# Three Fold Architects on behalf of Charles Morin and Emilie Bellet

# Energy & Sustainability Assessment

Proposed demolition of existing house and development of 1no new midterrace house @ 59 Camden Mews, London, NW1 9BY

13 October 2017

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### **Issue Status**

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### 1. Executive Summary

This document is in response to the London Borough of Camden Council's Local Plan 2016, and specifically deals with the following policies that cover climate change and sustainability:

- CC1 Climate Change Mitigation
- CC2 Adapting to Climate Change

The report details how the development will incorporate Sustainable Design and resource efficiency measures in accordance with the Energy Hierarchy, so to meet the policy requirements and reduce its overall environmental impact.

In relation to Policy CC1 – Renewable and Low-Carbon Sources of Energy, the development is required to achieve a 19% Carbon Reduction over Part L Compliancy of the Building Regulations, in addition to any requirements for renewable energy.

In order to demonstrate this 19% reduction in carbon emissions, four separate scenarios have been tested, each utilising a mix of resource efficiency measures, the application of Low / Zero Carbon technologies or both.

The figures used within this report have been based on the most recent issue of drawings (October 2017) and modelled using SAP 2012 to accurately predict Energy Usage and CO<sub>2</sub> reductions.

In the proposed scenario the new dwellings utilise highly efficient regular condensing gas boilers to satisfy both the space heating and well insulated hot water cylinders for the hot water requirement in addition to U Values and design targets specified to well exceed Part L 2014 compliance.

Following the LZC feasibility assessment, it is proposed that the development will not utilise any renewable technologies as the energy efficiency measures incorporated achieved the required percentage reduction.

As a result of the above, the predicted site wide reduction in  $CO_2$  over Part L 2014 of the Building Regulations is **19.3%**.

Therefore, the development complies with the  $CO_2$  reduction target requirement as outlined within Policy CC1.



# 2. Planning Statement

The following report relates to the proposed new dwelling on the land at 59 Camden Mews, London, NW1 9BY.

# 2.1 The Development

The development includes the demolition of the existing mid-terrace dwelling and the subsequent construction of 1No. two-storey, mid-terrace dwelling with accompanying garage.



Proposed Ground Floor Plan (not to scale)



### 2.2 Relevant Policies

This report is a resultant production in response to the London Borough of Camden Council's Local Plan 2016, and specifically deals with planning policies CC1 and CC2, covering Climate Change and Sustainability.

# CC1 – Mitigating and Adapting to Climate Change

# Policy CC1 Climate change mitigation

The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

We will:

- promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;
- b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;
- ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;
- d. support and encourage sensitive energy efficiency improvements to existing buildings;
- e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and
- f. expect all developments to optimise resource efficiency.
- For decentralised energy networks, we will promote decentralised energy by:
- g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;
- protecting existing decentralised energy networks (e.g. at Gower Street Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and
- i. requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.



### The energy hierarchy

The Council's Sustainability Plan 'Green Action for Change' commits the Council to seek low and where possible zero carbon buildings. New developments in Camden will be expected to be designed to minimise energy use and CO2 emissions in operation through the application of the "energy hierarchy". The energy hierarchy is a sequence of steps that minimise the energy consumption of a building. Buildings designed in line with the energy hierarchy prioritise lower cost passive design measures, such as improved fabric performance over higher cost active systems such as renewable energy technologies.

The following diagram shows a simplified schematic of the energy hierarchy, which is explained further in supplementary planning document Camden Planning Guidance 3: Sustainability.



All developments involving five or more dwellings and/or more than 500 sqm of (gross internal) any floorspace will be required to submit an energy statement demonstrating how the energy hierarchy has been applied to make the fullest contribution to CO2 reduction. All new residential development will also be required to demonstrate a 19% CO2 reduction below Part L 2013 Building Regulations (in addition to any requirements for renewable energy). This can be demonstrated through an energy statement or sustainability statement.

#### Be lean

Proposals should demonstrate how passive design measures including the development orientation, form, mass, and window sizes and positions have been taken into consideration to reduce energy demand, demonstrating that the minimum energy efficiency requirements required under building regulations will be met and where possible exceeded. This is in line with stage one of the energy hierarchy 'Be lean'.

#### Be clean

The second stage of the energy hierarchy 'Be clean' should demonstrate how the development will supply energy efficiently through decentralised energy. Please refer to the section below on decentralised energy generation.

#### Be green

The Council will expect developments of five or more dwellings and/or more than 500 sqm of any gross internal floorspace to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation (which can include sources of site related decentralised renewable energy) unless it can be demonstrated that such provision is not feasible. This is in line with stage three of the energy hierarchy 'Be green'. The 20% reduction should be calculated from the regulated CO2 emissions of the development after all proposed energy efficiency measures and any CO2 reduction from non-renewable decentralised energy (e.g. CHP) have been incorporated.

All major developments will also be expected to demonstrate how relevant London Plan targets for CO2 reduction, including targets for renewable energy, have been met. Where it is demonstrated that the required London Plan reductions in carbon dioxide emissions cannot be met on site, the Council will require a financial contribution to an agreed borough wide programme to provide for local low carbon projects. The borough wide programme will be connected to key projects identified in the Council's Green Action for Change.



# Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as::

- the protection of existing green spaces and promoting new appropriate green infrastructure;
- not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;
- c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and
- d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

# Sustainable design and construction measures

The Council will promote and measure sustainable design and construction by:

- e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;
- f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;
- g. expecting developments (conversions/extensions) of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and
- h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.



# 2.3 Sustainable Design Strategy

To achieve the most accurate calculations and estimates, the proposed dwelling has been modelled using *SAP 2012* the governments Standard Assessment Procedure for residential dwellings.

A Part L compliant baseline has been established and then further improvements have been made to the building fabric and specification prior to the addition of LZC technologies. This is in compliance with the Energy Hierarchy:



In accordance with the above methodology, the development will be designed with a fabric first approach, meaning all fabric U Values, air permeability and ventilation targets are above and beyond Building Regulations Compliancy.

Further efficiency measures to both the building fabric and building services will be incorporated to reduce the energy demand further and associated carbon emissions. This approach demonstrates a holistic low energy design concept, involving very low limiting values and thus leads to high energy performance targets.



# 2.4 Energy Efficient Design and Specification

In line with the above Sustainable Design Strategy, the following Energy Efficient design measures are specified.

- High levels of insulation throughout with minimal thermal bridges.
- Passive solar gains and internal heat sources.
- Excellent level of airtightness.
- Good indoor air quality by openable windows



The Proposed specifications and key energy efficient design measures are as follows:

- Ground Floor U-value of 0.12 W/m<sup>2</sup>K
- External Wall U-value of 0.2 W/m<sup>2</sup>K
- Roof U-value of 0.1 W/m<sup>2</sup>K
- Use of Accredited Construction Details to minimize Thermal Bridging and y Value. Specifically installing Hi-Therm lintels with a thermal conductivity of 0.05 W/m<sup>2</sup>K.
- Low Double-Glazed Window and Rooflight U-values of 1.2 W/m<sup>2</sup>K
- Low Door U-values of 1 W/m<sup>2</sup>K
- 100% low energy lighting throughout
- Vaillant ecoTEC plus 415 Regular Condensing gas boiler- 89.3% efficiency
- Design Air Permeability Rate of 4m<sup>3</sup>/hm<sup>2</sup>.
- Fully insulated, 100mm thickness, 300 Litre Hot Water Cylinder



Operational usage will be improved further by ensuring better occupant management through the following:

- Energy Display devices showing electricity and primary fuel consumption.
- Efficient White Goods where supplied (A+ or A rated).
- Low Water Use fittings on Sanitary Ware
- A Home User Guide to explain how to use the dwelling, fittings and appliances efficiently.



### 2.5 Sustainable Development

In addition to the primary building design and fabric, many other issues will influence creating a Sustainable Development. Sustainability should be shown early consideration and then continually promoted throughout construction. Features which enable more efficient usage should also be specified to encourage the building users to maintain efficient use throughout occupation.

# Materials

• Where possible, responsibly sourced (such as FSC timber), recycled or reclaimed materials will be used.

### Water Use

• Indoor water use will be restricted by use of fittings with lower flow rates, baths with smaller capacity, dual-flush toilets, and (where applicable) washing machines and dishwashers with low water usage.

### Waste

- The contractor will be obligated to produce a Site Waste Management Plan (SWMP) to set targets and monitor to reduce waste and divert from landfill.
- The development will incorporate dedicated internal and external general waste and recyclable storage in accordance with the LA collection.

### Health, Wellbeing & pollution

- Key rooms have good levels of day lighting and so the need for artificial lighting is reduced.
- Boilers with very Low NOx emissions will be specified.
- Improved acoustic performance between rooms.

### Demolition

The existing building, constructed in the 1970's, requires significant refurbishment and upgrading of the building fabric to meet the energy standards required under current building regulations. Significant works are also required to the fabric of the building to provide more space for its current owner occupiers. Early design proposals looked to reuse the existing building to improve its energy use, reduce C02 emissions and provide a higher quality family dwelling. Having reviewed the structural implications and outlined a sustainable design strategy to achieve this it was concluded that a better long term sustainable solution would to be to demolish and rebuild.



# 2.6 Choice and Impact of Renewable Technology

All reasonable technologies were investigated for their suitability to the site and development; please refer to section 3 for details, however no renewable technologies have been specified. This is due to highly efficient measures being incorporated into the design which enable to 19% reduction in carbon emissions being achieved.

# 2.7 Energy & CO2 Reduction Summary

A summary of all stages of the energy demand assessment from baseline figures to final carbon reduction are shown in Figures 1 and 2 below:

Summary of CO2 Emission Reductions	Total CO2 emissions (kgCO2/year)
Baseline emissions	2876.7
Improved emissions (after application of energy efficiency measures)	2321.9
Improved emissions (after incorporation of efficient energy supply)	2321.9
Improved emissions (after incorporation of renewable energy technology) % CO2 displaced in total	2321.9
% CO2 displaced in total	19.3%
% CO2 displaced by energy efficiency measures	19.3%
% CO2 displaced by efficient supply of energy	0.0%
% CO2 displaced by LZC Technologies	0.0%

Fig 1. Summary of CO2 Reductions



	Energy demand (kWh pa)	Energy saving achieved (%)	Regulated CO <sub>2</sub> emissions (k g pa)	Saving achieved on resid ual CO <sub>2</sub> emissions (%)
Building Regulations Part L compliance ("Baseline" energy demand & emissions)	12458.6		2876.7	
Proposed scheme after energy efficiency measures and CHP ("Residual" energy demand & emissions)	9890.0	20.6%	2321.9	19.3%
Proposed scheme after on-site renewables	9890.0	20.6%	2321.9	0.0%
Proposed scheme offset for financial contribution o r other "allowable solution"			0	0
Total savings on residual emissions				0.0%

Fig 2. Savings on residual emissions



For a full Breakdown of the figures and calculations, please see Appendix A – Energy Demand Assessment Spreadsheet.

### Baseline energy demand

'Standard Assessment Procedure - SAP 2012' produce example SAP reports to generate the figures used within the calculations.

Baseline energy demand (kWh pa)	12458.6
Regulated emissions (kg pa)	2876.7

### Heating

The heating and cooling hierarchy has been applied to the design process of the development. It has resulted in large focus on energy efficiency measures and as can be seen in Figure 1.

Energy savings from the use of CHP systems (kWh pa)	-
Emission savings from the use of CHP systems (kg pa)	-
Total regulated emissions after CHP savings (kg pa)	2321.9

### Energy efficiency

The following table demonstrates how the development achieves the reduction in carbon dioxide emissions from energy efficiency measures.

Energy savings from energy efficiency measures (kWh pa)	2568.6
Emission savings from energy efficiency measures (kg pa)	554.8
Total regulated emissions after CHP savings and energy effi ciency measures (kg pa) ("residual emissions")	2321.9



### On-site renewables

The following table demonstrates how the development achieves the reduction in carbon dioxide emissions from LZC technologies.

Energy saving from the use of renewables (kWh)	0.0
Saving on residual emissions from the use of renewables (kg)	0.0
Saving on residual emissions from the use of renewables (%)	0.0%

The chart below illustrates the improvements over the Part L Compliant Baseline for Scenario 1:





### 3. Feasibility assessment of renewable energy technologies

### Solar Hot Water (Thermal)

Solar water heating systems are one of the more familiar renewable technologies used at present. They use the energy from the sun to heat water, most commonly for hot water needs. Solar heating systems use a heat collector that is usually mounted on a roof in which the sun heats a fluid. This fluid is used to heat water that is stored in either a separate hot water cylinder or in a twin-coil hot water cylinder (the second coil is used to provide additional heating from a boiler or other heat source).

Solar hot water panels could be used however; PV will provide slightly better savings and avoid the need for water storage cylinders when compared.

### Renewable Technology Not Chosen.

### Wind

Wind turbines convert the kinetic energy in wind into mechanical energy and then again into electricity. Turbines are available in a range of sizes and designs and can be freestanding, mounted on a building or integrated into a building structure.

The wind speed in the area is under the advised minimum, the small size of the site and limited available space, in addition to the large initial costs means that a wind turbine would not be feasible.

### Renewable Technology Not Viable



### Photovoltaic Panels (PV)

Photovoltaic modules convert sunlight directly to DC electricity. The solar cells consist of a thin piece of semiconductor material, in most cases of silicon. Through a process called doping, very small amounts of impurities are added to the semiconductor, which creates two different layers called n-type and p-type layers.

Certain wavelengths of light are able to ionize the silicon atoms, which separates some of the positive charges (holes) from the negative charges (electrons). The holes move into the positive or p-layer and the electrons into the negative or n-layer. These opposite charges are attracted to each other, but most of them can only re-combine by the electrons passing through an external circuit, due to an internal potential energy barrier. This flow of electrons produces a DC current.

A PV array can be mounted on the suitable roof space and has been tested in scenario 3. However no PV has been specified for this development due to scenario 1 being proposed as PV has financial and aesthetic implications. Furthermore the percentage improvement requirements have been met through the use of highly efficient and thermally efficient specifications.

Renewable technology tested but not chosen



### **Biomass Heating**

Biomass is any plant-derived organic material that renews itself over a short period.

Biomass energy systems are based on either the direct or indirect combustion of fuels derived from those plant sources. The most common form of biomass is the direct combustion of wood in treated or untreated forms. The use of biomass is becoming increasingly common in some European countries (some countries such as Austria are heavily dependent on biomass).

The environmental benefits relate to the significantly lower amounts of energy used in biomass production and processing compared to the energy released when they are burnt. This can range from a four-fold return for biodiesel to an approximate 20-fold energy return for woody biomass. Biomass-fuels can be used to produce energy on a continuous basis (unlike renewables such as wind or solar energy) and it can be an economic alternative to fossil fuels as it is a potential source of both heat and electricity.

However, Biomass systems have particular design management and maintenance requirements associated with sourcing, transportation and storage and are therefore more commonly used in commercial developments rather than domestic installations. It can be less convenient to operate than mains-supplied fuels such as natural gas and are more management intensive and require expertise in facilities management. Sources of biomass can also fluctuate, so boilers should be specified to operate on a variety of fuels without risk of overheating or tripping out.

A communal biomass system would not be feasible for this development due to use, space and maintenance issues. The system would be extremely large and there is very little space around the properties to locate the boilers, hoppers and fuel stores that is suitable for deliveries, but also appropriate for feeding the boiler.

### Renewable Technology Not Viable



### Ground Source Heat pumps

A heat pump is a device that takes up heat at a certain temperature and releases it at a higher temperature. The essential components of a heat pump are heat exchangers (through which energy is extracted and emitted) and a means of pumping heat between the exchangers. The effectiveness of the heat pump is measured by the ratio of the heating capacity to the effective power input, usually known as the coefficient of performance (COP). Ground-source heat pumps (GSHP) extract heat from the ground. They are classified as either water-to-air or water-to-water units depending on whether the heat distribution system in the building uses air or water. Ground source heat pumps either use long shallow trenches or deep vertical boreholes to take low grade heat from the ground and then compress it to create higher temperatures.

Ground source heat pumps would not be suitable due to the lack of land space around the properties and the associates costs.

### Renewable Technology Not Viable



### Air Source Heat pumps

Air source heat pumps absorb heat from the outside air. This is usually used to heat radiators, underfloor heating systems, or warm air convectors and hot water in your home. An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside.

The system performs down to air temperatures of -20°c which means that they are more than suitable for installations within the UK. Hot water and Heating can be provided 365 days a year. The hot water is produced without the aid of electrical immersions and at 55°c is more than hot enough for baths and showers.

There are two main types of air source heat pump system:

- An air-to-water system distributes heat via your wet central heating system. Heat pumps work much more efficiently at a lower temperature than a standard boiler system would. So they are more suitable for under-floor heating systems or larger radiators, which give out heat at lower temperatures over longer periods of time.
- An air-to-air system produces warm air which is circulated by fans to heat your home. They are unlikely to provide you with hot water as well.

Air Source heat pumps are a good option to provide heating and cooling however the aesthetic and spatial implications associated with this development mean that this technology has not been opted for. It has been tested and information provided as part of this report for comparison purposes.

### Renewable technology tested but not chosen



			1	
House Type	House 1	TOTAL (kWh/γr)		TOTAL (kgCO2/yr)
BASELINE Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
Main Heating Fuel Requirement (DER)	9111.81	9111.8	0.216	1968.2
Secondary Main Heating Fuel Requirement (DER)	0	0.0	0.216	0.0
Secondary Heating Fuel Requirement (DER)	0	0.0	0.519	0.0
Water Fuel Requirement (DER)	2734.07	2734.1	0.216	590.6
Electricity Pumps Fans Requirement (DER)	75	75.0	0.519	38.9
Electricity Lighting Requirement (DER)	537.75	537.8	0.519	279.1
TOTAL PER DEVELOPMENT		12458.6		2876.7
AFTER ENERGY SAVING MEASURES Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
Main Heating Fuel Requirement (DER)	6464.89	6464.9	0.216	1396.4
Secondary Main Heating Fuel Requirement (DER)	0	0.0	0.216	0.0
Secondary Heating Fuel Requirement (DER)	0	0.0	0.519	0.0
Water Fuel Requirement (DER)	2812.39	2812.4	0.216	607.5
Electricity Pumps Fans Requirement (DER)	75	75.0	0.519	38.9
Electricity Lighting Requirement (DER)	537.75	537.8	0.519	279.1
TOTAL PER DEVELOPMENT		9890.0		2321.9
		•	•	
FINAL Dwelling Emission Rate (DER)	Total Energy Demand (kWh/yr)	Total Energy Demand (kWh/yr)	Carbon Emission Factor	Associated Total CO2 (kgCO2/yr)
Main Heating Fuel Requirement (DER)	6464.89	6464.9	0.216	1396.4
Secondary Main Heating Fuel Requirement (DER)	0	0.0	0.216	0.0
Secondary Heating Fuel Requirement (DER)	0	0.0	0.519	0.0
Water Fuel Requirement (DER)	2812.39	2812.4	0.216	607.5
Electricity Pumps Fans Requirement (DER)	75	75.0	0.519	38.9
Electricity Lighting Requirement (DER)	537.75	537.8	0.519	279.1
PV Energy Produced (DER)		0.0	0.519	0.0
TOTAL PER DEVELOPMENT		9890.0		2321.9



# **Regulations Compliance Report**

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.4.10 *Printed on 13 October 2017 at 14:59:02* 

Project Information	n:			
Assessed By:	Daniel Watt (STRO	0026464)	Building Type:	Mid-terrace House
Dwelling Details:				
NEW DWELLING	ESIGN STAGE		Total Floor Area: 1	70m²
Site Reference :	14107 Camden		Plot Reference:	59 Camden Mews - Option 1
Address :	59 Camden Mews	, London, tba		
Client Details:				
Name:				
Address :				
This report covers It is not a complete	items included wi e report of regulati	ithin the SAP calculations. ions compliance.		
1a TER and DER				
Fuel for main heatin	ng system: Mains ga	as		
Fuel factor: 1.00 (m	ains gas)	/		
Target Carbon Diox	ide Emission Rate	(TER)	16.92 kg/m <sup>2</sup>	01/
1b TEEE and DEE	oxide Emission Rat	e (DER)	13.66 Kg/m²	OK
Target Fabric Energy	v Efficiency (TEEE	)	66.4 k\\\h/m²	
Dwelling Fabric Energy	erav Efficiency (DFE	, EE)	47.7 kWh/m²	
		)		OK
2 Fabric U-values	5			
Element		Average	Highest	
External w	all	0.20 (max. 0.30)	0.20 (max. 0.70)	ОК
Party wall		0.00 (max. 0.20)	-	ОК
Floor		0.12 (max. 0.25)	0.12 (max. 0.70)	ОК
Roof		0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings		1.19 (max. 2.00)	1.20 (max. 3.30)	OK
2a Thermal bridg	ing			
Thermal bi	ridging calculated fr	om linear thermal transmittar	nces for each junction	
3 Air permeability			4.00 ( la sister al	
Air permeabi Maximum	lity at 50 pascals		4.00 (design val 10.0	Je) OK
4 Heating efficien	су			
Main Heating	g system:	Database: (rev 418, produc	ct index 017821):	
		Boiler systems with radiato Brand name: Vaillant Model: ecoTEC plus 415 Model qualifier: VU 156/6-5 (Regular) Efficiency 89.3 % SEDBUK Minimum 88.0 %	rs or underfloor heating - ma	ains gas OK
Secondary h	eating system:	None		

# **Regulations Compliance Report**

5 Cy	/linder insulation			
	Hot water Storage:	Measured cylinder loss: 2.27 kWh/ Permitted by DBSCG: 2.86 kWh/da	/day av	ок
	Primary pipework insulated:	Yes		OK
6 Cc	ontrols			-
	Space heating controls	TTZC by plumbing and electrical s	ervices	ок
	Hot water controls:	Cylinderstat		OK
		Independent timer for DHW		ОК
	Boiler interlock:	Yes		ОК
7 Lo	ow energy lights			
	Percentage of fixed lights with low	w-energy fittings	100.0%	
	Minimum	5, 5	75.0%	ОК
8 Me	echanical ventilation			
	Not applicable			
9 Su	Immertime temperature			
	Overheating risk (Thames valley)	):	Slight	ОК
Base	d on:		5	
	Overshading:		Average or unknown	
	Windows facing: South East		2.72m <sup>2</sup>	
	Windows facing: South East		3.12m <sup>2</sup>	
	Windows facing: North West		8.84m²	
	Windows facing: North East		3.12m <sup>2</sup>	
	Windows facing: North East		4.87m <sup>2</sup>	
	Windows facing: South East		3.2m <sup>2</sup>	
	Windows facing: South East		4.3m <sup>2</sup>	
	Windows facing: North West		2.28m <sup>2</sup>	
	Windows facing: North West		2.28m <sup>2</sup>	
	Roof windows facing: Horizontal		37.85m <sup>2</sup>	
	Ventilation rate:		8.00	
	Blinds/curtains:		Dark-coloured curtain or roller blind	
			Closed 100% of daylight hours	
10 K	cey features		A 14/21Z	
	Doors U-value		1 VV/m²K	
	ROUIS U-Value			
	Party vvalis U-value			
	Floors U-value		0.12 W/m <sup>2</sup> K	

# **Predicted Energy Assessment**

59 Camden Mews London tba Dwelling type: Date of assessment: Produced by: Total floor area: Mid-terrace House 13 October 2017 Daniel Watt 170 m<sup>2</sup>

Environmental Impact (CO<sub>2</sub>) Rating

This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

### **Energy Efficiency Rating**



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be. The environmental impact rating is a measure of a home's impact on the environment in terms of carbonn dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.



# **SAP Input**

Property Details: 59	9 Camden Mews - Optio	n 1				
Address: Located in: Region:		59 Camden Mews, Londo England Thames valley	n, tba			
UPRN: Date of assessm Date of certificat Assessment type Transaction type Tenure type: Related party dis Thermal Mass Pa Water use <= 12 PCDF Version:	ent: te: e: sclosure: arameter: 25 litres/person/da	13 October 2017 13 October 2017 New dwelling design stag New dwelling Owner-occupied Employed by the professi Indicative Value Medium ay: True 418	e onal dealing with <sup>.</sup>	the property tra	nsaction	
Property description	ו:					
Dwelling type: Detachment: Year Completed: Eloor Location:		House Mid-terrace 2017 Eloor area:				
Floor 0		90 m <sup>2</sup>	S	torey height 3 m	:	
Floor 1 Living area: Front of dwelling fa	aces:	80 m <sup>2</sup> 40 m <sup>2</sup> (fraction 0.235) South East		2.6 m		
Opening types:						
Name:	Source:	Type:	Glazing:		Argon:	Frame:
Door to garage	Manufacturer	Solid	C		0	
Bedroom 1/study	Manufacturer	Windows	low-E, $En = 0$	0.05, soft coat	Yes	Wood
Entrance door	SAP 2012	Windows	low-E, $En = 0$	0.05, soft coat	Yes	Wood
Living	Manufacturer	Windows	low-E, En = 0	0.05, soft coat	Yes	Wood
Kitchen Door	Manufacturer	Windows	low-E, $En = 0$	0.05, soft coat	Yes	Wood
Kitchen window	Manufacturer	Windows	low-E, $En = 0$	0.05, soft coat	Yes	Wood
Bedroom 2	Manufacturer	Windows	low-E, $En = 0$	0.05, soft coat	Yes	Wood
Bedroom 3	Manufacturer	Windows	low-E, En = 0	0.05, soft coat	Yes	Wood
En suite	Manufacturer	Windows	low-E, En = 0	0.05, soft coat	Yes	Wood
Master Bedroom	Manufacturer	Windows	low-E, $En = 0$	0.05, soft coat	Yes	Wood
Rooflights	Manufacturer	Roof Windows	low-E, $En = 0$	0.05, soft coat	Yes	Wood
Name:	Gap:	Frame Facto	r: g-value:	U-value:	Area:	No. of Openings:
Door to garage	mm	0.7	0	1	2.6	1
Bedroom 1/study	16mm or more	0.7	0.72	1.2	1.36	2
Entrance door	16mm or more	0.8	0.72	1.2	3.12	1
Living	16mm or more	0.7	0.72	1.2	8.84	1
Kitchen Door	16mm or more	0.7	0.72	1.2	3.12	1
Kitchen window	16mm or more	0.7	0.72	1.2	4.87	1
Bedroom 2	16mm or more	0.7	0.72	1.2	1.6	2
Bedroom 3	16mm or more	0.7	0.72	1.2	4.3	1
En suite	16mm or more	0.7	0.72	1.2	2.28	1
waster Bedroom Rooflights	16mm or more 16mm or more	0.7	0.72 0.73	1.2 1.2	2.28 37.85	1
Name	Tupo Namo	Location	Oriont		\ <b>\</b> /id+b.	Uniabt.
Door to garage	туре-матте:	Walls to Garage	North Fast		1 vviutit:	neight. 2.6
Bodroom 1/study		Exposed Walls	South East		1 0.8	∠.∪ 1 7
Entrance door		Exposed Walls	South Fast		1.2	2.6
			COMIN LUSI		· ·	

# **SAP Input**

Living Kitchen Door Kitchen window Bedroom 2 Bedroom 3 En suite Master Bedroom Rooflights		Ex Ex Ex Ex Ex Ex Ex Fla	posed Walls posed Walls posed Walls posed Walls posed Walls posed Walls posed Walls t Roof	North North South South North North Horizo	West East East East West West ontal	3.4 1.2 2.95 0.8 2.15 1.3 1.3 0.001	2.6 2.6 1.65 2 2 1.75 1.75 0	
Overshading:		Average	e or unknown					
Opaque Elements	5:							
Type: External Element	Gross area:	Openings:	Net area:	U-valu	e: Ru value:	Curtain	wall:	Карра:
Exposed Walls	129	34.73	94.27	0.2	0	False		N/A
Walls to Garage	25	2.6	22.4	0.2	0.68	False		N/A
Flat Roof	108	37.85	70.15	0.1	0			N/A
Ground	90			0.12				N/A
Floor to Garage Be	elow 18			0.12				N/A
Internal Element	<u>s</u>							
Party Elements Sheltered Walls	58							N/A
Thermal bridges:								
Thermal bridges:	:	User-de <b>Lengtł</b>	fined (individual Psi-valu	PSI-values) I <b>e</b>	Y-Value = 0.0451			
		19	0.05	E2	Other lintels (including	g other steel linte	els)	
	[Approved]	2.2	0.04	E3	Sill			
	[Approved]	49.9	0.05	E4	Jamb			
	[Approved]	21	0.16	E5	Ground floor (normal)			
	[Approved]	25	0.07	E6	Intermediate floor wit	hin a dwelling		
		45	0	E15	Flat roof with parapet			
	[Approved]	17	0.09	E16	Corner (normal)			
	[Approved]	8	-0.09	E17	Corner (inverted inter	nal area greater	than exterr	nal area)
	[Approved]	8	0.06	E18	Party wall between dv	vellings		
		25	0	E25	Staggered party wall k	between dwelling	S	
		8	0.16	P1	Ground floor			
		0	0	P3	Intermediate floor bet	ween dwellings (	in blocks o	of flats)
		14.24	0.08	R1	Head			
		14.24 43.46	0.06 0.08	R2 R3	Sill Jamb			
Vontilation								
Proscure test		Voc (Ac	designed)					
Ventilation:		Natural	ventilation (extra	act fans)				
Number of chimr	nevs:	0	Ventilation (extra					
Number of open	flues:	0 0						
Number of fans		7						
Number of passiv	ve stacks:	0						
Number of sides	sheltered:	2						
Pressure test:		4						
Main heating syst	em:							
Mala la s		D-11-	interne units an P	tere contra l	orfloor boother			
wain neating sys	siem:	Boller s	ystems with radia	11015 OF UND S	ernoor neating			

Fuel: mains gas

Info Source: Boiler Database

# **SAP Input**

	Database: (rev 418, product index 017821) Efficiency: Winter 79.6 % Summer: 90.3 Brand name: Vaillant Model: ecoTEC plus 415 Model qualifier: VU 156/6-5 (Regular boiler) Underfloor heating, pipes in screed above insulation Central heating pump : 2013 or later Design flow temperature: Design flow temperature<=35°C Room-sealed Boiler interlock: Yes Delayed start
Main heating Control:	
Main heating Control:	Time and temperature zone control by suitable arrangement of plumbing and electrical services Control code: 2110
Secondary heating system:	
Secondary heating system:	None
Water heating:	
Water heating:	From main heating system Water code: 901 Fuel :mains gas Hot water cylinder Cylinder volume: 300 litres Cylinder insulation: Factory 100 mm Primary pipework insulation: True Cylinderstat: True Cylinder in heated space: True Solar panel: False
Others:	
Electricity tariff: In Smoke Control Area: Conservatory: Low energy lights: Terrain type: EPC language: Wind turbine: Photovoltaics: Assess Zero Carbon Home:	Standard Tariff Unknown No conservatory 100% Dense urban English No None No

				User D	Details:						
Assessor Name:	Daniel Wa	tt			Strom	a Num	ber:		STRO	026464	
Software Name:	Stroma FS	AP 201	2		Softwa	are Ver	rsion:		Versio	n: 1.0.4.10	
			Pi	operty	Address	: 59 Can	nden Me	ws - Op	tion 1		
Address :	59 Camden	Mews, I	London,	tba							
1. Overall dwelling dime	nsions:										
				Are	a(m²)	1	Av. Hei	ight(m)		Volume(m <sup>3</sup> )	-
Ground floor					90	(1a) x		3	(2a) =	270	(3a)
First floor					80	(1b) x	2	6	(2b) =	208	(3b)
Total floor area TFA = (1a	a)+(1b)+(1c)+	(1d)+(1e	e)+(1n	)	170	(4)					
Dwelling volume						(3a)+(3b)	)+(3c)+(3d	)+(3e)+	.(3n) =	478	(5)
2. Ventilation rate:											
	main heating	se h	econdary neating	y	other		total			m <sup>3</sup> per hour	
Number of chimneys	0	+	0	+	0	=	0	X 4	40 =	0	(6a)
Number of open flues	0	+	0	+	0	] = [	0	x 2	20 =	0	(6b)
Number of intermittent fai	ns						7	x ^	10 =	70	(7a)
Number of passive vents						Γ	0	x ^	10 =	0	(7b)
Number of flueless gas fin	res					Γ	0	x 4	40 =	0	(7c)
						L					1
									Air ch	anges per hou	Ir
Infiltration due to chimney	/s, flues and f	ans = (6	a)+(6b)+(7	a)+(7b)+(	(7c) =	Ę	70		÷ (5) =	0.15	(8)
If a pressurisation test has be	een carried out o	r is intende	ed, proceed	l to (17),	otherwise of	continue fr	om (9) to (	16)	1	-	
Additional infiltration	ie dweining (na	>)						[(0)]	11×0.1 -	0	(9)
Structural infiltration: 0	25 for steel o	r timber t	frame or	0 35 fo	r masoni	v constr	uction	[(9)	-1]x0.1 =	0	(10)
if both types of wall are pr	esent, use the va	lue corres	ponding to	the grea	ter wall are	a (after	uction			0	](,,)
deducting areas of openin	ngs); if equal user	0.35		1 (000)	ad) alaa	ontor O					1
If no draught lobby, ent	1001, enter $0.2$	(unseal	ea) or 0.	r (seale	eu), eise	enter U				0	(12)
Borcontago of windows	er 0.05, erse	enter U	rinnod							0	$\begin{bmatrix} (13) \\ (14) \end{bmatrix}$
Window infiltration	s and 00015 ui	augin si	nppeu		0.25 - [0.2	× (14) ∸ 1	001 =			0	(14)
Infiltration rate					(8) + (10)	+ (11) + (1	2) + (13) +	+ (15) =		0	(10)
Air permeability value	a50 expresse	ed in cub	oic metre	s per h	our per s	quare m	etre of e	nvelope	area	0	(10)
If based on air permeabili	itv value, then	(18) = [(1	7) ÷ 20]+(8	), otherw	rise (18) = (	(16)		molopo	aiou	0.35	](18)
Air permeability value applies	s if a pressurisati	on test has	s been don	e or a de	gree air pe	rmeability	is being us	sed		0.00	](10)
Number of sides sheltere	d					-	-			2	(19)
Shelter factor					(20) = 1 -	[0.075 x (1	9)] =			0.85	(20)
Infiltration rate incorporat	ing shelter fac	tor			(21) = (18	) x (20) =				0.29	(21)
Infiltration rate modified for	or monthly wir	nd speed	ł								
Jan Feb	Mar Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	eed from Tab	e 7									
(22)m= 5.1 5	4.9 4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7		

Wind F	actor (2	22a)m =	(22)m ÷	4						-				
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18		
Adjuste	ed infiltr	ation rat	e (allow	ing for sł	nelter an	nd wind s	speed) =	: (21a) x	(22a)m					
	0.38	0.37	0.36	0.32	0.32	0.28	0.28	0.27	0.29	0.32	0.33	0.35		
Calcula	ate effe	ctive air	change	rate for t	he appli	cable ca	se			•			·	(00-)
lf evb	aust air b		llion. Using Ann	ondiv N (2	(23) – (23)	a) v Emv (e	auation (I	N5)) othe	rwise (23h	) - (23a)			0	(23a)
lf hala	anced with	heat reco	overv: effic	viency in %	allowing f	for in-use f	actor (from	n Table 4h	) –	) – (20d)			0	(230)
a) If	balance	nd moch			with ho	at rocov			) = (2)	2b)m i ('	22P) ^ [v	1 (22a)	0 · 1001	(230)
a) II (24a)m=									a = (2)			-(230)	÷ 100]	(24a)
b) If	balance	d mech:	l anical ve	entilation	without	heat rec	covery (I	 MV) (24h	1 = (2)	2b)m + (;	23b)			· · · ·
(24b)m=	0	0	0	0	0	0		0	0	0	0	0		(24b)
c) If	whole h	i ouse ex	ract ver	ntilation of	r positiv	/e input v	ı ventilatio	on from c	utside					
í	if (22b)n	n < 0.5 ×	<b>(23b)</b> , 1	then (24	c) = (23k	); other	wise (24	-c) = (22k	o) m + 0	.5 × (23b	)			
(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) lf i	natural if (22b)n	ventilation $n = 1$ , the	on or wh en (24d)	ole hous m = (221	se positi o)m othe	ve input erwise (2	ventilati 4d)m =	on from l 0.5 + [(2	oft 2b)m² x	0.5]				
(24d)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(24d)
Effe	ctive air	change	rate - er	nter (24a	) or (24l	) or (24	c) or (24	ld) in box	(25)					
(25)m=	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(25)
	-		•	•			•	•	•					
3 He	at losse	s and he	at loss i	narameti	er.									
3. He ELEN	at losse IENT	s and he Gros area	eat loss ss (m²)	parameto Openin m	er: Igs I <sup>2</sup>	Net Ar A ,r	rea m²	U-valı W/m2	ue K	A X U (W/ł	<)	k-value kJ/m²·I	) <	A X k kJ/K
3. Hea ELEN Doors	at losse IENT	s and he Gros area	eat loss ss (m²)	parameto Openin m	er: Igs I <sup>2</sup>	Net Ar A ,r 2.6	rea m²	U-valı W/m2	ue K =	A X U (W/ł 2.6	<)	k-value kJ/m²·I	9 <	A X k kJ/K (26)
3. Hea ELEN Doors Window	at losse IENT ws Type	s and he Gros area	eat loss ss (m²)	paramet Openin m	er: Igs I <sup>2</sup>	Net Ar A ,r 2.6	rea m² x x1	U-valı W/m2 1 /[1/( 1.2 )+	ue K =   0.04] =	A X U (W/I 2.6 1.56	<) 	k-value kJ/m²·I	e K	A X k kJ/K (26) (27)
3. Hei ELEN Doors Windov Windov	at losse IENT ws Type ws Type	s and he Gros area e 1 e 2	eat loss ss (m²)	paramet Openin m	er: gs 1 <sup>2</sup>	Net Ar A ,r 2.6 1.36 3.12	ea m <sup>2</sup> x x x1 x1	U-valu W/m2 [	ue K 0.04] = 0 0.04] = 0	A X U (W/I 2.6 1.56 3.57	<) 	k-value kJ/m²·I	≥ ≺	A X k kJ/K (26) (27) (27)
3. Hei ELEN Doors Windov Windov Windov	at losse IENT ws Type ws Type ws Type	s and he Gros area e 1 e 2 e 3	eat loss ss (m²)	paramete Openin m	er: gs 1 <sup>2</sup>	Net Ar A ,r 2.6 1.36 3.12 8.84	ea n <sup>2</sup> x x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup>	U-valı W/m2 [	Lie K 0.04] = 0.04] = 0.04] = 0.04] = 0.04]	A X U (W/I 2.6 1.56 3.57 10.12		k-value kJ/m²·I	≥ ≺	A X k kJ/K (26) (27) (27) (27)
3. Here ELEN Doors Window Window Window	at losse IENT ws Type ws Type ws Type	s and he Gros area e 1 e 2 e 3 e 4	eat loss ss (m²)	parameto Openin m	er: gs 1 <sup>2</sup>	Net Ar A ,r 2.6 1.36 3.12 8.84 3.12	ea n <sup>2</sup> x x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup>	U-valu W/m2 [	ue K 0.04] = 0.04] = 0.04] = 0.04] =	A X U (W/I 2.6 1.56 3.57 10.12 3.57		k-value kJ/m²·I	2	A X k kJ/K (26) (27) (27) (27) (27)
3. Here ELEM Doors Window Window Window Window	at losse MENT ws Type ws Type ws Type ws Type ws Type	s and he Gros area e 1 e 2 e 3 e 4 e 5	eat loss ss (m²)	paramete Openin m	er: gs 1 <sup>2</sup>	Net Ar A ,r 2.6 1.36 3.12 8.84 3.12 4.87	ea n <sup>2</sup> x x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup>	U-valu W/m2 [	Le K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	A X U (W/I 2.6 1.56 3.57 10.12 3.57 5.58		k-value kJ/m²·I	÷ ≺	A X k kJ/K (26) (27) (27) (27) (27) (27) (27)
3. Hei ELEM Doors Windov Windov Windov Windov	at losse MENT ws Type ws Type ws Type ws Type ws Type	s and he Gros area 4 5 6 6	eat loss ss (m²)	paramete Openin m	er: gs 1 <sup>2</sup>	Net Ar A ,r 2.6 1.36 3.12 8.84 3.12 4.87 1.6	ea n <sup>2</sup> x x1 x1 x1 x1 x1 x1 x1 x1 x1 x1	U-valı W/m2 1 /[1/( 1.2 )+ /[1/( 1.2 )+ /[1/( 1.2 )+ /[1/( 1.2 )+ /[1/( 1.2 )+ /[1/( 1.2 )+	LIE K 0.04] =   0.04] =   0.04] =   0.04] =   0.04] =   0.04] =	A X U (W/I 2.6 1.56 3.57 10.12 3.57 5.58 1.83		k-value kJ/m²·I	÷ ≺	A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27)
3. Here ELEN Doors Window Window Window Window Window Window	at losse IENT ws Type ws Type ws Type ws Type ws Type ws Type	s and he Gros area 4 5 6 6 7	eat loss ss (m²)	paramete Openin rr	er: gs 1 <sup>2</sup>	Net Ar A ,r 2.6 1.36 3.12 8.84 3.12 4.87 1.6 4.3	ea n <sup>2</sup> x x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup>	U-valu W/m2 1 /[1/( 1.2 )+ /[1/( 1.2 )+ /[1/( 1.2 )+ /[1/( 1.2 )+ /[1/( 1.2 )+ /[1/( 1.2 )+ /[1/( 1.2 )+	Le K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	A X U (W/I 2.6 1.56 3.57 10.12 3.57 5.58 1.83 4.92		k-value kJ/m²·I	÷ ≺	A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27)
3. Here ELEN Doors Window Window Window Window Window Window Window	at losse IENT ws Type ws Type ws Type ws Type ws Type ws Type ws Type	s and he Gros area 4 5 6 6 7 8 8	eat loss ss (m²)	paramete Openin m	er: gs 1 <sup>2</sup>	Net Ar A ,r 2.6 1.36 3.12 8.84 3.12 4.87 1.6 4.3 2.28	ea n <sup>2</sup> x x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup>	U-valu W/m2 [	Le K = = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	A X U (W/I 2.6 1.56 3.57 10.12 3.57 5.58 1.83 4.92 2.61		k-value kJ/m²+I	2	A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27
3. Hei ELEM Doors Windov Windov Windov Windov Windov Windov Windov	at losse IENT ws Type ws Type ws Type ws Type ws Type ws Type ws Type ws Type	s and he Gros area 4 5 6 6 7 8 8 9 9	eat loss ss (m²)	paramete Openin m	er: gs 1 <sup>2</sup>	Net Ar A ,r 2.6 1.36 3.12 8.84 3.12 4.87 1.6 4.3 2.28	ea n <sup>2</sup> x x1 x1 x1 x1 x1 x1 x1 x1 x1 x1 x1 x1 x1	U-valu W/m2 1 /[1/( 1.2 )+ /[1/( 1.2 )+	Le K 0.04] =   0.04] =	A X U (W/I 2.6 1.56 3.57 10.12 3.57 5.58 1.83 4.92 2.61 2.61		k-value kJ/m²-I	÷ ≺	A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27
3. Hei ELEN Doors Windov Windov Windov Windov Windov Windov Windov Rooflig	at losse IENT ws Type ws Type ws Type ws Type ws Type ws Type ws Type yhts	s and he Gros area 4 5 6 6 7 6 8 8 9 9	eat loss ss (m²)	paramete Openin m	er: gs 1 <sup>2</sup>	Net Ar A ,r 2.6 1.36 3.12 8.84 3.12 4.87 1.6 4.3 2.28 2.28 37.85	ea n <sup>2</sup> x x <sup>1</sup> x <sup>1</sup>	U-valu W/m2 1 /[1/( 1.2 )+ /[1/( 1.2 )+	Le K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	A X U (W/I 2.6 1.56 3.57 10.12 3.57 5.58 1.83 4.92 2.61 2.61 45.42		k-value kJ/m²·I	≥ ≺	A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27
3. Hei ELEN Doors Windov Windov Windov Windov Windov Windov Windov Rooflig Floor T	at losse IENT ws Type ws Type ws Type ws Type ws Type ws Type ws Type ghts	s and he Gros area 4 5 6 6 7 8 8 9 9	eat loss ss (m²)	paramete Openin m	er: gs 1 <sup>2</sup>	Net Ar A ,r 2.6 1.36 3.12 8.84 3.12 4.87 1.6 4.3 2.28 2.28 37.85 90	ea n <sup>2</sup> x x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>2</sup> x <sup>1</sup>	U-value W/m2 1 /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+	Le K 0.04] = 0.04] =	A X U (W/I 2.6 1.56 3.57 10.12 3.57 5.58 1.83 4.92 2.61 2.61 45.42 10.8		k-value kJ/m²·I	, <	A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27
3. Hei ELEN Doors Windov Windov Windov Windov Windov Windov Riodov Floor T	at losse <b>IENT</b> ws Type ws Type ws Type ws Type ws Type ws Type ws Type for the term ws Type ws Type the term the t	s and he Gros area 4 5 6 6 7 8 8 9 9	eat loss ss (m²)	paramete Openin m	er: gs 1 <sup>2</sup>	Net Ar A ,r 2.6 1.36 3.12 8.84 3.12 4.87 1.6 4.3 2.28 2.28 37.85 90 18	ea n <sup>2</sup> x x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>2</sup> x <sup>1</sup> x <sup>1</sup>	U-value W/m2 1 /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+	Le K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 1 0.04] = 0.04] = 1 0.04] = 1 0 0.04] = 1 0 0 0 0 0 0 0 0 0 0 0 0 0	A X U (W/I 2.6 1.56 3.57 10.12 3.57 5.58 1.83 4.92 2.61 2.61 45.42 10.8 2.16		k-value kJ/m²+ł		A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27
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3. Hei ELEN Doors Window Window Window Window Window Window Window Rooflig Floor T Floor T Floor T Walls T Walls T Roof	at losse <b>IENT</b> ws Type ws Type ws Type ws Type ws Type ws Type ws Type jhts Type 1 Type 2 Type1 Type2	s and he Gros area 2 2 3 4 2 2 3 4 2 5 2 4 2 2 2 2 3 4 2 2 2 2 3 2 4 2 2 2 2 3 2 4 2 2 2 2 2 2 2 2 2 2	eat loss ss (m <sup>2</sup> )	paramete           Openin           m           34.7           2.6           37.8	er: gs <sup>12</sup> 3 5	Net Ar A ,r 2.6 1.36 3.12 8.84 3.12 4.87 1.6 4.3 2.28 37.85 37.85 90 18 94.27 22.4 70.15	ea $n^2$ $x^1$ $x^1$ $x^1$ $x^1$ $x^1$ $x^1$ $x^1$ $x^1$ $x^1$ $x^2$	U-value W/m2 1 /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ /[1/(1.2)+ (1/(1.2)+ 0.12 0.12 0.2 0.18 0.1	Le K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 1 = 1 = 1 = 1 = 1 = 1 = 1 = 1	A X U (W/I 2.6 1.56 3.57 10.12 3.57 5.58 1.83 4.92 2.61 2.61 45.42 10.8 2.16 18.85 3.94 7.02		k-value kJ/m²-I		A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27

Party v	vall					58	x	0	=	0				(32)
* for win ** incluo	dows and le the area	roof winde	ows, use e sides of ir	effective wi	ndow U-va Is and par	alue calcul titions	ated using	g formula 1	 /[(1/U-valu	ue)+0.04] a	as given in	paragraph	1 3.2	
Fabric	heat los	s, W/K =	= S (A x	U)				(26)(30)	) + (32) =				128.48	(33)
Heat c	apacity	Cm = S(	Axk)						((28).	(30) + (3	2) + (32a).	(32e) =	14091.38	(34)
Therm	al mass	parame	ter (TMF		- TFA) ir	n kJ/m²K			Indica	ative Value	: Medium		250	(35)
For desi can be ι	ign assess Ised instea	ments wh ad of a dei	ere the de tailed calc	tails of the ulation.	construct	ion are not	t known p	recisely the	e indicative	e values of	TMP in T	able 1f		
Therm	al bridge	es : S (L	x Y) cal	culated	using Ap	pendix ł	<						16.68	(36)
if details	of therma	l bridging	are not kn	own (36) =	= 0.15 x (3	1)								
Total f	abric he	at loss							(33) +	- (36) =			145.16	(37)
Ventila	tion hea	t loss ca	alculated	d monthly	y	1	1	-	(38)m	n = 0.33 × (	(25)m x (5)	)	1	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m=	89.99	89.56	89.13	87.15	86.77	85.04	85.04	84.72	85.71	86.77	87.53	88.31		(38)
Heat tr	ansfer c	oefficier	nt, W/K						(39)m	n = (37) + (	38)m		_	
(39)m=	235.15	234.72	234.3	232.31	231.94	230.21	230.21	229.88	230.87	231.94	232.69	233.48		
Heat lo	oss para	meter (H	HLP), W	/m²K					(40)m	Average = n = (39)m ÷	Sum(39)₁ - (4)	12 /12=	232.31	(39)
(40)m=	1.38	1.38	1.38	1.37	1.36	1.35	1.35	1.35	1.36	1.36	1.37	1.37		
							-			Average =	Sum(40)1	12 /12=	1.37	(40)
Numbe	er of day	rs in mor	nth (Tab	le 1a) I									1	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
4. Wa	ater heat	ing enei	rgy requ	irement:								kWh/y	ear:	
4. Wa Assum if TF	ter heat and occu A > 13.9	ing ener pancy, I ∂, N = 1 ∂, N = 1	rgy requ N + 1.76 x	irement: : [1 - exp	(-0.0003	349 x (TF	FA -13.9	9)2)] + 0.(	0013 x (	TFA -13	2 .9)	kWh/ye	ear:	(42)
4. Wa Assum if TF if TF Annua Reduce not more	ater heat and occu A > 13.9 $A \pm 13.9$ I averag the annua o that 125	ing ener pancy, I 9, N = 1 9, N = 1 e hot wa al average litres per l	rgy requ N + 1.76 x ater usag hot water person per	irement: [1 - exp ge in litre usage by r day (all w	(-0.0003 es per da 5% if the o vater use, l	349 x (TF ay Vd,av welling is hot and co.	FA -13.9 erage = designed Id)	9)2)] + 0.( (25 x N) to achieve	0013 x ( + 36 a water u	TFA -13 se target c	9) 2 10	kWh/yd .96 4.56	ear:   	(42) (43)
4. Wa Assum if TF if TF Annua Reduce not more	ter heat A > 13.9 $A \pm 13.9$ $A \pm 13.9$	ing ener pancy, I 9, N = 1 9, N = 1 e hot wa al average litres per p Feb	rgy requ N + 1.76 x ater usag hot water person per Mar	irement: [1 - exp ge in litre usage by r day (all w Apr	(-0.0003 es per da 5% if the d rater use, l May	349 x (TF ay Vd,av welling is hot and co Jun	FA -13.9 erage = designed Id) Jul	9)2)] + 0.( (25 x N) to achieve Aug	0013 x ( + 36 a water u Sep	TFA -13 se target c Oct	9) 	kWh/yu .96 4.56 Dec	ear:   	(42) (43)
4. Wa Assum if TF if TF Annua Reduce not more	ater heat and occu A > 13.9 A £ 13.9 I averag the annua e that 125 Jan ar usage in	ing ener pancy, I d, N = 1 d, N = 1 e hot wa haverage litres per p Feb n litres per	rgy requ N + 1.76 x ater usag hot water person per Mar day for ea	irement: [1 - exp ge in litre usage by r day (all w Apr ach month	(-0.0003 es per da 5% if the d vater use, l May Vd,m = fa	349 x (TF ay Vd,av lwelling is hot and co Jun ctor from T	FA -13.9 erage = designed Id) Jul Table 1c x	9)2)] + 0.0 (25 x N) to achieve Aug	0013 x ( + 36 <i>a water u</i> Sep	TFA -13 se target c Oct	2.9) 10 10 Nov	kWh/ya .96 4.56 Dec	ear: ] ]	(42) (43)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> Hot wate (44)m=	ter heat and occu A > 13.9 $A \pm 13.9$ I averag the annua the annua that 125 Jan ar usage in 115.02	ing ener pancy, I $\partial$ , N = 1 $\partial$ , N = 1 e hot wa al average litres per Feb n litres per 110.83	rgy requ N + 1.76 x ater usag hot water person per Mar day for ea 106.65	irement: [1 - exp ge in litre usage by r day (all w Apr ach month 102.47	(-0.0003 es per da 5% if the d vater use, l May Vd,m = fa 98.29	349 x (TF ay Vd,ave lwelling is hot and co Jun ctor from T 94.11	FA -13.9 erage = designed Id) Jul Table 1c x	9)2)] + 0.0 (25 x N) to achieve Aug (43) 98.29	0013 x ( + 36 <i>a water u</i> Sep 102.47	TFA -13 se target c Oct 106.65	9) 2 10 10 Nov	kWh/yd .96 4.56 Dec 115.02	ear:     	(42) (43)
4. Wa Assum if TF if TF Annua Reduce not more Hot wate (44)m=	ter heat and occu A > 13.9 $A \pm 13.9$ I averag the annua e that 125 Jan er usage in 115.02	ing ener pancy, I P, N = 1 P, N = 1 e hot wa al average litres per Feb n litres per 110.83	rgy requ N + 1.76 x ater usag hot water berson per Mar day for ea 106.65	irement: [1 - exp ge in litre usage by r day (all w Apr ach month 102.47	(-0.0003 es per da 5% if the d vater use, l May Vd,m = fa 98.29	349 x (TF ay Vd,av welling is hot and co Jun ctor from T 94.11	FA -13.9 erage = designed Id) Jul Table 1c x 94.11	9)2)] + 0.( (25 x N) to achieve Aug (43) 98.29	0013 x ( + 36 <i>a water u</i> Sep 102.47	TFA -13 se target o Oct 106.65 Total = Su	2.9) 10 10 110.83 m(44)112	kWh/y .96 4.56 Dec 115.02	ear:	(42) (43)
4. Wa Assum if TF if TF Annua <i>Reduce</i> not more Hot wate (44)m= Energy of	ater heat and occu A > 13.9 A £ 13.9 I averag the annua e that 125 Jan Jan 115.02	ing ener pancy, I P, N = 1 P, N = 1 e hot wa <i>a verage</i> <i>litres per p</i> Feb n <i>litres per</i> 110.83	rgy requ N + 1.76 x ater usag hot water person per Mar day for ea 106.65 used - cal	irement: [1 - exp ge in litre usage by r day (all w Apr ach month 102.47	(-0.0003 es per da 5% if the d vater use, l May Vd,m = fa 98.29 onthly = 4.	349 x (TF ay Vd,ave lwelling is hot and co. Jun ctor from T 94.11 190 x Vd,r	FA -13.9 erage = designed Id) Jul Table 1c x 94.11	9)2)] + 0.0 (25 x N) to achieve Aug : (43) 98.29 DTm / 3600	0013 x ( + 36 <i>a water u</i> Sep 102.47	TFA -13 se target c Oct 106.65 Total = Su nth (see Ta	2 .9) 10 7 Nov 110.83 m(44) <sub>1.12</sub> ; ables 1b, 7	kWh/yd .96 4.56 Dec 115.02 = (c, 1d)	ear:	(42) (43)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> (44)m= <i>Energy</i> (45)m=	ater heat and occu A > 13.9 $A \pm 13.9$ $A \pm 13.$	ing ener pancy, I P, N = 1 P,	rgy requ N + 1.76 x ater usag hot water person per Mar 106.65 used - cal 153.94	irement: [1 - exp ge in litre usage by r day (all w Apr ach month 102.47 culated mo 134.21	(-0.0003 es per da 5% if the o rater use, l May Vd,m = fa 98.29 onthly = 4. 128.78	349 x (TF ay Vd,ave twelling is hot and co. Jun ctor from T 94.11 190 x Vd,r 111.12	FA -13.9 erage = designed Id) Table 1c x 94.11 m x nm x I 102.97	9)2)] + 0.0 (25 x N) to achieve (43) 98.29 DTm / 3600 118.16	0013 x ( + 36 <i>a water u</i> Sep 102.47 0 <i>kWh/mo</i> 119.57	TFA -13 se target c Oct 106.65 Total = Su nth (see Ta 139.35	2.9) 10 Nov 110.83 m(44) <sub>112</sub> ables 1b, 1 152.11	kWh/y .96 4.56 Dec 115.02 ( <i>c</i> , 1 <i>d</i> ) 165.19	ear:	(42) (43)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> (44)m= <i>Energy</i> (45)m= <i>If instan</i>	ater heat and occu A > 13.9 $A \ge 13.9$ $A \ge 13.$	ing ener pancy, I P, N = 1 P, N = 1 e hot water litres per Feb n litres per 110.83 hot water 149.18 rater heatin	rgy requ N + 1.76 x ater usag hot water person per Mar day for ea 106.65 used - cal 153.94	irement: [1 - exp ge in litre usage by a r day (all w Apr ach month 102.47 culated mo 134.21	(-0.0003 5% if the a sater use, I May Vd,m = fa 98.29 onthly = 4. 128.78	349 x (TF ay Vd,ave lwelling is hot and co Jun ctor from 1 94.11 190 x Vd,r 111.12	FA -13.9 erage = designed Id Jul Table 1c x 94.11 $n \times nm \times I$ 102.97 enter 0 in	9)2)] + 0.0 (25 x N) to achieve Aug (43) 98.29 DTm / 3600 118.16	0013 x ( + 36 a water u Sep 102.47 0 kWh/mou 119.57 i) to (61)	TFA -13 se target c Oct 106.65 Total = Su nth (see Ta 139.35 Total = Su	2.9) 10 Nov 110.83 m(44) <sub>112</sub> ables 1b, 1 152.11 m(45) <sub>112</sub>	kWh/yd .96 4.56 Dec 115.02 = (c, 1d) 165.19 =	ear:	(42) (43) (44) (45)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> (44)m= <i>Energy a</i> (45)m= <i>If instan</i> (46)m=	ater heat and occu A > 13.9 $A \pm 13.9$ $A \pm 13.9$ I averag the annual the annua	ing ener pancy, I P, N = 1 P, N = 1 e hot was laverage litres per Feb n litres per 110.83 hot water 149.18 ater heatil 22.38	rgy requ N + 1.76 x ater usag hot water berson per Mar 106.65 used - cal 153.94 ng at point 23.09	irement: [1 - exp ge in litre usage by r day (all w Apr ach month 102.47 iculated mo 134.21 cof use (no 20.13	(-0.0003 es per da 5% if the d vater use, l May Vd,m = fa 98.29 onthly = 4. 128.78 o hot water 19.32	849 x (TF ay Vd,ave lwelling is hot and co. Jun ctor from T 94.11 190 x Vd,r 111.12 r storage), 16.67	FA -13.9 erage = designed Id Jul Table 1c x 94.11 m x nm x I 102.97 enter 0 in 15.45	9)2)] + 0.0 (25 x N) to achieve Aug : (43) 98.29 DTm / 3600 118.16 boxes (46 17.72	0013 x ( + 36 a water u Sep 102.47 0 kWh/mod 119.57 i) to (61) 17.94	TFA -13 se target c Oct 106.65 Total = Su 139.35 Total = Su 20.9	2.9) 10 Nov 110.83 m(44) <sub>112</sub> : ables 1b, 1 152.11 m(45) <sub>112</sub> : 22.82	kWh/y .96 4.56 Dec 115.02 ( <i>c</i> , 1 <i>d</i> ) 165.19	ear:	(42) (43) (44) (45) (46)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> (44)m= <i>Energy of</i> (45)m= <i>If instan</i> (46)m= Water	ter heat A > 13.9 A > 13.9 $A \pm 13.9$ $A \pm 13$	ing ener pancy, I P, N = 1 P, N = 1 P, N = 1 P hot was <i>a verage</i> <i>litres per p</i> Feb <i>n litres per</i> 110.83 <i>hot water</i> 149.18 <i>rater heatin</i> 22.38 Ioss: P ( <i>litres</i> per)	rgy requ N + 1.76 x ater usag hot water person per Mar 106.65 used - cal 153.94 ng at point 23.09	irement: [1 - exp ge in litre usage by r day (all w Apr ach month 102.47 culated mo 134.21 f of use (no 20.13	(-0.0003) es per da 5% if the o vater use, l May Vd,m = fa 98.29 onthly = 4. 128.78 o hot water 19.32	349 x (TF         ay Vd,ave         lwelling is         hot and co.         Jun         ctor from T         94.11         190 x Vd,r         111.12         r storage),         16.67	FA -13.9 erage = designed Id Jul Table 1c x 94.11 $n \times nm \times I$ 102.97 enter 0 in 15.45	<ul> <li>1)2)] + 0.0</li> <li>(25 x N)</li> <li>to achieve</li> <li>Aug</li> <li>(43)</li> <li>98.29</li> <li>DTm / 3600</li> <li>118.16</li> <li>boxes (46)</li> <li>17.72</li> <li>with is a set of the set of</li></ul>	0013 x ( + 36 <i>a water u</i> Sep 102.47 0 <i>kWh/mo</i> 119.57 0 <i>to</i> (61) 17.94	TFA -13 se target c Oct 106.65 Total = Su nth (see Ta 139.35 Total = Su 20.9	2.9) 10 Nov 110.83 m(44) <sub>112</sub> ables 1b, 7 152.11 m(45) <sub>112</sub>	kWh/y .96 4.56 Dec 115.02 ( <i>c</i> , 1 <i>d</i> ) 165.19 = 24.78	ear:	(42) (43) (44) (44) (45) (46)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> <i>Hot wate</i> (44)m= <i>Energy</i> (45)m= <i>If instan</i> (46)m= Water Storag	ater heat and occu A > 13.9 $A \ge 13.9$ $A \ge 13.$	ing ener pancy, I P, N = 1 P, N = 1 P, N = 1 P, N = 1 P hot water Iitres per p Feb n litres per 110.83 hot water 149.18 pater heatin 22.38 loss: e (litres)	rgy requinations of the second	irement: [1 - exp ge in litre usage by a r day (all w Apr ach month 102.47 (ulated mo 134.21 f of use (no 20.13)	(-0.0003) es per da 5% if the d vater use, l May Vd,m = fa 98.29 onthly = 4. 128.78 o hot water 19.32 olar or W	349 x (TF ay Vd,ave lwelling is hot and co. Jun ctor from 7 94.11 190 x Vd,r 111.12 r storage), 16.67	FA - 13.9 erage = designed ld) Jul Table 1c x 94.11 m x nm x l 102.97 enter 0 in 15.45 storage	$(25 \times N)$ to achieve Aug (43) 98.29 DTm / 3600 118.16 boxes (46 17.72 within sa	0013 x ( + 36 a water u Sep 102.47 0 kWh/mod 119.57 c) to (61) 17.94 ame ves	TFA -13         se target c         Oct         106.65         Total = Su         139.35         Total = Su         20.9         ssel	2.9) 10 Nov 110.83 m(44) <sub>112</sub> ables 1b, 1 152.11 m(45) <sub>112</sub>	kWh/y         .96         4.56         Dec         115.02         (c, 1d)         165.19         24.78         300	ear:	(42) (43) (44) (44) (45) (46) (47)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> (44)m= (44)m= (45)m= <i>If instan</i> (46)m= Water Storag If comi	ater heat A bed occu A > 13.9 $A \ge 13.9$ $A \ge$	ing ener pancy, I P, N = 1 P, N = 1 P, N = 1 P, N = 1 P hot water Itres per p Feb n litres per 110.83 hot water 149.18 ater heatin 22.38 loss: P (litres) P eating a P stored	rgy requinations of the second	irement: [1 - exp ge in litre usage by a r day (all w Apr ach month 102.47 (102.47)	(-0.0003) es per da 5% if the d vater use, l May Vd,m = fa 98.29 onthly = 4. 128.78 o hot water 19.32 olar or W velling, e	A49 x (TF ay Vd,ave lwelling is hot and co. Jun ctor from T 94.11 190 x Vd,r 111.12 r storage), 16.67 /WHRS nter 110	FA - 13.9 erage = designed Id) Jul Table 1c x 94.11 m x nm x l 102.97 enter 0 in 15.45 storage	$(25 \times N)$ to achieve Aug (43) 98.29 DTm / 3600 118.16 boxes (46 17.72 within sa (47)	0013 x ( + 36 a water u Sep 102.47 0 kWh/mol 119.57 0 to (61) 17.94 ame ves	TFA -13 se target o Oct 106.65 Total = Su nth (see Ta 139.35 Total = Su 20.9 sel	2.9) 10 10 10 10 10 10 10 10 10 10	kWh/y .96 4.56 Dec 115.02 (c, 1d) 165.19 24.78 300	ear:	(42) (43) (44) (44) (45) (46) (47)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> (44)m= (44)m= (45)m= <i>If instan</i> (46)m= Water Storag If comit Otherv Water	ater heat and occu A > 13.9 A > 13.9 $A \ge 13.9$ $A \ge 13.9$ I averag the annual the annua	ing ener pancy, I P, N = 1 P, N = 1 P, N = 1 P, N = 1 P hot water P hot water 110.83 hot water 149.18 ater heath 22.38 P loss: P (litres) P eating a P stored P loss: P los	rgy requinations of the second	irement: [1 - exp ge in litre usage by or r day (all w Apr ach month 102.47 (ulated mo 134.21 t of use (no 20.13 ng any so ank in dw er (this in	(-0.0003 es per da 5% if the d vater use, l May Vd,m = fa 98.29 onthly = 4. 128.78 o hot water 19.32 olar or W velling, e acludes i	349 x (TF ay Vd,ave lwelling is a hot and counce Jun ctor from T 94.11 190 x Vd,rr 111.12 r storage), 16.67 /WHRS nter 110 nstantar	FA -13.9 erage = designed Id Jul Table 1c x 94.11 $n \times nm \times I$ 102.97 enter 0 in 15.45 storage litres in neous co	9)2)] + 0.0 (25 x N) to achieve Aug (43) 98.29 DTm / 3600 118.16 boxes (46 17.72 within sa (47) pombi boil	0013 x ( + 36 <i>a water u</i> Sep 102.47 0 <i>kWh/mo</i> 119.57 119.57 17.94 ame ves ers) ent	TFA -13 se target of Oct 106.65 Total = Su 139.35 Total = Su 20.9 ssel er '0' in (	2.9) 10 Nov 110.83 m(44) 112 ables 1b, 1 152.11 m(45) 112 22.82 (47)	kWh/y         .96         4.56         Dec         115.02         (c, 1d)         165.19         24.78         300	ear:	(42) (43) (44) (44) (45) (46) (47)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> <i>Hot wate</i> (44)m= <i>Energy</i> (45)m= <i>If instan</i> (46)m= Water Storag If comi Otherv Water a) If m	ater heat and occu A > 13.9 A > 13.9 $A \pm 13.9$ $A \pm 13.9$ a that 125 Jan a that 125 Jan 115.02 a that 125 a tha	ing ener pancy, I P, N = 1 P, N = 1 P, N = 1 P, N = 1 P hot was <i>litres per</i> 110.83 <i>hot water</i> 149.18 <i>rater heatin</i> 22.38 10ss: P (litres) P eating a P stored 10ss: P urer's defined	rgy requinations of the seclared I	irement: [1 - exp ge in litre usage by a r day (all w Apr ach month 102.47 (102.47 (102.47) (20.13) (2	(-0.0003 es per da 5% if the d vater use, l May Vd,m = fa 98.29 onthly = 4. 128.78 o hot water 19.32 olar or W velling, e ocludes i or is kno	349 x (TF ay Vd,ave lwelling is hot and co. Jun ctor from 7 94.11 190 x Vd,r 111.12 r storage), 16.67 /WHRS inter 110 nstantar wn (kWh	FA - 13.9 erage = designed ld) Jul Table 1c x 94.11 $m \times nm \times l$ 102.97 enter 0 in 15.45 storage litres in neous co	(25 x N) to achieve Aug (43) 98.29 07 <i>m</i> / 3600 118.16 boxes (46) 17.72 within sa (47) ombi boil	0013 x ( + 36 <i>a water u</i> Sep 102.47 0 <i>kWh/mol</i> 119.57 <i>b to (61)</i> 17.94 ame ves ers) ent	TFA -13 se target of Oct 106.65 Total = Su nth (see Ta 139.35 Total = Su 20.9 ssel er '0' in (	2.9) 10 Nov 110.83 m(44) <sub>112</sub> ables 1b, 1 152.11 m(45) <sub>112</sub> 22.82 (47)	kWh/y         .96         4.56         Dec         115.02         (c, 1d)         165.19         24.78         300         0	ear:	(42) (43) (44) (44) (45) (46) (47) (48)

Energy b) If m	y lost fro nanufact	om water urer's de	r storage eclared o	e, kWh/ye cylinder l	ear loss fact	or is not	known:	(48) x (49	) =		3	00		(50)
Hot wa	ater stor	age loss	factor fr	om Tabl	e 2 (kW	h/litre/da	ay)				0.	.01		(51)
If com	munity h	leating s	see secti	on 4.3										(50)
Tompo	e lactor aratura f	Irom Ta	ble∠a m Tablo	2h							0.	.74		(52)
- mpe				20				(47) (54	(50) (	50)	0.	.54		(53)
Energy	/ lost fro	m water	r storage	, kWh/ye	ear			(47) x (51	) x (52) x (	53) =	1.	23		(54)
Enter	(50) or (	(54) IN (5 	)								1.	.23		(55)
Water	storage	loss cal	culated	for each	month		ī	((56)m = (	55) × (41)	m •				
(56)m=	38.07	34.39	38.07	36.84	38.07	36.84	38.07	38.07	36.84	38.07	36.84	38.07		(56)
If cylinde	er contains	s dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (	(H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Append	ix H	
(57)m=	38.07	34.39	38.07	36.84	38.07	36.84	38.07	38.07	36.84	38.07	36.84	38.07		(57)
Primar	v circuit	loss (ar	nual) fro	om Table	3		•			•		0		(58)
Primar	v circuit	loss cal	lculated	for each	month (	59)m = (	(58) ÷ 36	65 x (41)	m			-		. ,
(mo	dified by	factor f	rom Tab	le H5 if t	here is s	solar wat	ter heatii	ng and a	. cylinde	r thermo	stat)			
, (59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	, 22.51	23.26		(59)
Combi			for oach	month (	(61)m -	(60) · 20	L	ـــــــــــــــــــــــــــــــــــــ						
						(00) <del>-</del> 30	05 × (41)		0			0		(61)
(01)11=	0					0			0					(01)
Total h	neat requ	uired for	water h	eating ca	alculated	for eac	h month	(62)m =	0.85 × (	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m=	231.9	204.58	215.27	193.56	190.11	170.48	164.3	179.49	178.93	200.68	211.47	226.52		(62)
Solar DI	HW input of	calculated	using App	endix G or	Appendix	H (negati	ve quantity	/) (enter '0	' if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or V	WWHRS	applies	, see Ap	pendix (	<u>3)</u>	i				
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	t from w	ater hea	ter											
(64)m=	231.9	204.58	215.27	193.56	190.11	170.48	164.3	179.49	178.93	200.68	211.47	226.52		
							-	Out	out from w	ater heate	r (annual)₁	12	2367.29	(64)
Heat g	ains fro	m water	heating,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	ı + (61)n	n] + 0.8 x	k [(46)m	+ (57)m	+ (59)m	]	
(65)m=	105.78	93.92	100.25	92.11	91.88	84.43	83.3	88.35	87.24	95.4	98.06	103.99	-	(65)
inclu	ude (57)	n in cal	culation	of (65)m	only if c	vlinder i	s in the o	dwellina	or hot w	u vater is fr	om com	n munitv h	eating	
5 Int				$\overline{5}$ and $\overline{5}a$	\.	ymraer i		anonng	or not n		oni com	incinity in	ouing	
<b>J</b> . III	lemai ya			, and Ja	).									
Metab	olic gain	IS ( I Able	e 5), Wat	ts Ann	Max	lun		A.1.0	San	Oct	Nev	Dee		
(00)	Jan			Apr	Iviay			Aug	5ep			177.75		(66)
(66)m=	1/7.75	1/7.75	177.75	1/7.75	177.75	1/7.75	177.75	177.75	177.75	177.75	177.75	177.75		(00)
Lightin	g gains	(calcula	ted in Ap	opendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5					
(67)m=	76.12	67.61	54.99	41.63	31.12	26.27	28.39	36.9	49.52	62.88	73.39	78.24		(67)
Applia	nces ga	ins (calc	ulated in	Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5				
(68)m=	509.78	515.07	501.74	473.36	437.53	403.87	381.37	376.08	389.41	417.79	453.61	487.28		(68)
Cookir	ng gains	(calcula	ated in A	ppendix	L, equat	ion L15	or L15a)	), also se	e Table	5				
(69)m=	55.74	55.74	55.74	55.74	55.74	55.74	55.74	55.74	55.74	55.74	55.74	55.74		(69)
Pumps	s and fai	ns gains	(Table !	5a)			•	•		•		•		
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
10000			n (nega	tive valu	L es) (Tah	L	I	I	I	I	I	I		
(71)m-	-112 5	-119 5	_118 5	-119 5	-118 5	-119 5	_119.5	_112.5	-119.5	_112.5	-119.5	-1185		(71)
(11)11=	-110.3	-110.0	-110.5	-110.5	-110.0	-110.5	-110.5	-110.5	-110.0	-110.5	-110.5	-110.5		(11)

Water	heating	g gains (T	able 5	)												_	
(72)m=	142.18	139.76	134.75	5	127.93	123.5	1	17.27	111.97	118	.76	121.17	128.23	3 136.2	139.77		(72)
Total i	nterna	l gains =						(66)	m + (67)m	n <mark>+ (6</mark> 8	3)m + (	(69)m + (1	70)m +	(71)m + (72)	m	_	
(73)m=	846.07	840.43	809.46	3	760.9	710.14	4 E	65.39	639.72	649	.73	678.09	726.89	781.19	823.28		(73)
6. So	lar gair	IS:															
Solar g	ains are	calculated u	using so	lar	flux from	Table 6	a and	d assoc	iated equa	tions	to con	vert to the	e applic	able orientat	ion.		
Orienta	ation:	Access F Table 6d	actor		Area m <sup>2</sup>			Flu Tal	x ble 6a		у Та	g_ ble 6b		FF Table 6c		Gains (W)	
Northe	act o ou						I			1		0.70	<b>п</b>			(,	
Northe	ast 0.9x	0.54		x	3.1	2	x		1.28	x		0.72		0.7	=	8.62	(75)
Northe	ast 0.9x	0.54		x	4.8	7	x		1.28			0.72	_	0.7		13.46	
Northe	ast 0.9x	0.54		x	3.1	2	x		2.97			0.72	-  ^	0.7		17.55	
Northe	ast 0.9x	0.54		×	4.8	7	x		2.97			0.72	-  ^	0.7		27.4	(75)
Northe		0.54		<b>^</b>	3.1	2			1.38			0.72	╡Û	0.7	=	31.62	
Northe		0.54		× v	4.8	7	x		7.00			0.72	╡゜	0.7		49.36	-(75)
Northe		0.54		^ _	3.1	2			27.96			0.72	╡Û	0.7	=	51.93	-(75)
Northe		0.54		<b>^</b>	4.8	7			1.25			0.72	╡Û	0.7	=	81.06	
Northe		0.54		<b>^</b>	3.1	2			4.05			0.72	╡Û	0.7	=	09.01	
Northe		0.54		<b>^</b>	4.8	7 2			7.35			0.72	╡Û	0.7	=	74.40	-(75)
Northe		0.54		<b>^</b>	3.1	2			7 20			0.72	╡Û	0.7	=	116.17	
Northe	ast 0.9x	0.54		^ v	4.0	2			07.30			0.72	-  ^	0.7	=	60.62	
Northe	ast 0.9x	0.54		^ v	3.1	2			91.1 01.1			0.72	-  ^	0.7	=	109.62	
Northe		0.54		^ _	4.0	/ 2			91.1 			0.72	╡Û	0.7	=	100.07 55.5	
Northe	ast 0.9x	0.54		<b>`</b>	3.1	2			2.03			0.72	_	0.7	= [	96.62	
Northea	ast <u>0.9x</u>	0.54		x	4.0	2	x		2.03			0.72	_	0.7	=	38.53	
Northea	ast <u>0 9x</u>	0.54		x	4.8	7	x	5	0.42 0 42			0.72	٦Ŷ	0.7		60.15	
Northea	ast 0.9x	0.54		x	3.1	2	x		28.07	x		0.72	۲ ۲	0.7		21.45	
Northea	ast 0.9x	0.54		x	4.8	7	x		28.07			0.72	_	0.7	<b>_</b>	33.48	
Northea	ast 0.9x	0.54		x	3.1	2	x		14.2	×		0.72		0.7	<b>⊣</b> _	10.85	
Northea	ast 0.9x	0.54		x	4.8	7	x		14.2	x		0.72		0.7		16.94	(75)
Northea	ast <u>0.9</u> x	0.54		x	3.1	2	x		9.21	x		0.72	– T x I	0.7		7.04	(75)
Northea	ast <mark>0.9x</mark>	0.54		x	4.8	7	x		9.21	x		0.72	ا_ x	0.7		10.99	(75)
Southe	ast <mark>0.9x</mark>	0.54		x	1.3	6	x		6.79	x		0.72	ا_ x	0.7		24.51	
Southe	ast <mark>0.9x</mark>	0.77		x	3.1	2	x		6.79	x		0.72	ا × ا	0.8		45.82	
Southe	ast <mark>0.9x</mark>	0.77		x	1.6	3	x		6.79	x		0.72	ا_ ×	0.7		41.12	(77)
Southe	ast <mark>0.9x</mark>	0.77		x	4.3	3	x		6.79	x		0.72	ا_ ×	0.7		55.26	(77)
Southe	ast <mark>0.9x</mark>	0.54		x	1.3	6	x	6	2.67	x		0.72	ן אר	0.7	=	41.76	(77)
Southe	ast <mark>0.9x</mark>	0.77		x	3.1	2	x	6	2.67	×		0.72	- x	0.8	=	78.05	(77)
Southe	ast <mark>0.9x</mark>	0.77		x	1.6	6	x	6	2.67	x		0.72	×	0.7		70.05	(77)
Southe	ast <mark>0.9x</mark>	0.77		x	4.3	3	x	6	2.67	x		0.72	اً × آ	0.7	=	94.13	(77)

Southeast 0.9x	0.54	×	1.36	x	85.75	x	0.72	x	0.7	=	57.13	(77)
Southeast 0.9x	0.77	x	3.12	×	85.75	×	0.72	x	0.8	i =	106.8	<b>–</b> (77)
Southeast 0.9x	0.77	x	1.6	×	85.75	×	0.72	x	0.7	i =	95.84	<b>–</b> (77)
Southeast 0.9x	0.77	x	4.3	×	85.75	×	0.72	x	0.7	i =	128.79	= (77)
Southeast 0.9x	0.54	] ×	1.36	×	106.25	x	0.72	x	0.7	<b>j</b> =	70.79	] (77)
Southeast 0.9x	0.77	x	3.12	×	106.25	×	0.72	x	0.8	i =	132.33	<b>–</b> (77)
Southeast 0.9x	0.77	x	1.6	x	106.25	x	0.72	x	0.7	=	118.75	(77)
Southeast 0.9x	0.77	x	4.3	×	106.25	×	0.72	x	0.7	=	159.58	(77)
Southeast 0.9x	0.54	x	1.36	×	119.01	×	0.72	x	0.7	=	79.29	(77)
Southeast 0.9x	0.77	x	3.12	×	119.01	×	0.72	x	0.8	] =	148.22	(77)
Southeast 0.9x	0.77	x	1.6	x	119.01	×	0.72	x	0.7	=	133.01	(77)
Southeast 0.9x	0.77	x	4.3	x	119.01	x	0.72	x	0.7	=	178.74	(77)
Southeast 0.9x	0.54	x	1.36	x	118.15	x	0.72	x	0.7	] =	78.72	(77)
Southeast 0.9x	0.77	x	3.12	x	118.15	x	0.72	x	0.8	=	147.14	(77)
Southeast 0.9x	0.77	x	1.6	x	118.15	x	0.72	x	0.7	=	132.05	(77)
Southeast 0.9x	0.77	x	4.3	x	118.15	x	0.72	x	0.7	=	177.45	(77)
Southeast 0.9x	0.54	x	1.36	x	113.91	x	0.72	x	0.7	=	75.89	(77)
Southeast 0.9x	0.77	x	3.12	x	113.91	x	0.72	x	0.8	=	141.86	(77)
Southeast 0.9x	0.77	x	1.6	x	113.91	x	0.72	x	0.7	=	127.31	(77)
Southeast 0.9x	0.77	x	4.3	x	113.91	x	0.72	x	0.7	=	171.08	(77)
Southeast 0.9x	0.54	x	1.36	x	104.39	x	0.72	x	0.7	=	69.55	(77)
Southeast 0.9x	0.77	x	3.12	×	104.39	x	0.72	x	0.8	=	130.01	(77)
Southeast 0.9x	0.77	x	1.6	x	104.39	x	0.72	x	0.7	=	116.67	(77)
Southeast 0.9x	0.77	x	4.3	×	104.39	x	0.72	x	0.7	] =	156.78	(77)
Southeast 0.9x	0.54	x	1.36	x	92.85	x	0.72	x	0.7	] =	61.86	(77)
Southeast 0.9x	0.77	x	3.12	x	92.85	x	0.72	x	0.8	] =	115.64	(77)
Southeast 0.9x	0.77	x	1.6	×	92.85	x	0.72	x	0.7	] =	103.78	(77)
Southeast 0.9x	0.77	x	4.3	x	92.85	x	0.72	x	0.7	=	139.45	(77)
Southeast 0.9x	0.54	x	1.36	×	69.27	x	0.72	x	0.7	] =	46.15	(77)
Southeast 0.9x	0.77	x	3.12	×	69.27	×	0.72	x	0.8	=	86.27	(77)
Southeast 0.9x	0.77	x	1.6	x	69.27	x	0.72	x	0.7	=	77.42	(77)
Southeast 0.9x	0.77	x	4.3	x	69.27	x	0.72	x	0.7	] =	104.03	(77)
Southeast 0.9x	0.54	x	1.36	×	44.07	x	0.72	x	0.7	] =	29.36	(77)
Southeast 0.9x	0.77	x	3.12	x	44.07	x	0.72	x	0.8	=	54.89	(77)
Southeast 0.9x	0.77	x	1.6	x	44.07	x	0.72	x	0.7	=	49.26	(77)
Southeast 0.9x	0.77	x	4.3	x	44.07	x	0.72	x	0.7	=	66.19	(77)
Southeast 0.9x	0.54	x	1.36	×	31.49	×	0.72	x	0.7	=	20.98	(77)
Southeast 0.9x	0.77	x	3.12	×	31.49	×	0.72	×	0.8	] =	39.22	(77)
Southeast 0.9x	0.77	x	1.6	×	31.49	x	0.72	x	0.7	] =	35.19	(77)
Southeast 0.9x	0.77	x	4.3	×	31.49	x	0.72	x	0.7	] =	47.29	(77)
Northwest 0.9x	0.54	x	8.84	×	11.28	×	0.72	x	0.7	] =	24.43	(81)
-												

Northwest 0.9x	0.77	×	2.28	x	11.28	x	0.72	x	0.7	=	8.99	(81)
Northwest 0.9x	0.77	×	2.28	x	11.28	x	0.72	x	0.7	i =	8.99	(81)
Northwest 0.9x	0.54	×	8.84	x	22.97	x	0.72	x	0.7	i =	49.73	(81)
Northwest 0.9x	0.77	×	2.28	×	22.97	x	0.72	x	0.7	<b>i</b> =	18.29	(81)
Northwest 0.9x	0.77	×	2.28	x	22.97	x	0.72	x	0.7	i =	18.29	(81)
Northwest 0.9x	0.54	×	8.84	x	41.38	x	0.72	x	0.7	i =	89.6	(81)
Northwest 0.9x	0.77	x	2.28	x	41.38	x	0.72	x	0.7	=	32.95	(81)
Northwest 0.9x	0.77	×	2.28	×	41.38	x	0.72	x	0.7	<b>j</b> =	32.95	- (81)
Northwest 0.9x	0.54	×	8.84	x	67.96	x	0.72	x	0.7	<b>i</b> =	147.15	- (81)
Northwest 0.9x	0.77	x	2.28	x	67.96	x	0.72	x	0.7	=	54.12	(81)
Northwest 0.9x	0.77	×	2.28	×	67.96	x	0.72	x	0.7	=	54.12	(81)
Northwest 0.9x	0.54	x	8.84	×	91.35	x	0.72	x	0.7	] =	197.79	(81)
Northwest 0.9x	0.77	x	2.28	x	91.35	x	0.72	x	0.7	] =	72.74	(81)
Northwest 0.9x	0.77	×	2.28	x	91.35	x	0.72	x	0.7	=	72.74	(81)
Northwest 0.9x	0.54	x	8.84	×	97.38	x	0.72	x	0.7	] =	210.87	(81)
Northwest 0.9x	0.77	x	2.28	×	97.38	x	0.72	x	0.7	] =	77.55	(81)
Northwest 0.9x	0.77	x	2.28	x	97.38	x	0.72	x	0.7	] =	77.55	(81)
Northwest 0.9x	0.54	×	8.84	x	91.1	x	0.72	x	0.7	=	197.26	(81)
Northwest 0.9x	0.77	x	2.28	×	91.1	x	0.72	x	0.7	] =	72.55	(81)
Northwest 0.9x	0.77	×	2.28	x	91.1	x	0.72	x	0.7	=	72.55	(81)
Northwest 0.9x	0.54	×	8.84	x	72.63	x	0.72	x	0.7	=	157.26	(81)
Northwest 0.9x	0.77	×	2.28	x	72.63	x	0.72	x	0.7	=	57.84	(81)
Northwest 0.9x	0.77	×	2.28	x	72.63	x	0.72	x	0.7	=	57.84	(81)
Northwest 0.9x	0.54	×	8.84	x	50.42	x	0.72	x	0.7	=	109.18	(81)
Northwest 0.9x	0.77	×	2.28	x	50.42	x	0.72	x	0.7	=	40.15	(81)
Northwest 0.9x	0.77	x	2.28	x	50.42	x	0.72	x	0.7	=	40.15	(81)
Northwest 0.9x	0.54	×	8.84	x	28.07	x	0.72	x	0.7	=	60.77	(81)
Northwest 0.9x	0.77	×	2.28	x	28.07	x	0.72	x	0.7	=	22.35	(81)
Northwest 0.9x	0.77	×	2.28	x	28.07	x	0.72	x	0.7	=	22.35	(81)
Northwest 0.9x	0.54	×	8.84	x	14.2	x	0.72	x	0.7	=	30.74	(81)
Northwest 0.9x	0.77	×	2.28	x	14.2	x	0.72	x	0.7	=	11.31	(81)
Northwest 0.9x	0.77	x	2.28	x	14.2	x	0.72	x	0.7	=	11.31	(81)
Northwest 0.9x	0.54	×	8.84	x	9.21	x	0.72	x	0.7	=	19.95	(81)
Northwest 0.9x	0.77	x	2.28	x	9.21	x	0.72	x	0.7	=	7.34	(81)
Northwest 0.9x	0.77	×	2.28	x	9.21	x	0.72	x	0.7	] =	7.34	(81)
Rooflights 0.9x	1	×	37.85	x	26	x	0.73	x	0.7	=	452.59	(82)
Rooflights 0.9x	1	x	37.85	x	54	x	0.73	x	0.7	=	939.99	(82)
Rooflights 0.9x	1	x	37.85	×	96	x	0.73	x	0.7	=	1671.09	(82)
Rooflights 0.9x	1	x	37.85	×	150	x	0.73	x	0.7	=	2611.08	(82)
Rooflights 0.9x	1	x	37.85	x	192	x	0.73	x	0.7	=	3342.19	(82)
Rooflights 0.9x	1	x	37.85	×	200	x	0.73	x	0.7	=	3481.44	(82)

Rooflia	hts <u>o ov</u> [	1		27	95	<u>у</u> [		190	Ι <sub>Υ</sub> Γ		0.72	٦ <sub>×</sub>	0.7	<u> </u>	2280.06	<b>–</b> (82)
Rooflia	hts o ox	1	^	37	85	∩ L √ [		157	^ L   <sub>v</sub> Г		0.73	۲Ŷ	0.7	=	2732.03	
Rooflig	hts $0.0x$	1	^	27	05	1 ^ \		115	^ L   ↓ Γ		0.73	٦Ŷ	0.7	=	2001.83	
Rooflig	hts $0.0 \times [$	1	^	27	05 05	^ [ ↓ [		66	^ L   V Г		0.73	╡ Û	0.7	$\dashv$	2001.83	
Rooflig	hts o ou	1	<b>_</b> ^	37.	85	1 ^ [		66			0.73	╡ ^	0.7	<u> </u>	1148.88	
Pooflig	hts o ou	1	×	37.	85			33			0.73		0.7		574.44	
Roonig	nts 0.9x	1	X	37.	85	×		21	×		0.73	×	0.7	=	365.55	(82)
0.1		- 11	-1- 1-4-		L				(22)	~		(00)				
Solar (	gains in	watts, ca	alculated	for eac	h month	15	72.26	1226 76	(83)m =	= Sun	m(74)m . 2710 72	(82)m	15 955 27	560.90		(83)
Total c	$\frac{003.79}{2}$	nternal a	2290.14	(84)m -	- (73)m	+3 + (8	13.30 13.30	4320.70	3021.0		2/10.72	1023.	15 055.27	500.88	<u>′</u>	(00)
(84)m-	1520.96	2105 66	2105 50	4241.9	- (73)m	+ (C	29.76	, waiis	4270	74 3	2200 01	2250	1636.46	129/ 1	7	(84)
(04)111=	1529.00	2195.00	3105.59	4241.0	5115.04	52	30.70	4900.40	4270.	/4 3	5500.01	2350.0	1030.40	1304.1	7	(04)
7. Me	an inter	nal temp	perature	(heating	season	)									-	
Temp	erature	during h	neating p	eriods ir	n the livi	ng a	area f	from Tab	ole 9, <sup>-</sup>	Th1	(°C)				21	(85)
Utilisa	ation fac	tor for g	ains for	living are	ea, h1,m	i (se	e Ta	ble 9a)						-	_	
	Jan	Feb	Mar	Apr	May		Jun	Jul	Au	g	Sep	Oc	t Nov	Dec	:	
(86)m=	0.99	0.96	0.85	0.62	0.42	0	.28	0.2	0.25	5	0.46	0.83	0.97	0.99		(86)
Mean	interna	l temper	ature in	living ar	ea T1 (fe	ollo	w ste	ps 3 to 7	' in Ta	able	9c)					
(87)m=	19.98	20.27	20.63	20.87	20.93	2	0.94	20.94	20.94	4	20.93	20.7	5 20.28	19.92	7	(87)
Tom		during h		L oriodo i	l root of		مالنمم	from To		 						
					10.70						2(0)	10.70	10.70	10.79	7	(88)
(00)11=	19.70	19.70	19.78	19.79	19.79	L '	9.0	19.0	19.0	,	19.0	19.73	19.79	19.70		(00)
Utilisa	ation fac	tor for g	ains for	rest of d	welling,	h2,	m (se	e Table	9a)						-	
(89)m=	0.99	0.95	0.81	0.57	0.36	0	.23	0.15	0.18	;	0.38	0.77	0.96	0.99		(89)
Mean	interna	l temper	ature in	the rest	of dwell	ing	T2 (fo	ollow ste	eps 3 t	io 7	in Tabl	e 9c)				
(90)m=	18.44	18.86	19.35	19.63	19.69	19	9.71	19.71	19.7 <i>°</i>	1	19.7	19.52	2 18.9	18.37	7	(90)
											f	LA = Li	ving area ÷	(4) =	0.24	(91)
Mean	interna	l temper	ature (fo	or the wh	ole dwe	llind	r) – fl	$A \times T1$	+ (1 _	. fΙ Δ	) <b>x</b> T2					
(92)m=	18.81	19.19	19.65	19.92	19.98	I	20 – 11	20	20		19.99	19.8 <sup>,</sup>	19.22	18.74	7	(92)
Apply	adiustr	nent to t	he mear	interna	l temper	I atu	re fro	m Table	4e w	 /here	e appro	opriate	<u> </u>			
(93)m=	18.66	19.04	19.5	19.77	19.83	1	9.85	19.85	19.85	5	19.84	19.60	, 5 19.07	18.59	7	(93)
8. Sp	ace hea	tina rea	uirement		1	I										
Set T	i to the i	mean int	ternal ter	nperatu	re obtair	ned	at ste	ep 11 of	Table	9b.	so tha	t Ti.m	=(76)m ar	nd re-ca	lculate	
the ut	tilisation	factor fo	or gains	using Ta	able 9a					,		,	(-)			
	Jan	Feb	Mar	Apr	May		Jun	Jul	Au	g	Sep	Oc	t Nov	Dec	:	
Utilisa	ation fac	tor for g	ains, hm	1:										_		
(94)m=	0.98	0.94	0.81	0.57	0.37	0	.23	0.15	0.19	)	0.39	0.77	0.96	0.99		(94)
Usefu	ul gains,	hmGm	, W = (94	4)m x (8	4)m									-		
(95)m=	1502.65	2057.66	2501.47	2414.09	1871.28	12	06.53	747.58	792.5	53 1	1311.67	1800.	6 1566.89	1367.1	4	(95)
Montl	hly aver	age exte	ernal tem	perature	e from T	able	8								-	
(96)m=	4.3	4.9	6.5	8.9	11.7	1	4.6	16.6	16.4	Ļ	14.1	10.6	7.1	4.2		(96)
Heat	loss rate	e for me	an intern	al temp	erature,	Lm	, W =	=[(39)m :	x [(93)	)m_	(96)m	]			-	
(97)m=	3375.8	3320.03	3046.24	2526.04	1886.24	12	07.95	747.73	792.9	9   1	1324.58	2100.	52 2785.84	3358.8	8	(97)
Spac	e heatin	g require	ement fo	r each n	nonth, k	Wh/	/mont	h = 0.02	24 x [(9	97)n	n – (95)	)m] x	(41)m		-	
(98)m=	1393.62	848.32	405.31	80.61	11.13		0	0	0		0	223.1	4 877.64	1481.8	6	

								Tota	l per year	(kWh/yeai	r) = Sum(9	8)15,912 =	5321.62	(98)
Space	e heatin	g require	ement in	n kWh/m²	²/year								31.3	(99)
9a. Ene	ergy rec	quiremer	nts – Ind	lividual h	eating s	ystems i	ncluding	micro-C	HP)					
Space	e heatii	ng:	t from o	aaandar	vlaunala	montory	ovetere						0	
Fracti	on of sr		at from n		y/supple	mentary	system	(202) – 1 -	- (201) -				0	$\begin{bmatrix} (201) \\ (202) \end{bmatrix}$
Fracti	on of to	tal boati	ng from		etom 1			(202) - 1	(201) =	(203)] -			1	$\begin{bmatrix} (202) \\ (204) \end{bmatrix}$
Efficie				ting evet	om 1			(204) - (2	52) ~ [ <sup>1</sup>	(200)] =			02.2	(204)
Efficie		nain spa		ling syste	v boatin	a svetor	0/						93.3	(200)
					May		I, 70	A.1.0	Sen	Oct	Nev	Dee		
Space	Jan e heatin	a require	ement (c	Apr Calculate	d above	Jun	Jui	Aug	Sep	Oct	INOV	Dec	kvvn/yea	lr
opuot	1393.62	848.32	405.31	80.61	11.13	0	0	0	0	223.14	877.64	1481.86		
י (211)m	i = {[(98	)m x (20	4)] } x 1	1 100 ÷ (20	)6)						1			(211)
	1493.7	909.23	434.42	86.4	11.93	0	0	0	0	239.16	940.67	1588.28		
			-	-	-			Tota	l (kWh/yea	ar) =Sum(2	211) <sub>15,1012</sub>	<u>-</u>	5703.78	(211)
Space	e heatin	g fuel (s	econdar	ry), kWh/	month									
= {[(98)	)m x (20	01)] } x 1	00 ÷ (20	)8) 1		0	0	0	0	0		0	l	
(215)111=	0	0	0	0	0	0	0	U Tota	0 I (kWh/vea	ur) =Sum(2	215)	=	0	(215)
Water	heating	1								, ,	/10,1012	-	Ŭ	](=:=)
Output	from w	ater hea	ter (calc	ulated a	bove)									
	231.9	204.58	215.27	193.56	190.11	170.48	164.3	179.49	178.93	200.68	211.47	226.52		-
Efficier	ncy of w	ater hea	iter										79.6	(216)
(217)m=	88.6	88	86.28	82.47	80.13	79.6	79.6	79.6	79.6	84.9	88	88.72		(217)
Fuel fo (219)m	r water 1 = (64)	heating, m x 100	kWh/m (217) ∸ (217)	onth )m										
( <u>-</u> 10)m=	261.73	232.47	249.51	234.7	237.26	214.17	206.41	225.5	224.78	236.39	240.3	255.32		
			-	-	-			Tota	I = Sum(2 <sup>-</sup>	19a) <sub>112</sub> =	-		2818.54	(219)
Annua	l totals									k	Wh/year	•	kWh/year	7
Space	heating	fuel use	ed, main	system	1								5703.78	ļ
Water	heating	fuel use	d										2818.54	
Electric	city for p	oumps, f	ans and	electric	keep-ho	t								
centra	al heatir	ig pump	:									30		(230c)
boiler	with a f	an-assis	sted flue									45		(230e)
Total e	lectricity	y for the	above,	kWh/yea	ır			sum	of (230a).	(230g) =			75	(231)
Electric	city for l	ighting											537.75	(232)
10a. F	- uel cos	sts - indiv	vidual he	eating sy	stems:									-
						<b>Fu</b> kW	<b>el</b> /h/year			<b>Fuel P</b> (Table	r <b>ice</b> 12)		<b>Fuel Cost</b> £/year	
Space	heating	- main s	system ?	1		(211	1) x			3.4	8	x 0.01 =	198.49	(240)
										-				_

Space heating - main system 2	(213)	x	0	x 0.01 =	0	(241)
Space heating - secondary	(215)	x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.48	x 0.01 =	98.09	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	9.89	(249)
(if off-peak tariff, list each of (230a) to (2 Energy for lighting	30g) separately a (232)	as applicable and	apply fuel price acco	ording to T x 0.01 =	Table 12a 70.93	(250)
Additional standing charges (Table 12)					120	(251)
Appendix Q items: repeat lines (253) and <b>Total energy cost</b>	d (254) as neede (245)(247) + (250)	ed )(254) =			497.4	(255)
11a. SAP rating - individual heating sys	stems					-
Energy cost deflator (Table 12) Energy cost factor (ECF)	[(255) x (256)] ÷ [(4)	+ 45.0] =			0.42	(256) (257)
SAP rating (Section 12)					86.45	(258)
12a. CO2 emissions – Individual heatin	ig systems incluc	ling micro-CHP				
	<b>Ene</b> kWh	<b>rgy</b> n/year	<b>Emission fa</b> kg CO2/kWh	ctor	<b>Emissions</b> kg CO2/yea	r
Space heating (main system 1)	(211)	X	0.216	=	1232.02	(261)
Space heating (secondary)	(215)	X	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	608.8	(264)
Space and water heating	(261)	+ (262) + (263) + (26	4) =		1840.82	(265)
Electricity for pumps, fans and electric keep	eep-hot (231)	X	0.519	=	38.93	(267)
Electricity for lighting	(232)	X	0.519	=	279.09	(268)
Total CO2, kg/year			sum of (265)(271) =		2158.84	(272)
CO2 emissions per m <sup>2</sup>			(272) ÷ (4) =		12.7	(273)
El rating (section 14)					87	(274)
13a. Primary Energy						
	<b>Ene</b> kWh	<b>rgy</b> n/year	<b>Primary</b> factor		<b>P. Energy</b> kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	6958.61	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	3438.62	(264)
Space and water heating	(261)	+ (262) + (263) + (26	4) =		10397.23	(265)
Electricity for pumps, fans and electric k	eep-hot (231)	x	3.07	=	230.25	(267)
Electricity for lighting	(232)	x	0	=	1650.88	(268)
'Total Primary Energy			sum of (265)(271) =		12278.36	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		72.23	(273)

					User [	Details:						
Assessor Name:	Dar	niel Wat	tt			Strom	a Num	ber:		STRO	026464	
Software Name:	Stro	ma FS	AP 201	2		Softwa	are Vei	rsion:		Versio	on: 1.0.4.10	
				Pi	operty	Address	: 59 Can	nden Me	ws - Op	tion 1		
Address :	59 C	Camden	Mews, I	London,	tba							
1. Overall dwelling dime	ensions	3:										
					Are	a(m²)		Av. Hei	ight(m)	-	Volume(m <sup>3</sup> )	-
Ground floor						90	(1a) x		3	(2a) =	270	(3a)
First floor						80	(1b) x	2	6	(2b) =	208	(3b)
Total floor area TFA = (1	a)+(1b	)+(1c)+(	(1d)+(1e	e)+(1n	)	170	(4)					
Dwelling volume							(3a)+(3b)	)+(3c)+(3d	)+(3e)+	.(3n) =	478	(5)
2. Ventilation rate:												
	r h	nain eating	se h	econdary neating	y	other		total			m <sup>3</sup> per hour	
Number of chimneys		0	] + [	0	] + [	0	] = [	0	X 4	40 =	0	(6a)
Number of open flues		0	+	0	] + [	0	] = [	0	x 2	20 =	0	(6b)
Number of intermittent fa	ans							4	x ^	10 =	40	(7a)
Number of passive vents	6						Г	0	x ^	10 =	0	(7b)
Number of flueless gas f	ires						Γ	0	x 4	40 =	0	(7c)
							_					-
							_			Air ch	langes per hou	ir -
Infiltration due to chimne	eys, flue	es and fa	ans = <mark>(6</mark>	a)+(6b)+(7	a)+(7b)+	(7c) =		40		÷ (5) =	0.08	(8)
Number of storeys in t	been can	nea out or Mina (na	r is intende	ea, proceec	1 to (17),	otherwise	continue m	om (9) to (	16)		2	
Additional infiltration		anng (na	<i>)</i>						[(9)-	-11x0 1 =	0	(3)
Structural infiltration: (	).25 for	steel or	timber t	frame or	0.35 fc	r masoni	v constr	uction	[(0)	110.1 -	0	(10)
if both types of wall are p	present, L	ise the va	lue corres	ponding to	the grea	ter wall are	a (after	uotion			0	]()
deducting areas of open If suspended wooden	ings); if e floor. e	<i>qual user</i> nter 0.2	0.35 (unseal	ed) or 0.	1 (seal	ed), else	enter 0				0	<b>]</b> (12)
If no draught lobby, er	nter 0.0	5. else e	enter 0		. (000	ou), 0.00					0	(13)
Percentage of window	s and o	doors dr	aught st	ripped							0	(14)
Window infiltration			0			0.25 - [0.2	! x (14) ÷ 1	00] =			0	(15)
Infiltration rate						(8) + (10)	+ (11) + (1	2) + (13) +	+ (15) =		0	(16)
Air permeability value,	q50, e	xpresse	ed in cub	oic metre	s per h	our per s	quare m	etre of e	nvelope	area	5	(17)
If based on air permeabi	lity valu	ue, then	(18) = [(1	7) ÷ 20]+(8	), otherw	/ise (18) = (	(16)				0.33	(18)
Air permeability value applie	es if a pre	essurisatio	on test has	s been don	e or a de	gree air pe	rmeability	is being us	sed			-
Number of sides shelter	ed										2	(19)
Shelter factor						(20) = 1 -	[0.075 x (1	[9)] =			0.85	(20)
Intiltration rate incorpora	ting sh	elter fac	tor			(21) = (18	) x (20) =				0.28	(21)
Infiltration rate modified	tor mor	nthly wir	nd speed	k 		1.	_				l	
Jan Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Monthly average wind sp	beed fro	om Tabl	e 7	,							1	
(22)m= 5.1 5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7		

Wind F	actor (2	2a)m =	(22)m ÷	4										
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18		
Adjuste	ed infiltra	ation rate	e (allowi	ing for sh	nelter an	nd wind s	peed) =	: (21a) x	(22a)m					
	0.36	0.35	0.35	0.31	0.3	0.27	0.27	0.26	0.28	0.3	0.32	0.33		
Calcula	ate effec	tive air o	change	rate for t	he appli	cable ca	se							
IT ME	echanica	I ventila		andix NL (0	26) (00	-)	austica (		nuice (22h	) (22a)			0	(23a)
li exna		boot room		ionovin 0/	.3D) = (238	a) × FIIIV (6	equation (i	NO)), Olne		) = (23a)			0	(23b)
ir bala	incea with	neat reco	very: emc	iency in %	allowing	for in-use f	actor (from	n Table 4n	) =			(00)	0	(23c)
a) If	balance	d mecha	anical ve	entilation	with he	at recove	ery (MV	HR) (24a T	a)m = (22	2b)m + (2	23b) × [7	1 – (23c)	÷100]	(24a)
(24a)m=	0	0		0	0	0	0					0		(24a)
b) If	balance	d mecha	anical ve	entilation	without	heat rec	covery (ľ	MV) (24b	)m = (22	2b)m + (2	23b)		l	(24)
(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0		(24D)
c) If v	whole ho		tract ver	ntilation o	or positiv	ve input v	ventilatio	on from o	outside	E (22h				
(24c)m-	0	0.5 ×	(230), i		z) = (230)			$\frac{1}{1}$	$\frac{1}{1}$	.5 × (230		0		(24c)
(24C)III=		0	0		0				- "	0	0	0		(240)
a) ir i	natural \ f (22b)m	r = 1. the	on or wn en (24d)	m = (22)	se positiv o)m othe	ve input erwise (2	ventilati (4d)m =	0.5 + [(2	oft 2b)m² x	0.51				
(24d)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56		(24d)
Effec	ctive air	change	rate - er	nter (24a	) or (24	) or (24	L c) or (24	ld) in boy	(25)		<u></u>			
(25)m=	0.57	0.56	0.56	0.55	0.55	0.54	0.54	0.53	0.54	0.55	0.55	0.56		(25)
				1			1	1	1					
		s and he	at loss	paramete Oponin	er:	Not Ar	00	LL volu	10			k volu	、 、	AXk
3. Hea	IENT	s and he Gros area	eat loss p ss (m²)	paramete Openin m	er: gs 1 <sup>2</sup>	Net Ar A ,r	ea n²	U-valı W/m2	ue K	A X U (W/ł	K)	k-value kJ/m²·l	e <	A X k kJ/K
3. Hea ELEN Doors	IENT	s and he Gros area	eat loss   ss (m²)	paramete Openin m	er: gs 1 <sup>2</sup>	Net Ar A ,r 2.6	ea m²	U-valı W/m2	ue K =	A X U (W/ł 2.6	K)	k-value kJ/m²·I	) <	A X k kJ/K (26)
3. Hea ELEN Doors Windov	IENT	s and he Gros area 1	eat loss   ss (m²)	paramete Openin m	er: gs 1 <sup>2</sup>	Net Ar A ,r 2.6	rea m² x x1	U-valı W/m2	ue K =   0.04] =	A X U (W/ł 2.6	K)	k-value kJ/m²-I	) <	A X k kJ/K (26) (27)
3. Hea ELEN Doors Windov Windov	IENT ws Type ws Type	Gros area 1	eat loss   SS (m²)	paramete Openin m	er: gs ²	Net Ar A ,r 2.6 0.75 1.72	ea m <sup>2</sup> x x1 x1	U-valı W/m2 [	ue K =   0.04] =   0.04] =	A X U (W/I 2.6 0.99 2.28	K)	k-value kJ/m²·I	9 <	A X k kJ/K (26) (27) (27)
3. Heat ELEN Doors Window Window Window	IENT ws Type ws Type ws Type	Gros area 1 2 3	eat loss ; ss (m²)	paramete Openin m	er: gs 1 <sup>2</sup>	Net Ar A ,r 2.6 0.75 1.72 4.86	ea n <sup>2</sup> x x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup>	U-valu W/m2 [	ue K 0.04] =   0.04] =   0.04] =	A X U (W/I 2.6 0.99 2.28 6.44	<>	k-value kJ/m²·I	9 X	A X k kJ/K (26) (27) (27) (27)
3. Heat ELEN Doors Window Window Window	IENT ws Type ws Type ws Type ws Type	and he Gros area 1 2 3 4	eat loss p es (m²)	paramete Openin m	er: gs ,2	Net Ar A ,r 2.6 0.75 1.72 4.86	ea n <sup>2</sup> × x1 x1 x1 x1 x1 x1	U-valu W/m2 [	ue K 0.04] =   0.04] =   0.04] =   0.04] =	A X U (W/I 2.6 0.99 2.28 6.44	K)	k-value kJ/m²·I	e <	A X k kJ/K (26) (27) (27) (27) (27)
3. Hea ELEN Doors Windov Windov Windov Windov	IENT ws Type ws Type ws Type ws Type ws Type	and he Gros area 1 2 3 4 5	eat loss ; ss (m²)	paramete Openin m	er: gs ,2	Net Ar A ,r 2.6 0.75 1.72 4.86 1.72 2.68	ea n <sup>2</sup> x x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup>	U-valu W/m2 [	ue K 0.04] =   0.04] =   0.04] =   0.04] =   0.04] =	A X U (W/I 2.6 0.99 2.28 6.44 2.28 3.55	K)	k-value kJ/m²·I	2	A X k kJ/K (26) (27) (27) (27) (27) (27)
3. Here ELEN Doors Windov Windov Windov Windov Windov	IENT ws Type ws Type ws Type ws Type ws Type ws Type	and he Gros area 1 2 3 4 5 6	eat loss p ss (m²)	paramete Openin m	er: gs 2	Net Ar A ,r 2.6 0.75 1.72 4.86 1.72 2.68	ea n <sup>2</sup> × x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup>	U-valu W/m2 [	Le K 0.04] =   0.04] =   0.04] =   0.04] =   0.04] =   0.04] =	A X U (W/I 2.6 0.99 2.28 6.44 2.28 3.55	<>	k-value kJ/m²-I	9 K	A X k kJ/K (26) (27) (27) (27) (27) (27) (27)
3. Her ELEN Doors Windov Windov Windov Windov Windov	IENT ws Type ws Type ws Type ws Type ws Type ws Type	and he Gros area 1 2 3 4 5 6 7	eat loss p ss (m²)	paramete Openin m	er: gs ,2	Net Ar A ,r 2.6 0.75 1.72 4.86 1.72 2.68 0.88	ea n <sup>2</sup> × x1 x1 x1 x1 x1 x1 x1 x1 x1 x1	U-valu W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+ /[1/( 1.4 )+	UE K 0.04] =   0.04] =   0.04] =   0.04] =   0.04] =   0.04] =   0.04] =	A X U (W/I 2.6 0.99 2.28 6.44 2.28 3.55 1.17	K)	k-value kJ/m²-I	÷ ≺	A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27)
3. Her ELEN Doors Windov Windov Windov Windov Windov Windov	IENT ws Type ws Type ws Type ws Type ws Type ws Type ws Type	and he Gros area 1 2 3 4 5 6 7 8	eat loss ; ss (m²)	paramete Openin m	er: gs ²	Net Ar A ,r 2.6 0.75 1.72 4.86 1.72 2.68 0.88 2.36	ea n <sup>2</sup> x x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup>	U-valu W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+	LIE K 0.04] =   0.04] =	A X U (W/I 2.6 0.99 2.28 6.44 2.28 3.55 1.17 3.13	K)	k-value kJ/m²·I	2 <	A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27
3. Her ELEN Doors Windov Windov Windov Windov Windov Windov Windov	IENT ws Type ws Type ws Type ws Type ws Type ws Type ws Type ws Type	and he Gros area 1 2 3 4 5 6 7 8 0	eat loss ; ss (m²)	paramete Openin m	er: gs 2	Net Ar A ,r 2.6 0.75 1.72 4.86 1.72 2.68 0.88 2.36 1.25	ea m <sup>2</sup> × 1 x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup> x <sup>1</sup>	U-valu W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+	Le K 0.04] =   0.04] =	A X U (W/I 2.6 0.99 2.28 6.44 2.28 3.55 1.17 3.13 1.66	<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	k-value kJ/m²-I	÷ ≺	A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27
3. Her ELEN Doors Windov Windov Windov Windov Windov Windov Windov	IENT ws Type ws Type ws Type ws Type ws Type ws Type ws Type ws Type	and he Gros area 1 2 3 4 5 6 7 8 9	eat loss ; ss (m²)	paramete Openin m	er: gs ,2	Net Ar A ,r 2.6 0.75 1.72 4.86 1.72 2.68 0.88 2.36 1.25 1.25	ea n <sup>2</sup> X X <sup>1</sup> X <sup>1</sup>	U-valu W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+	LE K 0.04] =   0.04] =	A X U (W/I 2.6 0.99 2.28 6.44 2.28 3.55 1.17 3.13 1.66 1.66	$\sim$	k-value kJ/m²·I	€ ≺	A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27
3. Here ELEN Doors Windov Windov Windov Windov Windov Windov Windov Windov	IENT ws Type ws Type ws Type ws Type ws Type ws Type ws Type ws Type ws Type hts	and he Gros area 1 2 3 4 5 6 7 8 9	eat loss ; ss (m²)	paramete Openin m	er: gs 2	Net Ar A ,r 2.6 0.75 1.72 4.86 1.72 2.68 0.88 2.36 1.25 1.25 20.807	ea n <sup>2</sup> x x <sup>1</sup> x <sup></sup>	U-valu W/m2 1 /[1/( 1.4 )+ /[1/( 1.4 )+	Le K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] =	A X U (W/I 2.6 0.99 2.28 6.44 2.28 3.55 1.17 3.13 1.66 1.66 35.3729		k-value kJ/m²·I	, ,	A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27
3. Her ELEN Doors Windov Windov Windov Windov Windov Windov Windov Rooflig Floor T	IENT ws Type ws Type ws Type ws Type ws Type ws Type ws Type ws Type hts Type 1	s and he Gros area 1 2 3 4 5 6 7 8 9	eat loss ; ss (m²)	paramete Openin m	er: gs 2	Net Ar A ,r 2.6 0.75 1.72 4.86 1.72 2.68 0.88 2.36 1.25 1.25 20.807	ea n <sup>2</sup> X X <sup>1</sup> X <sup>1</sup>	U-valu W/m2 1 /[1/( 1.4 )+ /[1/( 1.7) + 0.13	Le K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 1 = 1 1 =	A X U (W/I 2.6 0.99 2.28 6.44 2.28 3.55 1.17 3.13 1.66 1.66 35.3729 11.7		k-value kJ/m²·I		A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27
3. Her ELEN Doors Windov Windov Windov Windov Windov Windov Windov Rooflig Floor T Floor T	IENT ws Type ws Type ws Type ws Type ws Type ws Type ws Type ws Type hts Type 1 Type 2	and he Gros area 1 2 3 4 5 6 7 8 9	eat loss ; ss (m <sup>2</sup> )	paramete Openin m	er: gs 2	Net Ar A ,r 2.6 0.75 1.72 4.86 1.72 2.68 0.88 2.36 1.25 1.25 20.807 90 18	ea n <sup>2</sup> x x1 x1 x1 x1 x1 x1 x1	U-valu W/m2 1 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.7)+ 0.13 0.13	LE K 0.04] =   0.04]	A X U (W/I 2.6 0.99 2.28 6.44 2.28 3.55 1.17 3.13 1.66 1.66 35.3729 11.7 2.34		k-value kJ/m²-I		A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27
3. Here ELEN Doors Window Window Window Window Window Window Window Window Rooflig Floor T Floor T Walls 1	IENT ws Type ws Type ws Type ws Type ws Type ws Type ws Type ws Type hts Type 1 Type 2 Type1	s and he Gross area 1 2 3 4 5 6 7 8 9	eat loss ; ss (m <sup>2</sup> )	Deramete Openin m	er: gs 2	Net Ar A ,r 2.6 0.75 1.72 4.86 1.72 2.68 0.88 2.36 1.25 1.25 20.807 90 18 109.5	ea n <sup>2</sup> x x <sup>1</sup> x <sup>2</sup> x <sup>1</sup> x <sup>2</sup> x	U-value W/m2 1 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.7)+ 0.13 0.13 0.18	LE K 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 0.04] = 1 0.04] = 0.04] = 1 0.04] = 1 0 0.04] = 1 0 0.04] = 1 0 0 0 0 0 0 0 0 0 0 0 0 0	A X U (W/I 2.6 0.99 2.28 6.44 2.28 3.55 1.17 3.13 1.66 1.66 35.3729 11.7 2.34 19.78		k-value kJ/m²-I		A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27
3. Here ELEN Doors Windov Windov Windov Windov Windov Windov Windov Windov Rooflig Floor T Floor T Walls T Walls T	IENT ws Type ws Type ws Type ws Type ws Type ws Type ws Type ws Type hts Type 1 Type 2 Type1 Type2	s and he Gross area 1 2 3 4 5 6 7 8 9 9	eat loss p ss (m <sup>2</sup> )	Deramete Openin m 19.1 2.6	er: gs 2	Net Ar A,r 2.6 0.75 1.72 4.86 1.72 2.68 0.88 2.36 1.25 1.25 20.807 90 18 109.5 22.4	ea m <sup>2</sup> X X X X X X X X X X X X X X X X X X X	U-valu W/m2 1 /[1/( 1.4 )+ /[1/( 1.7 )+ 0.13 0.18 0.18	Je         0.04]       =         =       =         =       =         =       =         =       =	A X U (W/I 2.6 0.99 2.28 6.44 2.28 3.55 1.17 3.13 1.66 1.66 35.3729 11.7 2.34 19.78 4.03		k-value kJ/m²-I		A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27
3. Here ELEN Doors Windov Windov Windov Windov Windov Windov Windov Windov Rooflig Floor T Floor T Walls T Walls T Roof	IENT ws Type ws Type ws Type ws Type ws Type ws Type ws Type ws Type hts Type 1 Type 2 Type1 Type2	s and he Gross area 1 2 3 4 5 6 7 8 9 9	eat loss p ss (m <sup>2</sup> )	Deramete Openin m 19.1 2.6 20.8	er: gs ,2 1	Net Ar A,r 2.6 0.75 1.72 4.86 1.72 2.68 0.88 2.36 1.25 20.807 1.25 20.807 1.25 20.807 1.25 20.807 1.8 2.2.4 87.19	ea $n^2$ $x$ $x^1$ <td>U-valu W/m2 1 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.7)+ 0.13 0.13 0.18 0.13</td> <td>LE K 0.04] =   0.04] =   0.04]</td> <td>A X U (W/I 2.6 0.99 2.28 6.44 2.28 3.55 1.17 3.13 1.66 1.66 35.3729 11.7 2.34 19.78 4.03 11.34</td> <td></td> <td>k-value kJ/m²-I</td> <td></td> <td>A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27</td>	U-valu W/m2 1 /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.4)+ /[1/(1.7)+ 0.13 0.13 0.18 0.13	LE K 0.04] =   0.04]	A X U (W/I 2.6 0.99 2.28 6.44 2.28 3.55 1.17 3.13 1.66 1.66 35.3729 11.7 2.34 19.78 4.03 11.34		k-value kJ/m²-I		A X k kJ/K (26) (27) (27) (27) (27) (27) (27) (27) (27

Party v	vall					58	x	0	=	0				(32)
* for win ** inclua	dows and le the area	roof winde is on both	ows, use e sides of ir	effective wi nternal wal	ndow U-va Is and part	alue calcul titions	ated using	g formula 1	/[(1/U-valu	ie)+0.04] a	as given in	paragraph	3.2	
Fabric	heat los	s, W/K =	= S (A x	U)				(26)(30)	) + (32) =				110.23	(33)
Heat c	apacity	Cm = S(	(Axk)						((28)	.(30) + (32	2) + (32a).	(32e) =	14385.43	(34)
Therm	al mass	parame	ter (TMF		- TFA) ir	n kJ/m²K			Indica	tive Value	: Medium		250	(35)
For desi	ign assess	' ments wh	ere the de	tails of the	construct	ion are no	t known pr	recisely the	e indicative	values of	TMP in Ta	able 1f		
can be ι	ised instea	ad of a de	tailed calc	ulation.							_			
Therm	al bridge	es : S (L	x Y) cal	culated u	using Ap	pendix l	<						41.02	(36)
if details	of therma	l bridging	are not kn	own (36) =	= 0.15 x (3	1)			()	<i>(</i>				_
$(33) + (36) =$ Ventilation beat loss calculated monthly $(38)m = 0.33 \times (25)m \times (5)$													151.25	(37)
Ventila	ition hea	it loss ca	alculated	d monthly	y I	1	1		(38)m I	= 0.33 × (	25)m x (5) I	 		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(38)m=	89.18	88.78	88.39	86.55	86.2	84.6	84.6	84.3	85.21	86.2	86.9	87.63		(38)
Heat tr	ansfer c	oefficier	nt, W/K						(39)m	= (37) + (3	38)m			
(39)m=	240.43	240.03	239.64	237.79	237.45	235.84	235.84	235.55	236.46	237.45	238.15	238.88		
Heat lo	oss para	meter (H	HLP), W/	/m²K		•	•		(40)m	Average = = (39)m ÷	Sum(39)₁ · (4)	12 /12=	237.79	(39)
(40)m=	1.41	1.41	1.41	1.4	1.4	1.39	1.39	1.39	1.39	1.4	1.4	1.41		
										Average =	Sum(40)1	12 /12=	1.4	(40)
Numbe	er of day	rs in mor	nth (Tab	le 1a)										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31		(41)
4. Wa	ater heat	ing enei	rgy requi	irement:								kWh/ye	ear:	
4. Wa Assum if TF if TF	ter heat and occu A > 13.9	ing ener pancy, l Ə, N = 1 Ə, N = 1	rgy requi N + 1.76 x	irement: : [1 - exp	(-0.0003	349 x (TF	-A -13.9	)2)] + 0.(	0013 x ( <sup>-</sup>	TFA -13.	<u>2</u> . 9)	kWh/ye 96	ear:	(42)
4. Wa Assum if TF if TF Annua <i>Reduce</i>	nter heat ned occu A > 13.9 A £ 13.9 I averag the annua	ing ener pancy, I 9, N = 1 9, N = 1 e hot wa al average	rgy requi N + 1.76 x ater usag <i>hot water</i>	irement: [1 - exp ge in litre usage by s	(-0.0003 es per da 5% if the d	349 x (TF ay Vd,av Iwelling is	FA -13.9 erage = designed i	)2)] + 0.( (25 x N) to achieve	0013 x ( <sup>-</sup> + 36 a water us	TFA -13. se target o	9) 2. 10.	kWh/ye 96 4.56	ear:	(42) (43)
4. Wa Assum if TF if TF Annua Reduce not more	ter heat and occu A > 13.9 $A \pm 13.9$ $A \pm 13.9$ I averag the annual of that 125	ing ener pancy, I 9, N = 1 9, N = 1 e hot wa l average litres per p	rgy requi N + 1.76 x ater usag hot water person per	irement: [1 - exp ge in litre usage by a r day (all w	(-0.0003 es per da 5% if the d rater use, l	349 x (TF ay Vd,av welling is hot and co	FA -13.9 erage = designed i ld)	)2)] + 0.( (25 x N) to achieve	0013 x (* + 36 a water us	TFA -13. se target o	9) 2. 9)	kWh/ye 96 4.56	ear:	(42) (43)
4. Wa Assum if TF if TF Annua <i>Reduce</i> not more	nter heat ned occu TA > 13.9 TA £ 13.9 I averag the annua the annua that 125	ing ener pancy, I 9, N = 1 9, N = 1 e hot wa l average litres per p Feb	rgy requi N + 1.76 x ater usag hot water person per Mar	irement: [1 - exp ge in litre usage by s r day (all w Apr	(-0.0003 es per da 5% if the o rater use, l May	349 x (TF ay Vd,av Iwelling is hot and co Jun	FA -13.9 erage = designed i Id) Jul	)2)] + 0.( (25 x N) to achieve Aug	0013 x ( <sup>-</sup> + 36 a water us Sep	TFA -13. se target o Oct	9) 10. 10. 10.	kWh/ye 96 4.56 Dec	ear:	(42) (43)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i>	ater heat and occu A > 13.9 A £ 13.9 I averag the annua the annua that 125 Jan Jan	ing ener pancy, I 2, N = 1 2, N = 1 e hot wa l average litres per p Feb n litres per	rgy requi N + 1.76 x hot water person per Mar day for ea	irement: [1 - exp ge in litre usage by a r day (all w Apr ach month	(-0.0003 es per da 5% if the d vater use, l May Vd,m = fa	349 x (TF ay Vd,av lwelling is hot and co Jun ctor from 2	FA -13.9 erage = designed i Id) Jul Table 1c x	)2)] + 0.0 (25 x N) to achieve Aug (43)	0013 x (* + 36 a water us Sep	TFA -13. se target o Oct	2. 9) 10- 7 Nov	kWh/ye 96 4.56 Dec	ear:	(42) (43)
4. Wa Assum if TF if TF Annua Reduce not more Hot wate (44)m=	ter heat and occu A > 13.9 $A \pm 13.9$ l averag the annua the annua that 125 Jan ar usage ir 115.02	ing energy pancy, I $\partial$ , N = 1 $\partial$ , N = 1 e hot wa al average litres per p Feb n litres per 110.83	rgy requi N + 1.76 x ater usag hot water berson per Mar day for ea 106.65	irement: [1 - exp ge in litre usage by a r day (all w Apr ach month 102.47	(-0.0003 es per da 5% if the o rater use, l May Vd,m = fa 98.29	849 x (TF ay Vd,av Iwelling is hot and co Jun ctor from 1 94.11	FA -13.9 erage = designed i Id) Jul Table 1c x 94.11	)2)] + 0.( (25 x N) to achieve Aug (43) 98.29	0013 x ( <sup>-</sup> + 36 <i>a water us</i> Sep 102.47	TFA -13. se target o Oct 106.65	9) 10, Nov 110.83	kWh/ye 96 4.56 Dec 115.02	ear:	(42) (43)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> Hot wate (44)m=	ater heat hed occu A > 13.9 $A \pm 13.9$ I averag the annual the annual the that 125 Jan Jan in Jan 115.02	ing ener pancy, I 9, N = 1 9, N = 1 e hot wa al average litres per p Feb n litres per 110.83	rgy requi N + 1.76 x ater usag hot water berson per Mar Mar 106.65	irement: [1 - exp ge in litre usage by a r day (all w Apr ach month 102.47	(-0.0003 es per da 5% if the d sater use, l May Vd,m = fa 98.29	349 x (TF ay Vd,av Iwelling is hot and co Jun ctor from 1 94.11	FA -13.9 erage = designed i ld) Jul Table 1c x 94.11	)2)] + 0.0 (25 x N) to achieve Aug (43) 98.29	0013 x ( <sup>*</sup> + 36 <i>a water us</i> Sep 102.47	TFA -13. se target o Oct 106.65 Total = Su	9) 100 110.83 m(44)112 =	kWh/ye 96 4.56 Dec 115.02	ar: 1254.73	(42) (43)
4. Wa Assum if TF if TF Annua Reduce not more Hot wate (44)m= Energy	ter heat and occur A > 13.9 A £ 13.9 A £ 13.9 I averagthe annualthe annual the annual the annualthe annual the	ing ener pancy, I 9, N = 1 9, N = 1 e hot wa al average litres per p Feb n litres per 110.83 hot water	rgy requi N + 1.76 x ater usag hot water berson per Mar day for ea 106.65 used - cal	irement: [1 - exp ge in litre usage by a r day (all w Apr ach month 102.47	(-0.0003) es per da 5% if the o vater use, l May Vd,m = fa 98.29 onthly = 4.	349 x (TF ay Vd,av Iwelling is hot and co Jun ctor from 7 94.11 190 x Vd,r	FA -13.9 erage = designed i ld) Jul Table 1c x 94.11 n x nm x E	)2)] + 0.0 (25 x N) to achieve Aug (43) 98.29 DTm / 3600	0013 x (* + 36 <i>a water us</i> Sep 102.47	TFA -13. se target o Oct 106.65 Total = Su oth (see Ta	2. 9) 100 100 100 100 100 100 100 100 100 10	kWh/ye 96 4.56 Dec 115.02 = c, 1d)	ear: 1254.73	(42) (43)
4. Wa Assum if TF if TF Annua <i>Reduce</i> not more (44)m= <i>Energy</i> (45)m=	ater heat hed occu A > 13.9 $A \pm 13.9$ I averag the annual the annual	ing ener pancy, I P, N = 1 P, N = 1 P, N = 1 P, N = 1 P P P P P P P P	rgy requi N + 1.76 x ater usag hot water berson per Mar 106.65 used - cal 153.94	irement: [1 - exp ge in litre usage by s r day (all w Apr ach month 102.47 culated mo	(-0.0003 es per da 5% if the d vater use, l May Vd,m = fa 98.29 onthly = 4.	349 x (TF ay Vd,av Iwelling is hot and co Jun ctor from 7 94.11 190 x Vd,r 111.12	FA -13.9 erage = designed i Id) Jul Table 1c x 94.11 n x nm x E 102.97	)2)] + 0.0 (25 x N) to achieve (43) 98.29 DTm / 3600 118.16	0013 x ( <sup>-</sup> + 36 <i>a water us</i> Sep 102.47 	TFA -13. se target o Oct 106.65 Total = Su oth (see Ta 139.35	2. 9) 10. 10. 110.83 m(44)112 ables 1b, 1 152.11	kWh/ye 96 4.56 Dec 115.02 = c, 1d) 165.19	ear: 1254.73	(42) (43)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> <i>Hot wate</i> (44)m= <i>Energy</i> (45)m=	ter heat and occur A > 13.9 A £ 13.9 I averag the annual the annual the annual the annual the annual the annual the annual the annual the annual the annual the annual the annual the annual the annual the annual the annual the annual the annual the	ing energy pancy, I P, N = 1 P, N =	rgy requi N + 1.76 x ater usag hot water berson per Mar day for ea 106.65 used - cal 153.94	irement: [1 - exp ge in litre usage by a r day (all w Apr ach month 102.47 culated mo	(-0.0003 5% if the a sater use, I May Vd,m = fa 98.29 onthly = 4.	349 x (TF ay Vd,av Iwelling is hot and co Jun ctor from 7 94.11 190 x Vd,r 111.12	FA -13.9 erage = designed a ld Jul Table 1c x 94.11 m x nm x E 102.97	)2)] + 0.0 (25 x N) to achieve Aug (43) 98.29 DTm / 3600 118.16	0013 x (* + 36 <i>a water us</i> Sep 102.47 	TFA -13. se target o Oct 106.65 Total = Su oth (see Ta 139.35 Total = Su	2. 9) 10. 10. 10. 10. 10. 10. 10. 10. 10. 10.	kWh/ye 96 4.56 Dec 115.02 = c, 1d) 165.19	ear: 1254.73 1645.15	(42) (43) (44) (45)
4. Wa Assum if TF if TF Annua <i>Reduce</i> not more (44)m= <i>Energy</i> (45)m= <i>If instan</i>	ater heat hed occu A > 13.9 $A \pm 13.9$ I averag the annual the annu	ing ener pancy, I P, N = 1 P, N = 1 e hot wa al average litres per p Feb n litres per 110.83 hot water 149.18	rgy requi N + 1.76 x ater usag hot water person per Mar 106.65 used - cal 153.94	irement: [1 - exp ge in litre usage by s r day (all w Apr ach month 102.47 foulated mo 134.21 t of use (no	(-0.0003) es per da 5% if the o vater use, l May Vd,m = fa 98.29 onthly = 4. 128.78	349 x (TF ay Vd,av Iwelling is hot and co Jun ctor from 7 94.11 190 x Vd,r 111.12	FA -13.9 erage = designed i Jul Table 1c x 94.11 n x nm x E 102.97 enter 0 in	)2)] + 0.0 (25 x N) to achieve (43) 98.29 07m / 3600 118.16 boxes (46	0013 x ( <sup>-</sup> + 36 a water us Sep 102.47 - 0 kWh/mor 119.57 	TFA -13. se target o Oct 106.65 Total = Su oth (see Ta 139.35 Total = Su	2. 9) 10. f Nov 110.83 m(44) <sub>112</sub> = ables 1b, 1 152.11 m(45) <sub>112</sub> =	kWh/ye 96 4.56 Dec 115.02 = c, 1d) 165.19 =	ear: 1254.73 1645.15	(42) (43) (44) (45)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> <i>Hot wate</i> (44)m= <i>Energy a</i> (45)m= <i>If instan</i> (46)m=	eter heat and occur A > 13.9 A £ 13.9 A £ 13.9 A £ 13.9 A £ 13.9 A £ 13.9 A E annual $a the annuala the annual(a the annual(a the annual)(a the annual)($	ing energy pancy, I P, N = 1 P, N =	rgy requi N + 1.76 x ater usag hot water berson per Mar day for ea 106.65 used - cal 153.94 ng at point 23.09	irement: [1 - exp ge in litre usage by a r day (all w Apr ach month 102.47 iculated mo 134.21	(-0.0003) es per da 5% if the d vater use, l May Vd,m = fa 98.29 onthly = 4. 128.78 o hot water 19.32	349 x (TF ay Vd,av Iwelling is hot and co Jun ctor from 7 94.11 190 x Vd,r 111.12 r storage), 16.67	FA -13.9 erage = designed i ld) Jul Table 1c x 94.11 $n \times nm \times E$ 102.97 enter 0 in 15.45	)2)] + 0.0 (25 x N) to achieve (43) 98.29 07m / 3600 118.16 boxes (46 17.72	0013 x (* + 36 a water us Sep 102.47 / / / / / / / / / / / / / / / / / / /	TFA -13.         se target o         Oct         106.65         Total = Su         139.35         Total = Su         20.9	2.9) 100 110.83 m(44) <sub>112</sub> = ables 1b, 1 152.11 m(45) <sub>112</sub> = 22.82	kWh/ye 96 4.56 Dec 115.02 c, 1d) 165.19 = 24.78	ear: 1254.73 1645.15	(42) (43) (44) (45) (46)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> (44)m= <i>Energy o</i> (45)m= <i>If instan</i> (46)m= Water	ater heat hed occu A > 13.9 $A \pm 13.9$ I averag the annual the annual that 125 Jan 115.02 content of 170.57 taneous w 25.59 storage	ing energy pancy, I P, N = 1 P, N = 1 P, N = 1 P hot ware <i>litres per p</i> Feb <i>n litres per</i> 110.83 <i>hot water</i> 149.18 <i>ater heatil</i> 22.38 IOSS:	rgy requi N + 1.76 x ater usag hot water berson per Mar 106.65 used - cal 153.94 ng at point 23.09	irement: [1 - exp ge in litre usage by s r day (all w Apr ach month 102.47 culated mo 134.21 t of use (no 20.13	(-0.0003) es per da 5% if the o vater use, l May Vd,m = fa 98.29 onthly = 4. 128.78 o hot water 19.32	349 x (TF ay Vd,av <i>lwelling is</i> <i>hot and co</i> Jun <i>ctor from</i> 94.11 190 x Vd,r 111.12 r storage), 16.67	FA -13.9 erage = designed i ld) Jul Table 1c x 94.11 $n \times nm \times D$ 102.97 enter 0 in 15.45	)2)] + 0.0 (25 x N) to achieve (43) 98.29 07m / 3600 118.16 boxes (46 17.72	0013 x ( + 36 a water us Sep 102.47 	TFA -13.         se target o         Oct         106.65         Total = Su         139.35         Total = Su         20.9	2.9) 10. 10. 10. 10. 10. 10. 10. 10.	kWh/ye 96 4.56 Dec 115.02 = c, 1d) 165.19 = 24.78	ear: 1254.73 1645.15	(42) (43) (44) (45) (46)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> (44)m= <i>Lenergy a</i> (45)m= <i>If instan</i> (46)m= Water Storag	ater heat hed occu A > 13.9 $A \pm 13.9$ $A \pm 13.$	ing energy pancy, I P, N = 1 P, N = 1 P, N = 1 P, N = 1 P P P P P P P P	rgy requi N + 1.76 x ater usag hot water berson per Mar day for ea 106.65 used - cal 153.94 ng at point 23.09	irement: [1 - exp ge in litre usage by a r day (all w Apr ach month 102.47 culated month 102.47 culated month culated month culat	(-0.0003) es per da 5% if the d sater use, l May Vd,m = fa 98.29 onthly = 4. 128.78 o hot water 19.32 olar or W	349 x (TF ay Vd,av lwelling is hot and co Jun ctor from 1 94.11 190 x Vd,r 111.12 r storage), 16.67 /WHRS	FA -13.9 erage = designed i ld) Jul Table 1c x 94.11 $n \times nm \times D$ 102.97 enter 0 in 15.45 storage	)2)] + 0.0 (25 x N) to achieve Aug (43) 98.29 DTm / 3600 118.16 boxes (46) 17.72 within sa	0013 x (* + 36 a water us Sep 102.47 102.47 119.57 ) to (61) 17.94 ame vest	<pre>TFA -13. se target o     Oct     106.65 Total = Su     th (see Tai     139.35 Total = Su     20.9 sel</pre>	2.9) 100 110.83 m(44)112 ables 1b, 1 152.11 m(45)112 22.82	kWh/ye 96 4.56 Dec 115.02 c, 1d) 165.19 = 24.78	er: 1254.73 1645.15	(42) (43) (44) (44) (45) (46) (47)
4. Wa Assum if TF if TF Annua Reduce not more (44)m= (44)m= (45)m= If instan (46)m= Water Storag If comu	hter heat hed occu A > 13.9 $A \pm 13.9$ $A \pm 13.$	ing energy pancy, I P, N = 1 P, N = 1 P, N = 1 e hot ware <i>litres per p</i> Feb <i>n litres per</i> 110.83 <i>hot water</i> 149.18 <i>rater heatin</i> 22.38 Ioss: e (litres) e ating a	rgy requi	irement: [1 - exp ge in litre usage by ser- r day (all w Apr ach month 102.47 culated mod 134.21 column (not column (not) and any second and in dward	(-0.0003) es per da 5% if the o vater use, l May Vd,m = fa 98.29 onthly = 4. 128.78 o hot water 19.32 olar or W velling, e	349 x (TF ay Vd,av <i>twelling is</i> <i>hot and co</i> Jun <i>ctor from</i> 94.11 190 x Vd,r 111.12 <i>r storage),</i> 16.67 /WHRS inter 110	FA -13.9 erage = designed i Id Jul Table 1c x 94.11 n x nm x D 102.97 enter 0 in 15.45 storage 0 litres in	)2)] + 0.0 (25 x N) to achieve Aug (43) 98.29 DTm / 3600 118.16 boxes (46) 17.72 within sa (47)	0013 x ( + 36 a water us Sep 102.47 119.57 b kWh/mor 119.57 ) to (61) 17.94 ame vest	TFA -13. se target o Oct 106.65 Total = Su 139.35 Total = Su 20.9 sel	2. 9) 10. 10. 10. 10. 10. 10. 110.83 m(44) <sub>112</sub> = ables 1b, 1 152.11 m(45) <sub>112</sub> = 22.82	kWh/ye 96 4.56 Dec 115.02 c, 1d) 165.19 24.78	ear: 1254.73 1645.15	(42) (43) (44) (44) (45) (46) (47)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> (44)m= (44)m= (45)m= <i>If instan</i> (46)m= Water Storag If comi Otherv	ater heat hed occu A > 13.9 $A \pm 13.9$ $A \pm 13.$	ing energy pancy, I P, N = 1 P, N = 1 P, N = 1 P, N = 1 P P P P P P P P	rgy requi N + 1.76 x ater usag hot water berson per Mar 106.65 used - cal 153.94 ng at point 23.09 includir and no ta hot wate	irement: [1 - exp ge in litre usage by 3 r day (all w Apr ach month 102.47 foulated mod 134.21 r of use (not 20.13 ing any so ank in dw er (this in	(-0.0003 es per da 5% if the of vater use, l May Vd,m = fa 98.29 onthly = 4. 128.78 o hot water 19.32 olar or W velling, e ocludes i	349 x (TF ay Vd,av Iwelling is hot and co Jun ctor from 1 94.11 190 x Vd,r 111.12 r storage), 16.67 /WHRS enter 110 nstantar	FA -13.9 erage = designed i Jul Table 1c x 94.11 n x nm x E 102.97 enter 0 in 15.45 storage litres in neous co	)2)] + 0.0 (25 x N) to achieve (43) 98.29 07m / 3600 118.16 boxes (46) 17.72 within sa (47) ombi boil	0013 x (* + 36 a water us Sep 102.47 102.47 119.57 ) to (61) 17.94 ame ves ame ves	TFA -13. se target o Oct 106.65 Total = Su 139.35 Total = Su 20.9 Sel er '0' in (	2.9) 10.7 Nov 110.83 m(44)112 = ables 1b, 1 152.11 m(45)112 = 22.82 22.82 47)	kWh/ye         96         4.56         Dec         115.02         =         c, 1d)         165.19         =         24.78         150	er: 1254.73 1645.15	(42) (43) (44) (44) (45) (46) (47)
4. Wa Assum if TF if TF Annua Reduce not more (44)m= (44)m= (45)m= If instan (46)m= Water Storag If comi Otherv Water a) If m	hter heat hed occu A > 13.9 $A \pm 13.9$ $A \pm 13.9$ $A \pm 13.9$ I averag the annual the tanna the annual	ing energy pancy, I P, N = 1 P, N = 1 e hot was litres per p Feb n litres per 110.83 hot water 149.18 vater heatin 22.38 loss: e (litres) eating a p stored loss: urer's de	rgy requi	irement: [1 - exp ge in litre usage by ser r day (all w Apr ach month 102.47 culated mod 134.21 f of use (not 20.13 ing any sec ank in dw er (this in oss factor	(-0.0003) es per da 5% if the o vater use, l May Vd,m = fa 98.29 onthly = 4. 128.78 o hot water 19.32 olar or W velling, e ocludes i	349 x (TF ay Vd,av Iwelling is hot and co Jun ctor from 7 94.11 190 x Vd,r 111.12 r storage), 16.67 /WHRS inter 110 nstantar	FA -13.9 erage = designed inId) Jul Table 1c x 94.11 n x nm x E 102.97 enter 0 in 15.45 storage titres in neous co n/dav).	)2)] + 0.0 (25 x N) to achieve Aug (43) 98.29 07m / 3600 118.16 boxes (46 17.72 within sa (47) ombi boil	0013 x ( + 36 <i>a water us</i> Sep 102.47 102.47 119.57 <i>kWh/mor</i> 119.57 <i>ito</i> (61) 17.94 ame vess ers) ente	TFA -13. se target o Oct 106.65 Total = Su 139.35 Total = Su 20.9 Sel er '0' in (	2. 9) 10. 10. 10. 10. 10. 110. 110. 110. 110	kWh/ye 96 4.56 Dec 115.02 c, 1d) 165.19 24.78 150	ear: 1254.73 1645.15	(42) (43) (44) (44) (45) (46) (47)
4. Wa Assum if TF if TF Annua <i>Reduce</i> <i>not more</i> (44)m= (44)m= <i>If instan</i> (46)m= Water Storag If comi Otherv Water a) If m	ater heat hed occu A > 13.9 $A \pm 13.9$ $A \pm 13.$	ing energy pancy, I P, N = 1 P, N = 1 P, N = 1 P, N = 1 P P P P P P P P	rgy requi	irement: [1 - exp ge in litre usage by s r day (all w Apr ach month 102.47 culated mo 134.21 r of use (no 20.13 ng any so ank in dw er (this in oss facto 2b	(-0.0003 es per da 5% if the of rater use, I May Vd,m = fa 98.29 onthly = 4. 128.78 o hot water 19.32 olar or W yelling, e ocludes i or is kno	349 x (TF ay Vd,av Iwelling is hot and co Jun ctor from 7 94.11 190 x Vd,r 111.12 r storage), 16.67 /WHRS onter 110 nstantar wn (kWł	FA -13.9 erage = designed i Jul Table 1c x 94.11 n x nm x E 102.97 enter 0 in 15.45 storage litres in neous co n/day):	)2)] + 0.0 (25 x N) to achieve (43) 98.29 07m / 3600 118.16 boxes (46 17.72 within sa (47) ombi boil	20013 x ( + 36 a water us Sep 102.47 102.47 119.57 (119.57 ) to (61) 17.94 ame vess ers) ente	TFA -13. se target o Oct 106.65 Total = Su 139.35 Total = Su 20.9 sel er '0' in (	2.9) 10.7 10.7 Nov 110.83 m(44)112 = ables 1b, 1 152.11 m(45)112 = 22.82 22.82 47)	kWh/ye         96         4.56         Dec         115.02         c, 1d)         165.19         24.78         150         11         54	ear: 1254.73 1645.15	(42) (43) (44) (44) (45) (46) (47) (48) (48)

Energy lost from water storage, kWh/year b) If manufacturer's declared cylinder loss factor is not know Hot water storage loss factor from Table 2 (kWh/litre/day) If community heating see section 4.3 Volume factor from Table 2a								(48) x (49	) =		1.	0		(50) (51)
Tempe	e lactor erature fa	actor fro	on Table	2b								0		(52)
Energy	/ lost fro	m watei	r storage	, kWh/ye	ear			(47) x (51	) x (52) x (	53) =		0		(54)
Enter	(50) or (	(54) in (5	55)								1.	.14		(55)
Water	storage	loss cal	culated f	or each	month			((56)m = (	55) × (41)	m				
(56)m=	35.37	31.94	35.37	34.23	35.37	34.23	35.37	35.37	34.23	35.37	34.23	35.37		(56)
If cylinde	er contains	s dedicate	d solar sto	rage, (57)ı	m = (56)m	x [(50) – (	[H11)] ÷ (5	0), else (5	7)m = (56)	m where (	H11) is fro	m Append	ix H	
(57)m=	35.37	31.94	35.37	34.23	35.37	34.23	35.37	35.37	34.23	35.37	34.23	35.37		(57)
Primar	y circuit	loss (ar	nnual) fro	om Table	e 3							0		(58)
Primar	y circuit	loss cal	culated f	for each	month (	59)m = (	(58) ÷ 36	65 × (41)	m					
(moo	dified by	factor f	rom Tab	le H5 if t	here is s	solar wat	ter heatii	ng and a	cylinde	r thermo	stat)		I	
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26		(59)
Combi	loss ca	culated	for each	month (	(61)m =	(60) ÷ 30	65 × (41)	)m	-		-			
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0		(61)
Total h	eat requ	uired for	water he	eating ca	alculated	for eac	h month	(62)m =	0.85 ×	(45)m +	(46)m +	(57)m +	(59)m + (61)m	
(62)m=	229.2	202.13	212.57	190.95	187.4	167.86	161.6	176.79	176.31	197.98	208.85	223.81		(62)
Solar DH	-IW input o	calculated	using App	endix G or	Appendix	H (negati	ve quantity	y) (enter 'C	' if no sola	r contribut	ion to wate	er heating)		
(add a	dditiona	l lines if	FGHRS	and/or V	WWHRS	applies	, see Ap	pendix (	G)					
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0		(63)
Output	from w	ater hea	ter											
(64)m=	229.2	202.13	212.57	190.95	187.4	167.86	161.6	176.79	176.31	197.98	208.85	223.81		-
								Out	out from w	ater heate	r (annual)₁	12	2335.46	(64)
Heat g	ains froi	m water	heating,	kWh/mo	onth 0.2	5 ´ [0.85	× (45)m	ı + (61)n	n] + 0.8 x	k [(46)m	+ (57)m	+ (59)m	]	
(65)m=	103.62	91.97	98.09	90.01	89.72	82.34	81.14	86.19	85.15	93.24	95.97	101.83		(65)
inclu	ıde (57)ı	m in cale	culation of	of (65)m	only if c	ylinder i	s in the o	dwelling	or hot w	ater is fr	om com	munity h	eating	
5. Int	ernal ga	ains (see	e Table 5	and 5a	):									
Metabo	olic gain	s (Table	e 5), Wat	ts										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(66)m=	148.13	148.13	148.13	148.13	148.13	148.13	148.13	148.13	148.13	148.13	148.13	148.13		(66)
Lightin	g gains	(calcula	ted in Ap	pendix	L, equat	ion L9 o	r L9a), a	lso see	Table 5					
(67)m=	30.45	27.04	21.99	16.65	12.45	10.51	11.35	14.76	19.81	25.15	29.36	31.3		(67)
Applia	nces gai	ins (calc	ulated in	Append	dix L, eq	uation L	13 or L1	3a), also	see Ta	ble 5				
(68)m=	341.55	345.09	336.16	317.15	293.15	270.59	255.52	251.98	260.91	279.92	303.92	326.48		(68)
Cookin	ng gains	(calcula	ated in A	opendix	L, equat	ion L15	or L15a)	), also se	e Table	5				
(69)m=	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81	37.81		(69)
Pumps	and far	ns gains	(Table 5	āa)	•	•			•		•			
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3		(70)
Losses	s e.g. ev	aporatio	on (negat	tive valu	es) (Tab	le 5)	-	-		-				
(71)m=	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5	-118.5		(71)

Water	heating	g gains (T	able 5)													
(72)m=	139.27	136.85	131.84	125.02	120.5	9 1	14.36	109.06	115	.85 118.2	26 1	25.32	133.29	136.86		(72)
Total	interna	I gains =					(66)	m + (67)m	n + (68	3)m + (69)m	n + (70	)m + (	71)m + (72)	m		
(73)m=	581.71	579.43	560.43	529.26	496.63	3 4	465.9	446.37	453	.02 469.4	42 5	500.83	537.01	565.08	]	(73)
6. Sc	olar gair	าร:														
Solar	gains are	calculated	using sola	r flux fron	n Table 6	a and	d assoc	iated equa	tions	to convert t	o the a	applica	able orientat	ion.		
Orient	ation:	Access F	actor	Area	a		Flu	X blo 6a		g_ Table (	6h	-	FF Table 6c		Gains	
						1			1	Table		r			(**)	
Northe	ast 0.9x	0.54	×	1.	72	×		1.28	X	0.63		×	0.7	=	4.16	(75)
Northe	ast 0.9x	0.54	×	2.	68	×		1.28	X	0.63		×	0.7	=	6.48	(75)
Northe	ast 0.9x	0.54	×	1.	72	×		2.97	X	0.63		×	0.7	=	8.47	(75)
Northe	ast 0.9x	0.54	×	2.	68	×	2	2.97	X	0.63		×	0.7	=	13.19	(75)
Northe	ast 0.9x	0.54	×	1.	72	×		1.38	X	0.63		×	0.7	=	15.25	(75)
Northe	ast 0.9x	0.54	×	2.	68	×		1.38	X	0.63		×	0.7	=	23.77	(75)
Northe	ast 0.9x	0.54	×	1.	72	×	6	67.96	X	0.63		×	0.7	=	25.05	(75)
Northe	ast 0.9x	0.54	×	2.	68	×	6	67.96	X	0.63		×	0.7	=	39.03	(75)
Northe	ast 0.9x	0.54	X	1.	72	×	9	1.35	X	0.63		×	0.7	=	33.67	(75)
Northe	ast 0.9x	0.54	x	2.	68	×	9	1.35	X	0.63		×	0.7	=	52.47	(75)
Northe	ast 0.9x	0.54	X	1.	72	×		97.38	X	0.63		×	0.7	=	35.9	(75)
Northe	ast 0.9x	0.54	X	2.	68	×	6	97.38	X	0.63		×	0.7	=	55.94	(75)
Northe	ast 0.9x	0.54	x	1.	72	×		91.1	X	0.63		×	0.7	=	33.58	(75)
Northe	ast 0.9x	0.54	x	2.	68	×		91.1	X	0.63		×	0.7	=	52.33	(75)
Northe	ast 0.9x	0.54	x	1.	72	×	7	2.63	x	0.63		×	0.7	=	26.77	(75)
Northe	ast 0.9x	0.54	x	2.	68	×	7	2.63	x	0.63		×	0.7	=	41.72	(75)
Northe	ast 0.9x	0.54	x	1.	72	×	5	50.42	x	0.63		×	0.7	=	18.59	(75)
Northe	ast 0.9x	0.54	х	2.	68	×	5	50.42	x	0.63		×	0.7	=	28.96	(75)
Northe	ast 0.9x	0.54	x	1.	72	×	2	28.07	x	0.63		×	0.7	=	10.35	(75)
Northe	ast 0.9x	0.54	x	2.	68	×	2	28.07	x	0.63		×	0.7	=	16.12	(75)
Northe	ast 0.9x	0.54	X	1.	72	×		14.2	x	0.63		x	0.7	=	5.23	(75)
Northe	ast 0.9x	0.54	X	2.	68	×		14.2	x	0.63		×	0.7	=	8.15	(75)
Northe	ast <mark>0.9x</mark>	0.54	X	1.	72	×		9.21	x	0.63		×	0.7	=	3.4	(75)
Northe	ast 0.9x	0.54	x	2.	68	×		9.21	x	0.63		×	0.7	=	5.29	(75)
Southe	east <mark>0.9</mark> x	0.54	x	0.	75	×	3	86.79	x	0.63		x [	0.7	=	11.83	(77)
Southe	east <mark>0.9</mark> x	0.77	x	1.	72	×	3	86.79	x	0.63		x	0.7	=	19.34	(77)
Southe	east <mark>0.9</mark> x	0.77	x	0.	88	×	3	86.79	x	0.63		x	0.7	=	19.79	(77)
Southe	east <mark>0.9x</mark>	0.77	x	2.	36	x	3	86.79	×	0.63		×	0.7	=	26.54	(77)
Southe	east <mark>0.9x</mark>	0.54	x	0.	75	x	6	62.67	x	0.63		×	0.7	=	20.15	(77)
Southe	east <mark>0.9x</mark>	0.77	x	1.	72	x	6	62.67	x	0.63		×	0.7	=	32.94	(77)
Southe	east <mark>0.9x</mark>	0.77	X	0.	88	x	6	62.67	x	0.63		×	0.7	=	33.71	(77)
Southe	east <mark>0.9x</mark>	0.77	x	2.	36	x	6	62.67	x	0.63		×	0.7	=	45.2	(77)

Southeast 0.9x	0.54	x	0.75	x	85.75	x	0.63	x	0.7	=	27.57	(77)
Southeast 0.9x	0.77	×	1.72	×	85.75	×	0.63	x	0.7	i =	45.08	(77)
Southeast 0.9x	0.77	x	0.88	x	85.75	x	0.63	x	0.7	=	46.12	(77)
Southeast 0.9x	0.77	x	2.36	×	85.75	×	0.63	x	0.7	] =	61.85	(77)
Southeast 0.9x	0.54	x	0.75	×	106.25	×	0.63	x	0.7	] =	34.16	(77)
Southeast 0.9x	0.77	x	1.72	x	106.25	×	0.63	x	0.7	] =	55.85	(77)
Southeast 0.9x	0.77	x	0.88	x	106.25	x	0.63	x	0.7	=	57.15	(77)
Southeast 0.9x	0.77	x	2.36	x	106.25	x	0.63	x	0.7	=	76.63	(77)
Southeast 0.9x	0.54	x	0.75	×	119.01	x	0.63	x	0.7	] =	38.26	(77)
Southeast 0.9x	0.77	x	1.72	×	119.01	×	0.63	x	0.7	=	62.56	(77)
Southeast 0.9x	0.77	x	0.88	x	119.01	×	0.63	x	0.7	=	64.01	(77)
Southeast 0.9x	0.77	x	2.36	x	119.01	×	0.63	x	0.7	=	85.84	(77)
Southeast 0.9x	0.54	x	0.75	×	118.15	×	0.63	x	0.7	=	37.98	(77)
Southeast 0.9x	0.77	x	1.72	x	118.15	x	0.63	x	0.7	=	62.11	(77)
Southeast 0.9x	0.77	x	0.88	x	118.15	x	0.63	x	0.7	=	63.55	(77)
Southeast 0.9x	0.77	x	2.36	x	118.15	×	0.63	x	0.7	=	85.22	(77)
Southeast 0.9x	0.54	x	0.75	x	113.91	×	0.63	x	0.7	=	36.62	(77)
Southeast 0.9x	0.77	x	1.72	×	113.91	×	0.63	x	0.7	=	59.88	(77)
Southeast 0.9x	0.77	x	0.88	x	113.91	x	0.63	x	0.7	=	61.27	(77)
Southeast 0.9x	0.77	x	2.36	x	113.91	x	0.63	x	0.7	=	82.16	(77)
Southeast 0.9x	0.54	x	0.75	x	104.39	x	0.63	x	0.7	=	33.56	(77)
Southeast 0.9x	0.77	x	1.72	x	104.39	x	0.63	x	0.7	] =	54.87	(77)
Southeast 0.9x	0.77	x	0.88	x	104.39	×	0.63	x	0.7	=	56.15	(77)
Southeast 0.9x	0.77	x	2.36	x	104.39	x	0.63	x	0.7	=	75.29	(77)
Southeast 0.9x	0.54	x	0.75	×	92.85	×	0.63	x	0.7	=	29.85	(77)
Southeast 0.9x	0.77	x	1.72	x	92.85	x	0.63	x	0.7	=	48.81	(77)
Southeast 0.9x	0.77	x	0.88	x	92.85	x	0.63	x	0.7	=	49.94	(77)
Southeast 0.9x	0.77	x	2.36	x	92.85	x	0.63	x	0.7	=	66.97	(77)
Southeast 0.9x	0.54	x	0.75	x	69.27	x	0.63	x	0.7	=	22.27	(77)
Southeast 0.9x	0.77	x	1.72	x	69.27	x	0.63	x	0.7	=	36.41	(77)
Southeast 0.9x	0.77	x	0.88	x	69.27	x	0.63	x	0.7	=	37.26	(77)
Southeast 0.9x	0.77	x	2.36	x	69.27	x	0.63	x	0.7	=	49.96	(77)
Southeast 0.9x	0.54	x	0.75	x	44.07	x	0.63	x	0.7	] =	14.17	(77)
Southeast 0.9x	0.77	x	1.72	x	44.07	x	0.63	x	0.7	=	23.17	(77)
Southeast 0.9x	0.77	x	0.88	x	44.07	×	0.63	x	0.7	=	23.7	(77)
Southeast 0.9x	0.77	x	2.36	x	44.07	x	0.63	x	0.7	=	31.79	(77)
Southeast 0.9x	0.54	x	0.75	x	31.49	x	0.63	x	0.7	=	10.12	(77)
Southeast 0.9x	0.77	x	1.72	×	31.49	×	0.63	x	0.7	=	16.55	(77)
Southeast 0.9x	0.77	x	0.88	×	31.49	×	0.63	x	0.7	=	16.94	(77)
Southeast 0.9x	0.77	x	2.36	×	31.49	×	0.63	x	0.7	=	22.71	(77)
Northwest 0.9x	0.54	x	4.86	×	11.28	×	0.63	x	0.7	=	11.75	(81)

Northwest 0.9x	0.77	×	1.25	x	11.28	×	0.63	x	0.7	=	4.31	(81)
Northwest 0.9x	0.77	×	1.25	x	11.28	x	0.63	x	0.7	i =	4.31	(81)
Northwest 0.9x	0.54	x	4.86	x	22.97	x	0.63	x	0.7	<b>j</b> =	23.92	(81)
Northwest 0.9x	0.77	x	1.25	x	22.97	x	0.63	x	0.7	] =	8.77	(81)
Northwest 0.9x	0.77	x	1.25	x	22.97	_   x	0.63	x	0.7	=	8.77	(81)
Northwest 0.9x	0.54	x	4.86	x	41.38	x	0.63	x	0.7	=	43.1	(81)
Northwest 0.9x	0.77	x	1.25	x	41.38	x	0.63	x	0.7	] =	15.81	(81)
Northwest 0.9x	0.77	x	1.25	x	41.38	x	0.63	x	0.7	] =	15.81	(81)
Northwest 0.9x	0.54	x	4.86	x	67.96	x	0.63	x	0.7	] =	70.78	(81)
Northwest 0.9x	0.77	x	1.25	×	67.96	x	0.63	x	0.7	] =	25.96	(81)
Northwest 0.9x	0.77	x	1.25	x	67.96	x	0.63	x	0.7	=	25.96	(81)
Northwest 0.9x	0.54	x	4.86	x	91.35	x	0.63	x	0.7	=	95.15	(81)
Northwest 0.9x	0.77	x	1.25	x	91.35	x	0.63	x	0.7	] =	34.9	(81)
Northwest 0.9x	0.77	x	1.25	x	91.35	x	0.63	x	0.7	=	34.9	(81)
Northwest 0.9x	0.54	x	4.86	x	97.38	x	0.63	x	0.7	] =	101.44	(81)
Northwest 0.9x	0.77	x	1.25	x	97.38	<b>x</b>	0.63	x	0.7	] =	37.2	(81)
Northwest 0.9x	0.77	x	1.25	x	97.38	x	0.63	x	0.7	] =	37.2	(81)
Northwest 0.9x	0.54	x	4.86	x	91.1	x	0.63	x	0.7	] =	94.89	(81)
Northwest 0.9x	0.77	x	1.25	x	91.1	x	0.63	x	0.7	] =	34.8	(81)
Northwest 0.9x	0.77	x	1.25	x	91.1	x	0.63	x	0.7	=	34.8	(81)
Northwest 0.9x	0.54	×	4.86	x	72.63	x	0.63	x	0.7	=	75.65	(81)
Northwest 0.9x	0.77	x	1.25	x	72.63	x	0.63	x	0.7	<b>j</b> =	27.74	(81)
Northwest 0.9x	0.77	x	1.25	x	72.63	x	0.63	x	0.7	=	27.74	(81)
Northwest 0.9x	0.54	x	4.86	x	50.42	x	0.63	x	0.7	] =	52.52	(81)
Northwest 0.9x	0.77	x	1.25	x	50.42	x	0.63	x	0.7	] =	19.26	(81)
Northwest 0.9x	0.77	x	1.25	x	50.42	x	0.63	x	0.7	=	19.26	(81)
Northwest 0.9x	0.54	x	4.86	x	28.07	x	0.63	x	0.7	] =	29.24	(81)
Northwest 0.9x	0.77	x	1.25	x	28.07	<b>x</b>	0.63	x	0.7	] =	10.72	(81)
Northwest 0.9x	0.77	x	1.25	x	28.07	x	0.63	x	0.7	] =	10.72	(81)
Northwest 0.9x	0.54	x	4.86	x	14.2	x	0.63	x	0.7	] =	14.79	(81)
Northwest 0.9x	0.77	x	1.25	x	14.2	x	0.63	x	0.7	] =	5.42	(81)
Northwest 0.9x	0.77	x	1.25	x	14.2	x	0.63	x	0.7	] =	5.42	(81)
Northwest 0.9x	0.54	x	4.86	x	9.21	x	0.63	x	0.7	] =	9.6	(81)
Northwest 0.9x	0.77	x	1.25	x	9.21	<b>x</b>	0.63	x	0.7	] =	3.52	(81)
Northwest 0.9x	0.77	x	1.25	x	9.21	x	0.63	x	0.7	=	3.52	(81)
Rooflights 0.9x	1	x	20.81	x	26	X	0.63	x	0.7	=	214.72	(82)
Rooflights 0.9x	1	x	20.81	x	54	] x	0.63	x	0.7	=	445.96	(82)
Rooflights 0.9x	1	×	20.81	×	96	x	0.63	x	0.7	] =	792.82	(82)
Rooflights 0.9x	1	×	20.81	×	150	x	0.63	×	0.7	] =	1238.78	(82)
Rooflights 0.9x	1	x	20.81	x	192	x	0.63	x	0.7	=	1585.64	(82)
Rooflights 0.9x	1	x	20.81	x	200	x	0.63	x	0.7	] =	1651.71	(82)

Rooflig	hts <mark>0.9x</mark>	1	x	20.	81	x		189	x		0.63	x	0.7		= [	1560.86	(82)
Rooflig	hts 0.9x	1	x	20.	81	x		157	] x		0.63		0.7		= [	1296.59	(82)
Rooflig	hts 0.9x	1	x	20.	81	x		115	] x [		0.63	= .	0.7		= Ì	949.73	(82)
Rooflig	hts 0.9x	1	x	20.	81	x		66	] x		0.63	× [	0.7		= [	545.06	(82)
Rooflig	hts 0.9x	1	x	20.	81	x		33	İ x		0.63	⊾	0.7		= [	272.53	(82)
Rooflig	hts 0.9x	1	×	20.	81	x		21	] x		0.63	⊾ □ _ [	0.7	=	_ [	173.43	(82)
	L								J			เ			L		
Solar o	ains in	watts. ca	alculated	d for eac	h month	ì			(83)m	ı = Sı	um(74)m .	(82)m					
(83)m=	323.23	641.1	1087.17	1649.36	2087.39	21	68.24	2051.2	1716	6.09	1283.89	768.11	404.38	265.0	8		(83)
Total g	jains – i	nternal a	nd sola	r (84)m =	= (73)m	+ (	83)m	, watts					_!				
(84)m=	904.94	1220.53	1647.61	2178.62	2584.01	26	634.14	2497.57	2169	9.12	1753.31	1268.9	4 941.38	830.1	6		(84)
7. Me	an inter	nal temr	perature	(heating	seasor	י ר)		•	•	•			•	•			
Temp	erature	durina h	eating r	periods ir	n the livi	ina	area f	from Tal	ble 9.	. Th	1 (°C)				[	21	(85)
Utilis	ation fac	tor for a	ains for	living are	a h1 m	n (s	ee Ta	ble 9a)	010 0,	,	. ( 0)				l		
Canot	Jan	Feb	Mar	Apr	Mav	T	Jun			ua	Sen	Oct	Nov	De	c		
(86)m=	1	1	0.98	0.91	0.74		0.55	0.41	0.4	49 19	0.78	0.97	1	1	Ŭ		(86)
				l Linin an an					і 7 ін. т		. 0)						
			ature in	living ar			ow ste	ps 3 to 1	$\frac{1}{1}$		9C)	20.25	10.75	10.20			(87)
(07)11=	19.30	19.6	20.02	20.52	20.85	4	20.97	20.99	20.	99	20.86	20.35	19.75	19.32	2		(07)
Temp	erature	during h	eating p	periods in	n rest of	dw	elling	from Ta	able 9	9, Tł	n2 (°C)						
(88)m=	19.75	19.75	19.76	19.76	19.77	1	9.77	19.77	19.	77	19.77	19.77	19.76	19.76	6		(88)
Utilisa	ation fac	tor for g	ains for	rest of d	welling,	h2	,m (se	e Table	9a)								
(89)m=	1	0.99	0.97	0.87	0.68		0.45	0.3	0.3	36	0.69	0.96	1	1			(89)
Mean	interna	l temper	ature in	the rest	of dwell	ling	T2 (fe	ollow ste	eps 3	to 7	in Tabl	e 9c)					
(90)m=	17.58	17.94	18.54	19.24	19.63	T 1	9.75	19.77	19.	77	19.67	, 19.02	18.15	17.53	3		(90)
				1		-					f	LA = Liv	ing area ÷ (	4) =		0.24	(91)
Moon	intorna	ltompor	atura (fr	or the wh	olo dwa	allin	a) – fl	∧ <sub>∨</sub> ⊤1	<b>⊥ (1</b>	fl	۸) v T2				L		
(92)m=	18	18.33	18.88	19.54	19.92		9) – 11 20.04	20.06	20.	06	19.95	19.33	18.53	17.9	5		(92)
Apply	adiustr	nent to t	he meai	1 interna		ratu	ure fro	m Table	4e	<u> </u>	re appro	opriate					
(93)m=	18	18.33	18.88	19.54	19.92	2	20.04	20.06	20.	06	19.95	19.33	18.53	17.9	5		(93)
8. Sp	ace hea	ting requ	uiremen	t	I	1			1					1			
Set T	i to the i	mean int	ernal te	mperatu	re obtai	ned	l at ste	ep 11 of	Tabl	e 9b	o, so tha	t Ti,m=	:(76)m an	d re-c	alc	ulate	
the ut	ilisation	factor fo	or gains	using Ta	ble 9a			r									
	Jan	Feb	Mar	Apr	May		Jun	Jul	A	ug	Sep	Oct	Nov	De	с		
Utilisa	ation fac	tor for g	ains, hn r	ר: ד		_											()
(94)m=		0.99	0.96	0.87	0.68		0.48	0.32	0.3	39	0.71	0.95	0.99	1			(94)
Usefu	il gains,	hmGm	, W = (9	4)m x (8-	4)m		50.00		1 054	1	4007.40	4005.0			_ ]		(05)
(95)m=	902.31	1208.57	1585.97	1888.77	1/68.05	12	253.33	811.34	851	.57	1237.43	1205.0	/ 934.99	828.4	1		(95)
	aver					abl	е ठ 14 6	16.6	16		1/1	10.6	7 1	10			(96)
Heat	loss rate	$\int_{-\frac{4}{3}}^{\frac{4}{3}}$	an interr				۰ <del>۹</del> .0	-[(30)m	v [/0	<u>-</u> 3)w	- (06)m	1		4.2			(00)
(97)m=	3293 93	3223 33	2967.92	2530 13	1951 64		, vv = 283.03	815.64	861	.05 I	1383.35	2073.5	6 2721 8	3284	18		(97)
Space	e heatin	a require	ement fo	r each n	nonth k	Wh	/mont	h = 0.02	1 <u> </u>	(97)	m – (95	)ml x (/	41)m				~ /
(98)m=	1779.36	1353.92	1028.17	461.78	136.59	T	0	0			0	646.16	1286.51	1827.0	05		
	L	I	I	1	1				1					I			

														_
								Tota	l per year	(kWh/year	r) = Sum(98	8)15,912 =	8519.54	(98)
Space	e heatin	g require	ement in	kWh/m²	²/year								50.11	(99)
9a. En	ergy rec	quiremer	nts – Ind	ividual h	eating sy	ystems i	ncluding	micro-C	HP)					
Spac	e heatii	ng:			, .									
Fracti	on of sp	bace hea	it from s	econdar	y/supple	mentary	system	(000) 4	(204)				0	(201)
Fracti	on of sp	bace hea	it from m	nain syst	em(s)			(202) = 1 -	- (201) =	(222)]			1	(202)
Fracti	on of to	tal heatii	ng from	main sys	stem 1			(204) = (20	02) × [1 –	(203)] =			1	(204)
Efficie	ency of I	main spa	ace heat	ing syste	em 1								93.5	(206)
Efficie	ency of s	seconda	ry/suppl	ementar	y heating	g system	ı, %						0	(208)
_	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/yea	ar
Space	e heatin	g require	ement (c		d above)	)			0	0.40.40	4000 54	4007.05		
()	1779.36	1353.92	1028.17	461.78	136.59	0	0	0	0	646.16	1286.51	1827.05	I	
(211)m	$1 = \{[(98)]$	)m x (20	4)] } x 1	$100 \div (20)$	)6) 146.00	0	0	0	0	601.08	4075.04	1054.07		(211)
	1903.06	1448.05	1099.65	493.88	146.09	0	0	U Tota	U L (kWh/ve	$r_{\rm sum}(2)$	1375.94	1954.07	0111 01	7(211)
Snoo	- hootin	a fuel (e	aaandar		month			Tota	i (ittili yot		- ' '/15,1012		9111.01	
Space = {[(98	e neatin )m x (2(	g iuei (s )1)] } x 1	econdar 00 ÷ (20	у), күүп/ )8)	month									
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
				1				Tota	l (kWh/yea	ar) =Sum(2	215) <sub>15,1012</sub>	=	0	(215)
Water	heating	)												-
Output	from w	ater hea	ter (calc	ulated a	bove)		1						1	
	229.2	202.13	212.57	190.95	187.4	167.86	161.6	176.79	176.31	197.98	208.85	223.81		
Efficier	ncy of w	ater hea		07.00			70.0		70.0	07.74		00.40	79.8	(216)
(217)m=	89.14	88.95	88.47	87.08	83.99	79.8	79.8	79.8	79.8	87.74	88.84	89.19	I	(217)
ruei to (219)m	or water n = (64)	m x 100	кууп/m ) ÷ (217)	ontn )m										
(219)m=	257.13	227.24	240.28	219.27	223.14	210.35	202.51	221.54	220.94	225.64	235.1	250.93		
		-					-	Tota	I = Sum(2	19a) <sub>112</sub> =			2734.07	(219)
Annua	l totals									k	Wh/year		kWh/year	-
Space	heating	fuel use	ed, main	system	1								9111.81	_
Water	heating	fuel use	d										2734.07	
Electric	city for p	oumps, fa	ans and	electric	keep-ho	t								
centra	al heatir	ng pump:										30		(230c)
boiler	with a f	an-assis	ted flue									45		(230e)
Total e	lectricit	y for the	above, l	kWh/yea	r			sum	of (230a).	(230g) =			75	(231)
Electric	city for l	ighting											537.75	(232)
12a. (	CO2 em	issions -	– Individ	ual heat	ing syste	ems inclu	uding mi	cro-CHP	)					_
						Г	0.000			Emiac	ion foo	-	Emissions	
						En kW	/h/year			kg CO	2/kWh		kg CO2/yea	ır
Space	heating	(main s	ystem 1	)		(21	1) x			0.2	16	=	1968.15	(261)

Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	590.56	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2558.71	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	279.09	(268)
Total CO2, kg/year	sum	of (265)(271) =		2876.72	(272)

TER =

16.92 (273)