwellings. The thermal mass of this 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	There is no requirement for active cooling. A combination of passive measures and background mechanical ventilation in conjunction with natural ventilation have be incorporated to mitigate the overheating risk.			

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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.

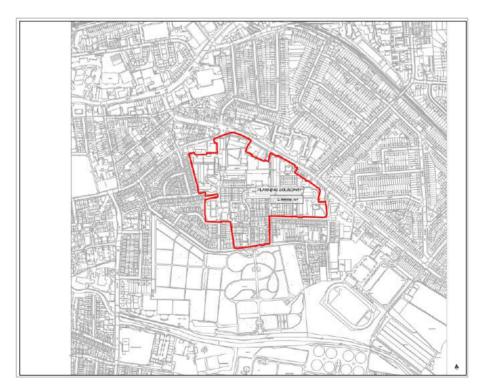


Figure 1: Site plan Courtesy of Patel Taylor

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.

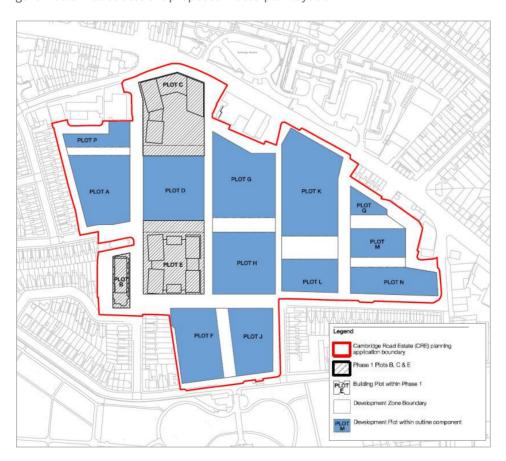


Figure 2: Parameter Plan (Patel Taylor, October 2020).



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):

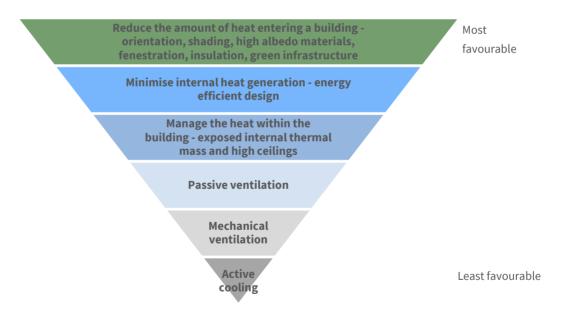


Figure 3: Cooling Hierarchy (Draft London Plan 2019)

- 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.

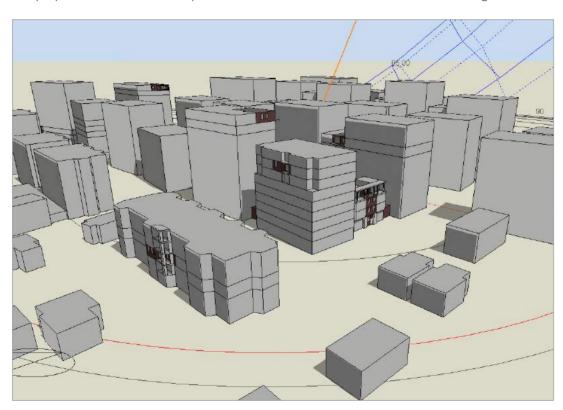


Figure 4: Design builder simulation model for Blocks B and E, sun path shown for 21st June 12:00 noon BST.

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 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.
- 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.

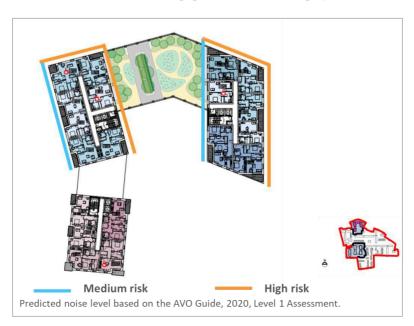


Figure 5: Diagram of the results of the noise modelling in line with AVO Guide risk assessment. (Patel Taylor 1st floor plan drawings with the noise information provided by WYG)

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.

Voise risk				
category	Room	Occupied Hours (TM59)	Window opening schedule	Discussion
Non-sensitive noise facades (the majority	Kitchen / Living areas	09:00-22:00	Kitchen/Living room: 9:00- 22:00	Windows open during the day in the kitchen/living
of the blocks)	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)	Bedrooms: 07:00-02:00	Bedrooms require windows to be open for some hours during the hottest nights of the year to cool down the space. Ensafe and WYG Consultants confirmed that the proposed strategy is acceptable and in line with noise and

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
62.11.6.2 D ED	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
62 5 5 20 40	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
F1 11 1 2DCD	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
E4.7.3 1B2P	Bedroom 1	0.06	22.67	Pass
E4.1.3 1DZP	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 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	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:	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 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	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 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

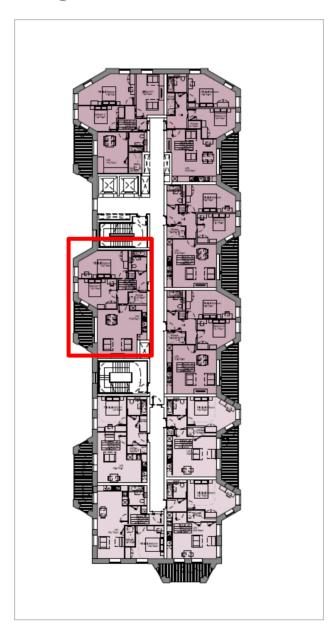


Figure T1.1. Block B, 2nd floor selected middle floor 2bed dwelling facing west (Patel Taylor drawings 21.09.2020).

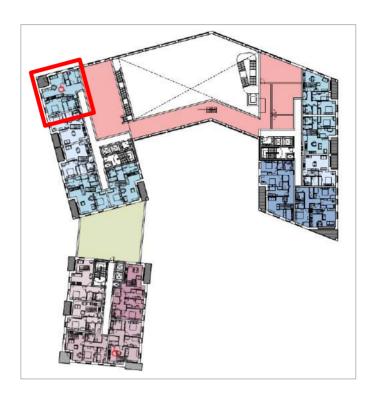


Figure T1.2. Block C, 1st floor selected 2bed dwelling on the nosy façade (Patel Taylor drawings 21.09.2020).

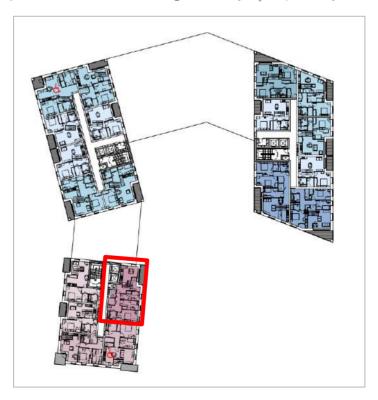


Figure T1.3. Block C, 5th floor selected 3Bed dwelling on the middle level (Patel Taylor drawings 21.09.2020).



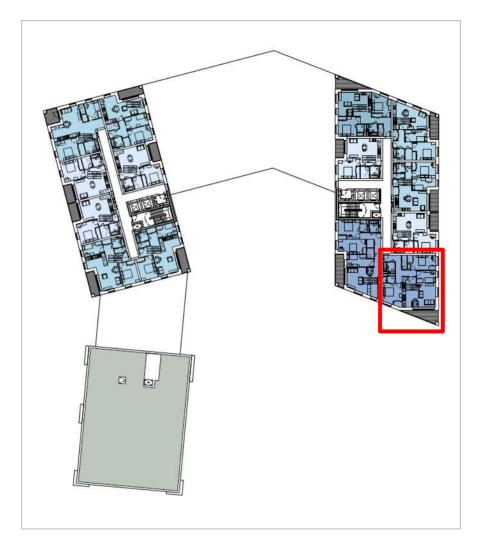


Figure T1.4. Block C, 11th floor selected 3bed dwelling on the top level (Patel Taylor drawings 21.09.2020).

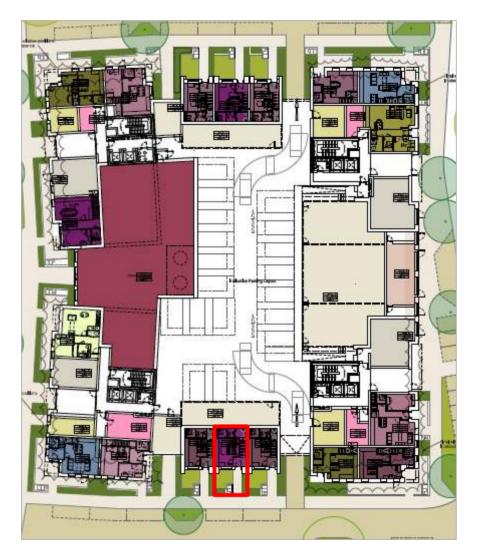


Figure T1.5. Block E, ground floor level selected Maisonette facing south (Patel Taylor drawings 21.09.2020).





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).

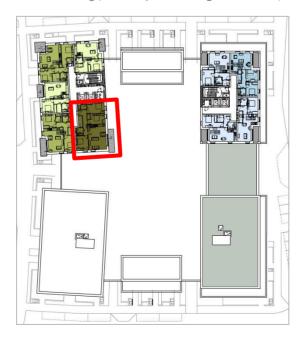


Figure T1.7. Block E, 11th level selected 3bed south-east dwelling top floor dual-aspect (Patel Taylor drawings 21.09.2020).

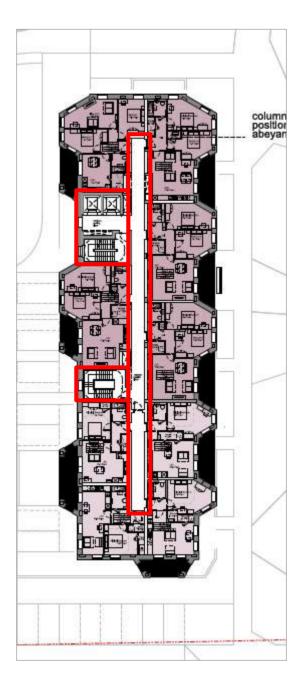


Figure T1.7. Block B 4th floor, middle-floor communal Corridor (Patel Taylor drawings 21.09.2020).



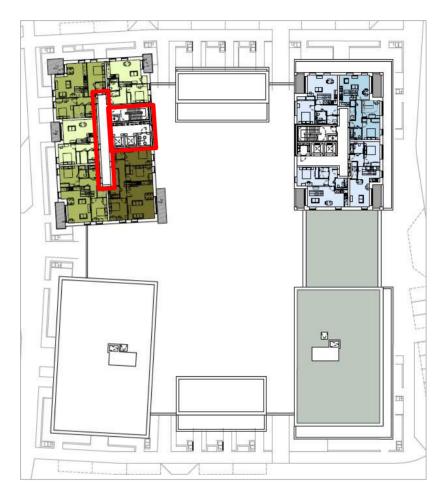


Figure T1.8. Block E 11th floor, top floor communal Corridor (Patel Taylor drawings 21.09.2020).

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 C 2DED	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	
	Bedroom 1	0.10	48.67	Fail	
C3.5.5 3B4P	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 E6.1.2	Bedroom 1 Single	0.02	25.67	Pass	
House IF Eb.1.2	Living Room	0.00	N/A	Pass	
	Bedroom 1 Single	0.00	28.33	Pass	
House 2F E6.2.2	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	
House 2F E6.2.2	Bedroom 1 Single	0.00	33.83	Fail	
	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		

APPENDIX T3

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					
E3.7.2 -3 bed	E1.11.1- 3bed	E6.0.2 House			
87.06	94.96	160.6			m ²
2.5	2.5	2.5			m
217.65	237.4	270.08			m³
	Minimun	n high rate (l	/s)		
13	13	13			l/s
8	8	8			l/s
8	8	16			l/s
8	8	16			l/s
					l/s
37	37	53			l/s
133.2	133.2	190.8			m³/hr
0.61	0.56	0.71			ach
	E3.7.2 -3 bed 87.06 2.5 217.65 13 8 8 8 137	E3.7.2 -3 bed 87.06 94.96 2.5 237.4 Minimur 13 13 8 8 8 8 8 8 8 8 1337 37	E3.7.2 -3 bed E1.11.1-3bed E6.0.2 House 87.06 94.96 160.6 2.5 2.5 2.5 217.65 237.4 270.08 Minimum high rate (I) 13 13 13 13 8 8 8 8 8 8 16 8 8 16 37 37 53	E3.7.2-3 bed Shed House 87.06 94.96 160.6 2.5 2.5 2.5 217.65 237.4 270.08 Minimum high rate (l/s) 13 13 13 13 8 8 8 16 8 8 16 8 16 16 16 16 16 16 16 16 16 16 16 16 16	E3.7.2 - 3 bed

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	m³	
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				



APPENDIX T4

GHA Early Stage Overheating Risk Tool Scoresheet

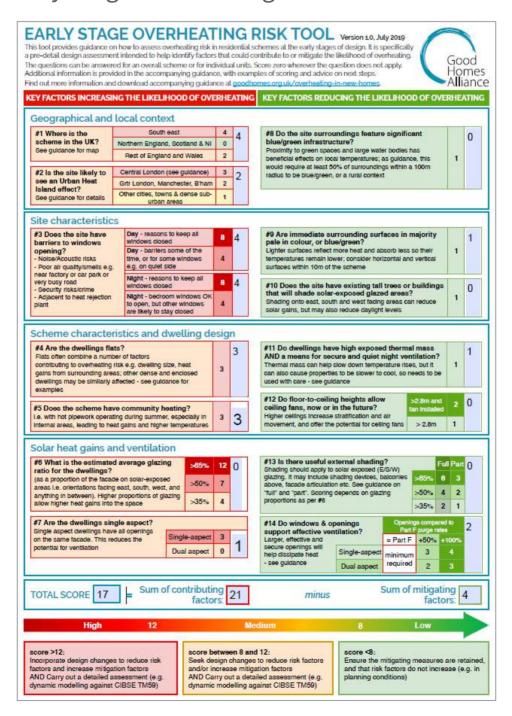


Figure T4.1. GHA overheating scoresheet for Phase 1 - Block C with noise constraints.

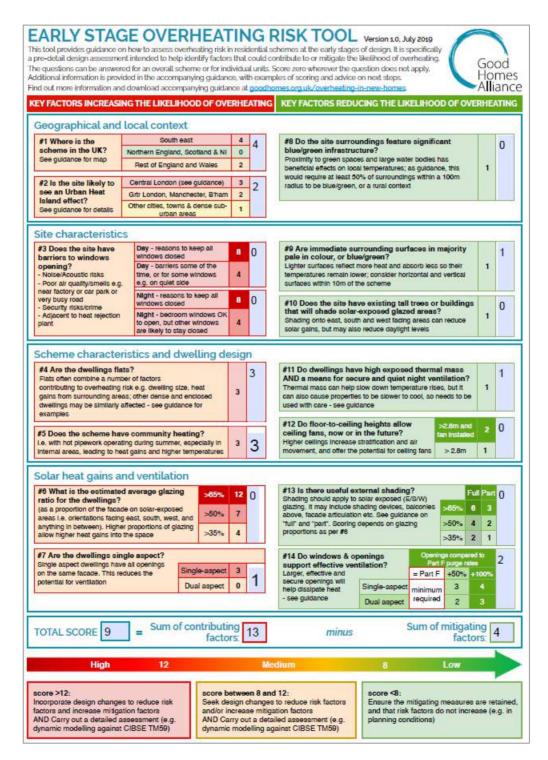


Figure T4.2. GHA overheating scoresheet for Phase 1 - Blocks B & E without noise constraints.



APPENDIX T5

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).

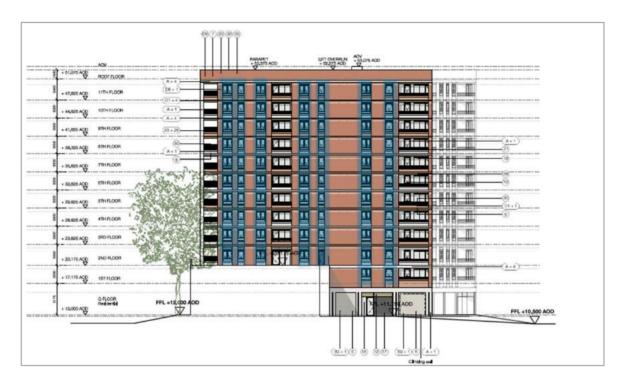


Figure T5.3. Block C2, east elevation. Windows that require blinds are marked up in blue (Patel Taylor drawings 23.10.2020).

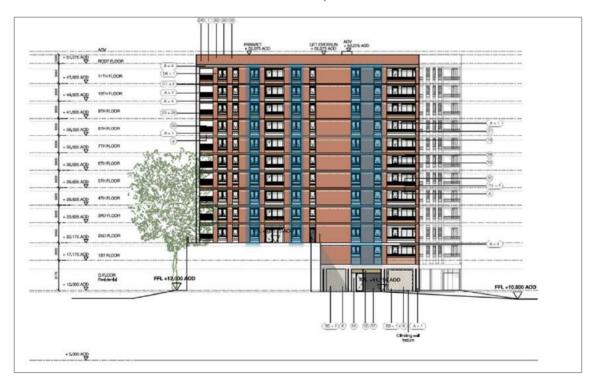


Figure T5.4. Block C2, west elevation. Windows that require blinds are marked up in blue (Patel Taylor drawings 23.10.2020).





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

APPENDIX T6

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 C 2DED	Bedroom 1	0.00	15.17	Pass
	Bedroom 2	0.00	33.83	Fail
C2.11.6 3B5P	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
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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.

Hodkinson Consultancy can accept no responsibility for misinformation or inaccurate information supplied by any third party as part of this assessment.

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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.



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1. INTRODUCTION

- 1.1 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.
- 2.8 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.

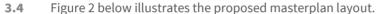
Proposed Development

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")."



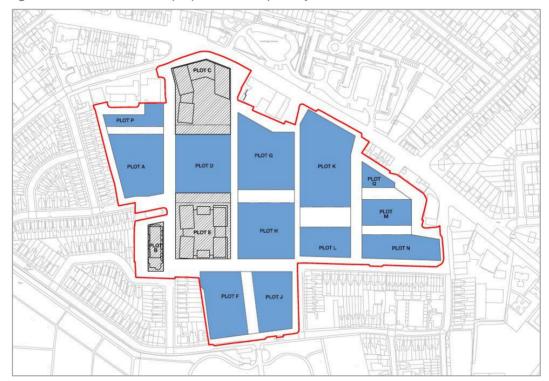


Figure 2: Proposed Masterplan Layout - Patel Taylor (October 2020)

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.
- **4.2** 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.
- 5.3 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.

- 5.14 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

- 5.17 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.
- 6.3 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

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.



- 6.8 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.
- 6.9 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.
- 6.10 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.
- 6.12 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.

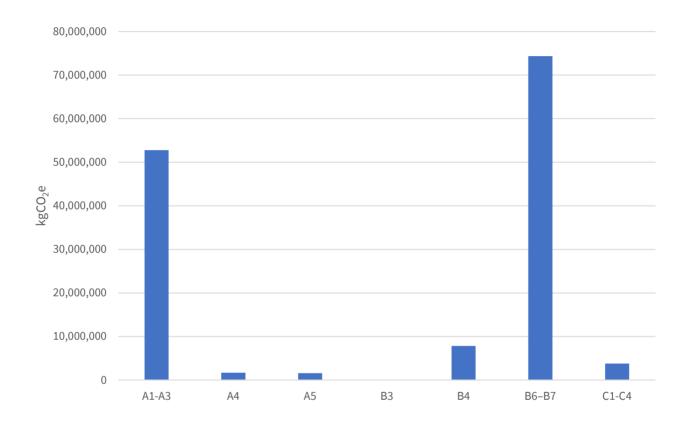


Figure 4: Total kgCO₂e - Life Cycle Stages

- 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.

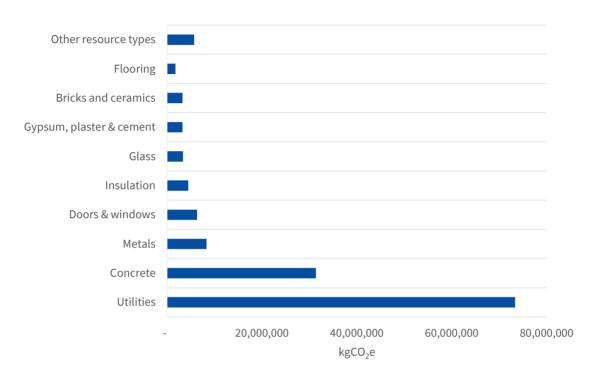


Figure 5: Total kgCO2e - Resource Types

8. HIGH LEVEL OBSERVATIONS

- **8.1** A set of high-level observations are set out below that could be considered as a part of the detail design post planning.
- **8.2** 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.

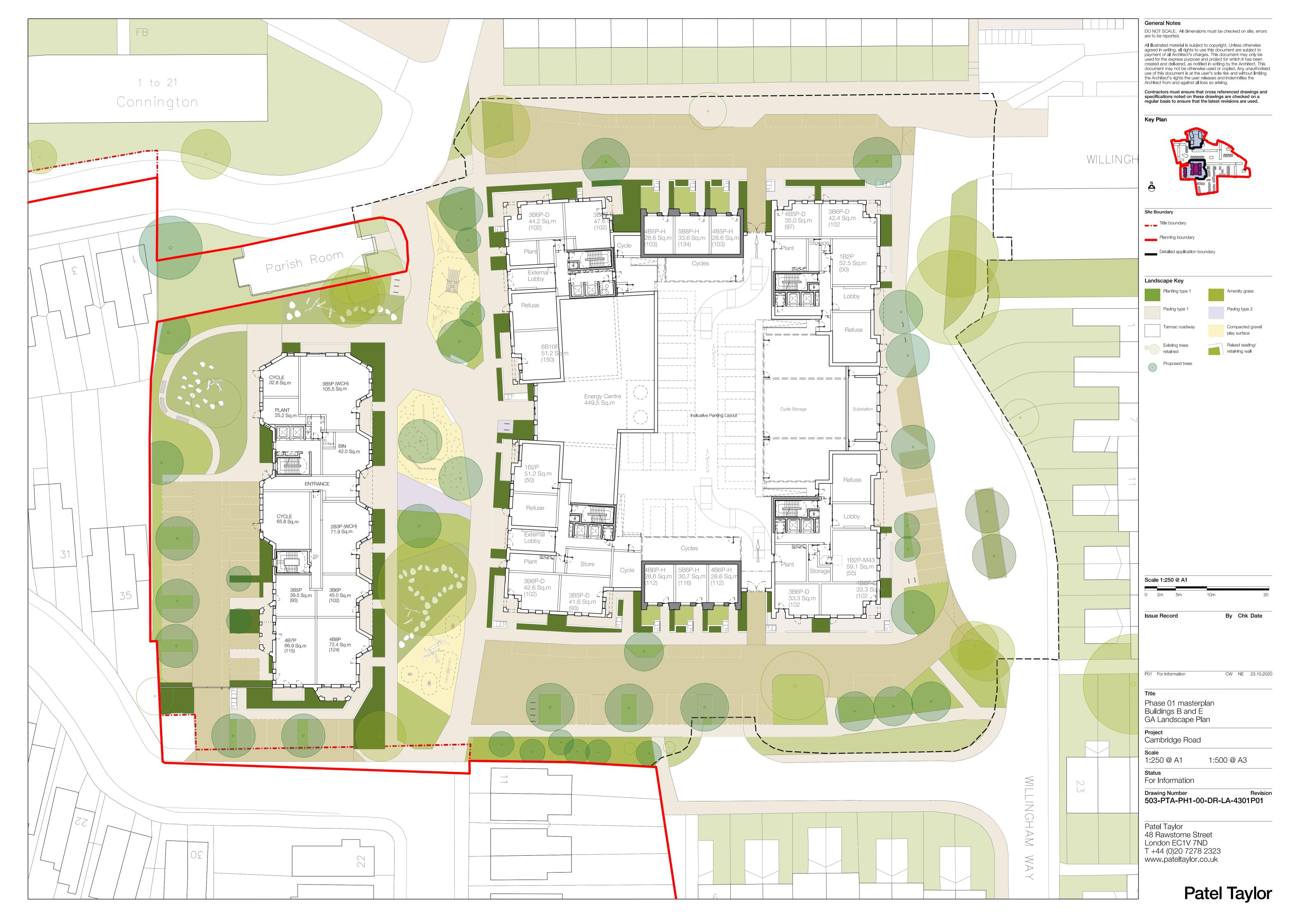
9. CONCLUSION

- 9.1 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.
- **9.2** 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)

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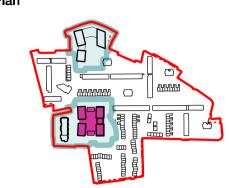
DO NOT SCALE. All dimensions must be checked on site, errors

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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

General Notes



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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