# 10-22 CANFIELD PLACE

ENERGY STATEMENT

FEBRUARY 2017



# 10-22 CANFIELD PLACE ENERGY STATEMENT

Imperial Resources SA

### Final Issue

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# **EXECUTIVE SUMMARY**

WSP | Parsons Brinkerhoff were commissioned by Imperial Resources S.A. to provide an Energy Strategy to support the proposed Canfield Place redevelopment in Camden. This Energy Strategy will be submitted as part of a suite of documents making the planning application pack.

Canfield Place is a new residential mews development located between Finchley Road Tube Station to the north and the Chiltern Railway tracks to the south. It involves demolition of 16 single storey garages and redevelopment of the site to provide 8 mews type residential dwellings (C3) comprising 3 x two storey properties and 5 x three storey properties with associated roof terraces.

#### 1.1 **ENERGY AND CARBON TARGETS**

Multiple layers of energy and carbon requirements apply to the development at a national, regional, and local level; each of which requiring different targets to be met. This strategy aims to address how these requirements can be met.

The relevant targets can be summarised as follows:

- All development must meet the prevailing Building Regulations requirements. The development will be brought forward under Part L 2013 and this has been used as the basis of this energy strategy.
- → In line with the London Plan, Camden Borough Council requires new developments to achieve a 35% reduction in carbon emissions compared to the minimum requirements of Part L 2013.
- $\rightarrow$  There is no Code for Sustainable Homes requirement, instead the project is aspiring to achieve 3 stars under the Building Research Establishments Home Quality Mark.
- → London Borough of Camden (LBC) requires that developments target a 20% reduction in carbon emissions through the use of low and zero carbon technologies.

#### 1.2 **ENERGY STRATEGY**

In accordance with best practice, this energy statement follows the principles of the energy hierarchy: Be Lean, Be Clean, Be Green.

The proposals for the scheme have been developed in accordance with the desire to provide homes of good environmental performance and will incorporate the following features:

- → Building fabric which will significantly exceed the minimum fabric requirements of Part L1A (2013) of the Building Regulations
- → 100% low energy lighting
- → Mechanical ventilation with heat recovery (MVHR) systems for ventilation
- Air source heat pump to provide heating and hot water in line with the requirements of Core Strategy Policy CS13

### RESULTS

1.3

Accredited Design SAP 2012 software was used to determine the regulated and non-regulated carbon emissions and fabric efficiency standards for a representative sample of 4 of the homes.

The results were then extrapolated across the whole development to project the total baseline carbon emissions, the carbon emissions after the application of energy efficiency measures, and the carbon emissions after the application of low and zero carbon technologies.

The results, summarised in Table 1-1, show compliance with Camden and the GLA's target of 35% carbon emissions reduction over Part L (2013) of the Building Regulations.

#### Table 1-1 **Carbon Emission Reductions**

	REGULATED EMISSIONS (TCO <sub>2</sub> )	UNREGULATED EMISSIONS (T CO <sub>2</sub> )	% REDUCTION IN REGULATED EMISSIONS
Part L Compliant Development	13.40	6.57	0.00%
After energy demand reduction	10.11	6.57	24.57%
After energy efficient supply	10.11	6.57	24.57%
After renewable energy	8.56	6.57	35.44%

# 2 **PROJECT BACKGROUND**

#### 2.1 **DEVELOPMENT DESCRIPTION**

Canfield Place, London NW6, is a mews development located between the Finchley Road tube station to the north and national rail tracks to south in the London Borough of Camden. The site is presently occupied by 16 single storeys lock-up garages with access provided from Canfield Gardens to the east.

The proposal would demolish the garages and replace them with a new development of 8 independent mews houses. There are 4 house types with 3 houses being two storeys high and 5 houses being three storeys high. All units are predominantly north facing.

For further details see the Design and Access Statement.



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# **POLICY CONTEXT**

LBC's approach to sustainable development is underpinned by policies from the London Plan, Camden's Core Strategy and LBC's draft Local Plan and Supplementary Planning Guidance documents.

#### THE LONDON PLAN 3.1

The Mayor of London published the London Plan in July 2011 with amendments in 2013, 2015, and 2016. Key policies underpinning London's approach to sustainable development include:

- → Policy 5.1 Climate Change Mitigation
- → Policy 5.2 Minimising Carbon Dioxide Emissions
- → Policy 5.3 Sustainable Design and Construction
- → Policy 5.5 Decentralised Energy Networks
- → Policy 5.6 Decentralised Energy in Development Proposals
- → Policy 5.7 Renewable Energy
- → Policy 5.9 Overheating and cooling

The Mayor's London Plan sets out policy in the London context and identifies a number of objectives to improve the City as a place to work and live. Policy 5.2 sets out the requirements to minimise CO<sub>2</sub> emissions through the application of the energy hierarchy which is split into three distinct stages:

- 1. Be lean: use less energy
- 2. Be clean: supply energy efficiently
- 3. Be green: use renewable energy

London Plan policy requires dwellings to achieve a 35% carbon emissions reduction over Part L (2013) of the Building Regulations.

The London Plan requires an assessment of energy demand that demonstrates the steps taken to apply the Mayor's energy hierarchy. The London Plan includes planning policies both for reducing energy consumption within buildings and the use of renewable energy. These policies cover the role of the boroughs in supporting the Mayor's energy strategy and the requirements of planning applications.

### POLICY 5.2

From October 2016 major residential development are required to achieve zero carbon, with at least 35% reduction achieved through on-site measures. The remaining regulated carbon emissions (up to 100%) are to be offset through a payment in lieu contribution.

Whilst usually a major development is deemed to be 10 units or above, Camden have confirmed their intent to charge £90 per tonne of Carbon offset for Canfield Place, which equates to £2,700 per tonne of CO<sub>2</sub> spread over a 30 year period, however the policy's application to this development is to be confirmed.

### LBC'S CORE STRATEGY. DRAFT LOCAL PLAN AND SUSTAINABILITY SPG

The LBC Core Strategy was adopted in November 2010 and sets out key elements of Camden's vision for the borough and is a central part of the Local Development Framework which includes a group of documents setting out planning strategy and policies. The Core Strategy plays a key part in shaping the kind of place Camden will be in the future, balancing the needs of residents, businesses and future generations between 2010 and 2025.

On 24<sup>th</sup> June 2016 the Council submitted the Camden Local Plan and supporting documents to the Secretary of State for Communities and Local Government for independent examination. When finalised the Local Plan will replace Camden's current Core Strategy and development Policies documents as the basis for planning decisions.

The Camden Planning Guidance 3 (CPG3) Sustainability document provides support for policies in the LDF and covers a range of topics such as how to achieve carbon emission reductions, and reaffirms the GLA's commitment to achieve a 35% carbon emission reduction against Part L 2013. This document is an additional 'material' consideration in planning decisions and outlines Camden's commitment to reducing carbon emissions in the borough.

3.3

3.2

### **BUILDING REGULATIONS (PART L)**

All new buildings constructed in the UK must meet the minimum requirements of the UK Building Regulations. Specifically with regard to energy and carbon compliance, all buildings must meet the building regulations Part L 'Target Emission Rate' (TER) requirements for the revision which is current at the time of construction works. The requirements of Part L 2013 will apply to Canfield Place. This includes the requirement for the dwellings to meet the new Target Fabric Energy Efficiency standards (TFEEs) introduced under Part L1A 2013.

# 4 BASELINE CO<sub>2</sub> EMISSIONS

The first stage of the energy assessment is to establish the baseline site energy demand and CO<sub>2</sub> emissions based on accredited SAP software.

NHER SAP software was used to establish the baseline regulated and unregulated carbon emissions for the development per annum.

Representative modelling has be undertaken on 4 dwellings, the results were then extrapolated to calculate the baseline carbon emissions and energy demand for the dwellings across the whole development.

Table 4-1The table below summarises these results.

 Table 4-1
 Baseline Regulated & Unregulated Carbon Emissions for the Proposed Development

	REGULATED EMISSIONS (TCO <sub>2</sub> )	UNREGULATED EMISSIONS (TCO <sub>2</sub> )
Building Regulations Part L 2013 Compliant Development	13.40	6.57



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# 5 BE LEAN: REDUCE ENERGY DEMAND

Once a representative baseline has been projected, the next step to achieving Building Regulations compliance and the targets outlined previously is to reduce energy demand. The measures associated with reducing demand can be termed as 'Energy Efficiency Measures'.

The Proposed Development intends to incorporate relevant energy conservation measures; the benefits of which are discussed below. In summary the following will be included:

- → Improved air tightness
- → High performance building fabric
- → High performance glazing
- → 100% low energy lighting
- → Whole house mechanical ventilation with heat recovery

### 5.1 **BUILDING FABRIC**

The building will be clad with in prefabricated brass panels fixed to traditional masonry or reinforced concrete walls. Alternatively prefabricated lightweight building units like Structural Insulated Panels will be used and also clad in brass.

At this stage it is anticipated that an overall U-value for the external walls will be 0.16W/m<sup>2</sup>K or better. For the purposes of this assessment the 1.6W/m<sup>2</sup>K value has been used, though solutions will be sought to reduce the U-value further where possible in order to realise further carbon reductions.

Glazing to the dwellings have been assumed to achieve a G-value of around 0.72. This is considered to provide an appropriate year round balance between maximising daylighting and beneficial wintertime solar gain, and minimising summertime solar gains to reduce the overheating risk.

The current proposals for the building fabric performance for Canfield Place are summarised in Table 5-1.

### 5.2 **BUILDING SERVICES**

Table 5-2 outlines the general approach to venting, lighting, and heating the Proposed Development.

### Table 5-1 Fabric Performance Targets

ELEMENT	FABRIC PERFORMANCE TARGET
External Walls overall U-value (W/m <sup>2</sup> K)	0.16
Party wall U-value (W/m <sup>2</sup> K)	0.00
Ground floor U-value (W/m <sup>2</sup> K)	0.11
Roof U-value (W/m <sup>2</sup> K)	0.11
Windows U-value (W/m <sup>2</sup> K)	1.2
Air permeability (m <sup>3</sup> /hr.m <sup>2</sup> @ 50 Pa)	3.00

## Table 5-2 General Heating, Ventilation and Lighting Specification

ELEMENT	GENERAL SPEC
Ventilation	Whole house mec (MVHR) units exp 0.61W/I/s with a h
Internal lighting	100% low energy.
Primary heat source	Gas fired boiler
Heating controls	Programmer, TRV
Heat emitters	Underfloor heating

5.3

### CARBON EMISSION REDUCTION

Based upon the energy efficiency measures outlined, the following total carbon emissions are calculated in Table 5-33. These carbon emissions for the development are shown to be lower than the minimum requirements of the Building Regulations.

This is achieved via the use of the energy efficiency measures proposed (including a highly efficient building fabric, 100% low energy lighting and whole house mechanical ventilation and heat recovery systems) which far exceed the minimum requirements of the Regulations.

Also, appropriate glazing percentages were used on the facade so that a good balance between favouring daylight levels and beneficial heat gains in winter and avoiding excessive heat gains in summer could be achieved.

### Table 5-3 Be Lean: Carbon Emissions after the Application of Energy Efficiency Measures

	REGULATED EMISSIONS (TCO <sub>2</sub> )	UNREGULATED EMISSIONS (TCO <sub>2</sub> )	REDUCTION IN REGULATED CARBON EMISSIONS
Building Regulations Part L 2013 Compliant Development	13.40	6.57	0.00%
After energy demand reduction	10.11	6.57	24.57%

### IFICATION

chanical ventilation with heat recovery ected to achieve a specific fan power of eat recovery efficiency of 88% or more.

/s, and bypass.

g (=<35°C)

## 5.4 PART L 2013 FABRIC ENERGY EFFICIENCY (FEE)

Accredited Design SAP2012 software was used to determine the FEE standards for the same sample of 4 typical dwellings. The results were then extrapolated across the whole development.

Results for the extrapolated target fabric energy efficiency (TFEE) and for the design building FEE are as follows:

### Table 5-3Fabric Energy by House

HOUSE	TARGET FEE (KWH M <sup>2</sup>	<b>DESIGN FEE (KWH M<sup>2</sup> IMPROVEMENT</b>
	YR)	YR)

	113	INJ	
HS-A2	43.80	32.30	26.30%
HS-B2	45.10	34.00	24.60%
HS-C1	43.50	31.60	27.40%
HS-D	50.20	38.30	23.70%



# 6 **BE CLEAN: SUPPLY ENERGY EFFICIENTLY**

After consumption has been reduced through the application of energy efficiency measures, the next step is to consider how low carbon technologies can provide further reduction in carbon dioxide emissions.

The following low carbon technologies have been investigated for the Proposed Development.

- → District heating network
- → Combined heat and power (CHP)

#### 6.1 **DISTRICT HEATING NETWORK**

The London Heat Map identifies existing and potential opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study. An excerpt from the London Heat Map (Figure 6-1) controlled to show the location of any existing and proposed district heating systems within the vicinity of the development. The location of the Canfield Place development is highlighted in red.

The map shows that there are no existing district heating networks in the vicinity of the development.



### Figure 6-1 Excerpt from the London Heat Map Showing Existing/Proposed DHNs

Camden's Core Strategy includes a map of existing and proposed combined heat and power networks (see Figure 6-2).

Figure 6-2 Combined Heat and Power Networks Camden



The Sustainability SPD also confirms that any proposed development falling within 500m or 1 km of an existing, emerging, or potential energy network, should undergo a connection feasibility study and possibly allow for future connections to be made. However as shown in Figure 6-3 the Proposed Development (highlighted by a red dot) falls outside of these boundaries.

### Figure 6-3 Location of Existing Districts Heat Networks



Taken together this information shows that there are no local viable existing heat networks available for Canfield Place.

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### 6.2 COMBINED HEAT AND POWER (CHP)

On the basis that the development cannot be supplied directly from a district heating network, in line with the requirements of Camden council, then CHP could be considered. If a centralised heat network for the 8 units was viable, then a CHP unit would have been a potential source of low carbon heat. However the combined properties do not have sufficient level of domestic water demand or consistency of space heating demand (as shown in the example graph below) to justify a central CHP led system. Therefore a CHP led system is not currently recommended for any of the buildings in the Proposed Development.

An additional issue is that proposed changes to SAP  $CO_2$  emission factors due to take force in 2017 suggest that CHP will increase  $CO_2$  emissions in comparison to gas fired boiler, and this is likely to be even more of an issue over the lifetime of such plant.

Figure 6-4 shows a typical annual hotel heating profile with the heat contribution from the CHP engines.





### 6.3 CARBON EMISSIONS REDUCTION

Due to the lack of justification for DHN or CHP the overall carbon emissions for the development remain at  $10.11 \text{ tCO}_2$  as shown in Table 6-1.

### Table 6-1 Be Clean: Carbon Emissions after the Provision of Energy Efficiency Supply Measures

	REGULATED EMISSIONS (TCO <sub>2</sub> )	UNREGULATED EMISSIONS (TCO <sub>2</sub> )	REDUCTION IN REGULATED CARBON EMISSIONS
Building Regulations Part L 2013 Compliant Development	13.40	6.57	0.00%
After energy demand reduction	10.11	6.57	24.57%
After energy efficient supply	10.11	6.57	24.57%

# **BE GREEN: RENEWABLE ENERGY TECHNOLOGIES**

The final step in the energy hierarchy is to consider how renewable energy technologies can be deployed to reduce carbon emissions of the Proposed Development. Renewable energy technologies are those listed below which can provide a source of energy on-site that is not primarily based on the consumption of fossil fuels or grid electricity and/or utilises a heat source that is renewable such as air, ground and solar systems.

- → Wind Power
- → Biomass Heating
- → Ground Source Heating and/or Cooling
- → Solar Thermal Hot Water Heating
- Photovoltaic Panels

In accordance with the requirements of Section 5.2 of the London Plan and Camden Core Strategy, we have evaluated a number of renewable energy technologies and outlined how they may be applied to the development.

#### 7.1 WIND POWER



Harnessing the kinetic energy of wind can provide a renewable source of on-site electricity generation. Wind turbines need to be positioned where a frequent and steady source of wind is available that is not too turbulent or uneven in direction. Typically wind turbines are positioned on the roof of buildings that are significantly higher than their surroundings and or located in open areas where there is minimum disruption to prevailing winds.

The development is located within an urban environment with numerous adjacent buildings of similar height providing turbulent wind conditions unsuitable for wind power generation.

Wind conditions prevent the implementation of wind power generation from being feasible. In addition, wind turbines are not considered to be appropriate in townscape and architectural terms to provide wind turbines on top of the building. On that basis they are not proposed for the Canfield Place development.

7.2

7.3

### **BIOMASS HEATING**



Biomass heating has embodied environmental impacts from transport quality from increased wood fuelled biomass use in London has been carried out by AEA Energy & Environment, and was published in

and fuel combustion which makes it less desirable in Air Quality Management Areas (AQMAs). A review of the potential impact on air December 2007. The assessment indicates that potentially increasing the contribution from small-scale wood fuelled biomass combustion may lead to a substantial increase in nitrogen dioxide and particulate matter concentrations. Further to this, solid biomass relies on a reliable fuel supply which must be delivered and stored on site. Sites using biomass solutions therefore require good access routes and space for fuel storage and plant, which could not feasibly be incorporated at Canfield Place. It also has relatively high maintenance requirements and fuel costs. This technology is therefore deemed to be unsuitable for the Proposed Development.

### **HEAT PUMPS**



Heat pumps use electricity to turn low grade heat to a higher temperature typically suitable for LTHW applications. They work most effectively when the source temperature (whether that is external air, the ground, or a large body of water) is at a relatively high temperature while the required output temperature is relatively low, i.e. between 35°C and 45°C. Some heat pumps can also be reversed to provide cooling.

arid.

Heat pumps are measured by their coefficient of performance (CoP); that is the ratio of input electricity to the output of heat. Air source heat pumps (ASHPs) generally operate between a CoP of 2.5 and 3, while a good ground or water source heat pump (GSHP / WSHP) may operate between 3.5 – 4.5. These CoPs vary considerably depending on the local source temperatures and the building heat distribution system. This technology operates most effectively when used to provide space heating via a very low temperature systems such as underfloor heating or low temperature radiators. If higher temperatures are required, the CoP reduces. As ground temperatures are stable year round, GSHPs provide a consistent level of performance throughout the year. Whereas the coefficient of performance of air source heat pumps is directly related to the air temperature. This means the CoP of an ASHP drops in the winter, when demand is greatest but rises in the summer when heating is not normally required. Ground source heating is an effective renewable energy source when used to provide space heating via low grade heating system such as underfloor heating. However a lack of adequate space and cost leads this not to be recommended for the Proposed Development. Air source heat pumps are easily located at various points, such as roof level, and are considered suitable for this development.

Heat pumps produce no emissions at point of use and so do not have an impact on air quality in the locality. Additionally their carbon emissions will reduce in line with the existing and expected decarbonisation of the national

#### 7.4 SOLAR HOT WATER



Solar hot water (SHW) generation involves capturing solar radiant heat to preheat or heat domestic hot water.

Correctly located and orientated, solar thermal systems can meet a proportion of a building's domestic hot water dependent on the expected demand profile and available space for locating SHW collectors.

SHW collectors do have an aesthetic impact and this may mitigate against their use, especially considering their likely location on the southern facade. On these grounds, whilst technically feasible, potentially suitable for this Scheme.

#### 7.5 **PHOTOVOLTAIC PANELS**

The feasibility of providing photovoltaic (PV) panels has been assessed based upon estimated energy production (kWh) from the installed location along with manufacturers cost data to enable a life cycle cost analysis to be undertaken. Panels correctly oriented, maintained and not obscured by shading can be expected to provide in the region of 120kWh/m<sup>2</sup>/year in London.

Due to the significant lack of south facing roof space, PV panels would need to be mounted vertically on the southern façade which would reduce their efficiency. It has been estimated that roughly 3m<sup>2</sup> of PV panels per dwelling house would be required to achieve a 35% carbon reduction against Part L (2013). Although this would have a material impact aesthetically and financially, PV technology is considered potentially appropriate for this development.



#### 7.7 **CARBON EMISSIONS REDUCTION**

All renewable energy technologies which may be considered feasible for the scheme have been assessed, the outcomes of which are summarised above. From that exercise, it was concluded that ASHPs, SHW collectors and PV panels could be suitable for inclusion in the proposals, with ASHPs being the preferred technology due to viability and buildability considerations. This result, using a candidate system (Dimplex A6M), has been reflected in table 7-2.

Camden's requirement to target a 20% reduction in CO<sub>2</sub> emissions from on-site renewable technologies for this project is not feasible due to the highly efficient fabric standards that were describe in stage 1 of the energy hierarchy.

### Table 7-2 Be Green: Carbon Emissions Utilising Air source heat pumps

	REGULATED EMISSIONS (T CO <sub>2</sub> )	UNREGULATED EMISSIONS (T CO <sub>2</sub> )	% REDUCTION IN REGULATED CO <sub>2</sub> EMISSIONS
Building Regulations Part L 2013 Compliant Development	13.40	6.57	0.0%
After energy demand reduction	10.11	6.57	24.57%
After energy efficient supply	10.11	6.57	24.57%
After renewable energy	8.65	6.57	35.44%

#### 7.6 SUITABILITY APPRAISAL

All renewable energy technologies which may be considered feasible for the scheme have been assessed and summarised in table 7-1.

### Table 7-1 Renewable technology suitability appraisal

TECHNOLOGY		APPRAISAL	
Wind		Not suitable at this site	
Biomass		Not suitable at this site	
Heat Pumps	Ground Source	Not suitable at this site	
	Air Source	Recommended at this site	
Solar Thermal		Potentially suitable at this site	
Photovoltaic Pa	anels	Potentially suitable at this site	

# 8 RESULTS

The three principal steps taken; Be Lean (Use Less Energy), Be Clean (Supply Energy Efficiently) and finally Be Green (Renewable Technology measures) are summarised below. The target (Building Regulations compliant) carbon emissions for the Proposed Development are calculated to be 13.40 tCO<sub>2</sub> per annum.

### 8.1 ENERGY CONSERVATION AND ENERGY EFFICIENCY (BE LEAN)

Through the application of the fabric efficiency measures identified in <u>Section 5</u> the regulated carbon emissions are shown projected to be 10.11 tCO<sub>2</sub> per annum.

### 8.2 SUPPLY ENERGY EFFICIENTLY (BE CLEAN)

The application of low carbon technologies such as connection to an existing local district heating network or the installation of a combined heat and power unit, has been explored and rejected. As such the overall regulated carbon emissions remains at  $10.11 \text{ tCO}_2$  per annum.

### 8.3 RENEWABLE TECHNOLOGY (BE GREEN)

Within Section 7 the feasibility of a range of renewable technologies has been assessed in the context of the London Plan. Air source heat pumps are proposed for each dwelling to provide a further reduction in overall carbon emissions. As a result the overall regulated carbon emissions are reduced to  $8.65 \text{ tCO}_2$  per annum. This represents a 35.44% reduction in CO<sub>2</sub> emissions against building regulations (2013) standards.

### Figure 8-1 Summary of the estimated carbon emissions reductions for the whole development



As discussed in section 3.1 LBC have confirmed that the GLA's Zero Carbon Homes tax will apply to Canfield Place. As such the remaining  $CO_2$  emissions other than those reduced on-site, are to be offset down to zero. Camden charge a static rate of £90 per tonne which equates to an approximate charge of c.£23,000, although this will be finalised once detailed design is complete and subject to further calculation methodology clarifications from LBC.

### 8.4

**LONDON PLAN – POLICY 5.2** 

APPENDIX A-1 SAP WORKSHEETS



# DER Worksheet Design - Draft



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

Assessor name	Mr Harry	Knibb					A	Assessor nur	nber	1		
Client							L	ast modified	d	23/02	/2017	
Address	Canfield P	lace 12 Ca	nfield Plac	e, Londor	า							
1. Overall dwelling dimen	nsions											
					Area (m²)		Ave ł	erage storey neight (m)	1	Vo	olume (m³)	
Lowest occupied					39.40	(1a) x		2.90	(2a) =		114.26	(3a)
+1					39.40	(1b) x		2.90	(2b) =		114.26	(3b)
+2					39.40	(1c) x		3.10	(2c) =		122.14	(3c)
Total floor area	(1a) -	+ (1b) + (1d	c) + (1d)(	1n) =	118.20	(4)						
Dwelling volume							(3;	a) + (3b) + (3	3c) + (3d)(3n	) =	350.66	(5)
2. Ventilation rate												
										m	<sup>3</sup> per hour	
Number of chimneys								0	x 40 =		0	(6a)
Number of open flues								0	x 20 =		0	(6b)
Number of intermittent far	าร							0	x 10 =		0	(7a)
Number of passive vents								0	x 10 =		0	(7b)
Number of flueless gas fire	S							0	x 40 =		0	(7c)
										Air	changes pe hour	r
Infiltration due to chimney	s, flues, fans	, PSVs		(6	a) + (6b) + (7	a) + (7b) + (	(7c) =	0	÷ (5) =		0.00	(8)
If a pressurisation test has	been carried	out or is i	ntended, p	roceed to	(17), otherw	vise continu	ie from (9)	to (16)				
Air permeability value, q50	), expressed i	n cubic me	etres per h	our per s	quare metre	of envelop	e area				3.00	(17)
If based on air permeabilit	y value, then	(18) = [(17	7) ÷ 20] + (	8), otherv	vise (18) = (1	6)					0.15	(18)
Number of sides on which	the dwelling	is sheltere	d								3	(19)
Shelter factor								1	- [0.075 x (19)	] =	0.78	(20)
Infiltration rate incorporat	ing shelter fa	ctor							(18) x (20	) =	0.12	(21)
Infiltration rate modified for	or monthly w	vind speed	:									
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind spe	ed from Tabl	e U2										
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4												
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (a	allowing for s	helter and	wind fact	or) (21) x	(22a)m							
0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14	(22b)
Calculate effective air char	ige rate for t	he applical	ole case:									
If mechanical ventilatio	n: air change	rate throu	ugh system	ı							0.50	(23a)
If balanced with heat re	covery: effic	iency in %	allowing f	or in-use f	factor from T	able 4h					74.80	(23c)
a) If balanced mechanic	al ventilation	n with hea	t recovery	(MVHR) (	22b)m + (23l	b) x [1 - (23	c) ÷ 100]					
0.27	0.27	0.27	0.25	0.25	0.24	0.24	0.23	0.24	0.25	0.26	0.26	(24a)



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

0.22	0.27	0.27	0.25	0.25	0.24	0.24	0.23	0.24	0.25	0.26	0.26	(25)
3. Heat losses and hea	loss parame	ter										
Element	loss parame		Gross	Openings	Net	area	U-value	A x U W	/К к-\	/alue,	Ахк,	
		â	area, m²	m²	Α,	m²	W/m²K		kJ	/m².K	kJ/K	
Window					25	5.04 x	1.15	= 28.67	·			(27)
Ground floor					39	0.40 x	0.11	= 4.33				(28a)
External wall					83	8.70 x	0.16	= 13.39				(29a)
Party wall					11	4.80 x	0.00	= 0.00				(32)
Roof					39	9.40 x	0.11	= 4.33				(30)
Total area of external el	ements ∑A, m	12			18	7.54						(31)
Fabric heat loss, W/K =	(A × U)							(26	5)(30) + (	32) =	50.73	_ (33)
Heat capacity $Cm = \sum (A)$	(K)	214					(28)	.(30) + (32) -	+ (32a)(3	2e) =	N/A	_ (34)
Thermal mass paramete	r (TMP) in kJ/i	m²K									250.00	] (35)
Thermal bridges: S(L X 4	) calculated u	ising Apper	Idix K						(22) + (2)	26) - [	9.38	(36) (27)
	Eeb	Mar	Apr	May	lun	bul	Δυσ	Son	(33) + (.	36) = <u>Nov</u>	60.12 Dec	_ (37)
Ventilation heat loss cal	reu culated montl	19181 hlv: 0 33 x (	<b>Арі</b> 25)m x (5)	ividy	Jun	Jui	Aug	Seh	000	NOV	Dec	
31.7	31 40	31.06	29 38	29.04	27 36	27 36	27.02	28.03	29.04	29.71	30.39	(38)
Heat transfer coefficien	, W/K (37)m	+ (38)m			27.00	1100	1 1/101	20.00		10071	00.00	] (88)
91.8	5 91.51	91.18	89.49	89.16	87.48	87.48	87.14	88.15	89.16	89.83	90.50	7
		1	1					Average = 5	(39)112	/12 =	89.41	(39)
Heat loss parameter (HI	P), W/m²K (3	9)m ÷ (4)										
0.78	0.77	0.77	0.76	0.75	0.74	0.74	0.74	0.75	0.75	0.76	0.77	
								Average = 2	<u>(</u> 40)112	/12 =	0.76	(40)
Number of days in mon	h (Table 1a)											
31.0	) 28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
A Water beating oper	v roquiromot	at										
Assumed occupancy. N	yrequiremen										2.86	(42)
Annual average hot wat	er usage in litu	res ner dav	Vd average	= (25 x N) +	36						102.03	_ (42) _ (43)
Jan	Feb	Mar	Apr	Mav	Jun	Jul	Aug	Sep	Oct	Nov	Dec	_ (+5)
Hot water usage in litre	per day for e	each month	Vd,m = fact	or from Tab	le 1c x (43	3)						
112.2	4 108.15	104.07	99.99	95.91	91.83	91.83	95.91	99.99	104.07	108.15	112.24	7
						1	-	4	<u>Σ</u> (44)1	.12 =	1224.38	(44)
Energy content of hot w	ater used = 4.	.18 x Vd,m :	x nm x Tm/3	3600 kWh/m	ionth (see	Tables 1b	, 1c 1d)					_
166.4	4 145.57	150.22	130.96	125.66	108.44	100.48	115.30	116.68	135.98	148.43	161.19	
									∑(45)1	.12 =	1605.36	(45)
Distribution loss 0.15 x	45)m											
24.9	7 21.84	22.53	19.64	18.85	16.27	15.07	17.30	17.50	20.40	22.27	24.18	(46)
Storage volume (litres) i	ncluding any s	solar or WV	VHRS storag	e within san	ne vessel						150.00	(47)
Water storage loss:												_
a) If manufacturer's dec	ared loss fact	or is knowr	n (kWh/day)								1.41	(48)
Temperature factor	rom Table 2b										0.54	(49)
Energy lost from wat	er storage (kV	Wh/day) (4	8) x (49)								0.76	<b>(50)</b>
Enter (50) or (54) in (55			_, , ,								0.76	(55)
Water storage loss calcu	lated for each	n month (5	5) x (41)m									٦,
23.6	) 21.32	23.60	22.84	23.60	22.84	23.60	23.60	22.84	23.60	22.84	23.60	J (56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56) 23.60 21.32 23.60 22.84 23.60 22.84 23.60 23.60 22.84 23.60 22.84 23.60 (57)Primary circuit loss for each month from Table 3 23.26 21.01 23.26 22.51 23.26 22.51 23.26 23.26 22.51 23.26 22.51 23.26 (59)Combi loss for each month from Table 3a, 3b or 3c 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (61)Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m 213.31 187.90 197.08 208.06 176.32 172.53 153.79 147.35 162.17 162.04 182.85 193.79 (62)Solar DHW input calculated using Appendix G or Appendix H 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (63)Output from water heater for each month (kWh/month) (62)m + (63)m 187.90 197.08 162.04 213.31 176.32 172.53 153.79 147.35 162.17 182.85 193.79 208.06 2157.17 ∑(64)1...12 = (64)Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m] 92.83 82.27 87.44 79.83 79.27 72.34 70.90 75.83 75.08 82.71 85.64 91.09 (65) 5. Internal gains Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Metabolic gains (Table 5) 142.80 142.80 142.80 142.80 142.80 142.80 142.80 142.80 142.80 142.80 142.80 142.80 (66)Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 25.22 22.40 18.21 13.79 10.31 8.70 9.40 12.22 16.41 20.83 24.31 25.92 (67)Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 282.85 285.79 278.39 262.64 242.77 224.09 211.61 208.67 216.07 231.81 251.69 270.37 (68)Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 37.28 37.28 37.28 37.28 37.28 37.28 37.28 37.28 37.28 37.28 37.28 37.28 (69) Pump and fan gains (Table 5a) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (70)Losses e.g. evaporation (Table 5) -114.24 -114.24 -114.24 -114.24 -114.24 -114.24 -114.24 -114.24 -114.24 -114.24 -114.24 -114.24 (71) Water heating gains (Table 5) 124.78 122.42 117.53 110.87 106.55 100.47 95.30 104.28 118.94 101.92 111.16 122.43 (72) Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m 498.69 496.44 479.97 453.15 425.47 399.10 382.15 388.66 402.59 429.65 460.78 484.56 (73) 6. Solar gains Access factor Solar flux FF Gains Area g Table 6d m² W/m<sup>2</sup> specific data specific data w or Table 6b or Table 6c 0.77 7.84 0.72 North 10.63 x 0.9 x 0.80 33.28 (74)х x х \_ South 0.77 17.20 46.75 x 0.9 x 0.72 0.80 320.99 х x = (78)х Solar gains in watts  $\Sigma(74)$ m...(82)m 354.26 589.28 777.70 930.41 1022.49 1009.30 975.27 905.58 829.44 642.71 421.53 305.10 (83)Total gains - internal and solar (73)m + (83)m 852.95 1085.73 1257.67 1383.56 1447.96 1408.40 1357.42 1294.24 1232.03 1072.36 882.31 789.66 (84) 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85) Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov

Utilisation factor	r for gains fo	or living are	a n1,m (se	e Table 9a)									
	0.99	0.97	0.90	0.75	0.57	0.40	0.28	0.31	0.49	0.80	0.97	1.00	(86)
Mean internal te	emp of living	g area T1 (s	teps 3 to 7	in Table 9c	:)								
	20.42	20.64	20.83	20.96	20.99	21.00	21.00	21.00	21.00	20.95	20.66	20.37	] (87)
Temperature du	ring heating	g periods in	the rest of	f dwelling fr	rom Table 9	ə, Th2(°C)							
	20.27	20.28	20.28	20.29	20.29	20.31	20.31	20.31	20.30	20.29	20.29	20.28	(88)
Utilisation facto	r for gains fo	or rest of d	welling n2,	m							•		1
	0.99	0.96	0.87	0.71	0.53	0.35	0.24	0.26	0.44	0.77	0.97	0.99	(89)
Mean internal te	emperature	in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	) Jc)			1	1	1	], ,
	19.74	19 96	20.15	20.26	20.29	20.31	, 20.31	20.31	20.30	20.26	20.00	19 71	] ( <u>90</u> )
Living area fract	ion	19.90	20.15	20.20	20.25	20.31	20.01	20.51		ving area ÷	(4) =	0.26	] (91)
Mean internal te	emnerature	for the wh	ole dwellin	σfIA x T1 +	-(1 - fl A) x T	г2				ing area i	(.)	0.20	] (31)
	10.02	20.14	20.22	20.44	20.47	20.49	20.49	20.40	20.49	20.42	20.17	10.99	] (02)
Apply adjustmen	19.92	20.14	20.52	20.44	20.47	20.40	20.40	20.49	20.46	20.45	20.17	19.88	] (92)
								20.40	20.40	20.42	20.47	10.00	
	19.92	20.14	20.32	20.44	20.47	20.48	20.48	20.49	20.48	20.43	20.17	19.88	] (93)
8. Space heatir	ıg requirem	ent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	r for gains. r	าm											
	0.99	0.96	0.88	0.72	0.54	0.37	0.25	0.28	0.46	0.77	0.96	0.99	] (94)
Liseful gains nm	Gm W (94	)m x (84)m	0.00	0.72	0.54	0.57	0.25	0.20	0.40	0.77	0.50	0.55	] (34)
	Q42 E0	1027 20	1101 61	006 76	777 52	E14.46	220 72	256.01	E61 24	820 E 6	950.22	702.00	
Monthly avorage	ovtornal t		from Tabl	0.111	111.52	514.40	339.75	330.01	301.24	829.30	830.23	765.56	] (55)
wontiny average					44.70	14.60	16.60	16.40	1110	10.00	7.40	4.20	
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	] (96)
Heat loss rate to	r mean inte	ernal tempe	rature, Lm	, w [(39)m	x [(93)m -	(96)mj					1		1
	1434.32	1394.23	1260.21	1032.83	781.97	514.68	339.75	356.03	562.32	876.68	1174.15	1419.22	] (97)
Space heating re	quirement,	kWh/mon	th 0.024 x	[(97)m - (9	5)m] x (41)i	m		1			1	1	7
	439.57	239.92	118.00	25.97	3.32	0.00	0.00	0.00	0.00	35.06	233.22	472.62	]
									∑(98	3)15, 10	.12 =	1567.68	」(98) ⁻
Space heating re	quirement	kWh/m²/ye	ear							(98)	÷ (4)	13.26	(99)
9a Energy reg	uirements -	individual	heating sv	stems inclu	ding micro	-СНР							
Space heating		mannaaan				Citi							
Fraction of char	a hoat from	cocondanu	launnlama	ntary cycto	m (tabla 11	۱					<b></b>	0.00	] (201)
		secondary,	(supplementer)	illary system		.)				1 /20	D1)	0.00	] (201) ] (202)
Fraction of space	e neat from	main syste	m(s)							1 - (20	J1) =	1.00	] (202)
Fraction of space	e neat from	main syste	m 2						(0.0			0.00	] (202) ] (202)
Fraction of total	space heat	from main	system 1						(20	)2) x [1- (20	3)] = [	1.00	] (204) ]
Fraction of total	space heat	from main	system 2							(202) x (20	03) =	0.00	] (205) ]
Efficiency of mai	n system 1	(%)										275.25	] (206)
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fu	iel (main sy	stem 1), kW	/h/month										_
	159.70	87.16	42.87	9.44	1.20	0.00	0.00	0.00	0.00	12.74	84.73	171.70	
									∑(21:	1)15, 10	.12 =	569.54	] (211)
Water heating													
Efficiency of wat	er heater												
	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	(217)
Water heating for	uel, kWh/m	onth											
	78.45	69.11	72.49	64.85	63.45	56.56	54.19	59.65	59.60	67.25	71.27	76.52	]

			5(219a)1 12 =	793 /0	(219)
Annual totals			2(2198)112 -	795.40	] (213)
Space heating fuel - main system 1				569 54	]
Water heating fuel				793.40	]
Electricity for pumps, fans and electric keep-hot (Table 4f)					1
mechanical ventilation fans - balanced, extract or positive inpu	ut from outside		326.20		(230a)
Total electricity for the above. kWh/year				326.20	(231)
Electricity for lighting (Appendix L)				445.33	(232)
Total delivered energy for all uses		(211	.)(221) + (231) + (232)(237b) =	2134.47	(238)
102 Evel costs - individual beating systems including micro-CH	D				
Toa. Tuer costs - mutvicular neating systems metuding micro-cir	Fuel		Fuel price	Fuel	
	kWh/year		ruciplice	cost £/year	
Space heating - main system 1	569.54	x	13.19 x 0.01 =	75.12	(240)
Water heating	793.40	x	13.19 x 0.01 =	104.65	(247)
Pumps and fans	326.20	x	13.19 x 0.01 =	43.03	(249)
Electricity for lighting	445.33	x	13.19 x 0.01 =	58.74	(250)
Additional standing charges				0.00	(251)
Total energy cost			(240)(242) + (245)(254) =	281.54	(255)
11a. SAP rating - individual heating systems including micro-CH	IP				
Energy cost deflator (Table 12)				0.42	(256)
Energy cost factor (ECF)				0.72	(257)
SAP value				89.89	]
SAP rating (section 13)				90	(258)
SAP band				В	]
12a. CO <sub>2</sub> emissions - individual heating systems including micro	o-CHP				
	Energy		Emission factor	Emissions	
	kWh/year		kg CO₂/kWh	kg CO₂/year	
Space heating - main system 1	569.54	x	0.519 =	295.59	(261)
Water heating	793.40	x	0.519 =	411.77	(264)
Space and water heating			(261) + (262) + (263) + (264) =	707.37	(265)
Pumps and fans	326.20	х	0.519 =	169.30	(267)
Electricity for lighting	445.33	х	0.519 =	231.13	(268)
Total CO <sub>2</sub> , kg/year			(265)(271) =	1107.79	(272)
Dwelling CO <sub>2</sub> emission rate			(272) ÷ (4) =	9.37	(273)
El value				90.90	
El rating (section 14)				91	(274)
El band				В	
13a. Primary energy - individual heating systems including mice	ro-CHP				
	Energy kWh/year		Primary factor	Primary Energy kWh/year	
Space heating - main system 1	569.54	x	3.07 =	1748.50	(261)
Water heating	793.40	x	3.07 =	2435.73	(264)
Space and water heating			(261) + (262) + (263) + (264) =	4184.23	(265)
	226.20	v	3 07 =	1001 44	(267)

Electricity for lighting Primary energy kWh/year

PREVIEW - THIS VERSION HAS NOT BEEN APPROVED

х

3.07

=

445.33

1367.16

6552.83

(268)

(272)

# TER Worksheet Design - Draft



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

Assessor name	Mr Harr	y Knibb						As	sessor num	ber	1		
Client								Las	st modified		23/02	/2017	
Address	Canfield	Place 12 Ca	anfield Plac	e, Lond	on								
				,									
1. Overall dwelling dim	ensions												
					Area (m²)			Aver he	age storey ight (m)		Va	lume (m³)	
Lowest occupied					39.40	(1a)	x		2.90	(2a) =		114.26	(3a)
+1					39.40	(1b)	x		2.90	(2b) =		114.26	(3b)
+2				Γ	39.40	(1c)	x		3.10	(2c) =		122.14	(3c)
Total floor area	(1a	) + (1b) + (1	c) + (1d)(	1n) = [	118.20	(4)							
Dwelling volume				_				(3a)	+ (3b) + (3e	c) + (3d)(3	3n) =	350.66	(5)
2. Ventilation rate													
											m	<sup>3</sup> per hour	
Number of chimneys									0	] x 40 =		0	(6a)
Number of open flues									0	] x 20 =		0	(6b)
Number of intermittent	fans								4	] x 10 =		40	(7a)
Number of passive vents	i								0	] x 10 =		0	(7b)
Number of flueless gas f	res								0	] x 40 =	:	0	(7c)
											Air	changes pe hour	r
Infiltration due to chimn	eys, flues, far	s, PSVs			(6a) + (6b) +	(7a) + (7t	o) + (7c) =	=	40	÷ (5) =	-	0.11	(8)
If a pressurisation test h	as been carrie	d out or is i	ntended, pi	roceed	to (17), othe	erwise cor	ntinue fro	om (9) t	o (16)				_
Air permeability value, q	50, expressed	l in cubic m	etres per h	our per	square met	re of env	elope are	ea				5.00	(17)
If based on air permeabi	lity value, the	n (18) = [(1	7) ÷ 20] + (8	3), othe	rwise (18) =	(16)						0.36	(18)
Number of sides on whic	h the dwellin	g is sheltere	ed									3	(19)
Shelter factor									1 -	[0.075 x (1	9)] =	0.78	(20)
Infiltration rate incorpor	ating shelter	factor								(18) x (2	20) =	0.28	(21)
Infiltration rate modified	l for monthly	wind speed	:										_
Jan	Feb	Mar	Apr	Ma	y Jun	Ju	I	Aug	Sep	Oct	Nov	Dec	
Monthly average wind s	beed from Tal	ble U2											
5.10	5.00	4.90	4.40	4.3	0 3.80	3.8	80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m $\div$ 4													
1.28	1.25	1.23	1.10	1.0	8 0.95	0.9	95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate	(allowing for	shelter and	d wind facto	or) (21)	x (22a)m								_
0.36	0.35	0.35	0.31	0.3	0 0.27	0.2	27	0.26	0.28	0.30	0.32	0.33	(22b)
Calculate effective air ch	ange rate for	the applica	ble case:										_
If mechanical ventilat	ion: air chang	ge rate thro	ugh system									N/A	(23a)
If balanced with heat	recovery: eff	iciency in %	allowing fo	or in-us	e factor fron	n Table 4l	า					N/A	(23c)
d) natural ventilation	or whole hou	ise positive	input venti	lation f	rom loft								
0.56	0.56	0.56	0.55	0.5	5 0.54	0.5	54	0.53	0.54	0.55	0.55	0.55	(24d)



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

			0 56			0.54	0.54	0.52	0.54	0.55	0.55	0.55	(25)
l	0.50	0.50	0.50	0.55	0.55	0.54	0.54	0.55	0.54	0.55	0.55	0.55	_ (25)
3. Heat losses a	nd heat lo	ss paramet	er										
Element				Gross	Openings	Net	area	U-value	A x U W	//К к-ч	value,	Ахк,	
			а	rea, m <sup>2</sup>	m-	Α,	m-	W/m <sup>2</sup> K		KJ,	/m².K	KJ/K	6. 1
Window						25	.04 x	1.33	= 33.20	)			(27)
Ground floor						39	.40 x	0.13	= 5.12				(28a)
External wall						83	.70 x	0.18	= 15.07	<u></u>			(29a)
Party wall							4.80 X	0.00	= 0.00				(32)
ROOT		anta 51 m²				<u> </u>	.40 X	0.13	= 5.12				(30)
Fabric boat loss		ents za, m-				18.	/.54		(2)	c) (20) i (2	22) -	E0 E1	(22)
Fabric field loss,	$VV/K = \sum (A$	x 0)						(28)	(20) (22)	(30) + (30) + (30)	32) =	58.51	] (33) ] (34)
Thormal mass na	$I = \sum (A \times K)$	MD) in kl/n	°2K					(28)	(30) + (32)	+ (32a)(3	2e) =	N/A	(34) (25)
Thermal bridges:		alculated us		div K								3 70	] (35) ] (36)
Total fabric beat			ing Appen							(33) + (3	26) -	62.21	_ (30) _ (37)
	lan	Feb	Mar	Apr	May	lun	hul	Διισ	Sen	(55) ( (. Oct		Dec	
Ventilation heat	loss calcula	ated month	lv 0.33 x (2	25)m x (5)	may	Jun	501	,	seb	000		200	
	65.35	65.06	64.77	63.43	63.18	62.02	62.02	61.80	62.47	63,18	63.69	64.22	(38)
Heat transfer coe	efficient. W	//K (37)m +	(38)m	00110	1 00120 1	02:02	01.01	1 01.00	02.17	00.20	00.00	0	
	127.56	127.27	126.98	125.64	125.39	124.23	124.23	124.01	124.68	125.39	125.90	126.43	7
I		ļ		1					Average = 3	∑(39)112/	/12 =	125.64	 ] (39)
Heat loss parame	eter (HLP),	W/m²K (39	)m ÷ (4)							_(, ,			
	1.08	1.08	1.07	1.06	1.06	1.05	1.05	1.05	1.05	1.06	1.07	1.07	7
·									Average = 2	Σ(40)112/	/12 =	1.06	(40)
Number of days i	in month ( <sup>-</sup>	Table 1a)											_
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
4. Water heatin	ig energy r	equiremen	:									• • •	
Assumed occupa	ncy, N					26						2.86	(42)
Annual average r	lot water i	Isage in litre	es per day	vd,average	= (25 x N) +	30	1.1	A	For	Oct		102.03 Dec	_ (43)
Hot water usage	in litres no	rep or day for ea	ividi ch month	Api Vd.m.= fact	ividy			Aug	Sep	001	NOV	Dec	
not water usage	112.24	108 15	104.07			01 82	01.83	05.01	00 00	104.07	108 15	112.24	7
	112.24	108.15	104.07	55.55	95.91	91.05	91.05	95.91	33.33	5(44)1	12 = 12	22/ 38	
Energy content o	of hot wate	r used = 4.1	8 x Vd.m x	nm x Tm/3	3600 kWh/m	onth (see	Tables 1b	. 1c 1d)		2(++)1	.12	224.30	] (++)
	166.44	145.57	150.22	130.96	125.66	108.44	100.48	115.30	116.68	135.98	148.43	161.19	7
I	100111	1 10107	100.111	100100	1 10100	100111	100110	110.00	110.000	Σ(45)1	.12 = 1	605.36	 (45)
Distribution loss	0.15 x (45	)m								2(13)1			
	24.97	21.84	22.53	19.64	18.85	16.27	15.07	17.30	17.50	20.40	22.27	24.18	(46)
Storage volume (	(litres) inclu	uding any so	olar or WW	/HRS storag	e within sar	ne vessel		1	1			150.00	(47)
Water storage lo	ss:	0 , .											
a) If manufacture	er's declare	ed loss facto	r is known	(kWh/day)	)							1.39	(48)
Temperature	factor fror	n Table 2b										0.54	(49)
Energy lost fro	om water s	storage (kW	h/day) (48	3) x (49)								0.75	(50)
Enter (50) or (54)	) in (55)	2 (										0.75	(55)
Water storage lo	ss calculat	ed for each	month (55	5) x (41)m									
	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If the vessel cont	tains dedica	ated solar s	storage or d	edicated W	WHRS (56	)m x [(47) -	Vs] ÷ (47),	else (56)					
	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33 (5	7)
Primary circuit lo	oss for each	month fro	om Table 3			•		•					
	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26 (5	9)
Combi loss for ea	ach month i	from Table	e 3a, 3b or 3	с									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (6	1)
Total heat requir	red for wate	er heating	calculated f	or each mo	onth 0.85 x	: (45)m + (40	6)m + (57)r	n + (59)m -	+ (61)m				
	213.04	187.66	196.81	176.05	172.26	153.53	147.08	161.90	161.77	182.58	193.53	207.78 (6	2)
Solar DHW input	calculated	using App	endix G or A	ppendix H									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (6	3)
Output from wat	ter heater f	or each mo	onth (kWh/r	month) (62	2)m + (63)n	n							
	213.04	187.66	196.81	176.05	172.26	153.53	147.08	161.90	161.77	182.58	193.53	207.78	
										∑(64)1	.12 =	2153.98 (6	4)
Heat gains from	water heat	ing (kWh/r	month) 0.25	5 × [0.85 ×	(45)m + (61	L)m] + 0.8 ×	[(46)m + (	57)m + (59)	)m]				
	92.62	82.07	87.22	79.62	79.06	72.13	70.69	75.61	74.87	82.49	85.43	90.87 (6	5)
E Internal gain	c												
5. Internal gain	Jan	Eeb	Mar	Apr	May	lun	Lut.	Δυσ	Son	Oct	Nov	Dec	
Metabolic gains	(Table 5)	105	wiai	дрі	iviay	Jun	501	Aug	Jep	000	1000	Dee	
Wetabolie Ballis	142.80	142 80	142.80	142 80	142 80	142 80	142 80	142.80	142.80	142 80	142.80	142.80 (6)	6)
Lighting gains (ca	alculated in	Appendix	L. equation	L9 or L9a).	also see Ta	able 5	112.00	112.00	112.00	112.00	112.00	112.00 (0	5)
0 0 0 0 0 0 0 0 0 0	25.27	22.45	18.25	13.82	10.33	8.72	9.42	12.25	16.44	20.87	24.36	25.97 (6)	7)
Appliance gains	(calculated	in Append	ix L, equatio	on L13 or L1	13a), also s	ee Table 5			1			(*	
	282.85	285.79	278.39	262.64	242.77	224.09	211.61	208.67	216.07	231.81	251.69	270.37 (6	8)
Cooking gains (ca	alculated in	Appendix	L, equation	L15 or L15	a), also see	Table 5				1	1	· · · · ·	
	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28	37.28 (6)	9)
Pump and fan ga	ins (Table 5	5a)						I	1			· · · · ·	
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00 (7	0)
Losses e.g. evapo	oration (Tab	ole 5)										· ·	
	-114.24	-114.24	-114.24	-114.24	-114.24	-114.24	-114.24	-114.24	-114.24	-114.24	-114.24	-114.24 (7	1)
Water heating ga	ains (Table	5)						•					
	124.49	122.13	117.23	110.58	106.26	100.18	95.01	101.63	103.99	110.87	118.65	122.14 (7	2)
Total internal ga	ins (66)m +	- (67)m + (6	68)m + (69)ı	m + (70)m	+ (71)m + (	72)m							
	501.45	499.20	482.72	455.89	428.20	401.83	384.88	391.39	405.34	432.40	463.54	487.32 (7	3)
C. Calan astro													
6. Solar gains			A		<b>A</b>	Cal	<b>f</b> l		_			Colina	
			Access T Table	6d	m²	Sola	ar flux //m²	spec	g sific data	specific o	data	W	
								or T	able 6b	or Table	e 6c		
North			0.7	7 x [	7.84	x 1	0.63 x	0.9 x	0.63 x	0.70	=	25.48 <b>(7</b> -	4)
South			0.77	7 X	17.20	x 4	6.75 x	0.9 x	0.63 x	0.70	=	245.75 (7	8)
Solar gains in wa	tts ∑(74)m	(82)m											
	271.23	451.17	595.43	712.35	782.84	772.74	746.69	693.34	635.04	492.07	322.73	233.59 (8	3)
Total gains - inte	rnal and so	lar (73)m +	⊦ (83)m										
	772.68	950.37	1078.15	1168.23	1211.04	1174.57	1131.57	1084.73	1040.38	924.48	786.28	720.92 (8	4)
7. Mean intern	al tempera	ture (heati	ing season)										
Temperature du	ring heating	neriods in	n the living :	area from T	Table 9 Th	(°C)						21.00 /2	5)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	-1

Utilisation facto	r for gains f	or living are	a n1,m (se	e Table 9a)									
	1.00	0.99	0.97	0.93	0.83	0.65	0.48	0.52	0.75	0.95	0.99	1.00	(86)
Mean internal to	emp of livin	g area T1 (s	teps 3 to 7	in Table 9c	:)								
	19.91	20.11	20.36	20.65	20.87	20.97	21.00	20.99	20.94	20.65	20.22	19.87	(87)
Temperature du	uring heating	g periods in	the rest of	dwelling fr	rom Table 9	9, Th2(°C)							
	20.02	20.02	20.02	20.03	20.03	20.04	20.04	20.04	20.04	20.03	20.03	20.03	(88)
Utilisation facto	r for gains for	or rest of d	welling n2,	n									-
	1.00	0.99	0.97	0.91	0.77	0.56	0.38	0.41	0.67	0.93	0.99	1.00	(89)
Mean internal to	emperature	in the rest	of dwelling	T2 (follow	steps 3 to	7 in Table 9	9c)	1			I		
	18 56	18 86	19.23	19.63	19.91	20.02	20.04	20.04	19 99	19.65	19.02	18 51	] (90)
Living area fract	ion	10.00	19.29	19.05	13.31	20.02	20.01	20.01	15.55	ving area ÷	(4) =	0.26	] (91)
Mean internal to	emnerature	for the wh	ole dwellin	σfIΔ x T1 +	-(1 - fl Δ) x T	г2				ving area .	(-) =	0.20	](31)
		10.10	10 52	10.00	20.15	20.27	20.29	20.29	20.24	10.01	10.22	10.06	7 (02)
Apply adjustment	18.91	19.18	19.52	19.89	20.15	20.27	20.28	20.28	20.24	19.91	19.33	18.80	] (92)
Apply aujustifier			temperatu					20.20	20.24	10.01	10.00	10.00	
	18.91	19.18	19.52	19.89	20.15	20.27	20.28	20.28	20.24	19.91	19.33	18.86	] (93)
8. Space heatir	ng requirem	ent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	r for gains.	าฑ		•	•			Ū					
	0.99	0.98	0.96	0.90	0.78	0.58	0.40	0.44	0.69	0.92	0 99	1.00	] (94)
Liseful gains nm		)m x (84)m	0.50	0.50	0.70	0.50	0.40	0.44	0.05	0.52	0.55	1.00	] (34)
			1026 57	1056.07	046.90	COFFO	<b>AEE 71</b>	479.41	720.02	052.21	775 55	719.02	
Monthly avorage	o ovtornal t	mporature	from Tabl	1050.07	940.80	085.58	433.71	470.41	720.03	055.21	775.55	/18.03	] (33)
wonting average				0.00	11.70	11.00	16.60	16.40	1110	10.00	7.40	4.20	
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	] (96)
Heat loss rate to	or mean inte	ernal tempe	rature, Lm	. w [(39)m	x [(93)m -	(96)mj							٦
	1863.18	1817.21	1653.04	1381.20	1059.97	704.01	457.76	481.73	764.92	1166.86	1539.88	1853.43	] (97)
Space heating re	equirement,	kWh/mon	th 0.024 x	[(97)m - (95	5)m] x (41)	m		1		1		i	7
	814.54	592.49	458.65	234.10	84.20	0.00	0.00	0.00	0.00	233.36	550.32	844.74	
									∑(9a	8)15, 10	12 = 3	3812.40	」(98) ┐
Space heating re	equirement	kWh/m²/ye	ear							(98)	÷ (4)	32.25	(99)
9a Energy reg	uirements -	individual	heating sv	tems inclu	ding micro	-СНР							
Space heating		mannaaan				CIII							
Fraction of chao	a haat from	cocondanu	kunnlama	atary system	m (tabla 11	۱						0.00	7 (201)
		secondary/	supplementer	italy system		.)				1 (2)		0.00	] (201) ] (202)
Fraction of space	e neat from	main syste	m(s)							1 - (20	)1) = [	1.00	] (202) ] (202)
	e neat from	main syste	m z						(2)	2) [4 (20		0.00	] (202) ] (204)
Fraction of total	space heat	from main	system 1						(20	)2) x [1- (20	3)] = [	1.00	] (204) ] (204)
Fraction of total	space heat	from main	system 2							(202) x (20	)3) = [	0.00	」(205) フィー・
Efficiency of ma	in system 1	(%)										93.50	] (206)
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fu	uel (main sy	stem 1), kW	/h/month										_
	871.17	633.68	490.54	250.37	90.06	0.00	0.00	0.00	0.00	249.58	588.58	903.46	
									∑(21)	1)15, 10	12 = 4	1077.44	(211)
Water heating													
Efficiency of wat	ter heater												
	88.05	87.67	87.00	85.57	83.02	79.80	79.80	79.80	79.80	85.47	87.45	88.17	(217)
Water heating f	uel, kWh/m	onth											
	241.94	214.04	226.23	205.73	207.48	192.39	184.31	202.88	202.72	213.62	221.30	235.67	]

				$\nabla(219a)1  12 =$	25/18 32	(219)
Annual totals				2(2190)112 -	2340.32	(213)
Space heating fuel - main system 1					4077.44	
Water heating fuel					2548.32	
Electricity for pumps, fans and electric keep-hot (Table 4f)						1
central heating pump or water pump within warm air heating	gunit		30.00	]		(230c)
boiler flue fan			45.00	]		(230e)
Total electricity for the above, kWh/year				-	75.00	(231)
Electricity for lighting (Appendix L)					446.29	(232)
Total delivered energy for all uses			(211)(221) + (231) +	(232)(237b) =	7147.04	(238)
10a. Fuel costs - individual heating systems including micro-CH	IP					
	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4077.44	x	3.48	] x 0.01 =	141.89	(240)
Water heating	2548.32	x	3.48	x 0.01 =	88.68	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	446.29	x	13.19	x 0.01 =	58.87	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242)	+ (245)(254) =	419.33	(255)
11a. SAP rating - individual heating systems including micro-C	HP					
Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					1.08	(257)
SAP value					84.95	
SAP rating (section 13)					85	(258)
SAP band					В	
12a. $CO_2$ emissions - individual heating systems including micr	o-CHP					
	Energy kWh/year		Emission factor kg CO₂/kWh		Emissions kg CO <sub>2</sub> /year	
Space heating - main system 1	4077.44	×	0.216	=	880.73	(261)
Water heating	2548.32	х	0.216	=	550.44	(264)
Space and water heating			(261) + (262) -	+ (263) + (264) =	1431.16	(265)
Pumps and fans	75.00	x	0.519	] =	38.93	(267)
Electricity for lighting	446.29	x	0.519	=	231.62	(268)
Total CO <sub>2</sub> , kg/year				(265)(271) =	1701.71	(272)
Dwelling CO <sub>2</sub> emission rate				(272) ÷ (4) =	21.06	(273)
El value					86.03	
El rating (section 14)					86	(274)
El band					В	
13a. Primary energy - individual heating systems including mid	cro-CHP					
	Energy kWh/year		Primary factor	~	Primary Energy kWh/year	
	1077		1	1	4075	1000

4077.44	x	1.22	=	4974.47	(261)
2548.32	] x	1.22	=	3108.95	(264)
		(261) + (262) +	(263) + (264) =	8083.42	(265)
75.00	] x	3.07	=	230.25	(267)
446.29	] x	3.07	=	1370.11	(268)
	4077.44 2548.32 75.00 446.29	4077.44       x         2548.32       x         75.00       x         446.29       x	4077.44       x       1.22         2548.32       x       1.22         (261) + (262) +       (261) + (262) +         75.00       x       3.07         446.29       x       3.07	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$

PREVIEW - THIS VERSION HAS NOT BEEN APPROVED

Primary energy kWh/year

Dwelling	primary	energy	rate	kWh/m2	/year

9683.78	(272)
81.93	(273)

# DER Worksheet Design - Draft



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

Assessor name	Mr Harry	Knibb							Asse	ssor num	nber	1		
Client									Last	modified	I	23/	02/2017	
Address	18 Canfie	ld Place HS	-B2. Londo	on					_					
1. Overall dwelling dimen	sions													
					Are	ea (m²)			Averag heig	ge storey ht (m)			Volume (m³)	
Lowest occupied					4	0.90	] (1a) x	[	2	.90	] (2a) =		118.61	(3a)
+1					4	0.90	] (1b) x	[	2	.90	](2b) =		118.61	(3b)
+2						2.70	] (1c) x	[	3	.10	] (2c) =		8.37	(3c)
Total floor area	(1a)	+ (1b) + (1c	c) + (1d)(	1n) = 🗌	8	84.50	(4)							
Dwelling volume									(3a) +	(3b) + (3	c) + (3d)(3	8n) = 🗌	245.59	(5)
2. Ventilation rate														
													m <sup>3</sup> per hour	
Number of chimneys								Г	-	0	x 40 =		0	(6a)
, Number of open flues								ſ		0	x 20 =		0	] (6b)
Number of intermittent fan	S							ľ		0	x 10 =		0	(7a)
Number of passive vents										0	x 10 =		0	] (7b)
umber of flueless gas fires								Γ		0	] x 40 =		0	(7c)
-								L			_	Ai	ir changes pe hour	r
Infiltration due to chimneys	s, flues, fans	, PSVs			(6a) +	- (6b) + (7a	a) + (7b) +	(7c) = [		0	÷ (5) =	: [	0.00	(8)
If a pressurisation test has l	been carried	l out or is ii	ntended, p	roceed	to (1)	7), otherw	ise continu	le from	(9) to (	(16)	_			_
Air permeability value, q50,	expressed	in cubic me	etres per h	our per	squa	ire metre o	of envelop	e area					3.00	(17)
If based on air permeability	value, then	(18) = [(17	7) ÷ 20] + (	8), othe	rwise	e (18) = (16	5)						0.15	(18)
Number of sides on which t	he dwelling	is sheltere	d										3	(19)
Shelter factor										1 -	[0.075 x (1	9)] = 🗌	0.78	(20)
Infiltration rate incorporation	ng shelter fa	ictor									(18) x (2	20) =	0.12	(21)
Infiltration rate modified fo	r monthly w	vind speed	:											
Jan	Feb	Mar	Apr	Ma	y	Jun	Jul	Au	g	Sep	Oct	Nov	Dec	
Monthly average wind spee	d from Tab	e U2												
5.10	5.00	4.90	4.40	4.3	0	3.80	3.80	3.7	0	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4														
1.28	1.25	1.23	1.10	1.08	8	0.95	0.95	0.9	3	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (a	llowing for s	helter and	wind fact	or) (21)	x (22	a)m								
0.15	0.15	0.14	0.13	0.12	2	0.11	0.11	0.1	.1	0.12	0.12	0.13	0.14	(22b)
Calculate effective air change	ge rate for t	he applical	ole case:											_
If mechanical ventilation	n: air change	e rate throu	ugh system	ı									0.50	(23a)
If balanced with heat red	covery: effic	iency in %	allowing f	or in-us	e fact	or from Ta	able 4h						74.80	(23c)
a) If balanced mechanica	al ventilatio	n with heat	t recovery	(MVHR	) (22t	o)m + (23b	o) x [1 - (23	c) ÷ 10	0]					-
0.27	0.27	0.27	0.25	0.2	5	0.24	0.24	0.2	3	0.24	0.25	0.26	0.26	(24a)



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

			0.27		iu) iii (23)	0.24	0.24	0.22	0.24	0.25	0.26	0.20	
L	0.27	0.27	0.27	0.25	0.25	0.24	0.24	0.23	0.24	0.25	0.26	0.26	_ (25)
3. Heat losses a	nd heat lo	ss paramete	er										
Element				Gross	Openings	s Net	area	U-value	A x U W	/К к-\	value,	Ахк,	
			а	irea, m²	m²	Α,	m²	W/m²K	[	kJ	/m².K	kJ/K	
Window						18	8.75 x	1.15	= 21.47	<u></u>			(27)
Ground floor						40	0.90 x	0.11	= 4.50				(28a)
External wall						55	.49 x	0.16	= 8.88				(29a)
Party wall						/4	.82 X	0.00	= 0.00				(32)
ROOT		anta 51 m²				40	.90 X	0.11	= 4.50				(30)
Fabric boat loss N		ents չA, m-				15	0.04		(2)	c) (20) i (	22) -	20.25	(31)
Heat capacity Cm	$VV/K = \sum (A$	× 0)						(29)	(20) (22)	5)(30) + ( (225) (2	32) = <u> </u>	39.35	(33)
Thormal mass na	$I = \sum (A \times K)$	MD) in kl/m	°2K					(28)	.(30) + (32) -	+ (32a)(3	2e) =	N/A	(34) (25)
Thermal bridges:		alculated us		div K								7 80	] (35) ] (36)
Total fabric beat		alculated us	пів Аррен							(33) + (	36) -	/.80	_ (30) _ (37)
Total labile field	lan	Feb	Mar	Apr	May	lun	lul	Δυσ	Sen	Oct	Nov	Dec	
Ventilation heat l	loss calcula	ated monthl	lv 0.33 x (2	25)m x (5)	may		501	1.48	ocp	011			
]	22.22	21.99	21.75	20.58	20.34	19,16	19.16	18.93	19.63	20.34	20.81	21.28	(38)
ا Heat transfer coe	efficient. W	//K (37)m +	(38)m	20.00		10.120	10.110	1 10:00	10.00	20.01			
]	69.37	69.14	68.90	67.72	67.49	66.31	66.31	66.07	66.78	67.49	67.96	68.43	7
L		ļ		1					Average = 5	5(39)112	/12 =	67.66	(39)
Heat loss parame	eter (HLP),	W/m²K (39	)m ÷ (4)							_(, ,			
[	0.82	0.82	0.82	0.80	0.80	0.78	0.78	0.78	0.79	0.80	0.80	0.81	7
-									Average = 2	Σ(40)112,	/12 =	0.80	(40)
Number of days i	in month (	Table 1a)											
[	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
4. Water heatin	g energy r	equirement	:									2.54	
Assumed occupat	ncy, N				(25 ··· NI) ·	20						2.54	_ (42)
Annual average n	lot water t	sage in litre	es per day	vo,average	= (25 x N) +	30	1.1	Aug	Son	Oct	Nov	94.59	_ (43)
Hot water usage	in litres ne	er day for ea	ch month	Vd m = fact	tor from Tab	)le 1c x (43	2)	Aug	Зер	000	NOV	Dec	
	104.05	100.27	96.48	92 70	88.91	85 13	85.13	88 91	92 70	96.48	100.27	104.05	7
L	104.05	100.27	50.40	52.70	00.51	05.15	05.15	00.91	52.70	<u>5(44)</u> 1	12 =	1135 08	 (44)
Energy content o	f hot wate	r used = 4.1	.8 x Vd,m x	nm x Tm/3	3600 kWh/m	nonth (see	Tables 1b	), 1c 1d)		2()=			]()
5,	154.30	134.95	139.26	121.41	116.50	100.53	93.15	106.89	108.17	126.06	137.61	149.43	7
L							1		4	∑(45)1	.12 =	1488.26	(45)
Distribution loss	0.15 x (45	)m									<u> </u>		
	23.15	20.24	20.89	18.21	17.47	15.08	13.97	16.03	16.23	18.91	20.64	22.41	(46)
Storage volume (	litres) inclu	uding any sc	olar or WW	/HRS storag	e within sar	ne vessel			•			150.00	(47)
Water storage los	ss:												_
a) If manufacture	er's declare	ed loss facto	r is known	(kWh/day)	)							1.41	(48)
Temperature	factor fror	n Table 2b										0.54	(49)
Energy lost fro	om water s	storage (kW	h/day) (48	8) x (49)								0.76	(50)
Enter (50) or (54)	in (55)											0.76	(55)
Water storage los	ss calculate	ed for each	month (5	5) x (41)m									
[	23.60	21.32	23.60	22.84	23.60	22.84	23.60	23.60	22.84	23.60	22.84	23.60	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56) 23.60 21.32 23.60 22.84 23.60 22.84 23.60 23.60 22.84 23.60 22.84 23.60 (57)Primary circuit loss for each month from Table 3 23.26 21.01 23.26 22.51 23.26 22.51 23.26 23.26 22.51 23.26 22.51 23.26 (59)Combi loss for each month from Table 3a, 3b or 3c 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (61)Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m 201.17 177.28 196.30 186.12 166.76 163.36 145.88 140.02 153.76 153.52 172.93 182.96 (62)Solar DHW input calculated using Appendix G or Appendix H 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (63)Output from water heater for each month (kWh/month) (62)m + (63)m 166.76 201.17 177.28 186.12 163.36 145.88 140.02 153.76 153.52 172.93 182.96 196.30 2040.07 ∑(64)1...12 = (64)Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m] 88.80 78.74 83.80 76.65 76.23 69.71 68.47 73.03 72.25 79.41 82.04 87.18 (65) 5. Internal gains Feb Jan Mar Apr May Jun Jul Aug Sep Oct Nov Dec Metabolic gains (Table 5) 127.14 127.14 127.14 127.14 127.14 127.14 127.14 127.14 127.14 127.14 127.14 127.14 (66)Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 20.38 18.10 14.72 11.14 8.33 7.03 7.60 9.88 13.26 16.83 19.65 20.95 (67)Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 174.62 228.59 230.96 224.98 212.26 196.19 171.01 187.34 203.40 218.50 181.10 168.64 (68)Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 35.71 35.71 35.71 35.71 35.71 35.71 35.71 35.71 35.71 35.71 35.71 35.71 (69) Pump and fan gains (Table 5a) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 (70)Losses e.g. evaporation (Table 5) -101.71 -101.71 -101.71 -101.71 -101.71 -101.71 -101.71 -101.71 -101.71 -101.71 -101.71 -101.71 (71) Water heating gains (Table 5) 119.35 117.17 112.63 106.46 102.46 92.02 100.35 106.73 113.94 96.82 98.17 117.18 (72) Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m 429.46 427.37 413.47 391.00 368.12 346.09 331.78 337.82 349.36 372.05 398.13 417.76 (73) 6. Solar gains Access factor Solar flux FF Gains Area g Table 6d m² W/m<sup>2</sup> specific data specific data w or Table 6b or Table 6c 0.77 7.84 0.72 33.28 North 10.63 x 0.9 x 0.80 (74)х x х \_ South 0.77 10.91 46.75 x 0.9 x 0.72 0.80 203.60 х x = (78)х Solar gains in watts  $\Sigma(74)$ m...(82)m 236.88 397.04 532.81 653.64 734.08 731.74 704.08 642.22 573.63 435.35 282.39 203.67 (83)Total gains - internal and solar (73)m + (83)m 666.34 824.41 946.29 1044.64 1102.20 1077.83 1035.86 980.04 922.99 807.40 680.52 621.44 (84) 7. Mean internal temperature (heating season) Temperature during heating periods in the living area from Table 9, Th1(°C) 21.00 (85) Feb Dec Jan Mar Apr May Jun Jul Aug Sep Oct Nov

Jtilisation factor for gains for living area n1,m (see Table 9a)           0.99         0.96         0.89         0.75         0.39         0.28         0.31         0.50         0.80         0.97         0.99         (86)													
	0.99	0.96	0.89	0.75	0.56	0.39	0.28	0.31	0.50	0.80	0.97	0.99	(86)
Mean internal te	emp of livin	g area T1 (s	teps 3 to 7	in Table 9c	:)								
	20.41	20.62	20.82	20.95	20.99	21.00	21.00	21.00	21.00	20.94	20.66	20.37	(87)
Temperature du	ring heating	g periods in	the rest of	f dwelling fi	rom Table 9	9, Th2(°C)							
	20.24	20.24	20.24	20.25	20.25	20.27	20.27	20.27	20.26	20.25	20.25	20.24	(88)
Utilisation facto	r for gains f	or rest of d	welling n2,	m									
	0.99	0.95	0.87	0.71	0.52	0.35	0.23	0.26	0.44	0.76	0.96	0.99	(89)
Mean internal te	emperature	in the rest	of dwelling	g T2 (follow	steps 3 to	7 in Table 9	əc)						-
	19.71	19.91	20.09	20.22	20.25	20.27	20.27	20.27	20.26	20.21	19.96	19.67	(90)
Living area fract	ion								Li	ving area ÷	(4) =	0.39	(91)
Mean internal te	emperature	for the wh	ole dwellin	g fLA x T1 +	-(1 - fLA) x T	Т2							_
	19.98	20.19	20.38	20.50	20.54	20.55	20.55	20.55	20.55	20.49	20.23	19.95	(92)
Apply adjustmer	nt to the me	an internal	temperatu	ure from Ta	ble 4e whe	ere appropr	iate						
P.P. 7 3	19.98	20.19	20.38	20.50	20.54	20.55	20.55	20.55	20.55	20.49	20.23	19.95	(93)
	10.00	20120	20.00	20.00	_0.0 .	20.00		20.00	20.00	1 10.15		10100	] (55)
8. Space heatir	ng requirem	ent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor	r for gains, ı	յՠ											
	0.98	0.95	0.87	0.72	0.54	0.37	0.25	0.28	0.47	0.78	0.96	0.99	(94)
Useful gains, ŋm	nGm, W (94	)m x (84)m											
	656.13	783.65	827.24	754.14	592.36	394.47	262.10	274.47	429.40	626.65	651.04	614.82	(95)
Monthly average	e external to	emperature	from Tabl	e U1							•		-
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate fo	or mean inte	ernal tempe	rature, Lm	, W [(39)m	x [(93)m -	(96)m]							_
	1087.83	1056.95	956.09	785.91	596.61	394.72	262.12	274.50	430.63	667.78	892.41	1077.49	(97)
Space heating re	equirement,	kWh/mon	th 0.024 x	[(97)m - (9!	5)m] x (41)	m						1	], ,
	321.19	183.65	95.87	22.87	3.17	0.00	0.00	0.00	0.00	30.60	173.79	344.23	1
									Σ(9)	8)15. 10	.12 = 1	175.37	」 ](98)
Space heating re	equirement	kWh/m²/ve	ear						210	(98)	÷ (4)	13.91	(99)
		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,								(50)		10101	] (33)
9a. Energy requ	uirements -	individual	heating sys	stems inclu	ding micro	-CHP							
Space heating													
Fraction of space	e heat from	secondary	/suppleme	ntary syste	m (table 11	.)						0.00	(201)
Fraction of space	e heat from	main syste	m(s)							1 - (20	01) =	1.00	(202)
Fraction of space	e heat from	main syste	m 2									0.00	(202)
Fraction of total	space heat	from main	system 1						(20	02) x [1- (20	3)] =	1.00	(204)
Fraction of total	space heat	from main	system 2							(202) x (20	03) =	0.00	(205)
Efficiency of mai	in system 1	(%)										211.19	(206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	-
Space heating fu	iel (main sy	stem 1), kW	/h/month										
	152.08	86.96	45.39	10.83	1.50	0.00	0.00	0.00	0.00	14.49	82.29	162.99	]
		·			1				Σ(21)	1)15. 10	.12 =	556.54	_ ] (211)
Water heating									21		L		], ,
Efficiency of wat	ter heater												
, -	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	(217)
Water heating fi	uel, kWh/m	onth											] (==; )
	73.99	65.20	68.46	61.33	60.08	53.65	51.50	56.55	56.47	63.60	67.29	72.20	1
				- 2.00		_ 0.00	- 2.00	20.00	20.17				

			_			
			Σ	(219a)112 =	750.33	(219)
Annual totals						-
Space heating fuel - main system 1					556.54	
Water heating fuel					750.33	
Electricity for pumps, fans and electric keep-hot (Table 4f)						
mechanical ventilation fans - balanced, extract or positive inp	ut from outside		228.46			(230a)
Total electricity for the above, kWh/year					228.46	(231)
Electricity for lighting (Appendix L)					359.90	(232)
Total delivered energy for all uses		(211	1)(221) + (231) + (2	232)(237b) =	1895.23	(238)
10a. Fuel costs - individual heating systems including micro-CH	P					
	Fuel		Fuel price		Fuel	
	kWh/year				cost £/year	
Space heating - main system 1	556.54	x	13.19	x 0.01 =	73.41	(240)
Water heating	750.33	x	13.19	x 0.01 =	98.97	(247)
Pumps and fans	228.46	x	13.19	x 0.01 =	30.13	(249)
Electricity for lighting	359.90	x	13.19	x 0.01 =	47.47	(250)
Additional standing charges					0.00	(251)
Total energy cost			(240)(242) +	(245)(254) =	249.98	(255)
11a. SAP rating - individual heating systems including micro-CH	łP					
Energy cost deflator (Table 12)					0.42	(256)
Energy cost activities (Table 12)					0.42	) (250) ] (257)
					0.01	] (2 <i>37</i> ) ]
SAP value					88.09	 (250)
SAP rating (section 13)					89	_ (258) _
SAP Dano					В	
12a. $CO_2$ emissions - individual heating systems including micro	o-CHP					
	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO₂/year	
Space heating - main system 1	556.54	×	0.519	=	288.85	(261)
Water heating	750.33	×	0.519	=	389.42	(264)
Space and water heating	100.00		(261) + (262) + (	263) + (264) =	678.27	(265)
Pumps and fans	228.46	×	0.519	=	118 57	(267)
Electricity for lighting	228.40	×	0.519	_	186.70	(268)
	335.50	~	0.515	-	083.62	(200)
Dwelling CO, emission rate				(203)(271) -	11.64	(272)
				(272) · (4) -	00.02	] (273)
El value					05.02	 (274)
El hand					90	] (274) ]
Erband					В	
13a. Primary energy - individual heating systems including mic	ro-CHP					
	Energy kWh/year		Primary factor		Primary Energy kWh/year	/
Space heating - main system 1	556.54	x	3.07	=	1708.59	(261)
Water heating	750.33	x	3.07	=	2303.51	(264)
				2(2) . (2(4)	4012.10	

Electricity for lighting Primary energy kWh/year

Pumps and fans

PREVIEW - THIS VERSION HAS NOT BEEN APPROVED

х

х

3.07

3.07

=

=

228.46

359.90

701.37

1104.88

5818.35

(267)

(268)

(272)

# TER Worksheet Design - Draft



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

Assessor name	Mi	<sup>.</sup> Harry Kni	bb							Ass	essor num	ber	1		
Client										Las	t modified		23/02	2/2017	
Address	18	Canfield P	lace HS	S-B2 Lond	on										
Address	10	cannela		, Lona	on										
1. Overall dwelling d	imensions	;													
						Α	rea (m²)			Avera hei	ige storey ght (m)		Ve	olume (m³)	
Lowest occupied							40.90	<mark>(1a)</mark> x			2.90	(2a) =		118.61	(3a)
+1							40.90	(1b) x			2.90	(2b) =		118.61	(3b)
+2							2.70	<mark>(1c)</mark> x			3.10	(2c) =		8.37	(3c)
Total floor area		(1a) + (1	.b) + (1	c) + (1d)	(1n) =		84.50	(4)							
Dwelling volume										(3a) -	+ (3b) + (3d	c) + (3d)(3	3n) =	245.59	(5)
2. Ventilation rate															
													m	<sup>3</sup> per hour	
Number of chimneys											0	x 40 =		0	(6a)
Number of open flues											0	x 20 =		0	(6b)
Number of intermitter	nt fans										3	x 10 =		30	(7a)
Number of passive ver	nts										0	x 10 =		0	(7b)
Number of flueless gas	s fires										0	x 40 =		0	(7c)
													Air	changes pe hour	r
Infiltration due to chin	nneys, flue	es, fans, PS	SVs			(6a)	+ (6b) + (7	a) + (7b) +	+ (7c) =		30	÷ (5) =		0.12	(8)
If a pressurisation test	has been	carried ou	t or is ii	ntended, p	orocee	d to (	17), otherw	vise contir	nue from	n (9) to	o (16)				_
Air permeability value,	, q50, expi	ressed in c	ubic me	etres per l	nour p	er squ	are metre	of envelo	pe area					5.00	(17)
If based on air permea	bility valu	e, then (18	3) = [(17	7) ÷ 20] + (	8), ot	herwis	se (18) = (1	6)						0.37	(18)
Number of sides on wl	hich the d	welling is s	heltere	ed										3	(19)
Shelter factor											1 -	[0.075 x (1	9)] =	0.78	(20)
Infiltration rate incorp	orating sh	elter facto	r									(18) x (2	20) =	0.29	(21)
Infiltration rate modifi	ed for mo	nthly wind	l speed	:											_
Ja	in F	eb I	Mar	Apr	Ν	/lay	Jun	Jul	A	ug	Sep	Oct	Nov	Dec	
Monthly average wind	l speed fro	m Table U	2												
5.2	10 5	.00 4	4.90	4.40	4	.30	3.80	3.80	3.	70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m $\div$ 4															
1.2	28 1	.25 2	1.23	1.10	1	.08	0.95	0.95	0.	93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration ra	ate (allowi	ng for shel	ter and	I wind fact	:or) (2	1) x (2	2a)m								
0.3	37 0	.36 (	0.35	0.32	0	.31	0.27	0.27	0.	27	0.29	0.31	0.32	0.34	(22b)
Calculate effective air	change ra	te for the a	applical	ble case:											
If mechanical venti	lation: air	change rat	te throu	ugh syster	n									N/A	(23a)
If balanced with he	at recover	y: efficien	cy in %	allowing f	or in-	use fa	ctor from T	able 4h						N/A	(23c)
d) natural ventilatio	on or who	le house p	ositive	input ven	tilatio	n from	n loft								
0.5	57 0	.56 (	0.56	0.55	0	.55	0.54	0.54	0.	54	0.54	0.55	0.55	0.56	(24d)



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

			0 56	0 55	iu) iii (23)	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(25)
	0.57	0.50	0.50	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.50	_ (23)
3. Heat losses a	and heat lo	ss paramete	er										
Element			а	Gross rea, m²	Openings m <sup>2</sup>	s Net A,	area m²	U-value W/m²K	A x U W	//К к-v kJ	/alue, /m².K	Ахк, kJ/K	
Window						18	8.75 x	1.33	= 24.86	5			(27)
Ground floor						40	).90 x	0.13	= 5.32				(28a)
External wall						55	.49 x	0.18	= 9.99				(29a)
Party wall						74	.82 x	0.00	= 0.00				(32)
Roof						40	).90 x	0.13	= 5.32				(30)
Total area of ext	ernal elem	ents ∑A, m²				15	6.04						(31)
Fabric heat loss,	W/K = ∑(A	× U)							(2	6)(30) + (	32) =	45.48	(33)
Heat capacity Cr	n = ∑(А x к)							(28)	.(30) + (32)	+ (32a)(3	2e) =	N/A	(34)
Thermal mass pa	arameter (1	MP) in kJ/m	1²K									250.00	(35)
Thermal bridges	: Σ(L x Ψ) c	alculated us	ing Appen	dix K								2.62	(36)
Total fabric heat	loss									(33) + (	36) =	48.10	(37)
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat	loss calcula	ated monthl	y 0.33 x (2	25)m x (5)						-		-	_
	46.00	45.79	45.58	44.60	44.42	43.56	43.56	43.41	43.89	44.42	44.79	45.18	(38)
Heat transfer co	efficient, W	//K (37)m +	(38)m	1			1			1	1	1	-
	94.10	93.89	93.68	92.70	92.51	91.66	91.66	91.50	91.99	92.51	92.88	93.27	
	. (		· · · · ·						Average = 2	∑(39)112,	/12 =	92.70	(39)
Heat loss param	eter (HLP),	W/m²K (39	)m ÷ (4)		T			1		1		1	-
	1.11	1.11	1.11	1.10	1.09	1.08	1.08	1.08	1.09	1.09	1.10	1.10	
Number of dave	in month (	Table 1a)							Average =	2(40)112,	/12 =	1.10	_ (40)
Number of days	21.00		21.00	20.00	21.00	20.00	21.00	21.00	20.00	21.00	20.00	21.00	(40)
	51.00	28.00	51.00	30.00	51.00	30.00	51.00	51.00	30.00	51.00	30.00	51.00	_ (40)
4. Water heating	ng energy r	equirement	t										
Assumed occupa	ancy, N											2.54	(42)
Annual average	hot water ι	isage in litre	es per day	Vd,average	= (25 x N) +	36						94.59	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage	in litres pe	r day for ea	ch month	Vd,m = fact	tor from Tab	ole 1c x (43	3)		_			-	_
	104.05	100.27	96.48	92.70	88.91	85.13	85.13	88.91	92.70	96.48	100.27	104.05	
										∑(44)1	.12 =	1135.08	(44)
Energy content of	of hot wate	r used = 4.1	.8 x Vd,m x	x nm x Tm/3	3600 kWh/m	nonth (see	Tables 1b	, 1c 1d)				1	7
	154.30	134.95	139.26	121.41	116.50	100.53	93.15	106.89	108.17	126.06	137.61	149.43	 
Distribution loss	0.45/45	\								∑(45)1	.12 =	1488.26	_ (45)
Distribution loss	0.15 X (45	)m	20.90	19.21	17.47	15.00	12.07	16.02	16.22	18.01	20.64	22.41	
Storago volumo	(litros) inclu	20.24	20.89	18.21	17.47	15.08	13.97	10.03	10.23	18.91	20.64	150.00	(40)
Water storage lo		uning any sc			ge within sai	ne vessei						150.00	_ (47)
a) If manufacture	or's declare	nd loss facto	r is known	(kWb/day)								1 39	(48)
Temperatura	factor from	n Tahle 2h		(Kwii/uay)	,							0.54	_ (40) ] ( <u>4</u> 0)
Fnerøv lost fr	om water o	storage (kM	h/dav) (49	3) x (49)								0.75	( <del>+</del> <i>3)</i> (50)
Enter (50) or (54	) in (55)	COLOGE (KVV	,, (+0	-, ^ ()								0.75	(55) (55)
Water storage In	oss calculat	ed for each	month (55	5) x (41)m								0.75	
	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)
		,	_0.00		_0.00		_0.00					_0.00	

If the vessel con	itains dedica	ated solar s	storage or d	edicated W	/WHRS (56	5)m x [(47) -	Vs] ÷ (47),	else (56)					
	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)
Primary circuit l	oss for each	month fro	om Table 3						·				
	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Combi loss for e	ach month	from Table	e 3a, 3b or 3	с									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requi	red for wate	er heating	calculated f	or each mo	onth 0.85 >	k (45)m + (4	6)m + (57)r	n + (59)m +	+ (61)m				
	200.90	177.04	185.85	166.50	163.09	145.62	139.75	153.49	153.26	172.66	182.70	196.03	(62)
Solar DHW inpu	t calculated	using App	endix G or A	ppendix H									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from wa	iter heater f	or each mo	onth (kWh/r	month) (62	2)m + (63)r	n							
	200.90	177.04	185.85	166.50	163.09	145.62	139.75	153.49	153.26	172.66	182.70	196.03	]
										∑(64)1	12 = 2	036.88	(64)
Heat gains from	water heat	ing (kWh/r	month) 0.25	5 × [0.85 ×	(45)m + (6	1)m] + 0.8 ×	[(46)m + (!	57)m + (59)	)m]				
	88.58	78.54	83.58	76.44	76.01	69.50	68.25	72.82	72.04	79.19	81.83	86.96	(65)
5 Internal gair	25												
J. Internal gai	lan	Eeb	Mar	Apr	May	lun	Int	Διισ	Sen	Oct	Nov	Dec	
Metabolic gains	(Table 5)	100	Widi	ΛÞ.	inay	Jun	541	AMP.	JCP	ott	1101	Dee	
Wietubolie guilis	127 14	127 14	127 14	127 14	127 14	127 14	127 14	127 14	127 14	127 14	127 14	127 14	(66)
Lighting gains (c	alculated in	Appendix	L equation	19 or 19a).	also see T	able 5	127.14	127.14	127.14	127.14	127.14	127.14	(00)
	20.38	18 10	1/1 72	11 15	8 33	7.03	7.60	9.88	13.26	16.84	19.65	20.95	(67)
Appliance gains	(calculated	in Append	ix L. equation	n   13 or   1	13a), also s	ee Table 5	7.00	5.00	15.20	10.04	15.05	20.55	(07)
rippiiance Banie	228 59	230.96	224.98	212 26	196 19	181 10	171.01	168 64	174 62	187 34	203 40	218 50	(68)
Cooking gains (c	calculated in	Appendix	L. equation	L15 or L15	a). also see	e Table 5		100.01		207101			(00)
00000	35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71	(69)
Pump and fan g	ains (Table 5	5a)				1							()
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evap	oration (Tab	ble 5)						1	1			1	
	-101.71	-101.71	-101.71	-101.71	-101.71	-101.71	-101.71	-101.71	-101.71	-101.71	-101.71	-101.71	(71)
Water heating g	ains (Table	5)							4				
	119.06	116.88	112.34	106.17	102.16	96.53	91.73	97.87	100.06	106.44	113.65	116.88	(72)
Total internal ga	ains (66)m +	- (67)m + (6	68)m + (69)ı	m + (70)m ·	+ (71)m + (	(72)m							
	432.17	430.08	416.18	393.71	370.83	348.80	334.48	340.53	352.07	374.76	400.85	420.48	(73)
6. Solar gains													
			Access f Table	actor 6d	Area m <sup>2</sup>	Sol	ar flux //m²	spec	g sific data	FF specific d	lata	Gains W	
								or T	able 6b	or Table	6c		
North			0.7	7 x	7.84	x 1	0.63 x	0.9 x 🚺	0.63 x	0.70	=	25.48	(74)
South			0.77	7 x	10.91	x 4	6.75 x	0.9 x 🔤	0.63 x	0.70	=	155.88	(78)
Solar gains in wa	atts ∑(74)m	(82)m											
	181.36	303.98	407.94	500.44	562.03	560.24	539.06	491.70	439.18	333.32	216.20	155.94	(83)
Total gains - inte	ernal and so	lar (73)m +	+ (83)m										
	613.53	734.06	824.12	894.15	932.86	909.04	873.55	832.23	791.26	708.08	617.05	576.41	(84)
7													
7. Mean intern	ial tempera	ture (heati	ing season)			1("0)						24.62	(0=)
remperature du	iring heating	g periods ir	n the living a	area trom T	able 9, Th	1( C)	11	۸	Car	0.00	Ne:-	21.00	(85)
	Jan	rep	war	Apr	iviay	Jun	Jul	Aug	sep	Oct	NOV	Dec	

Utilisation factor for gains for living area n1,m (see Table 9a)													
	1.00	0.99	0.97	0.92	0.80	0.62	0.46	0.50	0.74	0.94	0.99	1.00	(86)
Mean internal t	emp of livin	g area T1 (s	teps 3 to 7	in Table 9c	.)								
	19.92	20.12	20.37	20.66	20.88	20.98	21.00	20.99	20.94	20.67	20.24	19.89	(87)
Temperature du	uring heating	g periods in	the rest of	dwelling fr	om Table 9	9, Th2(°C)							
	19.99	19.99	19.99	20.00	20.01	20.01	20.01	20.01	20.01	20.01	20.00	20.00	(88)
Utilisation facto	r for gains f	or rest of d	welling n2,	m									
	0.99	0.98	0.96	0.89	0.75	0.54	0.36	0.40	0.65	0.91	0.98	1.00	(89)
Mean internal t	emperature	in the rest	of dwelling	T2 (follow	steps 3 to	7 in Table 9	Эс)						-
	18.57	18.85	19.22	19.62	19.89	20.00	20.01	20.01	19.97	19.64	19.03	18.52	(90)
Living area fract	ion								Li	ving area ÷	(4) =	0.39	(91)
Mean internal t	emperature	for the wh	ole dwellin	g fLA x T1 +	•(1 - fLA) x T	Г2							-
	19.10	19.35	19.67	20.03	20.27	20.38	20.40	20.40	20.35	20.04	19.50	19.05	(92)
Apply adjustme	nt to the me	an internal	temperatu	ire from Ta	ble 4e whe	re appropr	iate				1	1	
	19.10	19.35	19.67	20.03	20.27	20.38	20.40	20.40	20.35	20.04	19.50	19.05	(93)
													] (,
8. Space heating	ng requirem	ient											
	Jan	Feb	Mar	Apr	May	Jun	luL	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	r for gains,	ηm											
	0.99	0.98	0.96	0.89	0.76	0.57	0.40	0.44	0.68	0.91	0.98	0.99	(94)
Useful gains, ηn	nGm, W (94	)m x (84)m											
	608.49	719.62	787.15	798.28	713.27	516.44	346.31	362.91	540.77	646.68	605.74	572.86	(95)
Monthly averag	e external t	emperature	e from Tabl	e U1									
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate fo	or mean inte	ernal tempe	rature, Lm	, W [(39)m	x [(93)m -	(96)m]							
	1392.54	1356.39	1233.58	1031.59	793.30	529.74	347.95	365.60	574.68	873.17	1151.90	1385.51	(97)
Space heating re	equirement,	, kWh/mon	th 0.024 x	[(97)m - (9	5)m] x (41)ı	m							_
	583.33	427.91	332.14	167.98	59.54	0.00	0.00	0.00	0.00	168.51	393.23	604.61	7
						•		•	Σ(98	8)15, 10	.12 = 2	737.26	(98)
Space heating ro	equirement	kWh/m²/ye	ear						2.	(98)	÷ (4)	32.39	(99)
		,								. ,	. ,		
9a. Energy req	uirements -	individual	heating sys	stems inclu	ding micro	-CHP							
Space heating													
Fraction of space	e heat from	secondary	/suppleme	ntary system	m (table 11	)						0.00	(201)
Fraction of space	e heat from	main syste	m(s)							1 - (20	01) =	1.00	(202)
Fraction of space	e heat from	main syste	m 2									0.00	(202)
Fraction of tota	l space heat	from main	system 1						(20	02) x [1- (20	3)] =	1.00	(204)
Fraction of tota	l space heat	from main	system 2							(202) x (20	03) =	0.00	(205)
Efficiency of ma	in system 1	(%)										93.50	(206)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating for	uel (main sy	stem 1), kW	/h/month										
	623.89	457.66	355.23	179.66	63.68	0.00	0.00	0.00	0.00	180.22	420.57	646.64	
									∑(21:	1)15, 10	.12 = 2	927.55	(211)
Water heating													_
Efficiency of wa	ter heater												
	87.49	87.08	86.35	84.84	82.41	79.80	79.80	79.80	79.80	84.75	86.81	87.62	(217)
Water heating f	uel, kWh/m	onth					•			•		•	
-	229.61	203.30	215.24	196.26	197.91	182.48	175.12	192.34	192.06	203.73	210.46	223.72	1
				-	-	-		-				1	-

				Σ(219a)112 =	2422.23	(219)
Annual totals				2()		
Space heating fuel - main system 1					2927.55	]
Water heating fuel					2422.23	]
Electricity for pumps, fans and electric keep-hot (Table 4f)						
central heating pump or water pump within warm air heat	ting unit		30.00	]		(230c)
boiler flue fan			45.00	]		(230e)
Total electricity for the above, kWh/year				1	75.00	(231)
Electricity for lighting (Appendix L)					359.93	(232)
Total delivered energy for all uses		(211)	(221) + (231) +	(232)(237b) =	5784.72	(238)
		( )	x	(-) ()		] (,
10a. Fuel costs - individual heating systems including micro	-CHP					
	Fuel kWh/year		Fuel price		Fuel cost f/year	
Space heating - main system 1	2027 55	v	3 / 8	x 0.01 -	101.88	(240)
Water heating	2927.35	×	2.40	x 0.01 -	94.20	] (240) ] (247)
Numer and fanc	75.00	×	12 10	] X0.01 -	0.90	] (247) ] (240)
Electricity for lighting	259.93	×	13.19	x 0.01 -	3.03 17.18	] (249) ] (250)
Additional standing charges	333.33	^	13.13	J X 0.01 -	120.00	] (250) ] (251)
			(240) (242).	± (245) (254) -	363 54	] (255)
			(240)(242)	+ (243)(234) -	505.34	] (233)
11a. SAP rating - individual heating systems including micro	o-CHP					
Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					1.18	(257)
SAP value					83.55	
SAP rating (section 13)					84	(258)
SAP band					В	
12a. CO <sub>2</sub> emissions - individual heating systems including m	nicro-CHP					
	Energy kWh/year		Emission factor kg CO <sub>2</sub> /kWh		Emissions kg CO₂/year	
Space heating - main system 1	2927.55	x	0.216	=	632.35	(261)
Water heating	2422.23	x	0.216	=	523.20	(264)
Space and water heating			(261) + (262) +	- · (263) + (264) =	1155.55	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	359.93	x	0.519	=	186.81	(268)
Total CO <sub>2</sub> , kg/year				(265)(271) =	1381.28	(272)
Dwelling CO <sub>2</sub> emission rate				(272) ÷ (4) =	23.87	(273)
El value					85.71	]
El rating (section 14)					86	(274)
El band					В	]
13a. Primary energy - individual heating systems including	micro-CHP					
	Energy kWh/year		Primary factor		Primary Energy kWh/year	,

Space heating - main system 1       2927.55       x       1.22       =       3571.61       (261)         Water heating       2422.23       x       1.22       =       2955.12       (264)         Space and water heating       (261) + (262) + (263) + (264) =       6526.73       (265)         Pumps and fans       75.00       x       3.07       =       230.25       (267)         Electricity for lighting       359.93       x       3.07       =       1105.00       (268)		kWh/year				kWh/year	
Water heating       2422.23       x       1.22       =       2955.12       (264         Space and water heating       (261) + (262) + (263) + (264) =       6526.73       (265         Pumps and fans       75.00       x       3.07       =       230.25       (267         Electricity for lighting       359.93       x       3.07       =       1105.00       (268	Space heating - main system 1	2927.55	] x	1.22	=	3571.61	(261)
Space and water heating       (261) + (262) + (263) + (264) =       6526.73       (265         Pumps and fans       75.00       x       3.07       =       230.25       (267         Electricity for lighting       359.93       x       3.07       =       1105.00       (268	Water heating	2422.23	] x	1.22	=	2955.12	(264)
Pumps and fans       75.00       x       3.07       =       230.25       (267         Electricity for lighting       359.93       x       3.07       =       1105.00       (268	Space and water heating			(261) + (262) +	(263) + (264) =	6526.73	(265)
Electricity for lighting 359.93 x 3.07 = 1105.00 (268	Pumps and fans	75.00	] x	3.07	=	230.25	(267)
	Electricity for lighting	359.93	] x	3.07	=	1105.00	(268)

PREVIEW - THIS VERSION HAS NOT BEEN APPROVED

Primary energy kWh/year Dwelling primary energy rate kWh/m2/year

7861.98	(272)
93.04	(273)

# DER Worksheet Design - Draft



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

Assessor name		Mr Harry	Knibb							Asses	sor num	nber	1			
Client		,								Last r	nodified		27	7/02/	2017	
Addross		20 Capfie		C1 Lond	<u></u>											
Address		20 Carme	iu Flace fis	-c1, LUIIU	UII											
1. Overall dwelli	ing dimens	sions														
						Ar	rea (m²)			Averago heigh	e storey nt (m)			Vol	ume (m³)	
Lowest occupied					[		42.30	(1a) x	ſ	2.	90	(2a) =	[	:	122.67	(3a)
+1					[		42.30	] (1b) x	Ē	2.	90	(2b) =	[		122.67	(3b)
+2					[		42.30	(1c) x	Ē	2.	90	(2c) =	[		122.67	(3c)
Total floor area		(1a)	+ (1b) + (1d	c) + (1d)	(1n) = [	1	126.90	(4)								
Dwelling volume										(3a) + (	(3b) + (3	c) + (3d)(	3n) = [		368.01	(5)
	1 -							_								
2. Ventilation ra	te														nor hour	
Number of shires									Г			]	Γ			
Number of chimn	eys								L	(	) )	] X 40 :	] = ]			] (6a)
Number of open f	riues	_							L		)		] = 1			] (60) ] (7-)
Number of Intern	nittent fans	S									) 	] X 10 :	] = [			](/a) ](⁊ᢑ)
Number of passiv	e vents								Г		) )		] = 1			] (70) ] (70)
Number of flueles	ss gas mes								L		J	J X 40	- [	Air c	banges ne	] ( <i>/</i> C)
															hour	
Infiltration due to	chimneys	, flues, fans	, PSVs			(6a) -	+ (6b) + (7a	a) + (7b) + (	7c) = [	(	0	] ÷ (5)	= [		0.00	(8)
If a pressurisation	n test has b	been carried	l out or is ii	ntended, p	oroceea	to (1	7), otherw	ise continu	e from	(9) to (	16)	-				-
Air permeability v	value, q50,	expressed	in cubic me	etres per h	nour pe	r squ	are metre	of envelope	e area				[		3.00	(17)
If based on air per	rmeability	value, ther	(18) = [(17	7) ÷ 20] + (	8), oth	erwis	e (18) = (16	5)					[		0.15	(18)
Number of sides of	on which t	he dwelling	is sheltere	ed									[		3	(19)
Shelter factor											1 -	[0.075 x (1	.9)] = [		0.78	(20)
Infiltration rate in	corporatir	ng shelter fa	actor									(18) x (	20) = [		0.12	(21)
Infiltration rate m	odified for	r monthly v	vind speed	:												
	Jan	Feb	Mar	Apr	Ma	ay	Jun	Jul	Au	g	Sep	Oct	No	v	Dec	
Monthly average	wind spee	d from Tab	le U2													
	5.10	5.00	4.90	4.40	4.3	30	3.80	3.80	3.7	0	4.00	4.30	4.5	50	4.70	(22)
Wind factor (22)n	n ÷ 4															_
	1.28	1.25	1.23	1.10	1.0	)8	0.95	0.95	0.9	3	1.00	1.08	1.1	3	1.18	(22a)
Adjusted infiltrati	on rate (al	lowing for	shelter and	wind fact	or) (21	) x (22	2a)m									_
L	0.15	0.15	0.14	0.13	0.1	12	0.11	0.11	0.1	1	0.12	0.12	0.1	.3	0.14	(22b)
Calculate effective	e air chang	ge rate for t	he applical	ble case:									-			_
If mechanical	ventilation	: air change	e rate throu	ugh systen	n										0.50	(23a)
If balanced wit	th heat rec	covery: effic	ciency in %	allowing f	or in-u	se fac	tor from T	able 4h							74.80	(23c)
a) If balanced	mechanica	al ventilatio	n with hea	t recovery		R) (22	b)m + (23b	o) x [1 - (23)	c) ÷ 100	)] 		1	1			-
L	0.27	0.27	0.27	0.25	0.2	25	0.24	0.24	0.2	3	0.24	0.25	0.2	26	0.26	(24a)



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

	0.27	0.27	0.27	0.25	0.25	0 24	0.24	0.23	0.24	0.25	0.26	0.26	(25)
	0.27	0.27	0.27	0.25	0.23	0.24	0.24	0.23	0.24	0.23	0.20	0.20	_ (23)
3. Heat losses	and heat lo	oss paramet	er										
Element			-	Gross	Openings	s Net	area m²	U-value	A x U W	/К к-ч	value, /m² K	Ахк,	
Window			d	irea, iii		A,			- 22 54		/111 .K	KJ/ K	(27)
Ground floor						23	230 V	0.11	- 35.54				(27)
External wall						90		0.11	= 4.05				(208)
Party wall						10	7.88 x	0.00	= 0.00				(32)
Roof						42	2.30 x	0.11	= 4.65				(30)
Total area of ext	ternal elem	ents ∑A, m²				20	4.66						(31)
Fabric heat loss,	, W/K = ∑(A								(26	5)(30) + (	32) =	57.37	(33)
Heat capacity Cr	m = ∑(А x к)	)						(28)	.(30) + (32) -	+ (32a)(3	2e) =	N/A	(34)
Thermal mass p	arameter (1	TMP) in kJ/n	n²K									250.00	(35)
Thermal bridges	s: Σ(L x Ψ) c	alculated us	ing Appen	dix K								10.24	(36)
Total fabric heat	t loss									(33) + (	36) =	67.60	(37)
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat	t loss calcula	ated month	ly 0.33 x (2	25)m x (5)									
	33.30	32.95	32.60	30.83	30.48	28.71	28.71	28.36	29.42	30.48	31.18	31.89	(38)
Heat transfer co	efficient, W	V/K (37)m +	- (38)m										_
	100.91	100.55	100.20	98.44	98.08	96.32	96.32	95.97	97.02	98.08	98.79	99.50	
									Average = 2	(39)112	/12 =	98.35	(39)
Heat loss param	eter (HLP),	W/m²K (39	9)m ÷ (4)	1						[	T		_
	0.80	0.79	0.79	0.78	0.77	0.76	0.76	0.76	0.76	0.77	0.78	0.78	 ¬
	in month (								Average = 2	(40)112	/12 =	0.78	_ (40)
Number of days			21.00	20.00	21.00	20.00	21.00	21.00	20.00	21.00	20.00	21.00	
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	_ (40)
4. Water heati	ng energy r	requiremen	t										
Assumed occupa	ancy, N											2.89	(42)
Annual average	hot water u	usage in litre	es per day	Vd,average	e = (25 x N) +	36						102.75	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage	e in litres pe	er day for ea	ich month	Vd,m = fact	tor from Tak	ole 1c x (43	3)	_ <b>.</b>				_	_
	113.03	108.92	104.81	100.70	96.59	92.48	92.48	96.59	100.70	104.81	108.92	113.03	
										∑(44)1	.12 =	1233.05	(44)
Energy content	of hot wate	er used = 4.1	.8 x Vd,m >	(nm x Tm/3	3600 kWh/m	nonth (see	Tables 1k	o, 1c 1d)	1		1	1	-
	167.62	146.60	151.28	131.89	126.55	109.20	101.19	116.12	117.51	136.94	149.48	162.33	
Distribution loss		1.00								∑(45)1	.12 =	1616.72	_ (45)
DISTRIBUTION 1055	0.15 X (45	21.00	22.60	10.79	10.00	16 20	1E 10	17.40	17.62	20 54	22.42	24.25	(46)
Storage volume	(litres) inclu		22.09	HRS stored	10.90		15.10	17.42	17.05	20.54	22.42	150.00	(40) (47)
Water storage lo		duing any so				ne vessei						150.00	(+7)
a) If manufactur	er's declare	ed loss facto	or is known	(kWh/day)	)							1 41	(48)
Temperature	e factor from	m Table 2b										0.54	(49)
Energy lost f	rom water	storage (kW	'h/dav) (4	8) x (49)								0.76	(50)
Enter (50) or (54	4) in (55)	0- (	, -,/ ( <sup>1</sup>	/								0.76	(55)
Water storage lo	oss calculat	ed for each	month (5	5) x (41)m							L		
-	23.60	21.32	23.60	22.84	23.60	22.84	23.60	23.60	22.84	23.60	22.84	23.60	(56)
		-						-					-

If the vessel con	tains dedica	ated solar s	torage or d	edicated W	/WHRS (56)	)m x [(47)	- Vs] ÷ (47),	else (56)					
	23.60	21.32	23.60	22.84	23.60	22.84	23.60	23.60	22.84	23.60	22.84	23.60	(57)
Primary circuit l	oss for each	month fro	m Table 3										
	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Combi loss for e	ach month	from Table	3a, 3b or 3	с									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	] (61)
Total heat requi	red for wate	er heating o	calculated f	or each mo	onth 0.85 x	(45)m + (4	46)m + (57)	m + (59)m ·	+ (61)m				
	214.48	188.93	198.14	177.24	173.42	154.56	148.06	162.99	162.86	183.81	194.84	209.20	] (62)
Solar DHW inpu	t calculated	using Appe	endix G or A	Appendix H			_	_					_
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from wa	ter heater f	or each mo	onth (kWh/ı	month) (62	2)m + (63)m	ו ו					1	1	٦
	214.48	188.93	198.14	177.24	173.42	154.56	148.06	162.99	162.86	183.81	194.84	209.20	
					(		5(1.0)	() (		∑(64)1	.12 = 2	168.52	(64)
Heat gains from	water heat	ing (kWh/n	nonth) 0.25	5 × [0.85 ×	(45)m + (61	.)m] + 0.8	× [(46)m +	(57)m + (59	)m]				7 (0-)
	93.23	82.61	87.79	80.14	/9.57	/2.59	/1.14	/6.10	/5.35	83.03	85.99	91.47	] (65)
5. Internal gair	ıs												
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains	(Table 5)												
	144.32	144.32	144.32	144.32	144.32	144.32	144.32	144.32	144.32	144.32	144.32	144.32	(66)
Lighting gains (c	alculated in	Appendix	L, equation	L9 or L9a),	also see Ta	ble 5							
	26.21	23.28	18.93	14.33	10.71	9.04	9.77	12.70	17.05	21.65	25.27	26.93	] (67)
Appliance gains	(calculated	in Appendi	ix L, equatio	on L13 or L	13a), also se	ee Table 5							_
	293.94	296.99	289.31	272.94	252.29	232.87	219.90	216.85	224.54	240.90	261.56	280.97	(68)
Cooking gains (c	alculated in	Appendix	L, equation	L15 or L15	a), also see	Table 5							-
	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	(69)
Pump and fan g	ains (Table 5	5a)					1	1					٦
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	] (70)
Losses e.g. evap			115.40	115 40	115 40	115 40	115 40	115.40	115.40	115 40	115 40	115 40	7 (74)
Water beating a	-115.40	-115.40 5)	-115.46	-115.46	-115.46	-115.46	-115.46	-115.46	-115.46	-115.46	-115.46	-115.46	] (/1)
water neating g		122.02	119.00	111.20	106.05	100.92	05.62	102.20	104.66	111 50	110.42	122.04	] (72)
Total internal ga	123.30	122.95 + (67)m + (f	58)m + (69)	m + (70)m	+ (71)m + (7	72)m	95.02	102.29	104.00	111.39	119.43	122.94	] (72)
	511.75	509.50	492.53	464.87	436.25	409.04	391.59	398.14	412.55	440.44	472.55	497.15	(73)
	511.75	303.30	152.55	101.07	150.25	105.01	331.33	550.11	112.00	110.11	172.33	137.13	] (, 3)
6. Solar gains													
			Access f	actor	Area	So	lar flux		g sific data	FF	data	Gains	
			Table	ou			vv/111	or T	Table 6b	or Table	e 6c	vv	
North			0.7	7 X	7.84	x	10.63	( 0.9 x	0.72 x	0.80	=	33.28	(74)
South			0.7	7 X	21.45		46.75	( 0.9 x	0.72 x	0.80	= [	400.30	(78)
Solar gains in wa	atts ∑(74)m	ı(82)m											-
	433.58	719.18	943.16	1117.42	1217.36	1196.84	1158.51	1083.53	1002.29	782.81	515.54	373.64	(83)
Total gains - inte	ernal and so	lar (73)m +	· (83)m	_	_	_	_	_	_	_	_	_	
	945.33	1228.68	1435.70	1582.29	1653.61	1605.88	1550.10	1481.68	1414.83	1223.25	988.09	870.78	(84)
7 Magainterr		turo (kesti											
Tomporature d	ring hosting	ure (neati	the living		Table 0 The	(°C)						21.00	
remperature du	ining neating	perious ir <b>دمہ</b>	Mar	Anr	aule 9, 1111 May	lun	hul	Δυσ	San	Oct		21.00 Dec	(כס) [
	2011					2411	301	~~5	JCP			500	

Utilisation factor	r for gains f	or living are	a n1,m (se	e Table 9a)									
	0.99	0.96	0.88	0.72	0.55	0.38	0.27	0.30	0.47	0.78	0.97	0.99	(86)
Mean internal te	emp of livin	g area T1 (s	teps 3 to 7	in Table 9c	:)								
	20.41	20.65	20.85	20.96	20.99	21.00	21.00	21.00	21.00	20.95	20.67	20.36	(87)
Temperature du	ring heating	g periods in	the rest of	dwelling fr	rom Table 9	9, Th2(°C)							
	20.26	20.26	20.26	20.27	20.28	20.29	20.29	20.29	20.28	20.28	20.27	20.27	(88)
Utilisation factor	r for gains for	or rest of d	welling n2,	m									<u> </u>
	0.99	0.95	0.85	0.69	0.51	0.34	0.23	0.25	0.42	0.74	0.96	0.99	(89)
Mean internal te	emperature	in the rest	of dwelling	T2 (follow	steps 3 to	7 in Table 9	) Əc)	I			1		], ,
		19.96	20.14	20.25	20.27	20.29	20.29	20.29	20.28	20.24	19.99	19.69	(90)
Living area fracti	ion	19.90	20.11	20.25	20.27	20.25	20.23	20.25	10.20	ving area -	(A) =	0.26	] (91)
Mean internal te	emnerature	for the wh	ole dwellin	σ fl Δ x T1 +	-(1 - fl Δ) x T	г2				ving area .	(-) -	0.20	] (31)
Wear meenarie		20.14	20.22	20.44	20.46	20.47	20.47	20.48	20.47	20.42	20.17	10.96	
Apply adjustment	19.90	20.14	20.33	20.44	20.40	20.47	20.47	20.48	20.47	20.43	20.17	19.80	] (92)
Apply aujustiner								20.40	20.47	20.42	20.47	40.00	
	19.90	20.14	20.33	20.44	20.46	20.47	20.47	20.48	20.47	20.43	20.17	19.86	] (93)
8. Space heatin	ig requirem	ent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor	r for gains. I	าฑ						Ū					
	0.99	0.95	0.86	0.70	0.52	0.35	0.24	0.26	0.44	0.75	0.96	0.99	(94)
Useful gains nm	Gm W (9/	)m x (84)m	0.00	0.70	0.52	0.55	0.24	0.20	0.44	0.75	0.50	0.55	] (34)
			1220.08	1101 20	955.07	565.52	272.12	201.10	616.09	019 52	046.07	962.90	
Monthly avorage	955.47		1229.90	0.111	655.07	505.52	575.12	591.10	010.98	910.52	940.97	005.80	] (95)
				0.00	11.70	11.00	10.00	16.40	1110	10.00	7.40	4.20	
llest less weter fo	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	] (96)
Heat loss rate to	r mean inte	ernal tempe	rature, Lm	, w [(39)m	x [(93)m -	(96)mj						L	1
	1574.41	1532.41	1385.35	1135.47	859.35	565.75	373.13	391.12	617.99	963.93	1290.74	1558.34	] (97)
Space heating re	quirement,	kWh/mon	th 0.024 x	[(97)m - (9	5)m] x (41)	m		1		1	1	1	1
	476.86	247.96	115.59	24.61	3.18	0.00	0.00	0.00	0.00	33.79	247.52	516.74	] -
									∑(98	8)15, 10	.12 = 1	1666.25	] (98) _
Space heating re	quirement	kWh/m²/ye	ear							(98)	÷ (4)	13.13	(99)
9a Energy reg	uirements -	individual	heating sv	stems inclu	ding micro	-СНР							
Space heating		mannadar				CIII							
Space neating	hoot from	cocondom	launniama	atom custo	m (table 11	`					<b></b>	0.00	1 (201)
	e neat from	secondary,	(supplemented)	ntary system	in (table 11	.)				4 (2)		0.00	] (201) ] (202)
Fraction of space	e neat from	main syste	m(s)							1 - (20	J1) =	1.00	] (202) ] (202)
Fraction of space	e neat from	main syste	m 2						101			0.00	] (202) ] (202)
Fraction of total	space heat	from main	system 1						(20	)2) x [1- (20	[3)] = [	1.00	] (204) ]
Fraction of total	space heat	from main	system 2							(202) x (20	03) =	0.00	] (205) ]
Efficiency of mai	n system 1	(%)										301.08	] (206)
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fu	iel (main sy	stem 1), kW	/h/month										_
	158.38	82.36	38.39	8.17	1.06	0.00	0.00	0.00	0.00	11.22	82.21	171.63	
									∑(21:	1)15, 10	.12 =	553.43	(211)
Water heating													
Efficiency of wat	er heater												
	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	(217)
Water heating fu	uel, kWh/m	onth											
	78.89	69.49	72.88	65.19	63.78	56.85	54.46	59.95	59.90	67.60	71.66	76.94	]

						1 (
				∑(219a)112 =	797.57	(219)
Annual totals						1
Space heating fuel - main system 1					553.43	]
Water heating fuel					797.57	
Electricity for pumps, fans and electric keep-hot (Table 4f)			[	1		
mechanical ventilation fans - balanced, extract or positive input	ut from outside		342.34			(230a)
Total electricity for the above, kWh/year					342.34	] (231)
Electricity for lighting (Appendix L)					462.79	(232)
Total delivered energy for all uses		(211	)(221) + (231) +	(232)(237b) =	2156.14	(238)
10a. Fuel costs - individual heating systems including micro-CH	Р					
	Fuel		Fuel price		Fuel	
	kWh/year				cost £/year	-
Space heating - main system 1	553.43	x	13.19	x 0.01 =	73.00	(240)
Water heating	797.57	x	13.19	x 0.01 =	105.20	(247)
Pumps and fans	342.34	x	13.19	x 0.01 =	45.15	(249)
Electricity for lighting	462.79	x	13.19	x 0.01 =	61.04	(250)
Additional standing charges					0.00	(251)
Total energy cost			(240)(242)	+ (245)(254) =	284.39	(255)
11a. SAP rating - individual heating systems including micro-CH	P					
Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					0.69	(257)
SAP value					90.31	]
SAP rating (section 13)					90	(258)
SAP band					В	]
12a. CO <sub>2</sub> emissions - individual heating systems including micro	o-CHP					
	Energy		Emission factor		Emissions	
	kWh/year		kg CO₂/kWh	_	kg CO₂/year	_
Space heating - main system 1	553.43	x	0.519	=	287.23	(261)
Water heating	797.57	x	0.519	=	413.94	(264)
Space and water heating			(261) + (262) +	- (263) + (264) =	701.17	(265)
Pumps and fans	342.34	х	0.519	] =	177.68	(267)
Electricity for lighting	462.79	х	0.519	] =	240.19	(268)
Total CO <sub>2</sub> , kg/year				(265)(271) =	1119.04	(272)
Dwelling CO <sub>2</sub> emission rate				(272) ÷ (4) =	8.82	(273)
El value					91.28	]
El rating (section 14)					91	(274)
El band					В	]
13a. Primary energy - individual heating systems including micr	ro-CHP					
	Energy		Primary factor		Primary Energy	
	kWh/year				kWh/year	
Space heating - main system 1	553.43	х	3.07	] =	1699.03	(261)
Water heating	797.57	х	3.07	] =	2448.55	(264)
Space and water heating			(261) + (262) +	- (263) + (264) =	4147.59	(265)

Electricity for lighting Primary energy kWh/year

Pumps and fans

PREVIEW - THIS VERSION HAS NOT BEEN APPROVED

х

х

3.07

3.07

=

=

342.34

462.79

1050.99

1420.78

6619.35

(267)

(268)

(272)

# TER Worksheet Design - Draft



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

Assessor name	Mr Harry Kni	bb						Asses	sor num	ber	1		
Client								Last r	nodified		27/02	/2017	
Address	20 Canfield P	Place HS	-C1, Londo	n									
			,										
1. Overall dwelling dimen	nsions												
					Area (m²)			Average heigh	e storey nt (m)		Vo	olume (m³)	
Lowest occupied					42.30	(1a) x	[	2.	90	(2a) =		122.67	(3a)
+1					42.30	(1b) x		2.	90	(2b) =		122.67	(3b)
+2					42.30	(1c) x	[	2.	90	(2c) =		122.67	(3c)
Total floor area	(1a) + (1	lb) + (1c	) + (1d)(1	.n) = 🗌	126.90	(4)							
Dwelling volume								(3a) + (	3b) + (3o	c) + (3d)(3	8n) =	368.01	(5)
2 Ventilation rate													
2. Ventilation rate											m	<sup>3</sup> per hour	
Number of chimneys							Г		<u>า</u>	x 40 =		0	(62)
Number of open flues							L		י ר	v 20 -		0	] (0a)
Number of intermittent fa	06								1	x 20 -		40	] (00) ] (7a)
Number of passive vents	15						Ĺ		<u>+</u> ר	x 10 =		-40	] (7a)
Number of flueless gas fire	ic.						Г		י ז	x10-		0	$\left[ (7c) \right]$
Number of fuciess gas fire							L		5		Air	changes pe	_ ( <i>/ C)</i> r
											,	hour	
Infiltration due to chimney	s, flues, fans, PS	SVs		(6	5a) + (6b) + (7	a) + (7b) +	(7c) = [	4	0	÷ (5) =		0.11	(8)
If a pressurisation test has	been carried ou	it or is in	ntended, pr	oceed t	o (17), otherv	ise continu	le from	(9) to (	16)				
Air permeability value, q50	), expressed in c	ubic me	tres per ho	our per s	square metre	of envelop	e area					5.00	(17)
If based on air permeabilit	y value, then (18	8) = [(17	) ÷ 20] + (8	), other	wise (18) = (1	6)						0.36	(18)
Number of sides on which	the dwelling is s	heltere	d									3	(19)
Shelter factor									1 -	[0.075 x (1	9)] =	0.78	(20)
Infiltration rate incorporat	ing shelter facto	or								(18) x (2	20) =	0.28	(21)
Infiltration rate modified for	or monthly wind	speed:											
Jan	Feb	Mar	Apr	May	Jun	Jul	Au	ıg	Sep	Oct	Nov	Dec	
Monthly average wind spe	ed from Table U	12											
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.7	70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4													_
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.9	93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (a	allowing for shel	lter and	wind facto	r) (21) >	(22a)m								_
0.35	0.35 (	0.34	0.31	0.30	0.26	0.26	0.2	26	0.28	0.30	0.31	0.33	(22b)
Calculate effective air char	nge rate for the a	applicab	ole case:										_
If mechanical ventilatio	n: air change rat	te throu	gh system									N/A	(23a)
If balanced with heat re	ecovery: efficien	cy in % a	allowing fo	r in-use	factor from T	able 4h						N/A	(23c)
d) natural ventilation o	r whole house p	ositive i	nput ventil	ation fr	om loft	-	-					-	-
0.56	0.56 0	0.56	0.55	0.54	0.53	0.53	0.5	53	0.54	0.54	0.55	0.55	(24d)



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

	0.56	0.56	0.56	0.55	0.54	0.52	0.52	0.52	0.54	0.54	0.55	0.55	(25)
	0.50	0.50	0.50	0.55	0.54	0.55	0.55	0.55	0.54	0.54	0.55	0.55	_ (25)
3. Heat losse	s and heat lo	ss paramet	er										
Element				Gross	Opening	s Net	area	U-value	A x U W	//К к-\	value,	Ахк,	
			а	rea, m <sup>2</sup>	m-	А,	<b>m-</b>	W/m²K		кJ,	/m².K	KJ/K	
Window						29	.29 x	1.33	= 38.83	<u> </u>			(27)
Ground floor						42	.30 × [	0.13	= 5.50				(28a)
External wall						90	.77 x [	0.18	= 16.34				(29a)
Party wall						107	7.88 x	0.00	= 0.00				(32)
Roof						42	.30 x	0.13	= 5.50				(30)
Total area of e	external elem	ents ∑A, m²				204	.66						(31)
Fabric heat los	s, W/K = ∑(A	×U)							(20	5)(30) + (3	32) =	66.17	_ (33)
Heat capacity	Cm = ∑(А x к)	)	2.4					(28)	(30) + (32)	+ (32a)(3	2e) =	N/A	_ (34)
Thermal mass	parameter (	IMP) in kJ/n	n²K									250.00	] (35) ] (35)
Thermal bridg	es: Σ(L x Ψ) c	alculated us	sing Appen	dix K								4.37	] (36) ] (35)
l otal fabric he	at loss	<b>F</b> . L		• • • •					6	(33) + (	36) =	70.54	_ (37)
Mantilatian ha	Jan	Feb	Mar	Apr	Ivlay	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
ventilation ne			IV 0.33 X (2	25)m x (5)		64.96	64.06	64.74	65.44		66.66	67.00	
11	68.35	68.05	67.76	66.40	66.14	64.96	64.96	64.74	65.41	66.14	66.66	67.20	(38)
Heat transfer		V/K (37)m +	- (38)m	126.04	126.60	425.40	125 40	425.27	425.05	126.60	407.00	427.74	٦
	138.89	138.59	138.30	136.94	136.68	135.49	135.49	135.27	135.95		137.20	137.74	
llest less para	motor (III D)	W/m2K (20	(1)						Average = 2	<u>&gt;(</u> 39)112/	/12 =	136.94	(39)
neat ioss para		W/III⁻K (35	9)m ÷ (4)	1.09	1.09	1.07	1.07	1.07	1.07	1.09	1.09	1.00	7
	1.09	1.09	1.09	1.08	1.00	1.07	1.07	1.07	1.07	(1.00)	/12 -	1.09	
Number of day	vs in month (	Table 1a)							Average = 2	<u>&gt;(</u> 40)112)	12 =	1.08	_ (40)
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	21.00	20.00				_
	51.00	28.00	51.00	30.00	51.00		31.00			21 00	20.00	21.00	(40)
4 Water hea						30.00	01.00	31.00	30.00	31.00	30.00	31.00	(40)
water nea	ting energy r	requiremen	t			30.00		31.00	30.00	31.00	30.00	31.00	<b>(40)</b>
Assumed occu	ting energy r pancy, N	requiremen	t			30.00		31.00	30.00	31.00	30.00	2.89	_ (40) _ (42)
Assumed occu	ting energy r pancy, N e hot water u	requiremen usage in litre	t es per day '	Vd,average	= (25 x N) -	+ 36		31.00	30.00	31.00	30.00	31.00 2.89 102.75	(40) (42) (43)
Assumed occu Annual averag	ting energy r pancy, N e hot water u Jan	requiremen usage in litre Feb	t es per day ' <b>Mar</b>	Vd,average <b>Apr</b>	= (25 x N) - May	+ 36 Jun	Jul	Aug	Sep	31.00 Oct	30.00	31.00 2.89 102.75 Dec	(40) (42) (43)
Assumed occu Annual averag Hot water usa	ting energy r pancy, N ge hot water u Jan ge in litres pe	requiremen usage in litro Feb er day for ea	t es per day ' <b>Mar</b> ach month	Vd,average <b>Apr</b> Vd,m = fact	= (25 x N) - <b>May</b> tor from Tal	+ 36 Jun ble 1c x (43	Jul	Aug	Sep	31.00 Oct	30.00	31.00 2.89 102.75 Dec	(40) (42) (43)
Assumed occu Annual averag Hot water usa	ting energy r pancy, N te hot water to Jan ge in litres pe	requiremen usage in litre Feb er day for ea 108.92	t es per day ' Mar ach month 104.81	Vd,average <b>Apr</b> Vd,m = fact 100.70	= (25 x N) - <b>May</b> tor from Tal 96.59	+ 36 Jun ble 1c x (43 92.48	Jul ) 92.48	Aug 96.59	Sep 100.70	31.00 Oct 104.81	30.00	31.00 2.89 102.75 Dec 113.03	(40) (42) (43)
Assumed occu Annual averag Hot water usa	ting energy r pancy, N te hot water t Jan ge in litres pe 113.03	requiremen usage in litre Feb er day for ea 108.92	t es per day ' Mar ach month 104.81	Vd,average <b>Apr</b> Vd,m = fact 100.70	= (25 x N) - <b>May</b> tor from Tai 96.59	+ 36 Jun ble 1c x (43 92.48	Jul ) 92.48	Aug 96.59	Sep 100.70	31.00 Oct 104.81 Σ(44)1	30.00 Nov 108.92	31.00 2.89 102.75 <b>Dec</b> 113.03 1233.05	(40) (42) (43) (43)
Assumed occu Annual averag Hot water usa Energy conten	ting energy r pancy, N te hot water to Jan ge in litres pe 113.03 t of hot wate	requiremen usage in litre Feb er day for ea 108.92 er used = 4.1	t es per day ' Mar ach month 104.81 L8 x Vd,m x	Vd,average <b>Apr</b> Vd,m = fact 100.70	= (25 x N) - <b>May</b> tor from Tal 96.59 3600 kWh/r	+ 36 Jun ble 1c x (43 92.48 month (see	Jul ) 92.48 Tables 1b,	Aug 96.59	Sep	31.00 Oct 104.81 Σ(44)1	30.00 Nov 108.92	31.00 2.89 102.75 <b>Dec</b> 113.03 1233.05	(40) (42) (43) (44)
Assumed occu Annual averag Hot water usa Energy conten	ting energy r pancy, N te hot water to Jan ge in litres pe 113.03 tt of hot wate 167.62	requiremen usage in litre Feb er day for ea 108.92 er used = 4.1 146.60	t Mar ach month 104.81 18 x Vd,m x 151.28	Vd,average <b>Apr</b> Vd,m = fact 100.70 c nm x Tm/3 131.89	= (25 x N) - <b>May</b> tor from Tal 96.59 3600 kWh/r 126.55	+ 36 Jun ble 1c x (43 92.48 nonth (see 109.20	Jul ) 92.48 Tables 1b, 101.19	Aug 96.59 , 1c 1d) 116.12	Sep 100.70	<b>Οct</b> 104.81 Σ(44)1 136.94	30.00 Nov 108.92 .12 = 149.48	31.00 2.89 102.75 Dec 113.03 123.05 162.33	(40) (42) (43) (43)
Assumed occu Annual averag Hot water usa Energy conten	ting energy r apancy, N ge hot water of Jan ge in litres pe 113.03 it of hot wate 167.62	requiremen usage in litre Feb er day for ea 108.92 er used = 4.1 146.60	t Mar ach month 104.81 L8 x Vd,m x 151.28	Vd,average <b>Apr</b> Vd,m = fact 100.70 anm x Tm/3 131.89	= (25 x N) - <b>May</b> tor from Tal 96.59 3600 kWh/r 126.55	+ 36 Jun ble 1c x (43 92.48 nonth (see 109.20	Jul ) 92.48 Tables 1b, 101.19	Aug 96.59 , 1c 1d) 116.12	Sep 100.70	31.00 Oct 104.81 Σ(44)1 136.94 Σ(45)1	30.00 Nov 108.92 .12 = 149.48 .12 =	31.00 2.89 1∪2.75 <b>Dec</b> 1233.05 1233.05 162.33 162.33	(40) (42) (43) (43) (44) (44)
Assumed occu Annual averag Hot water usa Energy conten Distribution lo	ting energy r pancy, N te hot water to Jan ge in litres per 113.03 tt of hot wate 167.62 sss 0.15 x (45	requiremen usage in litro Feb er day for ea 108.92 er used = 4.1 146.60	t Mar ach month 104.81 18 x Vd,m x 151.28	Vd,average <b>Apr</b> Vd,m = fact 100.70 x nm x Tm/3 131.89	= (25 x N) - <b>May</b> tor from Tal 96.59 3600 kWh/r 126.55	+ 36 Jun ble 1c x (43 92.48 nonth (see 109.20	Jul ) 92.48 Tables 1b, 101.19	Aug 96.59 , 1c 1d) 116.12	Sep 100.70	<b>Oct</b> 104.81 Σ(44)1 136.94 Σ(45)1	30.00 Nov 108.92 .12 = 149.48 .12 =	31.00 2.89 102.75 Dec 113.03 1233.05 1616.72 	(40) (42) (43) (43) (44) (44)
Assumed occu Annual averag Hot water usa Energy conten Distribution lo	ting energy r pancy, N te hot water to Jan ge in litres pe 113.03 tt of hot wate 167.62 sss 0.15 x (45 25.14	requiremen usage in litre Feb er day for ea 108.92 er used = 4.1 146.60 )m 21.99	t Mar ach month 104.81 18 x Vd,m x 151.28 22.69	Vd,average <b>Apr</b> Vd,m = fact 100.70 anm x Tm/3 131.89 19.78	= (25 x N) - May tor from Tal 96.59 3600 kWh/r 126.55 18.98	+ 36 Jun ble 1c x (43 92.48 nonth (see 109.20	Jul ) 92.48 Tables 1b, 101.19 15.18	Aug 96.59 , 1c 1d) 116.12	Sep 100.70 117.51	31.00 Oct 104.81 Σ(44)1 136.94 Σ(45)1 20.54	30.00 Nov 108.92 .12 = 149.48 .12 = 22.42	31.00 2.89 1∪2.75 <b>Dec</b> 113.03 1233.05 162.33 162.33 162.33 162.33	(40) (42) (43) (43) (44) (45) (46)
Assumed occu Annual averag Hot water usa Energy conten Distribution lo	ting energy r pancy, N te hot water to Jan ge in litres per 113.03 tt of hot wate 167.62 ss 0.15 x (45 25.14 te (litres) inclu	requirement usage in litre Feb er day for ea 108.92 er used = 4.1 146.60 )m 21.99 uding any so	t Mar ach month 104.81 18 x Vd,m x 151.28 22.69 plar or WW	Vd,average <b>Apr</b> Vd,m = fact 100.70 c nm x Tm/3 131.89 19.78 /HRS storage	= (25 x N) - May tor from Tal 96.59 3600 kWh/r 126.55 18.98 ge within sa	+ 36 Jun ble 1c x (43 92.48 nonth (see 109.20 16.38 me vessel	Jul ) 92.48 Tables 1b, 101.19 15.18	Aug 96.59 , 1c 1d) 116.12 17.42	Sep 100.70 117.51 17.63	<b>Oct</b> 104.81 Σ(44)1 136.94 Σ(45)1 20.54	30.00 Nov 108.92 .12 = 149.48 .12 = 22.42	<ul> <li>31.00</li> <li>2.89</li> <li>1∪2.75</li> <li>Dec</li> <li>113.03</li> <li>123.05</li> <li>162.33</li> <li>1616.72</li> <li>162.35</li> <li>24.35</li> <li>150.00</li> </ul>	(40) (42) (43) (43) (44) (44) (45) (46) (47)
Assumed occu Annual averag Hot water usa Energy conten Distribution lo Storage volum Water storage	ting energy r pancy, N te hot water to Jan ge in litres pe 113.03 t of hot wate 167.62 ss 0.15 x (45 25.14 te (litres) inclu-	requiremen usage in litre Feb er day for ea 108.92 er used = 4.1 146.60 .)m 21.99 uding any so	t Mar ach month 104.81 18 x Vd,m x 151.28 22.69 Dlar or WW	Vd,average <b>Apr</b> Vd,m = fact 100.70 anm x Tm/3 131.89 19.78 /HRS storage	= (25 x N) - May tor from Tai 96.59 3600 kWh/r 126.55 18.98 ge within sa	+ 36 Jun ble 1c x (43 92.48 nonth (see 109.20 16.38 me vessel	Jul ) 92.48 Tables 1b, 101.19 15.18	Aug 96.59 , 1c 1d) 116.12	Sep 100.70 117.51 17.63	31.00 Oct 104.81 Σ(44)1 136.94 Σ(45)1 20.54	30.00 Nov 108.92 .12 = 149.48 .12 = 22.42	<ul> <li>31.00</li> <li>2.89</li> <li>2.75</li> <li>Dec</li> <li>113.03</li> <li>123.05</li> <li>162.33</li> <li>162.33</li> <li>167.20</li> <li>24.35</li> <li>150.00</li> </ul>	(40) (42) (43) (43) (44) (44) (45) (46) (47)
Assumed occu Annual averag Hot water usa Energy conten Distribution lo Storage volum Water storage a) If manufact	ting energy r pancy, N te hot water to Jan ge in litres per 113.03 tt of hot water 167.62 tss 0.15 x (45 25.14 te (litres) inclu- e loss: urer's declare	requiremen usage in litre Feb er day for ea 108.92 er used = 4.1 146.60 )m 21.99 uding any so ed loss facto	t Mar ach month 104.81 18 x Vd,m x 151.28 22.69 olar or WW	Vd,average <b>Apr</b> Vd,m = fact 100.70 anm x Tm/3 131.89 19.78 /HRS storage (kWh/day)	= (25 x N) - May tor from Tal 96.59 3600 kWh/r 126.55 18.98 ge within sa	+ 36 Jun ble 1c x (43 92.48 nonth (see 109.20 16.38 me vessel	Jul ) 92.48 Tables 1b, 101.19 15.18	Aug 96.59 , 1c 1d) 116.12 17.42	Sep 100.70 117.51 17.63	31.00 Oct 104.81 Σ(44)1 136.94 Σ(45)1 20.54	30.00 Nov 108.92 .12 = 149.48 .12 = 22.42	31.00 2.89 1∪2.75 Dec 113.03 1233.05 10233 162.33 162.33 1023	(40) (42) (43) (43) (44) (44) (45) (45) (46) (47) (48)
Assumed occu Annual averag Hot water usa Energy conten Distribution lo Storage volum Water storage a) If manufact Temperatu	ting energy r pancy, N te hot water to Jan ge in litres pe 113.03 it of hot wate 167.62 its 0.15 x (45 25.14 it (litres) inclu- e loss: urer's declare ire factor from	requiremen usage in litro Feb er day for ea 108.92 er used = 4.1 146.60 )m 21.99 uding any so ed loss facto m Table 2b	t Mar ach month 104.81 18 x Vd,m x 151.28 22.69 Dlar or WW	Vd,average Apr Vd,m = fact 100.70 anm x Tm/3 131.89 19.78 /HRS storage (kWh/day)	= (25 x N) - <b>May</b> tor from Tal 96.59 3600 kWh/r 126.55 18.98 ge within sa	+ 36 Jun ble 1c x (43 92.48 nonth (see 109.20 16.38 me vessel	Jul ) 92.48 Tables 1b, 101.19 15.18	Aug 96.59 , 1c 1d) 116.12	Sep 100.70 117.51 17.63	<b>Oct</b> <b>Oct</b> 104.81 Σ(44)1 136.94 Σ(45)1 20.54	30.00 Nov 108.92 .12 = 149.48 .12 = 22.42	31.00       2.89       1∪2.75       Dec       113.03       123.05       1616.72       1616.72       150.00       1.39       0.54	(40) (42) (43) (43) (44) (44) (45) (45) (46) (47) (48) (49)
Assumed occu Annual averag Hot water usa Energy conten Distribution lo Storage volum Water storage a) If manufact Temperatu Energy lost	ting energy r apancy, N te hot water to Jan ge in litres per 113.03 tt of hot water 167.62 ss 0.15 x (45 25.14 te (litres) inclu- te (litres) inclu- te factor from the from water to the form water to	requiremen usage in litre Feb er day for ea 108.92 er used = 4.1 146.60 )m 21.99 uding any so ed loss facto m Table 2b storage (kW	t Mar ach month 104.81 18 x Vd,m x 151.28 22.69 Dlar or WW or is known	Vd,average <b>Apr</b> Vd,m = fact 100.70 anm x Tm/3 131.89 19.78 /HRS storage (kWh/day) 8) x (49)	= (25 x N) - May tor from Tal 96.59 3600 kWh/r 126.55 18.98 ge within sa	+ 36 Jun ble 1c x (43 92.48 month (see 109.20 16.38 me vessel	Jul ) 92.48 Tables 1b, 101.19 15.18	Aug 96.59 , 1c 1d) 116.12	Sep 100.70 117.51 17.63	31.00 Oct 104.81 Σ(44)1 136.94 Σ(45)1 20.54	30.00 Nov 108.92 .12 = [	31.00 2.89 1∪2.75 Dec 2.30 113.03 1233.05 10233 1	(40) (42) (43) (43) (44) (44) (44) (45) (45) (46) (47) (48) (49) (50)
Assumed occu Annual average Hot water usa Energy conten Distribution lo Storage volum Water storage a) If manufact Temperatu Energy lost Enter (50) or (	ting energy r pancy, N te hot water to Jan ge in litres pe 113.03 t of hot wate 167.62 ss 0.15 x (45 25.14 te (litres) inclustion e loss: urer's declared tre factor from t from water s 54) in (55)	requiremen usage in litro Feb er day for ea 108.92 er used = 4.1 146.60 a)m 21.99 uding any so ed loss facto m Table 2b storage (kW	t Mar ach month 104.81 18 x Vd,m x 151.28 22.69 Dlar or WW or is known /h/day) (48	Vd,average <b>Apr</b> Vd,m = fact 100.70 c nm x Tm/3 131.89 19.78 /HRS storage (kWh/day) 3) x (49)	= (25 x N) - May tor from Tal 96.59 3600 kWh/r 126.55 18.98 ge within sa	+ 36 Jun ble 1c x (43 92.48 nonth (see 109.20 16.38 me vessel	Jul ) 92.48 Tables 1b, 101.19 15.18	Aug 96.59 , 1c 1d) 116.12	Sep 100.70 117.51 17.63	<b>Oct</b> <b>Oct</b> 104.81 Σ(44)1 136.94 Σ(45)1 20.54	30.00 Nov 108.92 .12 = 149.48 .12 = 22.42	31.00       2.89       102.75       Dec       113.03       123.05       1616.72       1616.72       24.35       1.39       0.54       0.75       0.75	(40) (42) (43) (43) (44) (44) (44) (45) (46) (47) (48) (49) (50) (55)
Assumed occu Annual averag Hot water usa Energy conten Distribution lo Storage volum Water storage a) If manufact Energy lost Enter (50) or ( Water storage	ting energy r pancy, N ge hot water u Jan ge in litres pe 113.03 it of hot wate 167.62 iss 0.15 x (45 25.14 ie (litres) inclust closs: urer's declare ire factor from tfrom water s 54) in (55)	requiremen usage in litre Feb er day for ea 108.92 er used = 4.1 146.60 )m 21.99 uding any so ed loss facto m Table 2b storage (kW ed for each	t es per day ' Mar ach month 104.81 18 x Vd,m x 151.28 22.69 olar or WW or is known /h/day) (48 month (55	Vd,average <b>Apr</b> Vd,m = fact 100.70 a nm x Tm/3 131.89 19.78 /HRS storage (kWh/day) 8) x (49) 5) x (41)m	= (25 x N) - May tor from Tal 96.59 3600 kWh/r 126.55 18.98 ge within sa	+ 36 Jun ble 1c x (43 92.48 nonth (see 109.20 16.38 me vessel	Jul ) 92.48 Tables 1b, 101.19 15.18	Aug 96.59 , 1c 1d) 116.12	Sep 100.70 117.51 17.63	31.00 Oct 104.81 Σ(44)1 136.94 Σ(45)1 20.54	30.00 30.00 Nov 108.92 .12 = [	31.00       2.89       1∪2.75       Dec       113.03       1233.05       1233.05       162.33       162.33       150.00       1.39       0.54       0.75       0.75	(40) (42) (43) (43) (44) (44) (44) (45) (45) (47) (48) (49) (50) (55)

PREVIEW - THIS VERSION HAS NOT BEEN APPROVED

If the vessel con	ntains dedica	ated solar s	torage or d	edicated W	WHRS (56	)m x [(47)	- Vs] ÷ (47),	else (56)					
	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)
Primary circuit l	oss for each	month fro	m Table 3										
	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Combi loss for e	each month	from Table	3a, 3b or 3	с									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requi	ired for wat	er heating o	calculated f	or each mo	onth 0.85 x	: (45)m + (4	16)m + (57)	m + (59)n	n + (61)m				
	214.21	188.69	197.87	176.98	173.15	154.30	147.79	162.72	162.60	183.54	194.58	208.92	(62)
Solar DHW inpu	t calculated	using Appe	endix G or A	Appendix H									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from wa	ater heater f	or each mo	onth (kWh/i	month) (62	2)m + (63)n	n							
	214.21	188.69	197.87	176.98	173.15	154.30	147.79	162.72	162.60	183.54	194.58	208.92	]
										∑(64)1.	12 = 2	165.34	(64)
Heat gains from	water heat	ing (kWh/n	nonth) 0.25	5 × [0.85 ×	(45)m + (61	L)m] + 0.8	× [(46)m +	(57)m + (5	59)m]				
	93.01	82.41	87.58	79.93	79.35	72.38	70.92	75.89	75.14	82.81	85.78	91.25	] (65)
5 Internal gair	as												
J. Internargan	lan	Feb	Mar	Apr	May	lun	Int	Διισ	Sen	Oct	Nov	Dec	
Metabolic gains	(Table 5)	100	iviai		indy	Jun	Jui	745	JCP	ott	1101	Dee	
Wietubolie guilis	144 32	144 32	144 32	144 32	144 32	144 32	144 32	144 32	144 32	144 32	144 32	144 32	] (66)
Lighting gains (c	alculated in	Appendix I	equation	19 or 19a).	also see Ta	able 5	144.52	144.52	. 144.52	144.52	144.52	144.52	] (00)
	26.21	23.28	18.93	14 33	10 71	9.04	9 77	12 70	17.05	21.65	25.27	26.93	] (67)
Appliance gains	(calculated	in Appendi	x L. equation	on L13 or L	13a). also s	ee Table 5	5.77	12.70	17.05	21.05	25.27	20.55	
	293.94	296.99	289.31	272.94	252.29	232.87	219.90	216.8	5 224.54	240.90	261.56	280.97	] (68)
Cooking gains (c	calculated in	Appendix	L. equation	L15 or L15	a). also see	Table 5	1	110.00		1.000	101.00		] (00)
00 (	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	37.43	] (69)
Pump and fan g	ains (Table !	5a)											] (/
	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	7(70)
Losses e.g. evap	oration (Tal	ble 5)						1					
	-115.46	-115.46	-115.46	-115.46	-115.46	-115.46	-115.46	-115.4	6 -115.46	-115.46	-115.46	-115.46	7(71)
Water heating g	gains (Table	5)						•		•	•	•	_
	125.01	122.64	117.71	111.01	106.66	100.53	95.33	102.00	) 104.37	111.30	119.13	122.65	(72)
Total internal ga	ains (66)m -	+ (67)m + (6	58)m + (69)	m + (70)m	+ (71)m + (	72)m							-
	514.46	512.21	495.24	467.58	438.96	411.75	394.30	400.85	415.25	443.15	475.26	499.85	(73)
					_								
6. Solar gains						6-	1		_			<b>6</b>	
			Access T Table	6d	m²	50	N/m <sup>2</sup>	sp	g ecific data	specific	data	W	
								01	Table 6b	or Table	e 6c		
North			0.7	7 X	7.84	x 📑	10.63	x 0.9 x	0.63	x 0.70	) =	25.48	(74)
South			0.7	7 X	21.45	x	46.75	x 0.9 x	0.63	x 0.70	) =	306.48	] (78)
Solar gains in wa	atts ∑(74)m	ı(82)m											
	331.96	550.62	722.11	855.52	932.05	916.33	886.99	829.58	3 767.37	599.34	394.71	286.07	(83)
Total gains - inte	ernal and so	lar (73)m +	(83)m										
	846.42	1062.83	1217.35	1323.10	1371.00	1328.08	1281.29	1230.4	3 1182.63	1042.49	869.97	785.92	(84)
7 Magazinter		ture (heat											
7. Wean Intern	iai tempera	ture (neati	ng season)			(°C)						21.00	
remperature du	uning neating	g periods in	i the living a	area trom I	able 9, 101	L( L)	11	۸	5	0+		21.00	ן (ג <u>א</u> ) (
	Jail	rep	Widf	Ahi	ividy	Juli	Jui	Aug	Sep	UCL	NUV	Dec	

Utilisation facto	r for gains f	or living are	ea n1,m (se	e Table 9a)									
	1.00	0.99	0.97	0.92	0.81	0.63	0.46	0.50	0.73	0.94	0.99	1.00	(86)
Mean internal to	emp of livin	g area T1 (s	teps 3 to 7	in Table 9c	:)								
	19.90	20.12	20.38	20.67	20.88	20.98	21.00	20.99	20.94	20.67	20.22	19.85	(87)
Temperature du	iring heating	g periods in	the rest of	dwelling fr	rom Table 9	9, Th2(°C)							
	20.01	20.01	20.01	20.02	20.02	20.03	20.03	20.03	20.02	20.02	20.02	20.01	(88)
Utilisation facto	r for gains f	or rest of d	welling n2,	m									
	1.00	0.99	0.96	0.89	0.75	0.54	0.36	0.40	0.65	0.92	0.99	1.00	(89)
Mean internal to	emperature	in the rest	of dwelling	T2 (follow	steps 3 to	7 in Table 9	Əc)				•	•	-
	18.54	18.86	19.24	19.64	19.91	20.01	20.03	20.03	19.98	19.65	19.01	18.48	] (90)
Living area fract	ion	1					1		Li	ving area ÷	(4) =	0.26	] (91)
Mean internal te	emperature	for the wh	ole dwellin	g fLA x T1 +	-(1 - fLA) x T	r2				0	.,		, , L
	18.89	19 19	19 54	19 91	20.16	20.26	20.28	20.28	20.23	19 92	19 33	18 84	] (92)
Apply adjustme	nt to the me	an internal	temperati	ire from Ta	ble 4e whe	re appropr	riate	20.20	20.25	15.52	19.55	10.04	] (32)
	18.80	10 10	10 5/	10.01	20.16	20.26	20.28	20.28	20.23	10.02	10.33	18.84	] (03)
	10.09	19.19	15.54	19.91	20.10	20.20	20.28	20.28	20.23	19.92	19.55	10.04	] (55)
8. Space heating	ng requirem	ent											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	r for gains,	ηm											
	0.99	0.98	0.95	0.89	0.76	0.56	0.39	0.42	0.67	0.91	0.98	1.00	(94)
Useful gains. nm	1Gm. W (94	)m x (84)m											] (- )
0 / 1	841 27	1043 53	1162 33	1178 25	1044 53	749 29	496 38	521.40	790 88	951 11	856 70	782 55	] (95)
Monthly average	e external t	emperature	from Tabl	e U1	1011.55	7 15.25	150.50	521.10	750.00	551.11	000.70	702.00	] (33)
wonthy averag	4 30	4 90	6 50	8 90	11 70	14.60	16.60	16.40	14.10	10.60	7 10	4 20	7 (96)
Heat loss rate fo	r mean inte	ernal tempe	erature Im	W [(39)m	x [(93)m -	(96)ml	10.00	10.40	14.10	10.00	7.10	4.20	] (50)
		1000 10	1902.27	1507.92	1156.06	767 19	409.26	E24 E9	022.02	1272 55	1677 56	2016.46	7 (07)
Space beating r		1300.10	1003.37	1307.83	$(41)_{5}$	707.18 m	498.30	524.58	633.93	1275.55	1077.50	2010.40	] (97)
Space nearing re		620.42	476.04	227.20	82.00	0.00	0.00	0.00	0.00	220.80	F01 02	018.02	7
	001.97	029.45	470.94	257.50	02.99	0.00	0.00	0.00	0.00	259.69	12	916.05	
		1.) A /h /ma 2 /							Σ(96	(00)	12 = 4	21.07	] (98) ] (90)
space neating re	equirement	KVVN/m-/ye	ear							(98)	÷ (4)	31.97	] (99)
9a. Energy req	uirements -	individual	heating sys	stems inclu	ding micro	-CHP							
Space heating				_									
Fraction of space	e heat from	secondary	/supplemer	ntarv syster	m (table 11	)						0.00	(201)
Fraction of space	e heat from	main syste	m(s)	,.,		,				1 - (2)	)1) =	1.00	] (202)
Fraction of space	e heat from	main syste	m 2							- (-		0.00	(202)
Fraction of total	snace heat	from main	system 1						(20	)2) x [1- (20	3)] =	1.00	] (204)
Fraction of total	space heat	from main	system 2						(20	(202) × (20	- (su	0.00	) (205)
Efficiency of ma	in system 1	(%)	System 2							(202) × (20	JJ) =	93 50	] (205) ] (206)
Linciency of ma	lan system 1	( <sup>70</sup> )	Mar	Apr	May	lun	1.1	Aug	Son	Oct	Nov	93.30 Doc	] (200)
Charac booting f		stom 1) k)A	/h/month	дрі	iviay	Jun	501	Aug	Зер	000	NOV	Dec	
Space heating it			510.00	252.00	00.75	0.00	0.00	0.00	0.00	256 57	622.40	004.05	7
	943.29	673.19	510.09	253.80	88.75	0.00	0.00	0.00	0.00	250.57	632.10	981.85	
									∑(21:	1)15, 10	.12 = 4	339.64	] (211)
Water heating													
Efficiency of wat	ter heater	I			l			,		1		1	7
	88.19	87.79	87.08	85.60	82.98	79.80	79.80	79.80	79.80	85.53	87.59	88.30	(217)
Water heating f	uel, kWh/m	onth											-
	242.90	214.94	227.24	206.76	208.66	193.35	185.20	203.90	203.76	214.59	222.14	236.59	

				∑(219a)112 =	2560.05	(219)
Annual totals						] ( - /
Space heating fuel - main system 1					4339.64	]
Water heating fuel					2560.05	
Electricity for pumps, fans and electric keep-hot (Table 4f)						1
central heating pump or water pump within warm air heating	g unit		30.00			(230c)
boiler flue fan	-		45.00			(230e)
Total electricity for the above, kWh/year					75.00	(231)
Electricity for lighting (Appendix L)					462.79	(232)
Total delivered energy for all uses		(211	)(221) + (231) + (	232)(237b) =	7437.48	(238)
10a. Fuel costs - individual heating systems including micro-CH	IP					
	Fuel		Fuel price		Fuel	
	kWh/year				cost £/year	1
Space heating - main system 1	4339.64	×	3.48	x 0.01 =	151.02	(240)
Water heating	2560.05	x	3.48	x 0.01 =	89.09	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	462.79	x	13.19	x 0.01 =	61.04	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242) +	(245)(254) =	431.04	(255)
11a. SAP rating - individual heating systems including micro-Cl	НР					
Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					1.05	(257)
SAP value					85.31	]
SAP rating (section 13)					85	(258)
SAP band					В	]
12a. CO2 emissions - individual heating systems including micr	ю-СНР					
	Energy kWh/year		Emission factor		Emissions	
Space heating main system 1	4220 64	×	0.216	_	027.26	(261)
Water heating	2560.05	×	0.216	_	552.07	(201)
Space and water heating	2500.05	~	$(261) \pm (262) \pm$	- (263) + (264) -	1/100 33	(265)
Pumps and fans	75.00	×	0 519	=	38.93	(267)
Electricity for lighting	/62 79	x	0.519	=	2/0 19	(268)
	402.75	~	0.515	(265) (271) =	1769.45	(200)
Dwelling $CO_2$ emission rate				(203)(271) = $(272) \div (4) =$	20.40	(273)
El value				(2)2) : (4) -	86.21	] (273)
El rating (section 1/1)					86	) (274)
El hand					D D	] ( <i>214)</i> ]
						]
13a. Primary energy - individual heating systems including mid	cro-CHP					
	Energy kWh/year		Primary factor		Primary Energy kWh/year	
					[	1

Space heating - main system 1	4339.64	x	1.22	=	5294.36	(261)
Water heating	2560.05	x	1.22	=	3123.26	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	8417.61	(265)
Pumps and fans	75.00	х	3.07	=	230.25	(267)
Electricity for lighting	462.79	x	3.07	=	1420.78	(268)

PREVIEW - THIS VERSION HAS NOT BEEN APPROVED

Primary energy kWh/year Dwelling primary energy rate kWh/m2/year

10068.64	(272)
79.34	(273)

# DER Worksheet Design - Draft



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

Assessor name	Mr Harry K	nibb						Assessor num	ber	1		
Client	· · ·							Last modified		23/02	/2017	
Addross	24 Capfield		Dlanda	<b>^</b>						,,		
Address	24 Canneiu		D, LONGO									
1. Overall dwelling dimens	ions											
				A	area (m²)		Δ	verage storey height (m)		Vo	lume (m³)	
Lowest occupied					52.90	](1a) x	Г	2.90	(2a) =		153.41	(3a)
+1					52.90	(1b) x		2.90	(2b) =		153.41	(3b)
Total floor area	(1a) +	(1b) + (1c)	+ (1d)(	1n) =	105.80	(4)						
Dwelling volume								(3a) + (3b) + (3d	c) + (3d)(3n)	=	306.82	(5)
<b></b>												
2. Ventilation rate						-						
										m³	per hour	-
Number of chimneys							L	0	x 40 =		0	(6a)
Number of open flues								0	x 20 =		0	(6b)
Number of intermittent fans	5						L	0	x 10 =		0	(7a)
Number of passive vents								0	x 10 =		0	(7b)
Number of flueless gas fires								0	x 40 =		0	(7c)
										Air c	hanges per hour	
Infiltration due to chimneys	flues, fans, I	PSVs		(6a)	) + (6b) + (7	a) + (7b) + (	7c) = 🗌	0	÷ (5) =		0.00	(8)
If a pressurisation test has b	een carried c	out or is in	tended, p	roceed to (	(17), otherw	ise continu/	e from (	′9) to (16)				
Air permeability value, q50,	expressed in	cubic met	tres per h	our per squ	uare metre	of envelope	e area				3.00	(17)
If based on air permeability	value, then (	18) = [(17)	÷ 20] + (8	8), otherwi	se (18) = (1	6)					0.15	(18)
Number of sides on which the	ne dwelling is	s sheltered	ł								2	(19)
Shelter factor								1 -	[0.075 x (19)]	=	0.85	(20)
Infiltration rate incorporation	g shelter fac	tor							(18) x (20)	=	0.13	(21)
Infiltration rate modified for	monthly wir	nd speed:										
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	s Sep	Oct	Nov	Dec	
Monthly average wind spee	d from Table	U2										
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4												
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	3 1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (al	lowing for sh	elter and	wind fact	or) (21) x (2	22a)m							-
0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	2 0.13	0.14	0.14	0.15	(22b)
Calculate effective air change	e rate for the	e applicab	le case:	•	-	•		•	· · · · ·		-	-
If mechanical ventilation	: air change r	ate throug	gh system	1							0.50	(23a)
If balanced with heat rec	overy: efficie	ency in % a	Illowing fo	or in-use fa	ictor from T	able 4h					74.80	(23c)
a) If balanced mechanica	l ventilation	with heat	recovery	(MVHR) (2	2b)m + (23l	b) x [1 - (23d	c) ÷ 100	]				
0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(24a)
Effective air change rate - er	nter (24a) or	(24b) or (2	24c) or (24	4d) in (25)					•			_ `



	0.29	0.29	0.28	0.27	0.26	0.25	0.25	0.24	0.25	0.26	0.27	0.28	(25)
3. Heat losses a	and heat lo	ss paramete	er										
Element			a	Gross rea, m²	Openings m <sup>2</sup>	Net A,	area m²	U-value W/m²K	A x U W	//К к-\ kJ,	value, /m².K	Ахк, kJ/K	
Window						24	.44 x	1.15	= 27.98	3			(27)
Ground floor						52	90 x	0.11	= 5.82				(28a)
External wall						11	2.22 x	0.16	= 17.96	5			(29a)
Party wall						45	.46 x	0.00	= 0.00				(32)
Roof						52	90 x	0.11	= 5.82				(30)
Total area of ext	ernal elem	ents ∑A, m²				24	2.46						(31)
Fabric heat loss,	W/K = Σ(A	× U)							(2)	6)(30) + (3	32) =	57.58	(33)
Heat capacity Cr	m = Σ(Ахк)							(28)	(30) + (32)	+ (32a)(3	2e) =	N/A	(34)
Thermal mass pa	arameter (T	- MP) in kJ/m	1²K						. , . ,	. , .	,	250.00	(35)
Thermal bridges	: Σ(L x Ψ) ca	alculated us	ing Appen	dix K								12.12	(36)
Total fabric heat	loss		0 11-							(33) + (3	36) =	69.70	(37)
	Jan	Feb	Mar	Apr	Mav	Jun	Jul	Aug	Sep	Oct	Nov	Dec	] ()
Ventilation heat	loss calcula	ated monthl	v 0.33 x (2	25)m x (5)				. 5					
	29.22	28.89	28 57	26.96	26.64	25.02	25.02	24 70	25.67	26.64	27.28	27.93	(38)
Heat transfer co	efficient. W	//K (37)m +	(38)m	20.00		10:01		1					] (88)
	98.92	98 59	98 27	96.66	96.33	94 72	94 72	94 40	95.37	96.33	96.98	97.62	1
	50.52	50.55	50.27	50.00	50.55	54.72	54.72	54.40	Average = 1	(39)1 12	/12 =	96.58	] ] (30)
Heat loss naram	eter (HI P)	W/m²K (39	)m ∸ (4)						Average - 2	<u>/////////////////////////////////////</u>	12 -	50.50	] (33)
			0.02	0.01	0.01	0.00	0.90	0.80	0.00	0.01	0.02	0.02	1
	0.93	0.95	0.93	0.91	0.91	0.90	0.90	0.89	0.90	(40)1 12	(12 -	0.92	] (40)
Number of days	in month (	Table 1a)							Average - 2	<u>/</u> (+0)112/	12 -	0.91	] (40)
Number of days	21.00		21.00	20.00	21.00	20.00	21.00	21.00	20.00	21.00	20.00	21.00	
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	] (40)
4. Water heati	ng energy r	equirement	:										
Assumed occupa	ancy, N											2.79	(42)
Annual average	hot water ι	usage in litre	es per day	Vd,average	= (25 x N) +	36						100.39	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	-
Hot water usage	e in litres pe	er day for ea	ch month '	Vd,m = fact	or from Tab	le 1c x (43	3)						
	110.43	106.42	102.40	98.39	94.37	90.35	90.35	94.37	98.39	102.40	106.42	110.43	1
								•		∑(44)1	.12 =	1204.73	(44)
Energy content	of hot wate	r used = 4.1	8 x Vd,m x	nm x Tm/3	3600 kWh/m	onth (see	Tables 1b,	1c 1d)					
	163.77	143.23	147.80	128.86	123.64	106.70	98.87	113.45	114.81	133.80	146.05	158.60	1
	L						1	1	1	Σ(45)1	.12 =	1579.59	(45)
Distribution loss	0.15 x (45	)m								200	L		], ,
	24.57	21.49	22.17	19.33	18.55	16.00	14.83	17.02	17.22	20.07	21.91	23.79	(46)
Storage volume	(litres) inclu	uding any so	plar or WW	HRS storag	e within san	ne vessel						150.00	(47)
Water storage lo	oss:										L	200.00	]()
a) If manufactur	er's declare	od loss facto	r is known	(kWh/day)								1 41	(48)
Temperature	a factor from	n Tahle 2h		(kwn/uuy)								0.54	
Energy lost f	om water r	torage (LM	h/day (49	R) v (10)								0.76	] (50)
Enter (50) or (54	) in (55)	storage (KW	17 uayj (40	Ŋ∧(4J)								0.76	] (50) ] (55)
Water storage la	n in (55) See calculati	ed for each	month /⊑⊑	$5) \times (41)m$								0.70	] [22]
water storage it		21 22		27 27 27	22 60	22 01	22 60	22 60	22.04	22 60	22.01	22 60	(56)
If the vessel con	tains dedice	ted solar st		ledicated M	/WHRS (56)r	22.04 n x [(Δ7) -	23.00 Vs] ∸ (17)	23.00 else (56)	22.04	23.00	22.04	23.00	] (30)
IL LILE VESSEL CUIT	canno ucuito	accu solal St	. Ji uge Ul U	cultureu M		··· ^ ((+/) -	· · · · (+/),	CIJC (JU)					

	23.60	21.32	23.60	22.84	23.60	22.84	23.60	23.60	22.84	23.60	22.84	23.60 (	57)
Primary circuit l	oss for each	month from	m Table 3										
	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26 (	59)
Combi loss for e	ach month	from Table	3a, 3b or 3d	2									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (	61)
Total heat requi	red for wat	er heating c	alculated fo	or each mo	nth 0.85 x	(45)m + (4	6)m + (57)ı	m + (59)m +	· (61)m				
	210.64	185.56	194.67	174.21	170.51	152.05	145.73	160.32	160.16	180.66	191.41	205.47 (	62)
Solar DHW inpu	t calculated	using Appe	ndix G or A	ppendix H									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (	63)
Output from wa	iter heater f	or each mo	nth (kWh/n	nonth) (62	2)m + (63)m								
	210.64	185.56	194.67	174.21	170.51	152.05	145.73	160.32	160.16	180.66	191.41	205.47	
										∑(64)1	12 = 2	131.40 (	64)
Heat gains from	water heat	ing (kWh/m	onth) 0.25	× [0.85 × (	45)m + (61	)m] + 0.8 ×	[(46)m + (	57)m + (59)	m]				
	91.95	81.49	86.64	79.13	78.60	71.76	70.37	75.22	74.46	81.98	84.85	90.23 (	65)
E Internal activ													
5. Internal gair	15	<b>5</b> . h	<b>N</b> 4	<b>.</b>	<b>N</b> 4	1		•	6	0.1	New	<b>D</b>	
Matabalia saina	Jan (Tabla C)	Feb	iviar	Apr	iviay	Jun	Jui	Aug	Sep	Oct	NOV	Dec	
Metabolic gains		420.00	120.20	420.26	122.26	120.20	122.25	122.25	120.26	420.20	122.26	120.26	
lishting spins (s	139.36	139.36	139.36	139.36	139.36	139.36	139.36	139.36	139.36	139.36	139.36	139.36 (	66)
Lighting gains (C			, equation	L9 OF L9a),			0.02	11.17	45.20	10.54	22.04	24.22	
Appliance gains	23.66	21.01	17.09	12.94	9.67	8.16	8.82	11.47	15.39	19.54	22.81	24.32 (	67)
Appliance gains							100 53	405 70	202.72	247.40	226.4.4	252.67	
Cooking going (a	265.38	268.13	261.19	246.42	227.77	210.24	198.53	195.78	202.72	217.49	236.14	253.67	68)
COOKINg gains (C			, equation				26.04	26.04	26.04	26.04	26.04	26.04	
Dump and fap g	30.94	36.94	36.94	36.94	36.94	36.94	36.94	36.94	36.94	36.94	36.94	36.94 (	69)
Pullip allu lali g			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20)
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00 (	70)
LUSSES E.g. Evap			111 49	111 40	111 40	111 /0	111 40	111 10	111 / 0	111 10	111 /0	111 /0 /	71)
Water beating a	ins (Table	-111.40   5)	-111.40	-111.40	-111.40	-111.40	-111.40	-111.40	-111.40	-111.40	-111.40	-111.40 (	/1)
water neating g		121.26	116.45	109.90	105 65	99.67	0/ 58	101 10	103 /1	110.10	117.8/	121 27 (	72)
Total internal ga	(66)m =	121.20   + (67)m + (6	8)m + (69)n	109.90	+ (71)m + (7	2)m	94.30	101.10	105.41	110.19	117.04	121.27	72)
		475.22	159 51	<u>134 06</u>	407.90	387.88	366.74	373 15	386 33	/12.03	441.60	464.07 (	73)
	477.45	475.22	455.54	454.00	407.50	502.00	500.74	575.15	500.55	412.05	441.00	(	75)
6. Solar gains													
			Access fa	actor	Area	Sol	ar flux		g	FF		Gains	
			Table	6d	m²	v	//m²	speci or T	ific data able 6b	specific d or Table	ata 6c	W	
South			0.77		12.06		6 75		<u>72</u>			242.72	'70\
South			0.77		1.22	] X [ 4	0.75 X		).72 X	0.80		243.72 (	76) (76)
East			0.77		1.22		9.64 X		).72 X	0.80		9.56	76)
VVESI	$\Delta ttc \Sigma(74)m$	(92)m	0.77	× L	10.10		9.64 X	0.9 X (	).72 X	0.80	=	/9.05 (	80)
Solar gains in wa			705 00	002.05	1112 57	1102.10	1002 75	070.00	005.40	627.62	400.14	202.07 /	(02)
Total gains inte	332.94	5/3.08    ar (72)m +	/95.88   (82)m	993.85	1112.57	1102.19	1003.75	976.90	805.42	037.02	400.14	283.97	83)
Total gains - inte			1255 41	1427.02	1520.46	1495.07	1420.40	1250.05	1251 76	1040 65	941 74	749.02 (	01)
	010.57	1040.90	1233.41	1421.92	1320.40	1403.07	1430.49	1330.03	1231.70	1049.00	041./4	740.03	04)
7. Mean intern	al tempera	ture (heatir	ng season)										
Temperature du	iring heating	g periods in	the living a	rea from T	able 9, Th1	(°C)						21.00 (	85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation facto	r for gains f	or living are	ea n1,m (se	e Table 9a)									
	0.99	0.97	0.91	0.76	0.58	0.41	0.29	0.32	0.52	0.84	0.98	1.00	(86)
Mean internal te	emp of livin	g area T1 (s	teps 3 to 7	in Table 9c	:)								
	20.22	20.47	20.73	20.92	20.99	21.00	21.00	21.00	20.99	20.89	20.51	20.17	(87)
Temperature du	ring heating	g periods in	the rest of	f dwelling fr	rom Table 9	ə, Th2(°C)							_
	20.14	20.14	20.14	20.16	20.16	20.17	20.17	20.17	20.17	20.16	20.15	20.15	(88)
Utilisation facto	r for gains for	or rest of d	welling n2,	m									_
	0.99	0.96	0.88	0.72	0.53	0.35	0.24	0.26	0.46	0.80	0.97	0.99	( <u>89)</u>
Mean internal te	emperature	in the rest	of dwelling	T2 (follow	steps 3 to	7 in Table 9	) )	0.20					] (,
	10./3	10.68	10.02	20.10	20.15	20.17	20.17	20.17	20.16	20.08	10.73	19.40	
Living area fract		15.00	15.55	20.10	20.15	20.17	20.17	20.17	20.10	20.00	(4) -	0.21	] (01)
Moon internal to	mporaturo	for the wh	olo dwollin	α fl Δ v T1 μ	(1 fl A) v T	г <b>э</b>			LI LI	vilig alea <del>-</del>	(4) -	0.21	] (91)
				gila x i i +		12					10.00	10-50	
	19.60	19.85	20.10	20.27	20.33	20.35	20.35	20.35	20.34	20.25	19.90	19.56	] (92)
Apply adjustme	nt to the me	ean internal	temperatu	ure from Ta	ble 4e whe	re appropr	iate				1	1	-
	19.60	19.85	20.10	20.27	20.33	20.35	20.35	20.35	20.34	20.25	19.90	19.56	(93)
8 Snace heatin	g requirem	ent											
8. Space heath	lan	Eab	Mar	Apr	May	lun	11	Aug	Son	Oct	Nov	Dec	
1.14111	Jan	reb	war	Apr	iviay	Jun	IUL	Aug	Sep	001	NOV	Dec	
Utilisation facto	r for gains, i	յm			1					1			п
	0.99	0.96	0.88	0.73	0.54	0.37	0.25	0.28	0.47	0.80	0.97	0.99	_ (94)
Useful gains, ηm	iGm, W (94	)m x (84)m								•			_
	801.10	1005.10	1107.47	1037.95	821.36	543.50	354.78	372.60	591.70	841.64	814.09	742.28	(95)
Monthly average	e external to	emperature	e from Tabl	e U1									
	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate fo	r mean inte	ernal tempe	rature, Lm	, W [(39)m	x [(93)m -	(96)m]							
	1513.32	1473.97	1336.35	1099.40	831.04	544.21	354.83	372.69	594.97	929.67	1240.97	1499.52	(97)
Space heating re	equirement,	kWh/mon	th 0.024 x	[(97)m - (9	5)m] x (41)ı	m							
	529.89	315.08	170.29	44.24	7.20	0.00	0.00	0.00	0.00	65.49	307.35	563.38	7
									Σ(98	8)15, 10	.12 = 2	2002.94	_ ] (98)
Space heating re	auirement	kWh/m²/ve	ear						2.	(98)	÷ (4)	18.93	] (99)
		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,								()			] (,
9a. Energy req	uirements -	individual	heating sys	stems inclu	ding micro	-CHP							
Space heating													
Fraction of space	e heat from	secondary	/suppleme	ntary syster	m (table 11	.)						0.00	(201)
Fraction of space	e heat from	main syste	m(s)							1 - (20	) =	1.00	_ ] (202)
Fraction of space	e heat from	<i>.</i> main syste	m 2									0.00	] (202)
Fraction of total	snace heat	from main	system 1						(20	)2) x [1- (20	3)] =	1 00	] (204)
Eraction of total	space heat	from main	system 2						(20	(202) x (20	- (2)	0.00	] (205)
Efficiency of ma	in system 1	(0/)	System 2							(202) x (20	JJ) =	205.00	] (205) ] (206)
Efficiency of fila	lin system 1	(%)	Max	A	Max	1	11	A	Sam	Oct	Nev	295.96 Dec	] (200)
	Jan	FeD	iviar	Apr	iviay	Jun	Jui	Aug	Sep	Uct	NOV	Dec	
Space heating fu	iel (main sy:	stem 1), kW	/h/month		I					1		1	-
	179.03	106.45	57.53	14.95	2.43	0.00	0.00	0.00	0.00	22.13	103.84	190.35	
									∑(21:	1)15, 10	.12 =	676.72	(211)
Water heating													
Efficiency of wat	er heater												
	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	271.89	] (217)
Water heating f	uel, kWh/m	onth											
	77.47	68.25	71.60	64.08	62.71	55.92	53.60	58.96	58.91	66.45	70.40	75.57	]

				$\Sigma(210_{2})1$ 12 -	792.02	(210)
Annual totals				2(219d)112 =	783.92	] (219)
Space heating fuel - main system 1					676 72	]
Water heating fuel					783.92	]
Electricity for numps fans and electric keen-hot (Table 4f)					703.52	]
mechanical ventilation fans - halanced, extract or nositive inn	it from outside		285.42	]		(230a)
Total electricity for the above kWb/year			200112	l	285.42	(231)
Electricity for lighting (Annendix I.)					417 82	(232)
Total delivered energy for all uses		(211	) (221) + (231) +	(232) (237h) =	2163.87	(238)
		(	,(===) * (===) *	(,(, z),		] (200)
10a. Fuel costs - individual heating systems including micro-CHF	•					
	Fuel kWb/year		Fuel price		Fuel	
Space besting main system 1			12.10	× 0.01 –		(240)
Space heating - main system 1	782.02	x	13.19	X 0.01 =	89.26	] (240) ] (247)
Water nearing	783.92	X	13.19	X 0.01 =	27.65	(247)
Pumps and rans	285.42	x	13.19	X 0.01 =	37.05	] (249) ] (250)
Electricity for lighting	417.82	х	13.19	x 0.01 =	55.11	) (250)
			(240) (242)	· (245) (254) -		) (251)
Total energy cost			(240)(242) -	+ (245)(254) =	285.42	] (255)
11a. SAP rating - individual heating systems including micro-CH	Р					
Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					0.79	(257)
SAP value					88.91	]
SAP rating (section 13)					89	(258)
SAP band					В	]
12a. CO <sub>2</sub> emissions - individual heating systems including micro	-СНР	· · · · · · · · · · · · · · · · · · ·				
	Energy		Emission factor		Emissions	
	kWh/year		kg CO₂/kWh		kg CO₂/year	
Space heating - main system 1	676.72	x	0.519	=	351.22	(261)
Water heating	783.92	x	0.519	=	406.85	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	758.07	(265)
Pumps and fans	285.42	х	0.519	=	148.13	(267)
Electricity for lighting	417.82	х	0.519	=	216.85	(268)
Total CO <sub>2</sub> , kg/year				(265)(271) =	1123.05	(272)
Dwelling CO <sub>2</sub> emission rate				(272) ÷ (4) =	10.61	(273)
El value					90.02	
El rating (section 14)					90	(274)
El band					В	]
13a. Primary energy - individual heating systems including micr	o-CHP					
	Energy		Primary factor		Primary Energy	
	kWh/year				kWh/year	
Space heating - main system 1	676.72	х	3.07	=	2077.52	(261)
Water heating	783.92	х	3.07	=	2406.63	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	4484.15	(265)

Pumps and fans

Electricity for lighting

Primary energy kWh/year

876.24

1282.70

6643.09

=

=

(267)

(268)

(272)

PREVIEW - THIS VERSION HAS NOT BEEN APPROVED

285.42

417.82

х

х

3.07

3.07

# TER Worksheet Design - Draft



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

Assessor name	Mr Harry	Knibb						Assessor num	iber	1		
Client	,							Last modified		23/02	/2017	
	24 Confin		Dlandar									
Address	24 Canne	Id Place HS-	-D, Londor	1								
1. Overall dwelling dimens	sions											
				A	rea (m²)		ŀ	Average storey height (m)		Vo	lume (m³)	
Lowest occupied					52.90	(1a) x	Ē	2.90	(2a) =		153.41	(3a)
+1					52.90	(1b) x	Ē	2.90	(2b) =		153.41	(3b)
Total floor area	(1a) ·	+ (1b) + (1c	) + (1d)(1	1n) =	105.80	(4)						
Dwelling volume								(3a) + (3b) + (3	c) + (3d)(3n)	=	306.82	(5)
2 Ventilation rate												
2. Ventilation rate										m	<sup>3</sup> per hour	
Number of this second							Г	0				
Number of chimneys								0	] x 40 =			] (6a) ] (6b)
Number of open flues								0	] x 20 =		0	] (ad) [ ] (a, )
Number of intermittent fans	S							4	] x 10 =		40	] (/a) ] ( )
Number of passive vents								0	] x 10 =			](7b) ](-)
Number of flueless gas fires								U	] x 40 =			] (7C)
											hour	
Infiltration due to chimneys	, flues, fans	, PSVs		(6a)	+ (6b) + (7	a) + (7b) + ( <sup>-</sup>	7c) = 🗌	40	÷ (5) =		0.13	(8)
If a pressurisation test has b	een carried	out or is in	tended, pr	roceed to (1	17), otherw	vise continue	e from	(9) to (16)	-			-
Air permeability value, q50,	expressed i	n cubic me	tres per ho	our per squ	are metre	of envelope	area				5.00	(17)
If based on air permeability	value, then	(18) = [(17	) ÷ 20] + (8	3), otherwis	se (18) = (1	6)					0.38	(18)
Number of sides on which the	he dwelling	is sheltered	d								2	(19)
Shelter factor								1 -	[0.075 x (19)]	= [	0.85	(20)
Infiltration rate incorporatir	ng shelter fa	ctor							(18) x (20)	) = [	0.32	(21)
Infiltration rate modified for	r monthly w	ind speed:										-
Jan	Feb	Mar	Apr	May	Jun	Jul	Au	g Sep	Oct	Nov	Dec	
Monthly average wind spee	d from Tabl	e U2										
5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	0 4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4												
1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	3 1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (al	lowing for s	helter and	wind facto	or) (21) x (2	2a)m							
0.41	0.40	0.40	0.36	0.35	0.31	0.31	0.3	0.32	0.35	0.36	0.38	(22b)
Calculate effective air change	ge rate for t	he applicab	le case:									
If mechanical ventilation	: air change	rate throu	gh system								N/A	(23a)
If balanced with heat rec	covery: effic	iency in % a	allowing fo	or in-use fa	ctor from T	able 4h					N/A	(23c)
d) natural ventilation or	whole hous	e positive i	nput venti	lation from	n loft							
0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	4 0.55	0.56	0.57	0.57	(24d)
Effective air change rate - ei	nter (24a) o	r (24b) or (2	24c) or (24	d) in (25)								



	0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.57	0.57	(25)
3. Heat losses a	and heat lo	ss paramet	er										
Element			а	Gross rea, m²	Openings m <sup>2</sup>	Net A,	area m²	U-value W/m²K	A x U W	/К к- kJ	value, I/m².K	Ахк, kJ/K	
Window						24	.44 x	1.33	= 32.40				(27)
Ground floor						52	.90 x	0.13	= 6.88				(28a)
External wall						112	2.22 x	0.18	= 20.20				(29a)
Party wall						45	.46 x	0.00	= 0.00				(32)
Roof						52	.90 x	0.13	= 6.88				(30)
Total area of ext	ternal elem	ents ∑A, m²	2			242	2.46						(31)
Fabric heat loss,	W/K = ∑(A	× U)							(26	5)(30) + (	(32) =	66.36	(33)
Heat capacity Cr	m = ∑(А x к)							(28)	.(30) + (32) +	+ (32a)(3	2e) =	N/A	(34)
Thermal mass pa	arameter (T	MP) in kJ/r	n²K									250.00	(35)
Thermal bridges	:: Σ(L x Ψ) ca	alculated us	sing Appen	dix K								3.79	(36)
Total fabric heat	t loss									(33) + (	(36) =	70.15	(37)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	_
Ventilation heat	loss calcula	ated month	ly 0.33 x (2	25)m x (5)									
	59.23	58.89	58.57	57.03	56.74	55.40	55.40	55.15	55.92	56.74	57.32	57.93	(38)
Heat transfer co	efficient, W	//K (37)m +	⊦ (38)m										
	129.38	129.04	128.71	127.18	126.89	125.55	125.55	125.30	126.07	126.89	127.47	128.08	
									Average = ∑	(39)112	/12 =	127.18	(39)
Heat loss param	eter (HLP),	W/m²K (39	9)m ÷ (4)										
	1.22	1.22	1.22	1.20	1.20	1.19	1.19	1.18	1.19	1.20	1.20	1.21	
									Average = ∑	(40)112	/12 =	1.20	(40)
Number of days	in month (	Table 1a)											_
	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)
4. Water heati	ng energy r	equiremen	t										
Assumed occupa	ancy, N											2.79	(42)
Annual average	hot water ι	isage in litr	es per day '	/d,average	= (25 x N) +	36						100.39	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage	e in litres pe	er day for ea	ach month	Vd,m = fact	or from Tab	le 1c x (43	<b>(</b> )						
	110.43	106.42	102.40	98.39	94.37	90.35	90.35	94.37	98.39	102.40	106.42	110.43	
										∑(44)1.	12 =	1204.73	(44)
Energy content	of hot wate	r used = 4.:	18 x Vd,m x	nm x Tm/3	8600 kWh/m	onth (see	Tables 1b,	, 1c 1d)					_
	163.77	143.23	147.80	128.86	123.64	106.70	98.87	113.45	114.81	133.80	146.05	158.60	
										∑(45)1.	12 =	1579.59	(45)
Distribution loss	0.15 x (45	)m										-	_
	24.57	21.49	22.17	19.33	18.55	16.00	14.83	17.02	17.22	20.07	21.91	23.79	_ (46)
Storage volume	(litres) inclu	uding any s	olar or WW	HRS storag	e within san	ne vessel						150.00	(47)
Water storage lo	oss:												_
a) If manufactur	er's declare	ed loss facto	or is known	(kWh/day)								1.39	(48)
Temperature	e factor fron	n Table 2b										0.54	(49)
Energy lost fi	rom water s	storage (kW	/h/day) (48	8) x (49)								0.75	<b>(50)</b>
Enter (50) or (54	l) in (55)											0.75	(55)
Water storage lo	oss calculate	ed for each	month (55	5) x (41)m				1	· · · · ·		1		
	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)
If the vessel con	tains dedica	ated solar s	torage or d	edicated W	/WHRS (56)r	n x [(47) -	Vs] ÷ (47),	else (56)					

	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)
Primary circuit l	oss for each	month fro	m Table 3										
	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Combi loss for e	ach month	from Table	3a, 3b or 3o	С									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat requi	red for wate	er heating c	alculated fo	or each mo	onth 0.85 x	(45)m + (4	6)m + (57)r	n + (59)m +	- (61)m				
	210.36	185.32	194.40	173.95	170.24	151.79	145.46	160.05	159.90	180.39	191.14	205.20	(62)
Solar DHW inpu	t calculated	using Appe	endix G or A	ppendix H									
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from wa	ter heater f	or each mo	nth (kWh/n	nonth) (62	2)m + (63)m	I							
	210.36	185.32	194.40	173.95	170.24	151.79	145.46	160.05	159.90	180.39	191.14	205.20	
										∑(64)1	12 = 2	128.21	(64)
Heat gains from	water heat	ing (kWh/m	nonth) 0.25	5 × [0.85 × (	(45)m + (61	)m] + 0.8 ×	[(46)m + (!	57)m + (59)	m]				
	91.73	81.29	86.42	78.92	78.39	71.55	70.15	75.00	74.25	81.76	84.64	90.01	(65)
5 Internal gair	) S												
J. Internal gai	lan	Eab	Mar	Apr	May	lun	Int	Δυσ	Son	Oct	Nov	Dec	
Metabolic gains	Jan (Table 5)	reb	Ividi	Арі	iviay	Juli	Jui	Aug	Seh	011	NOV	Dec	
Wetabolic gains		120.26	120.26	120.26	120.26	120.26	120.26	120.26	120.26	120.26	120.26	120.26	(66)
Lighting gains (c	alculated in	Annendiy I	equation	135.30	2155.50	139.30	139.30	139.30	139.30	139.30	139.30	139.30	(00)
		21 01	17.00	12 04		9 16	0 07	11 47	15 20	10.54	22.61	24.22	(67)
Annliance gains	(calculated	in Annendi		12.94	13a) also se	e Table 5	0.02	11.47	15.55	19.94	22.01	24.52	(07)
Appliance Bailio	265.38	268 13	261 19	246.42	227 77	210.24	198 53	195 78	202 72	217/19	236.14	253.67	(68)
Cooking gains (c	alculated in	Appendix I	equation	115 or 115	a) also see	Table 5	198.55	195.78	202.72	217.49	230.14	255.07	(00)
Cooking Barris (c	36.94	36.94	36.94	36.94	36.94	36.94	36.94	36.94	36.94	36.94	36.94	36.94	(69)
Pump and fan g	ains (Table	50.54 5a)	50.54	50.54	50.54	30.54	50.54	50.54	50.54	50.54	50.54	50.54	(05)
i anip ana ian 8	3 00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3 00	3.00	(70)
Losses e.g. evap	oration (Tab	ole 5)	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	3.00	(, 0)
	-111 48	-111 48	-111 48	-111 48	-111 48	-111 48	-111 48	-111 48	-111 48	-111 48	-111 48	-111 48	(71)
Water heating g	ains (Table	5)		111110		111110	111.10		111.10	111.10			(, _)
	123.29	120.97	116.16	109.61	105.36	99.37	94.29	100.81	103.12	109.90	117.55	120.98	(72)
Total internal ga	ins (66)m +	- (67)m + (6	8)m + (69)r	n + (70)m -	+ (71)m + (7	72)m							(/
Ū	480.14	477.92	462.25	436.77	410.61	385.59	369.45	375.86	389.04	414.74	444.31	466.77	(73)
								I	1				
6. Solar gains													
			Access fa	actor	Area	Sol	ar flux		g ifia data	FF		Gains	
			Table	ou	m-	v	//m-	or T	able 6b	or Table	6c	vv	
South			0.77	7 X	13.06	<b>x</b> 4	6.75 x	0.9 x (	).63 x	0.70		186.60	(78)
East			0.77		1.22		9.64 x	0.9 x (	).63 x	0.70		7.32	(76)
West			0.77		10.16	] x [ 1	9.64 x	0.9 x (	0.63 x	0.70		60.98	(80)
Solar gains in wa	atts ∑(74)m	(82)m											()
0	254.91	439.23	609.34	760.92	851.81	843.87	814.43	747.94	662.59	488.18	306.36	217.41	(83)
Total gains - inte	ernal and so	lar (73)m +	(83)m										1
Ū	735.04	917.15	1071.59	1197.69	1262.42	1229.45	1183.88	1123.80	1051.63	902.92	750.66	684.19	(84)
		-			·								
7. Mean intern	al tempera	ture (heatii	ng season)										
Temperature du	iring heating	g periods in	the living a	irea from T	able 9, Th1	(°C)						21.00	(85)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation facto	r for gains f	or living are	a n1,m (se	e Table 9a)									
	1.00	0.99	0.97	0.91	0.80	0.62	0.46	0.50	0.74	0.94	0.99	1.00	(86)
Mean internal to	emp of livin	g area T1 (s	teps 3 to 7	in Table 9c	:)								
	19.75	19.97	20.27	20.61	20.85	20.97	20.99	20.99	20.92	20.59	20.10	19.71	(87)
Temperature du	iring heating	g periods in	the rest of	dwelling fr	rom Table 9	9, Th2(°C)							
	19.90	19.90	19.91	19.92	19.92	19.93	19.93	19.93	19.93	19.92	19.92	19.91	(88)
Utilisation facto	r for gains f	or rest of d	welling n2,	n									_
	0.99	0.99	0.96	0.89	0.74	0.53	0.35	0.39	0.66	0.92	0.99	1.00	(89)
Mean internal to	emperature	in the rest	of dwelling	T2 (follow	steps 3 to	7 in Table 9	) Əc)			1	1		_ · ·
	18.25	18 58	19.01	19.48	19.78	19 91	,	19.93	19.87	19.47	18 77	18 20	] (90)
Living area fract	ion	10.50	15.01	19.40	15.70	15.51	15.55	15.55	15.07	ving area ÷	(A) =	0.21	] (90) ] (91)
Mean internal to	emnerature	for the wh	ole dwellin	σflΔxT1 +	-(1 - fl Δ) x T	r?				ing area .	(-) -	0.21	
Weathinternatio		10.07	10.29	10.72		20.12	20.15	20.15	20.00	10.70	10.05	10 50	
Apply adjustma	18.57	10.07	19.28	19.72	20.01	20.13	20.15	20.15	20.09	19.70	19.05	18.52	] (92)
Apply adjustme			temperatu		Die 4e wrie			20.45	20.00	10.70	10.05	40.50	
	18.57	18.87	19.28	19.72	20.01	20.13	20.15	20.15	20.09	19.70	19.05	18.52	] (93)
8. Space heating	ng requirem	ient								-			
	Jan	Feb	Mar	Apr	Mav	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation facto	r for gains.	nm		·				Ű					
		0.98	0.95	0.88	0.75	0.55	0.37	0.42	0.67	0.91	0.98	0 99	(10) آ
Liseful gains no	0.55	0.50	0.55	0.00	0.75	0.55	0.57	0.42	0.07	0.51	0.50	0.55	] (34)
			1010 60	1055.25	042.21	675 59	442.75	166.40	706 10	824.07	720.00	680.40	
Monthly average	729.02	099.10	from Tabl	1055.55	945.21	075.58	445.75	400.40	700.10	024.97	756.06	060.49	] (95)
wonting averag					11.70	14.60	10.00	16.40	1110	10.00	7.40	4.20	
llest less vete fr	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	] (96)
Heat loss rate to	fr mean inte	ernal tempe	rature, Lm,	, w [(39)m	x [(93)m -	(96)m]							- د - ۲
	1845.68	1803.06	1644.53	1376.02	1054.23	694.64	446.08	470.22	755.40	1155.10	1522.95	1833.92	] (97)
Space heating re	equirement	, kWh/mon	th 0.024 x	[(97)m - (95	5)m] x (41)i	m						1	٦
	830.35	607.41	464.95	230.89	82.60	0.00	0.00	0.00	0.00	245.62	565.10	858.15	
									∑(98	3)15, 10	.12 = 3	3885.08	」(98) っ
Space heating re	equirement	kWh/m²/ye	ear							(98)	÷ (4)	36.72	(99)
9a. Energy reg	uirements -	individual	heating sys	stems inclu	ding micro	-CHP							
Snace heating													
Eraction of space	a haat from	socondary	/suppleme	atary system	m (tabla 11	,						0.00	7 (201)
Fraction of space	e heat from		m(c)	italy system		.)				1 (2)	01) – [	1.00	] (201) ] (202)
Fraction of space	e heat from	main syste	m 2							1 - (20	JI) – [	1.00	] (202) ] (202)
	e neat from	finalii syste	III Z						(20	2) [4. (20		0.00	] (202) ] (204)
	space neat	from main	system 1						(20	)2) X [1- (20	3)] =	1.00	] (204) ] (204)
Fraction of total	space heat	from main	system 2							(202) x (20	03) =	0.00	] (205) ] (205)
Efficiency of ma	in system 1	(%)						_	-	• •		93.50	_ (206)
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fu	uel (main sy	stem 1), kW	/h/month										-
	888.08	649.64	497.27	246.94	88.34	0.00	0.00	0.00	0.00	262.70	604.39	917.81	
									∑(21:	1)15, 10	.12 = 4	155.16	(211)
Water heating													
Efficiency of war	ter heater												
	88.11	87.75	87.06	85.57	83.01	79.80	79.80	79.80	79.80	85.64	87.53	88.22	] (217)
Water heating f	uel, kWh/m	onth											
	238.75	211.19	223.30	203.29	205.09	190.21	182.29	200.56	200.38	210.65	218.37	232.60	]

				Σ(219a)112 =	2516.67	(219)
Annual totals				2(2130)112	2010.07	_ (210)
Space heating fuel - main system 1					4155.16	7
Water heating fuel					2516.67	]
Electricity for pumps, fans and electric keep-hot (Table 4f)						_
central heating pump or water pump within warm air heating	ng unit		30.00	]		(230c)
boiler flue fan	-		45.00	7		(230e)
Total electricity for the above, kWh/year			L	-	75.00	(231)
Electricity for lighting (Appendix L)					417.82	(232)
Total delivered energy for all uses			(211)(221) + (231) +	(232)(237b) =	7164.65	(238)
10a. Fuel costs - individual heating systems including micro-0	СНР					
	Fuel		Fuel price		Fuel	
	kWh/year				cost £/year	
Space heating - main system 1	4155.16	x	3.48	x 0.01 =	144.60	(240)
Water heating	2516.67	x	3.48	x 0.01 =	87.58	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	417.82	x	13.19	x 0.01 =	55.11	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)(242)	+ (245)(254) =	417.18	(255)
11a. SAP rating - individual heating systems including micro-	СНР					
Energy cost deflator (Table 12)					0.42	(256)
Energy cost factor (ECF)					1.16	(257)
SAP value					83.79	]
SAP rating (section 13)					84	(258)
SAP band					В	
12a. CO <sub>2</sub> emissions - individual heating systems including mid	cro-CHP					
	Energy		Emission factor	r	Emissions	
	kWh/year		kg CO₂/kWh	_	kg CO₂/year	_
Space heating - main system 1	4155.16	x	0.216	=	897.51	(261)
Water heating	2516.67	х	0.216	=	543.60	(264)
Space and water heating			(261) + (262)	+ (263) + (264) =	1441.11	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	417.82	х	0.519	=	216.85	(268)
Total CO <sub>2</sub> , kg/year				(265)(271) =	1696.89	(272)
Dwelling CO <sub>2</sub> emission rate				(272) ÷ (4) =	23.53	(273)
El value					84.92	
El rating (section 14)					85	(274)
El band					В	
13a. Primary energy - individual heating systems including m	nicro-CHP					
	Energy kWh/year		Primary factor		Primary Energy kWh/year	1

	kWh/year		,		kWh/year	
Space heating - main system 1	4155.16	] x	1.22	=	5069.30	(261)
Water heating	2516.67	] x	1.22	=	3070.33	(264)
Space and water heating			(261) + (262) +	(263) + (264) =	8139.63	(265)
Pumps and fans	75.00	] x	3.07	=	230.25	(267)
Electricity for lighting	417.82	] x	3.07	=	1282.70	(268)

PREVIEW - THIS VERSION HAS NOT BEEN APPROVED

Primary energy kWh/year

Dwelling primary energy rate kWh/m2,	/year
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9652.58	(272)
91.23	(273)