Sustainability & Energy Statement

Arlington Works, 23 Arlington Road, Twickenham

(With Amendments Highlighted in Yellow)

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Executive Summary

This revision to the Sustainability and Energy Statement has been amended in response to queries raised by Climate Integrated Solutions acting for LBRuT. The Statement has been prepared in support of a planning application to provide five commercial units totalling 610 m^2 and 24, 1, 2 and 3-bedroom apartments at the Arlington Works, 23 Arlington Road, Twickenham. It includes an energy demand assessment showing how selected energy efficiency, low carbon and renewable energy measures have been incorporated into the development design.

Working drawings have yet to been produced but SAP calculations have been prepared for a sample of the apartments based upon an agreed construction specification and the detailed planning drawings and a SBEM calculation for a similar unit built to a similar specification has been used for the commercial accommodation. When aggregated across all development these calculations provide an estimate of the total baseline emissions. The calculations used are attached as Appendices 4 & 5.

It is proposed to enhance the fabric insulation standards of the buildings and the energy modelling has assumed the installation of an air source heat pump into each of the five commercial units. The specific unit will be selected at the construction stage but details of an appropriate unit have been attached as Appendix 6. These systems will provide space heating and cooling if required. The apartments will be provided with individual gas condensing boilers. In addition it is proposed to install a photovoltaic array totalling 19.8 kW. This will be comprised of 66 x 300W panels and a Roof Layout is attached as Appendix 3 showing the possible location of the panels. The layout is indicative but demonstrates the quantity of panels can be accommodated. A sketch is also attached in Appendix 3 showing the spacing required between rows to avoid overshadowing.

There is currently no district heating network serving the site and we understand none is planned in the foreseeable future. The site does not have sufficient baseload to efficiency sustain a communal heating system either with or without a combined heat and power unit and therefore neither is proposed.

The combined reduction as a result of the energy efficiency measures (Be Clean) and the use renewable technologies (Be Green) can be summarised as follows;

	Total Emissions	**% Reduction**
	kg CO_2 per year	
Baseline (Building Regulations TER) - Commercial	12,139	-
Baseline (Building Regulations TER) - Residential	27,182	
Baseline (Building Regulations TER) - **Total**	**39,321**	
Be Lean - after energy efficiency (BER) - Commercial	9,882	18.59%
Be Lean - after energy efficiency (DER) - Residential	25,182	7.36%
Be Lean - after energy efficiency (BER/DER) - **Total**	**35,064**	**10.83%**
Be Green - after efficiency and renewable energy	**25,494**	**35.16%** (of TER)

The residual carbon dioxide emissions are **25.494 tonnes** and therefore the carbon offset payment required by the London Plan is **£44,089**. The Council's Consultant has asked for confirmation of the residual emissions from just the residential element. The photovoltaic array is proposed to be installed on the roof of both residential buildings and therefore the residual emissions are calculated as **15.612 tonnes**. The carbon offset for the residential element is therefore calculated as **£28,102.**

The commercial accommodation will achieve BREEAM, 'Excellent' and a Pre-Assessment Estimator is included as Appendix 1.

The London Borough of Richmond Sustainable Construction Checklist is attached as Appendix 2.

The summer overheating risk to the most vulnerable apartments is assessed as 'Medium'. This meets the requirements of the Building Regulations for overheating criteria.

1.0 Introduction

This report has been commissioned by Sharpe Refinery Service (Hydro-Carbons) Ltd and provides a Sustainability and Energy Statement for the construction of five commercial units totalling 610 m^2 in floor space and 24, 1, 2 & 3-bedroom apartments on land at Arlington Works, 23 Arlington Road, Twickenham.

The report describes the methodology used in assessing the development and the initiatives proposed.

The buildings have been designed and will be constructed to reduce energy demand and carbon dioxide emissions. The objective is to reduce the energy demand to an economic minimum by making investment in the parts of the buildings that have the greatest impact on energy demand and are the most difficult and costly to change in the future, namely the building fabric. Once cost effective structures have been designed, low-carbon and renewable technologies will be considered for installation to provide heat and/or electricity.

The following hierarchy will be followed:

Lean	reduce demand and consumption
Clean	increase energy efficiency
Green	provide low carbon renewable energy sources

The report has been prepared by Ivan Ball of Bluesky Unlimited who are sustainability consultants.

2.0 Planning Policy Context

National Policy

The UK Government published its sustainable development strategy in 1999 entitled "A better quality of life: A strategy for sustainable development in the UK". This sets out four main objectives for sustainable development in the UK:

- Social progress that recognises the needs of everyone.
- Effective protection of the environment.
- Prudent use of natural resources.
- Maintenance of high stable levels of economic growth and employment.

Sustainable Communities: Building for the Future, known colloquially as the Communities Plan was published in 2003. The Plan sets out a long-term programme of action for delivering sustainable communities in both urban and rural areas. It aims to tackle housing supply issues in parts of the country, low demand in other parts and the quality of our public spaces. The Communities Plan describes sustainable communities as: Active, inclusive and safe, well run, environmentally sensitive, well designed and built, well connected, thriving, well served and fair for everyone.

The most relevant national planning policy guidance on sustainability is set out in:

- National Planning Policy Framework - 2018

Paragraph 148 states;

"The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure."

Regional and Local Policies

The Development Plan comprises the London Plan (2016) and the London Borough of Richmond Local Plan (2018).

London Plan, published March 2016 **–** the following policies are relevant to the application:

Policy 5.2 – Minimising carbon dioxide emissions

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

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

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

Residential and Non-residential buildings:

Year	***Improvement on 2013 Building Regulations***
2013 – 2016	*35 per cent*

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

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

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

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

Policy 5.3 – Sustainable design and construction

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

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

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

- *a. minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems)*
- *b. avoiding internal overheating and contributing to the urban heat island effect*
- *c. efficient use of natural resources (including water), including making the most of natural systems both within and around buildings*
- *d. minimising pollution (including noise, air and urban runoff)*
- *e. minimising the generation of waste and maximising reuse or recycling*
- *f. avoiding impacts from natural hazards (including flooding)*
- *g. ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions*
- *h. securing sustainable procurement of materials, using local supplies where feasible, and*
- *i. promoting and protecting biodiversity and green infrastructure.*

Policy 5.6 – Decentralised energy in development proposals

A *Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems.*

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

- *1 Connection to existing heating or cooling networks*
- *2 Site wide CHP network*
- *3 Communal heating and cooling.*

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

Policy 5.7 – Renewable Energy

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

Policy 5.15 – Water Use and Supplies

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

Sustainable Design and Construction SPG – April 2014

The SPG provides Guidance on how schemes should comply with the London Plan and this Sustainability Statement has been prepared in accordance with the Guidance provided.

London Borough of Richmond

The London Borough of Richmond adopted its new Local Plan on the 3rd July 2018 and this supersedes the Core Strategy (2009) and the Development Management Plan (2011).

The following policy is of particular relevance to the topic area of this Statement and has been edited for clarity and relevance to the application in question.

Local Plan (2018)

Policy LP 22 - Sustainable Design and Construction

A. Developments will be required to achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change. Applicants will be required to complete the following:

1. *Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to complete the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.*
2. *Development that results in a new residential dwelling, including conversions, change of use, and extensions that result in a new dwelling unit, will be required to incorporate water conservation measures to achieve maximum water consumption of 110 litres per person per day for homes (including an allowance of 5 litres or less per person per day for external water consumption).*
3. *New non-residential buildings over 100sqm will be required to meet BREEAM 'Excellent' standard.*

Reducing Carbon Dioxide Emissions

B. Developers are required to incorporate measures to improve energy conservation and efficiency as well as contributions to renewable and low carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:

1. *All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy.*
2. *All other new residential buildings should achieve a 35% reduction.*
3. *All non-residential buildings over 100sqm should achieve a 35% reduction. From 2019 all major non-residential buildings should achieve zero carbon standards in line with London Plan policy.*

Targets are expressed as a percentage improvement over the target emission rate (TER) based on Part L of the 2013 Building Regulations.

C. This should be achieved by following the Energy Hierarchy:

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

Decentralised Energy Networks

D. The Council requires developments to contribute towards the Mayor of London target of 25% of heat and power to be generated through localised decentralised energy (DE) systems by 2025. The following will be required:

1. *All new development will be required to connect to existing DE networks where feasible. This also applies where a DE network is planned and expected to be operational within 5 years of the development being completed.*

Applicants are required to consider the installation of low, or preferably ultra-low, NOx boilers to reduce the amount of NOx emitted in the borough.

Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged where appropriate.

3.0 Assessment Methodology

The baseline energy demand and carbon dioxide emissions for the development have been established using agreed building specifications and the detailed planning drawings.

A number of calculations have been prepared for a representative number of units.

A SBEM calculation prepared for one of the commercial units and the results have been aggregated across all commercial accommodation to provide a total emissions figure.

A range of SAP calculations have been prepared for the representative range of the residential units including a 1-Bedroom apartment of 50.6 m^2, which has been modelled as a ground-floor and mid-floor unit (there are no top-floor 1-Bedroom apartments) and for a 3-Bedroom apartment of 76.1 m^2 modelled as a ground, mid and top-floor unit. It is assumed the two duplex apartments will have the same emissions as a top-floor 3-Bedroom unit.

The results from the SAP calculations have been aggregated across units of a similar floor area to deduce the total site emissions.

Emission Factors

The CO_2 emission factors, where applicable, used throughout this report have been taken from the Building Regulation Approved Document L - 2013.

	kg CO_2/kWh
Natural Gas	0.216
Grid supplied electricity	0.519
Displaced electricity	0.519

In assessing this proposal we have also been informed by the following guidance:

- **London Sustainability Checklist**
- **BRE Green Guide to Specification**
  The Building Research Establishment Green Guide to Specification lists building materials and components, and ranks their potential life cycle environmental impact.

4.0 Proposal

The proposal is for the erection of five, commercial units and 24, 1, 2 & 3-bedroom apartments.

The accommodation schedule is;

Unit Type	No.	Area	Totals
		m^2	m^2
Commercial			
Unit 5	1	75.2	75.2
Unit 3	1	133.0	133.0
Unit 1	1	133.2	133.2
Unit 2	1	133.8	133.8
Unit 4	1	134.8	134.8
Sub-Total	**5**		**610.0**
Residential			
1-Bedroom apartment	5	50.6	253.0
2-Bedroom apartment	2	62.0	124.0
2-Bedroom apartment	2	62.4	124.8
2-Bedroom apartment	1	71.5	71.5
2-Bedroom apartment	1	72.1	72.1
2-Bedroom apartment	1	74.1	74.1
3-Bedroom apartment	4	75.7	302.8
3-Bedroom apartment	3	76.1	228.3
3-Bedroom apartment	2	76.4	152.8
2-Bedroom apartment	1	78.0	78.0
3-Bedroom duplex apartment	1	101.0	101.0
3-Bedroom duplex apartment	1	101.1	101.1
Sub-Total	**24**		**1,683.5**
Total			**2,293.5**

5.0 Energy Efficiency

5.1 Demand Reduction (Be Lean)

Design

The energy performance of a building is affected by its design, construction and use and whilst occupant behaviour is beyond the remit of this statement, better design and construction methods can significantly reduce the life cycle emissions of a building and assist the occupant to reduce consumption.

Sustainable design is not just about incorporating renewable technologies; buildings should be designed at the outset to provide suitable environmental conditions for the occupants whilst also consuming as little energy as practical. It is possible to exceed Building Regulations requirements (Part L - 2013) through demand reduction measures alone, which typically include a combination of passive design measures (e.g. building design and efficient building fabric) and active design measures (e.g. variable speed motors).

Passive Design Measures

The passive design measures proposed include;

Passive Solar Gain

Passive measures include allowing for natural ventilation and exposed thermal mass coupled with high levels of insulation, air tightness and the control of solar gain.

The layout of the buildings are in the context of the shape of the site and surrounding development but broadly the commercial units and homes are arranged to provide all units with either a north-west and south-east or south-west and north-east orientation. There are six single aspect units (1-Bedroom apartments) which benefit from a south-east orientation.

There are no units with a solely northerly aspect and therefore all have access to sunshine at some point throughout the day.

Natural Daylighting

The orientation and the size of the windows have been optimised to maximise the amount of natural daylight and therefore reduce the demand for artificial lighting.

Efficient Building Fabric

Building Envelope

U-values of the building envelope must meet Building Regulations Part L standards and further improvements to U-values will reduce the building's heating requirements.

There is a commitment to exceed the minimum U-values required by the Building Regulations

Whilst the construction type has not been fixed both the residential and commercial units would suit the use of load bearing walls with either timber I beam or concrete intermediate floors.

The following U-values have been based upon the use of a 300mm load bearing cavity wall with 100mm cavity fully filled with XtraTherm CavityTherm or similar. Ground floors will be insulated with 150mm PIR insulation and flat roofs will be insulated with PIR insulation on top of the roof decking.

Windows are proposed as double glazed with Low 'e' soft coat and argon filled.

It is proposed to set maximum limits for the elemental U-values as follows:

Element	Part L Limiting U-values	Proposed U-values	Proposed Improvement
	W/m^{2}K	W/m^{2}K	
External Walls	**0.30**	**0.17**	**43%**
Flat Roofs	**0.20**	**0.16**	**20%**
Ground Floors	**0.20**	**0.11**	**40%**
Windows	**2.00**	**1.40**	**30%**

Air Leakage

Large amounts of heat are lost in winter through air leakage from a building (also referred to as infiltration or air permeability) often through poor sealing of joints and openings in the building

The Building Regulations set a minimum standard for air permeability of 10 m^3 of air per hour per m^2 of envelope area, at 50Pa. The air tightness standards at this site will target a 60% improvement over the Regulations and will seek to achieve a permeability of less than 4m^3/hr/m^2.

Thermal Bridging

The significance of Thermal Bridging, as a potentially major source of fabric heat losses, is increasingly understood. Improving the U-values for the main building fabric without accurately addressing the Thermal Bridging is no longer an option and will not achieve the fabric energy efficiency and energy and CO_2 reduction targets set out in this strategy.

Accredited Construction Details (ACD's) have been developed to provide the performance standards required to achieve the higher energy efficiency requirements of the Building Regulations. The bridging losses have been calculated using SAP Appendix K Table 1.

Ventilation

As a result of increasing thermal efficiency and air tightness, Building Regulations Approved Document F18 was also revised in 2006 to address the possibility of overheating and poor air quality. It has been assumed that individual mechanical extract ventilation units will be provided to all WCs, bathrooms and shower rooms and that the apartments on the south-eastern side of the main building will benefit from natural ventilation and for those rooms on the north-western side of the main building acoustically damped ventilation units will be installed and ventilation systems will be used to allow windows adjacent to the railway to remain closed when required.

Active Design Measures will include;

Efficient Lighting and Controls

Throughout the scheme natural lighting will be optimised.

Approved Document L1A requires three in four light fittings (75%) to be dedicated low energy fittings. The development will exceed this and all light fittings will be of a dedicated energy efficient type.

External lighting will be fitted with time controls and light sensors to ensure illumination is restricted to required times. External lighting will be limited to a maximum fitting output of 150w.

Heating

Space heating and hot water demand will be provided to the apartments by natural gas fired combination boilers.

The SAP calculations have been modelled on the use of an Alpha Intec combination boiler, which has NOx emissions of 27 mg/kWh and therefore complies with the policy requirements governing boiler emissions.

The space heating to the commercial units is proposed to be provided by air source heat pumps, which could also provide cooling if required. The requirement for cooling will depend on the end use of the unit in question but the BRUKL used to calculate the carbon emissions has assumed cooling is provided to all units and therefore assumes the worse case scenario. The specific unit to be used will be determined at the detailed working drawing stage but an appropriate unit is attached as Appendix 6 showing an example of the type of installation proposed.

5.2 Establishing Carbon Dioxide Emissions

Commercial Accommodation

The baseline emissions for the non-residential space has been established by using a SBEM calculation from similar accommodation built to a similar specification. The calculation used is attached as Appendix 4. Also attached is an alternative BRUKL calculation for another similar unit.

The specification has been assumed as follows and includes an installation of an air source heat pump to provide space heating and cooling:

Element	Specification
Ventilation	VRF with mechanical ventilation
SFP (W/l/s)	1.6
HR %	70
Heating	Electric Heat Pump
Efficiency %	450
Cooling	Electric
Efficiency %	4.5
Hot Water	Electric
Efficiency %	100%

The emissions are calculated as follows:

B1 Accommodation	TER CO_2 Emissions	BER CO_2 Emissions
	kg CO_2 /yr	kg CO_2 /yr
B1 accommodation	19.9	16.2
Emissions (per year)	**19.9**	**16.2**

Residential

SAP calculations have been prepared for a 1-Bedroom Ground-floor and Mid-floor apartment at 50.6 m^2, which are presented as representative of the five 1-Bedroom apartments. A SAP calculation has been prepared for a 3-Bedroom Ground, Mid and Top-floor apartment at 76.1 m^2, which are presented as representative of all 2 and 3-Bedroom apartments.

It is assumed the two, 3-Bedroom Duplex apartments will have similar emissions to the Top-floor 3-Bedroom apartments.

The modelling has been based on the use of a gas combination boiler to provide space and hot water heating. The Building Regulation Compliance Report, TER and DER Worksheets are attached as Appendix 5 but the results can be summarised as follows:

1-Bed Ground-floor apartment **50.6 m^2**	**CO$_2$ TER**	**CO$_2$ DER**
	kg/m^2/yr	kg/m^2/yr
Space heating	5.92	5.79
Water heating	8.30	7.06
Electricity for pumps and fans	0.77	0.77
Electricity for lighting	2.43	2.43
Total	**17.42**	**16.05**

1-Bed Mid-floor apartment **50.6 m^2**	**CO$_2$ TER**	**CO$_2$ DER**
	kg/m^2/yr	kg/m^2/yr
Space heating	3.70	4.17
Water heating	8.39	7.07
Electricity for pumps and fans	0.77	0.77
Electricity for lighting	2.43	2.43
Total	**15.29**	**14.44**

3-Bed Ground-floor apartment **76.1 m^2**	**CO$_2$ TER**	**CO$_2$ DER**
	kg/m^2/yr	kg/m^2/yr
Space heating	7.82	7.27
Water heating	6.64	5.50
Electricity for pumps and fans	0.51	0.51
Electricity for lighting	2.28	2.28
Total	**17.25**	**15.56**

3-Bed Mid-floor apartment **76.1 m^2**	**CO$_2$ TER**	**CO$_2$ DER**
	kg/m^2/yr	kg/m^2/yr
Space heating	5.55	5.49
Water heating	6.69	5.51
Electricity for pumps and fans	0.51	0.51
Electricity for lighting	2.28	2.28
Total	**15.03**	**13.79**

3-Bed Top-floor apartment **76.1 m^2**	**CO_2 TER**	**CO_2 DER**
	kg/m^2/yr	kg/m^2/yr
Space heating	7.23	7.53
Water heating	6.65	5.50
Electricity for pumps and fans	0.51	0.51
Electricity for lighting	2.28	2.28
Total	**16.67**	**15.82**

Total Emissions

Using the above information the total carbon emissions from the site following the energy efficiency measures detailed can be calculated as follows:

	Area	**TER CO_2**	**DER/BER CO_2**
	m^2	kg/year	kg/year
Commercial			
B1 Office Accommodation	610.0	12,139	9,882
Sub-total	**610.0**	**12,139**	**9,882**
Residential			
1-Bed ground-floor apartments	50.6	881	812
1-Bed mid-floor apartments	202.4	3,095	2,923
2 & 3-Bed ground-floor apartments	399.0	6,883	6,208
2 & 3-Bed mid-floor apartments	531.7	7,991	7,332
2 & 3-Bed top-floor apartments (inc. duplexes)	499.8	8,332	7,907
Sub-total	**1683.5**	**27,182**	**25,182**
Totals		**39,321**	**35,064**

The total emissions based upon the TER for the units is assessed as:

- **39,321 kg CO_2 per year**

The total emissions based upon the DER and BER for the units is assessed as:

- **35,064 kg CO_2 per year**

The reduction in site CO_2 emissions as a result of the energy efficiency measures incorporated in the building is assessed as;

- **4,257 kg CO_2 per year, which equates to a reduction of 10.83%**

5.3 Overheating Assessment

Commercial

Commercial units 3 and 4 only have openings on the north-west elevation and therefore do not have any risk of overheating.

Commercial units 1, 2 and 5 do have existing openings orientated towards the south-east.

However the existing openings are relatively small and the percentage of the window opening area to the floor area for each floor of each unit can be presented as follows;

	Floor Area (FA)	Window Area (WA)	% (FA/WA)
	m^2	m^2	
Unit 1 Ground-floor	66.6	1.94	**2.91%**
Unit 1 First-floor	66.6	3.38	**5.08%**
Unit 2 Ground-floor	66.9	1.94	**2.90%**
Unit 2 First-floor	66.9	6.69	**10.00%**
Unit 5 Ground-floor	37.6	0.88	**2.34%**
Unit 5 First-floor	37.6	5.06	**13.46%**

As can be seen the percentages of window opening to floor area is low for each unit. Therefore, it is suggested a full TM59 overheating assessment is not required and the risk of overheating to the commercial units is low.

Residential

As a consequence of the proximity of railway line to the north-west of the site a number of apartments will require noise attenuation measures. The apartments, which have a façade facing the railway line are all at least dual aspect and therefore the rooms to the south-west, south-east or north-east elevation can benefit from opening windows. In addition the rooms, which are orientated towards the railway line are north-west facing and therefore are not likely to suffer from excessive solar gain. The SAP modelling has assumed windows on the south-west (or north-east) and south-east elevations will be opening and that windows on the north-west elevation will be designed to be closed with ventilation to specific room provided by acoustically damped ventilation units.

The increased thermal mass provided by traditional construction will assist in stabilising summer night-time temperatures.

In addition, the 'g' value of the glazing has been reduced to 0.63 to reduce solar gain. This glazing has been selected as providing the best balance between winter solar gain to provide passive heating within the apartments and limiting summer solar gain to reduce passive overheating.

The Overheating Assessment for each of the modelled apartments can be summarised as follows;

	Likelihood of High Internal Temperature			**Assessment**
	June	July	August	
1-Bed Ground-floor	Slight	Medium	Medium	**Medium**
1-Bed Mid-floor	Slight	Medium	Medium	**Medium**
3-Bed Ground-floor	Slight	Medium	Medium	**Medium**
3-Bed Mid-floor	Slight	Medium	Medium	**Medium**
3-Bed Top-floor	Slight	Medium	Medium	**Medium**

These results demonstrate the apartments all pass Building Regulations with regards to the overheating criteria.

5.4 Low-Carbon and Renewable Technologies (Be Clean and Be Green)

The energy demand established above has been used to test the viability of various low-carbon and renewable technologies as follows.

This section determines the appropriateness of each renewable technology and considers the ability of each technology to comply with the planning requirements as set out above in Section 2.0.

The Government's Renewable Obligation defines renewable energy in the UK. The identified technologies are;

- Small hydro-electric
- Landfill and sewage gas
- Onshore and offshore wind
- Biomass
- Tidal and wave power
- Geothermal power
- Solar

The use of landfill or sewage gas, offshore wind or any form of hydroelectric power is not suitable for the site due to its location. The remaining technologies are considered below;

Wind

Wind turbines are available in various sizes from large rotors able to supply whole communities to small roof or wall-mounted units for individual dwellings.

The Government wind speed database predicts local wind speeds at Arlington Road to be 4.6 m/s at 10m above ground level and 5.4 m/s at 25m above ground level. This is below the level generally required for commercial investment in large wind turbines and in addition the land take, potential for noise and signal interference make a large wind turbine unsuitable for this development.

Roof mounted turbines could be used at the development to generate small but valuable amounts of renewable electricity but the small output and contribution to total emissions means any investment would be small and purely tokenism. In addition the use of wind turbines will have a detrimental aesthetic impact on the development.

Combined Heat and Power and Community Heating

Combined heat and power (CHP) also called co-generation is a de-centralised method of producing electricity from a fuel and 'capturing' the heat generated for use in buildings. The plant is essentially a small-scale electrical power station.

The production and transportation of electricity via the National Grid is very inefficient with over 65% of the energy produced at the power station being lost to the atmosphere and through transportation. Consequently CHP can demonstrate significant CO_2 savings and although not necessary classed as renewable energy (depending on the fuel used) the technology is low carbon.

For a CHP plant to be economic it needs to operate for as much of the time as possible (usually deemed to be in excess of 14 hours per day) and therefore the size of the unit are usually based upon the hot water load of the buildings with additional boilers meeting the peak space heating demand.

In order to optimise a combined heat and power or communal heating system, whether fuelled by biomass or a fossil fuel the site needs to be relatively dense with buildings close together and preferable multi storey in order to minimise infrastructure pipe work.

The total hot water load from the residential units is 44,726 kWh per year. Mirco CHP units are available with outputs from around 12.5 kW_{th} and 5.5. kW_e, and with the anticipated baseload the unit would run for 9.80 hours per day, which is not economic. CHP is not proposed.

Ground Source Heat Pumps

Sub soil temperatures are reasonably constant and predictable in the UK, providing a store of the sun’s energy throughout the year. Below London the groundwater in the lower London aquifer is at a fairly constant temperature of 12^o C. Ground source heat pumps (GSHP) extract this low-grade heat and convert it to usable heat for space heating.

GSHP operates on a similar principle to refrigerators, transferring heat from a cool place to a warmer place. They operate most efficiently when providing space heating at a low temperature, typically via under floor heating or with low temperature radiators.

Theoretically, ground source heat pumps could be used subject to satisfactory ground investigation to establish whether the sub strata is appropriate.

However, there is insufficient ground area to accommodate a horizontal ‘slinky’ collector system for the homes and bore-hole systems would be necessary and the installation of ground source heat pumps into apartment buildings is very complex.

GSHP systems are not proposed.

Solar

(i) Solar Water Heating

Solar hot water panels use the suns energy to directly heat water circulating through panels or pipes and the technology is simple and easily understood by purchasers.

Solar hot water heating panels are based generally around two types, which are available being 'flat plate collectors' and 'evacuated tubes'. Flat plate collectors can achieve an output of up to 1,124 kWh/annum (Schuco) and evacuated tubes can achieve outputs up to 1,365 kWh/annum (Riomay).

Panels are traditionally roof mounted and for highest efficiencies should be mounted plus or minus 30 degrees of due south. Evacuated tubes can be laid horizontally on flat roofs but flat plate collectors are recommended for installation at an incline of 30 degrees

Solar hot water panels are considered appropriate and evacuated tube panels could be installed horizontally on the flat roof of the apartment building.

However, servicing units on lower floors can be problematic and therefore it is only really practical to service Plots 17-20 and Plots 23 & 24. These units have currently been modelled with a combination gas boiler and the use of solar hot water panels would require a switch to a conventional boiler with accompanying hot water cylinder. This could detrimentally impact on internal space planning. The total hot water load from these six units is 12,725 kWh per year. Assuming panels could reduce energy demand by 50%, this equates to a reduction in demand of 6,363 kWh per year with an associated reduction in CO_2 emissions of 1,374 kg CO_2 per year.

When combined with the energy efficiency measures this equates to a total reduction in emissions of **5,631 kg CO_2 per year** or **14.32%** of total (TER) emissions.

Solar hot water panels are not proposed.

(ii) Photovoltaics

Photovoltaic panels (PV) provide clean silent electricity. They generate electricity during most daylight conditions although they are most efficient when exposed to direct sunlight or are orientated to face plus or minus 30 degrees of due south.

PV panels can be integrated into many different aspects of a development including roofs, walls, shading devices or architectural panels. The panels typically have an electrical warranty of 20-25 years and an expected system lifespan of 25-40 years.

Photovoltaic panels could be used and could be installed on the flat roof of all buildings.

In order to achieve the requirements of the planning policy (and accounting for the reduction from energy efficiency measures of 4,257 kg CO_2 per year) a total of 66 x 300W photovoltaic panels would be required.

These could be accommodated on the roofs of the buildings and an indicative Roof Layout is attached as Appendix 3. This quantity of panels would reduce emissions by **9,570 kg CO_2 per year**, which when combined with the reductions from energy efficiency measures equates to a reduction of **35.16%** of TER emissions.

In addition the reduction in emissions from renewable technologies would equate to 27.29% of the DER emissions.

Photovoltaic panels are a viable method of achieving the policy requirement and there is sufficient roof area to accommodate the required quantity. The panels will be installed on frames, inclined at circa 15 degrees and orientated towards south-west. The electricity generated by each array will be connected to the landlords meter within each building with any surplus generated sold back to the Grid. A sketch is included within Appendix 3 showing how the panels could be arranged.

Air Source Heat Pumps (ASHP)

Air sourced heat pumps operate using the same reverse refrigeration cycle as ground source heat pumps, however the initial heat energy is extracted from the external air rather than the ground. These heat pumps can be reversed to provide cooling to an area although this reduces the coefficient of performance of the pumps.

ASHPs are an appropriate technology for the commercial units where there is a low hot water demand but care will need to be taken to ensure the location of the outside unit does not create a noise nuisance either to the residential neighbours or to other occupants of the commercial accommodation.

The Statement assumes the use of air source heat pumps to each commercial unit and the BRUKL modelling assumes cooling may be required. However, this will be determined by the end use of the unit in question but by assuming cooling is provided to all assumes the worse case scenario.

The specific unit to be used will be determined at the detailed working drawing stage but an appropriate unit is attached as Appendix 6 showing an example of the type of installation proposed.

5.5 Summary of Calculations and Proposals for Low-carbon and Renewable Technologies

The total site CO_2 emissions are calculated as **39,321 kg CO_2 per year** (TER) and **35,064 kg CO_2 per year** (DER/BER)**.**

To meet the requirements of the planning policy, a reduction of 35% of the total (TER) emissions need to be achieved and the DER emissions need to be reduced by 20% through the use of renewable technologies.

Various technologies are considered above and whilst wind turbines, combined heat and power, ground or air source heat pumps (for the residential units) and solar hot water heating panels are not considered appropriate the use of photovoltaic panels and air source heat pumps for the commercial units are considered feasible and appropriate.

Be Lean

The construction standards proposed include U-values, which demonstrate good practice and improve upon those required by the Building Regulations. Air tightness standards are targeted at a 60% improvement upon the minimum required by the Building Regulations.

The DER/BER is reduced from the TER by **4,257 kg CO_2 per year** or **10.83%** as a result of the energy efficiency measures incorporated into the design.

Be Green

It is proposed to install a total of 66 x 300W photovoltaic panels. The reduction in emissions as a result of the PV panels is **9,570 kg CO_2 per year**.

The total reduction in emissions following the energy efficiency measures (Be Lean) and the photovoltaic panels (Be Green) is 13,827 kg CO_2 per year, which equates to a reduction of 35.16% of the TER emissions.

The reduction in (DER) emissions from renewable technologies is 27.29%

6.0 Climate change adaption and Water resources

Sustainable Drainage Systems (SUDS)

The site lies within Flood Zone 1 and is classified as being of low risk.

Surface Water Management

Rainwater harvesting butts will be provided for landscaping maintenance.

Consideration has been given to the use of grey water recycling. However, customer’s resistance to the appearance of the recycled water and the cost of the systems does not currently make them a viable option. They have therefore not been included in the proposals.

Water efficiency measures

In excess of 20% of the UK’s water is used domestically with over 50% of this used for flushing WCs and washing (source: Environment Agency). The majority of this comes from drinking quality standard or potable water.

The water efficiency measures included will ensure that the apartments achieve a water use target of 105 litres per person per day.

Water efficient devices will be fully evaluated, and installed, wherever possible. The specification of such devices will be considered at detailed design stage and each will be subject to an evaluation based on technical performance, cost and market appeal, together with compliance with the water use regulations.

The following devices will be incorporated within the apartments:

- Water efficient taps.
- Water efficient toilets.
- Low output showers.
- Flow restrictors to manage water pressures to achieve optimum levels.
- Water meters with guidance on water consumption and savings.

Water consumption calculations have been carried out using the Water Efficiency Calculator provided by the BRE. Although not perfect this calculator gives a good indication of the probable water use in a dwelling.

Below is a typical specification, which would achieve the 105 Litres per person per day target.

Schedule of Appliance Water Consumption

Appliance	Flow rate or capacity	Total Litres
WC	4/2.6 litres dual flush	14.72
Basin	1.7 litres/min.	5.98
Shower	8 litres/min	24.00
Bath	160 litres	25.60
Sink	4 litres/min	14.13
Washing Machine	Default used	16.66
Dishwasher	Default used	3.90
		104.99

7.0 Materials

The BRE Green Guide to Specification is a simple guide for design professionals. The guide provides environmental impact, cost and replacement interval information for a wide range of commonly used building specifications over a notional 60-year building life. The construction specification will prioritise materials within ratings A+, A or B.

Preference will be given to the use of local materials & suppliers where viable to reduce the transport distances and to support the local economy. A full evaluation of these suppliers will be undertaken at the next stage of design.

In addition, timber would be sourced, where practical, certified by PEFC or an equivalent approved certification body and all site timber used within the construction process would be recycled.

All insulation materials to will have a zero ozone depleting potential

Construction waste

Targets will be set to promote resource efficiency in accordance with guidance from WRAP, Envirowise, BRE and DEFRA.

The overarching principle of waste management is that waste should be treated or disposed of within the region where it is produced.

Construction operations generate waste materials as a result of general handling losses and surpluses. These wastes can be reduced through appropriate selection of the construction method, good site management practices and spotting opportunities to avoid creating unnecessary waste.

The Construction Strategy will explore these issues, some of which are set out below:

- Proper handling and storage of all materials to avoid damage.
- Efficient purchasing arrangements to minimise over ordering.
- Segregation of construction waste to maximise potential for reuse/recycling.
- Suppliers who collect and reuse/recycle packaging materials

Appendix 1 – BREEAM Pre-Assessment Estimator

BREEAM UK New Construction 2014 Pre-Assessment Estimator: Assessment Issue Scoring

Building name	Arlington Works
Building score (%)	71.85%
Building rating	Excellent
Minimum standards level achieved	Excellent level

MANAGEMENT

Man 01 Project brief and design

No. of BREEAM credits available	4	Available contribution to overall score	3.33%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will stakeholder consultation (project delivery) take place?	Yes	1	1
Will stakeholder consultation (third party) take place?	No	1	0
Will a sustainability champion (design) be assigned?	Yes	1	1
Will a sustainability champion (monitoring progress) be assigned?	Yes	1	1

Total BREEAM credits achieved	3
Total contribution to overall building score	2.50%
Total BREEAM innovation credits achieved	0
Minimum standard(s) level	N/A

Comments/notes:

Man 02 Life cycle cost and service life planning

No. of BREEAM credits available	4	Available contribution to overall score	3.33%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will an elemental life cycle cost (LCC)analyses be carried out?	No	2	0
Will a component level LCC plan be developed?	No	1	0
Will the predicted capital cost be reported?	No	1	0
Expected capital cost of the project (if available)		£/m^2	

Total BREEAM credits achieved	0
Total contribution to overall building score	0.00%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Man 03 Responsible construction practices

No. of BREEAM credits available	6	Available contribution to overall score	5.00%
No. of BREEAM innovation credits available	1	Minimum standards applicable	Yes

Assessment Criteria	Compliant?	Credits available	Credits achieved
Is all site timber used in the project 'legally harvested and traded timber'?	Yes		
Will/does the principal contractor operate a compliant Environmental Management System?	Yes	1	1
Will a construction stage sustainability champion be assigned?	Yes	1	1
Will a considerate construction scheme be used by the principal contractor? (One credit where 'compliance' has been achieved. Two credits where 'compliance' is significantly exceeded.)	1	2	1
Will construction site impacts be metered/monitored?	Yes		
Will site utility consumption be metered/monitored?	Yes	1	1
Will transport of construction materials and waste be metered/monitored?	No	1	0
Will exemplary level criteria be met?			

Total BREEAM credits achieved	4
Total contribution to overall building score	3.33%
Total BREEAM innovation credits achieved	0
Minimum standard(s) level	Excellent level

Comments/notes:

Man 04 Commisioning and handover

No. of BREEAM credits available	1	Available contribution to overall score	0.83%
No. of BREEAM innovation credits available	0	Minimum standards applicable	Yes

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will commissioning schedule and responsibilities be developed & accounted for?			
Will a commissioning manager be appointed?			
Will the building fabric be commissioned?	Yes	1	1
Will a training schedule for building occupiers/managers at Handover?			
Will a building user guide be developed prior to handover?			

Total BREEAM credits achieved	1
Total contribution to overall building score	0.83%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Man 05 Aftercare

Assessment issue not applicable

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will aftercare support be provided to building occupiers?			
Will seasonal commissioning occur over 12months once substantially occupied?			
Will a post occupancy evaluation be carried out 1 year after occupation?			
Will exemplary level criteria be met?			

Total BREEAM credits achieved	N/A
Total contribution to overall building score	N/A
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

HEALTH & WELLBEING

Hea 01 Visual Comfort

No. of BREEAM credits available	4	Available contribution to overall score	4.44%
No. of BREEAM innovation credits available	1	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will the design provide adequate glare control for building users?	Yes	1	1
Will relevant building areas be designed to achieve appropriate daylight factor(s)?	1	1	1
Will the design provide adequate view out for building users?	Yes	1	1
Will internal/external lighting levels, zoning and controls be specified in accordance with the relevant CIBSE Guides/British Standards?	Yes	1	1
Will exemplary level criteria be met?	Yes	1	1

Total BREEAM credits achieved	4
Total contribution to overall building score	4.44%
Total BREEAM innovation credits achieved	1
Minimum standard(s) level	N/A

Comments/notes:

Hea 02 Indoor Air Quality

No. of BREEAM credits available	1	Available contribution to overall score	1.11%
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will an air quality plan be produced and building designed to minimise air pollution?			
Will building be designed to minimise the concentration and recirculation of pollutants in the building?			
Will the relevant products be specified to meet the VOC testing and emission levels required?			
Will formaldehyde and total VOC levels be measured post construction?			
Will the building be designed to, or have the potential to provide, natural ventilation?	Yes	1	1
Will exemplary level VOCs (products)criteria be met?			

Total BREEAM credits achieved	1
Total contribution to overall building score	1.11%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Hea 03 Safe containment in laboratories

Assessment issue not applicable

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will an objective risk assessment of proposed laboratory facilities' design be completed?			
Will the manufacture & installation of fume cupboards and containment devices meet best practice standards?			
Will containment level 2 & 3 labs meet best practice safety & performance criteria?			

Total BREEAM credits achieved	N/A
Total contribution to overall building score	N/A
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Hea 04 Thermal comfort

No. of BREEAM credits available	1	Available contribution to overall score	1.11%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will thermal modelling of the design be carried out?	Yes	1	1

Total BREEAM credits achieved	1
Total contribution to overall building score	1.11%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Hea 05 Acoustic Performance

No. of BREEAM credits available	1	Available contribution to overall score	1.11%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Credits	Credits available	Credits achieved
Will the building meet the appropriate acoustic performance standards and testing requirements for: a. Sound insulation b. Indoor ambient noise level c. Reverberation times?	1	1	1

Total BREEAM credits achieved	1
Total contribution to overall building score	1.11%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Hea 06 Safety and Security

No. of BREEAM credits available	2	Available contribution to overall score	2.22%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Where external site areas are present, will safe access be designed for pedestrians and cyclists?	Yes	1	1
Will a suitably qualified security consultant be appointed and security considerations accounted for?	Yes	1	1

Total BREEAM credits achieved	2
Total contribution to overall building score	2.22%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

ENERGY

Ene 01 Reduction of energy use and carbon emissions

No. of BREEAM credits available	12	Available contribution to overall score	10.88%
No. of BREEAM innovation credits available	5	Minimum standards applicable	Yes

How do you wish to assess the number of BREEAM credits achieved for this issue?	Define a target number of BREEAM credits achieved
Select the target number of BREEAM credits for the Ene01 issue:	8

Ene 01 Calculator

Country of the UK where the building is located		Confirm building regulation and version to be used:	

New Construction (shell only)

Building floor area		m2
Notional building heating and cooling energy demand		MJ/m2yr
Actual building heating and cooling energy demand		MJ/m2yr
Notional building primary energy consumption		kWh/m2yr
Actual building primary energy consumption		kWh/m2yr
Target emission rate (TER)		kgCO2/m2yr
Building emission rate (BER)		kgCO2/m2yr
Building emission rate improvement over TER		
Heating & cooling demand energy performance ratio (EPR_{ED})		
Primary consumption energy performance ratio (EPR_{PC})		
CO_2 Energy performance ratio (EPR_{CO2})		
Overall building energy performance ratio (EPR_{NC})		

Where specified, please confirm the energy production from onsite or near site energy generation technologies	
Equivalent % of the building's ‘regulated’ energy consumption generated by carbon neutral sources and used to meet energy demand from ‘unregulated’ building systems or processes?	
Is the building designed to be 'carbon negative' ?	
If the building is defined as 'carbon negative' what is the total (modelled) renewable/carbon neutral energy generated and exported?	

Total BREEAM credits achieved	8
Total contribution to overall building score	7.25%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	Outstanding level

Comments/notes:

Ene 02 Energy monitoring

Assessment issue not applicable

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	0	Minimum standards applicable	Yes

Assessment criteria	Compliant?	Credits available	Credits achieved
Will a BMS or sub-meters be specified to monitor energy use from major building services systems?			
Will a BMS or sub-meters be specified to monitor energy use by tenant/building function areas?			

Total BREEAM credits achieved	N/A
Total contribution to overall building score	N/A
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Ene 03 External lighting

No. of BREEAM credits available	1	Available contribution to overall score	0.91%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment criteria	Compliant?	Credits available	Credits achieved
Will external light fittings and controls be specified in accordance with the BREEAM criteria?	Yes	1	1

Total BREEAM credits achieved	1
Total contribution to overall building score	0.91%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Ene 04 Low carbon design

No. of BREEAM credits available	3	Available contribution to overall score	2.72%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment criteria	Compliant?	Credits available	Credits achieved
Will passive design measures be used in line with an analysis be carried out during concept design stage (RIBA stage 2 or equivalent)?	Yes	1	1
Will free cooling measures be implemented in the whole building in line with the passive design analysis?	No	1	0
Will a LZC technology be specified in line with a feasibility study carried out by the completion of the Concept Design stage (RIBA Stage 2 or equivalent)?	Yes	1	1

Total BREEAM credits achieved	2
Total contribution to overall building score	1.81%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Ene 05 Energy efficient cold storage

Assessment issue not applicable

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Assessment criteria	Compliant?	Credits available	Credits achieved
Will the refrigeration system be designed, installed & commissioned in accrodance with BREEAM criteria?			
Will the refrigeration system demonstrate a saving in indirect greenhouse gas emissions?			

Total BREEAM credits achieved	N/A
Total contribution to overall building score	N/A
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Ene 06 Energy efficient transportation systems **Assessment issue not applicable**

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Assessment criteria	Compliant?	Credits available	Credits achieved
Will a transportation system analysis be carried out to determine and specify the optimum number, size and type of lifts that is most energy efficient?			
Will the relevant energy-efficient features criteria be met?			

Total BREEAM credits achieved	N/A
Total contribution to overall building score	N/A
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Ene 07 Energy efficient laboratory systems **Assessment issue not applicable**

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Assessment criteria	Compliant?	Credits available	Credits achieved
Pre-requisite: Criterion 1 of Hea 03 - risk assessment of laboratory facilities			
Have the occupants' laboratory requirements & performance criteria been confirmed during the preparation of the initial project brief to minimise energy demand?			
Best Practice Energy Practices in Laboratories (table 27)			
Will the laboratory meet criteria item b) Fan power?			
Will the laboratory criteria item c) Fume cupboard volume flow rates?			
Will the lab meet item d) Grouping / isolation of high filtration/ventilation activities?			
Will the laboratory meet criteria item e) Energy recovery - heat?			
Will the laboratory meet criteria item f) Energy recovery - cooling?			
Will the laboratory meet criteria item g) Grouping of cooling loads?			
Will the laboratory meet criteria item h) Free cooling?			
Will the laboratory meet criteria item i) Load responsiveness?			
Will the laboratory meet criteria item j) Cleanrooms?			
Will the laboratory meet criteria item k) Diversity?			
Will the laboratory meet criteria item l) Room air-change rates?			

Total BREEAM credits achieved	N/A
Total contribution to overall building score	N/A
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Ene 08 Energy efficient equipment

Assessment issue not applicable

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Assessment criteria

Which of the following will be present and likely to be a/the major contributor to 'unregulated' energy use?	Present	Major impact
Ref A Small power and plug in equipment?		
Ref B Swimming pool?		
Ref C Communal laundry?		
Ref D Data centre?		
Ref E IT-intensive operation areas?		
Ref F Residential areas?		
Ref G Healthcare?		
Ref H Kitchen and catering facilities?		

	Compliant	Credits available	Credits achieved
Will the significant majority contributor(s) to 'unregulated' energy use above meet the BREEAM criteria?			

Total BREEAM credits achieved	N/A
Total contribution to overall building score	N/A
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Ene 09 Drying space

Assessment issue not applicable

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Assessment criteria	Compliant?	Credits available	Credits achieved
Will internal/external drying space and fixings be provided?			

Total BREEAM credits achieved	N/A
Total contribution to overall building score	N/A
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

TRANSPORT

Tra 01 Public Transport Accessibility

No. of BREEAM credits available	3	Available contribution to overall score	3.83%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Building type category (for purpose of Tra01 issue assessment)	Business (office/industrial)

Assessment Criteria	Compliant	Credits available	Credits achieved
Indicative public transport accessibility index (AI):	10.00	3	3
Will the building have a dedicated bus service?			N/A

AI	Indicative Accessibility Index for pre-assessment
0	Poor or no public transport provision
1	A single BREEAM compliant public transport node available
2	Some BREEAM compliant public transport nodes/services available
4	A selection of BREEAM compliant public transport nodes/services available
8	Good provision of public transport i.e. small urban centre / suburban area
10	Very Good provision of public transport i.e. small/medium urban centre
12	Excellent provision of public transport, i.e. medium urban centre
18	Excellent provision of public transport, i.e. large urban/metropolitan city centre

Total BREEAM credits achieved	3
Total contribution to overall building score	3.83%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Tra 02 Proximity to Amenities

No. of BREEAM credits available	1	Available contribution to overall score	1.28%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will the building be in close proximity of and accessible to applicable amenities?	Yes	1	1

Total BREEAM credits achieved	1
Total contribution to overall building score	1.28%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Tra 03 Cyclist facilities

No. of BREEAM credits available	2	Available contribution to overall score	2.56%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Building type category (for purpose of Tra03 issue assessment)	Business - (office/Industrial)
How many compliant cycle storage spaces will be provided?	14
What cyclist facilities will be provided?	No compliant facilities

Assessment Criteria	Compliant?	Credits available	Credits achieved
Cycle storage spaces	Yes	2	1
Cyclist facilities	No		

Total BREEAM credits achieved	1
Total contribution to overall building score	1.28%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Tra 04 Maximum Car Parking Capacity

No. of BREEAM credits available	2	Available contribution to overall score	2.56%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Building type category (for purpose of Tra04 issue)	Business - (office/Industrial)
Building's indicative Accessibility Index (sourced from issue Tra01)	10

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will BREEAM's maximum parking capacity criteria for the building type/Accessibility Index be met?	Yes	2	2

Total BREEAM credits achieved	2
Total contribution to overall building score	2.56%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Tra 05 Travel Plan

No. of BREEAM credits available	1	Available contribution to overall score	1.28%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will a transport plan based on site specific travel survey/assessment be developed?	Yes	1	1

Total BREEAM credits achieved	1
Total contribution to overall building score	1.28%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

WATER

Wat 01 Water Consumption

Assessment issue not applicable

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

How do you wish to assess the number of BREEAM credits to be achieved for this issue?

Please select the calculation procedure used

Standard approach data

Water Consumption from building micro-components	
Water demand met via greywater/rainwater sources	
Total net water consumption	
Improvement on baseline performance	

Key Performance Indicator - use of freshwater resource

Total net Water Consumption	
Default building occupancy	

Alternative approach data

Overall microcomponent performance level achieved	
Please select:	

Total BREEAM credits achieved	N/A
Total contribution to overall building score	N/A
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Wat 02 Water Monitoring

No. of BREEAM credits available	1	Available contribution to overall score	2.00%
No. of BREEAM innovation credits available	0	Minimum standards applicable	Yes

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will there be a water meter on the mains water supply to the building(s)?	Yes	1	1
Will metering/monitoring equipment be specified on the water supply to any relevant			
Will all specified water meters have a pulsed output?	Yes		
If the site/building has an existing BMS connection, will all pulsed meters be connected to the BMS?	N/A		

Total BREEAM credits achieved	1
Total contribution to overall building score	2.00%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	Outstanding level

Comments/notes:

Wat 03 Water Leak Detection and Prevention

No. of BREEAM credits available	1	Available contribution to overall score	2.00%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will a mains water leak detection system be installed on the building's mains water supply?	Yes	1	1
Will flow control devices be installed in each sanitary area/facility?			

Total BREEAM credits achieved	1
Total contribution to overall building score	2.00%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Wat 04 Water Efficient Equipment

Assessment issue not applicable

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Assessment Criteria	Compliant?	Credits available	Credits achieved
Has a meaningful reduction in unregulated water demand been achieved?			

Total BREEAM credits achieved	N/A
Total contribution to overall building score	N/A
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

MATERIALS

Mat 01 Life Cycle Impacts

No. of BREEAM credits available	5	Available contribution to overall score	6.73%
No. of BREEAM innovation credits available	3	Minimum standards applicable	No

How do you wish to assess the number of BREEAM credits to be achieved for this issue?	Define the number of Mat 01 credits achieved

Assessment Criteria

Predicted total Mat01 credits achieved	3
Predicted total Mat01 points achieved	
Number of building elements assessed	
Green Guide exemplary level compliant?	No
Has IMPACT compliant software been used?	No

Total BREEAM credits achieved	3
Total contribution to overall building score	4.04%
Total BREEAM innovation credits achieved	0
Minimum standard(s) level	N/A

Comments/notes:

Mat 02 Hard Landscaping and Boundary Protection

No. of BREEAM credits available	1	Available contribution to overall score	1.35%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will ≥80% of all external hard landscaping and boundary protection achieve a Green Guide A or A+ rating?	No	1	0

Total BREEAM credits achieved	0
Total contribution to overall building score	0.00%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Mat 03 Responsible Sourcing

No. of BREEAM credits available	4	Available contribution to overall score	5.38%
No. of BREEAM innovation credits available	1	Minimum standards applicable	Yes

Assessment Criteria	Compliant	Credits available	Credits achieved
All timber and timber based products are 'Legally harvested and trader timber'	Yes		
Is there a documented sustainable procurement plan?	Yes	1	1
Percentage of available responsible sourcing of materials points achieved	36.00%	3	2

Please confirm the route used to assess Mat03: Route 2: Proportion of materials responsibly sourced

Total BREEAM credits achieved	3
Total contribution to overall building score	4.04%
Total BREEAM innovation credits achieved	0
Minimum standard(s) level	Outstanding level

Comments/notes:

Mat 04 Insulation

No. of BREEAM credits available	1	Available contribution to overall score	1.35%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria		Credits available	Credits achieved	
What is the building's targeted insulating index?	2.50	1	1	Note: An insulation

Total BREEAM credits achieved	1
Total contribution to overall building score	1.35%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Mat 05 Designing for durability and resilience

No. of BREEAM credits available	1	Available contribution to overall score	1.35%
No. of BREEAM innovation credits available	0	Minimum standards applicable	N/A

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will suitable durability/protection measures be specified and installed to vulnerable areas of the building?	N/A	1	1
Will suitable durability/protection measures be specified and installed to exposed parts of the building?	Yes		

Total BREEAM credits achieved	1
Total contribution to overall building score	1.35%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Mat 06 Material efficiency

No. of BREEAM credits available	1	Available contribution to overall score	1.35%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will material efficiency measures be identified & implemented during all RIBA stages?	No	1	0

Total BREEAM credits achieved	0
Total contribution to overall building score	0.00%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

WASTE

Wst 01 Construction Waste Management

No. of BREEAM credits available	4	Available contribution to overall score	5.50%
No. of BREEAM innovation credits available	1	Minimum standards applicable	Yes

How do you wish to assess the number of BREEAM credits to be achieved for this issue?: Define a target number of BREEAM credits

Select the number of BREEAM credits being targeted for issue Wst 01:	2	BREEAM Wst01 Innovation credits:	0

Assessment Criteria	Compliant?
Construction resource management plan	
Compliant Pre-demolition audit	
Does the excavation waste meet the exemplary level requirements?	

Key Performance Indicators - Construction Waste

Measure/units for the data being reported		
Non-hazardous construction waste (excluding demolition/excavation)		
Total non-hazardous construction waste generated		Note: At the pre-assessment stage this fig
Non-hazardous non-demolition const. waste diverted from landfill		Note: At this stage this will be a target ber
Total non-hazardous non-demolition const. waste diverted from landfill		Note: At the pre-assessment stage this fig
Total non-hazardous demolition waste generated		Note: At this stage this will be a target ber
Non-hazardous demolition waste diverted from landfill		Note: At this stage this will be a target ber
Total non-hazardous demolition waste to disposal		Note: At the pre-assessment stage this fig
Material for reuse		Note: At this stage this will be a target ber
Material for recycling		Note: At this stage this will be a target ber
Material for energy recovery		Note: At this stage this will be a target ber
Hazardous waste to disposal		Note: At this stage this will be a target ber

Total BREEAM credits achieved	2
Total contribution to overall building score	2.75%
Total BREEAM innovation credits achieved	0
Minimum standard(s) level	Outstanding level

Comments/notes:

Wst 02 Recycled Aggregates

No. of BREEAM credits available	1	Available contribution to overall score	1.38%
No. of BREEAM innovation credits available	1	Minimum standards applicable	No

Assessment Criteria	Total
What is the target total % of high-grade aggregate that will be recycled/secondary aggregate?	0%

% of high-grade aggregate that is recycled/secondary aggregate - by application

Structural frame	
Bitumen/hydraulically bound base, binder and surface courses	
Building foundations	
Concrete road surfaces	
Pipe bedding	
Granular fill and capping	

Total BREEAM credits achieved	0
Total contribution to overall building score	0.00%
Total BREEAM innovation credits achieved	0
Minimum standard(s) level	N/A

Comments/notes:

Wst 03 Operational Waste

No. of BREEAM credits available	1	Available contribution to overall score	1.38%
No. of BREEAM innovation credits available	0	Minimum standards applicable	Yes

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will operational recyclable waste volumes be segregated and stored?	Yes	1	1
Will static waste compactor(s) or baler(s) be specified where appropriate?	N/A		
Will vessel(s) for composting suitable organic waste where appropriate?	N/A		

Total BREEAM credits achieved	1
Total contribution to overall building score	1.38%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	Outstanding level

Comments/notes:

Wst 04 Speculative Floor and Ceiling Finishes

Assessment issue not applicable

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Assessment Criteria	Compliant?	Credits available	Credits achieved

Total BREEAM credits achieved	N/A
Total contribution to overall building score	N/A
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Wst 05 Adaption to climate change

No. of BREEAM credits available	1	Available contribution to overall score	1.38%
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will a climate change adaptation strategy appraisal for structural and fabric resilience be conducted by the end of Concept Design (RIBA Stage 2 or equivalent)?	No	1	0
Will emexplary level criteria – Responding to adaptation to climate change be met?			

Total BREEAM credits achieved	0
Total contribution to overall building score	0.00%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Wst 06 Functional adaptability

No. of BREEAM credits available	1	Available contribution to overall score	1.38%
No. of BREEAM innovation credits available	0	Minimum standards applicable	N/A

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will a building specific functional adaptation strategy appraisal be conducted by Concept Design (RIBA Stage 2 or equivalent) and will functional adaptation measures be implemented?	No	1	0

Total BREEAM credits achieved	0
Total contribution to overall building score	0.00%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

LAND USE & ECOLOGY

LE 01 Site Selection

No. of BREEAM credits available	2	Available contribution to overall score	2.60%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will at least 75% of the proposed development's footprint be located on previously occupied land?	Yes	1	1
Is the site deemed to be significantly contaminated?	Yes	1	1

Total BREEAM credits achieved	2
Total contribution to overall building score	2.60%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

LE 02 Ecological Value of Site and Protection of Ecological Features

No. of BREEAM credits available	2	Available contribution to overall score	2.60%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Can the land within the construction zone be defined as 'land of low ecological value'?	Yes	1	1
Will all features of ecological value surrounding the construction zone/site boundary be protected?	Yes	1	1

Total BREEAM credits achieved	2
Total contribution to overall building score	2.60%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

LE 03 Mitigating Ecological Impact

No. of BREEAM credits available	2	Available contribution to overall score	2.60%
No. of BREEAM innovation credits available	0	Minimum standards applicable	Yes

Assessment Criteria

What is the likely change in ecological value as a result of the sites development?	≥0 species (i.e. no negative change)	Plant species richne

Total BREEAM credits achieved	2
Total contribution to overall building score	2.60%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	Outstanding level

Comments/notes:

LE 04 Enhancing Site Ecology

No. of BREEAM credits available	2	Available contribution to overall score	2.60%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved	
Will a suitably qualified ecologist be appointed to report on enhancing and protecting site ecology?	Yes	2	1	
Will the suitably qualified ecologist's general recommendations be implemented?	Yes			
What is the targeted/intended improvement in ecological value as a result of enhancement actions?	<6 species (small positive change)			Plant species richn

Total BREEAM credits achieved	1
Total contribution to overall building score	1.30%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

LE 05 Long Term Impact on Biodiversity

No. of BREEAM credits available	2	Available contribution to overall score	2.60%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will a Suitably Qualified Ecologist be appointed to monitor/minimise impacts of site activities on biodiversity?	Yes	2	0
Will a landscape and habitat management plan be produced covering at least the first five years after project completion in accordance with British Standards?	No		
Number of applicable measures to improve biodiversity confirmed by SQE:	0		
Number of applicable measures implemented:	0		

Total BREEAM credits achieved	0
Total contribution to overall building score	0.00%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

POLLUTION

Pol 01 Impact of Refrigerants

Assessment issue not applicable

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Assessment Criteria

		Credits available	Credits achieved
Refrigerant containing systems installed in the assessed building?			
Do all systems (with electric compressors) comply with the requirements of BS EN 378:2008 (parts 2 & 3) & where refrigeration systems containing ammonia are installed, the IoR Ammonia Refrigeration Systems Code of Practice?			
Global Warming Potential of the specified refrigerant(s) 10 or less?			
What is the target range Direct Effect Life Cycle CO2eq. emissions for the system?			
Cooling/Heating capacity of the system			
Will a refrigerant leak detection and containment system be specified/installed?			

Total BREEAM credits achieved	N/A
Total contribution to overall building score	N/A
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Pol 02 NO_x Emissions

Assessment issue not applicable

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Assessment Criteria

NO_x emission level - space heating	
NOx emission level - water heating	
Does this building meet BREEAM's definition of a highly insulated building?	
Energy consumption: heating and hot water	

Total BREEAM credits achieved	N/A
Total contribution to overall building score	N/A
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Pol 03 Surface Water Run off

No. of BREEAM credits available	5	Available contribution to overall score	5.00%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
What is the actual/likely annual probability of flooding for the assessed site?	Low	2	2
Will a Flood Risk Assessment be undertaken?	Yes		
Will the site meet the BREEAM criteria for peak rate surface water run off?	Yes	1	1
Will the site meet the criteria for surface water run off volume, attenuation and/or limiting discharge?	Yes	1	1
Will the site be designed to minimise watercourse pollution in accordance with the BREEAM criteria?	Yes	1	1

Total BREEAM credits achieved	5
Total contribution to overall building score	5.00%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Pol 04 Reduction of Night Time Light Pollution

No. of BREEAM credits available	1	Available contribution to overall score	1.00%
No. of BREEAM innovation credits available	0	Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Will the external lighting specification be designed to reduce light pollution?	Yes	1	1

Total BREEAM credits achieved	1
Total contribution to overall building score	1.00%
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

Pol 05 Noise Attenuation **Assessment issue not applicable**

No. of BREEAM credits available	N/A	Available contribution to overall score	N/A
No. of BREEAM innovation credits available	N/A	Minimum standards applicable	N/A

Assessment Criteria	Compliant	Credits available	Credits achieved
Will there be noise-sensitive areas/buildings within 800m radius of the development?			
Will a noise impact assessment be carried out and, if applicable, noise attenuation measures specified?			

Total BREEAM credits achieved	N/A
Total contribution to overall building score	N/A
Total BREEAM innovation credits achieved	N/A
Minimum standard(s) level	N/A

Comments/notes:

INNOVATION

Inn 01 Innovation

No. of BREEAM innovation credits available	10	Available contribution to overall score	10.00%
		Minimum standards applicable	No

Assessment Criteria	Compliant?	Credits available	Credits achieved
Man 03 Responsible construction practices	No	1	0
Man 05 Aftercare	N/A	N/A	N/A
Hea 01 Visual Comfort	Yes	1	1
Hea 02 Indoor Air Quality	N/A	N/A	N/A
Ene 01 Reduction of energy use and carbon emissions	No	5	N/A
Wat 01 Water Consumption	N/A	N/A	N/A
Mat01 Life Cycle Impacts	No	3	0
Mat03 Responsible Sourcing of Materials	No	1	0
Wst01 Construction Waste Management	No	1	0
Wst02 Recycled Aggregates	No	1	0
Wst 05 Adaption to climate change	N/A	N/A	N/A

Number of 'approved' innovation credits achieved? 0

Total BREEAM innovation credits achieved	1
Total contribution to overall building score	1.00%
Minimum standard(s) level	N/A

Comments/notes:

Appendix 2 – London Borough of Richmond Sustainable Construction Checklist

LBRUT Sustainable Construction Checklist - January 2016

This document forms part of the Sustainable Construction Checklist SPD. This document **must** be filled out as part of the planning application for the following developments: all residential development providing **one or more new residential units (including conversions leading to one or more new units)**, and all other forms of development providing **100sqm or more of non-residential floor space**. Developments including new non-residential development of less than 100sqm floor space, extensions less than 100sqm, and other conversions are strongly encouraged to comply with this checklist. Where further information is requested, please either fill in the relevant section, or refer to the document where this information may be found in detail, e.g. Flood Risk Assessment or similar. **Further guidance** on completing the Checklist may be found in the Justification and Guidance section of this SPD.

Property Name (if relevant): Arlington Works, 23 Arlington Road, Twickenham

Application No. (if known):

Address (include. postcode): Arlington Works, 23 Arlington Road, Twickenham

Completed by: Ivan Ball

For Non-Residential
Size of development (m2): 610

For Residential
Number of dwellings: 24

1 MINIMUM COMPLIANCE (RESIDENTIAL AND NON-RESIDENTIAL)

Energy Assessment

Has an energy assessment been submitted that demonstrates the expected energy and carbon dioxide emissions saving from energy efficiency and renewable energy measures, including the feasibility of CHP/CCHP and community heating systems? If yes, please tick. Yes

Carbon Dioxide emissions reduction

What is the carbon dioxide emissions reduction against a Building Regulations Part L (2013) baseline: 35.16

Policy DM SD 1 and London Plan Policy 5.2 (2015) require a 35% reduction in CO_2 *emissions beyond Building Regulations 2013.*

Percentage of **total** site CO2 emissions saved through renewable energy installation? 27.29

1A MINIMUM POLICY COMPLIANCE (NON-RESIDENTIAL AND DOMESTIC REFURBISHMENT)

Please check the Guidance Section of this SPD for the policy requirements

Environmental Rating of development:

Non-Residential new-build (100sqm or more)			
BREEAM Level	Excellent	Have you attached a pre-assessment to support this?	☑
Extensions and conversions for residential dwellings			
BREEAM Domestic Refurbishment	Please Select	Have you attached a pre-assessment to support this?	☐
Extensions and conversions for non-residential buildings			
BREEAM Level	Please Select	Have you attached a pre-assessment to support this?	☐

Score awarded for Environmental Rating:

BREEAM: Good = *0* , Very Good = 4, Excellent = *8,* Outstanding = *16*

Subtotal 8

1B MINIMUM POLICY COMPLIANCE (RESIDENTIAL)

Water Usage

Internal water usage limited to 105 litres person per day. (Excluding an allowance 5 litres per person per day for external water consumption). Calculations using the water efficiency calculator for new dwellings have been submitted. ☑ *1*

Subtotal 1

2. ENERGY USE AND POLLUTION

2.1 Need for Cooling

Score

a. How does the development incorporate cooling measures? Tick all that apply:

Energy efficient design incorporating specific heat demand to less than or equal to 15 kWh/sqm ☐ 6
Reduce heat entering a building through providng/improving insulation and living roofs and walls ☐ 2
Reduce heat entering a building through shading ☑ 3
Exposed thermal mass and high ceilings ☑ 4
Passive ventilation ☑ 3
Mechanical ventilation with heat recovery ☐ 1
Active cooling systems, i.e. Air Conditioning Unit ☐ 0

2.2 Heat Generation

b. How have the heating and cooling systems, with preference to the heating system hierarchy, been selected (defined in London Plan policy **5.6**)? Tick all heating and cooling systems that will be used in the development:

Connection to existing heating or cooling networks powered by renewable energy ☐ 6
Connection to existing heating or cooling networks powered by gas or electricity ☐ 5
Site wide CHP network powered by renewable energy ☐ 4
Site wide CHP network powered by gas ☐ 3
Communal heating and cooling powered by renewable energy ☐ 2
Communal heating and cooling powered by gas or electricity ☐ 1
Individual heating and cooling ☑ 0

2.3 Pollution: Air, Noise and Light

a. Does the development plan to implement reduction strategies for dust emissions from construction sites? ☑ 2

b. Does the development plan include a biomass boiler? ☐ -

If yes, please refer to the biomass guidelines for the Borough of Richmond, please see guidance for supplementary information. If the proposed boiler is of a qualifying size, you may need to completed the information request form found on the Richmond website. ☐ -

c. Please tick only one option below

Has the development taken measures to reduce existing noise and enhance the existing soundscape of the site? ☑ 3
Has the development taken care to not create any new noise generation/transmission issues in its intended operation? ☐ 1

d. Has the development taken measures to reduce light pollution impacts on character, residential amenity and biodiversity? ☑ 3

e. Have you attached a Lighting Pollution Report? ☐ -

Subtotal 18

Please give any additional relevant comments to the Energy Use and Pollution Section below

A Construction Plan will be prepared, which will seek to reduce dust, noise and other disturbances to immediate neighbours.

3. TRANSPORT

3.1 Provision for the safe efficient and sustainable movement of people and goods

a. Does your development provide opportunities for occupants to use innovative travel technologies?

Please explain:

b. Does your development include charging point(s) for electric cars? ☐ 2

c. **For major developments ONLY**: Has a Transport Assessment been produced for your development based on TfL's Best Practice Guidance?

If you have provided a Transport Assessment as part of your planning application, please tick here and move to Section 3 of this Checklist. ☑ 5

d. **For smaller developments ONLY**: Have you provided a Transport Statement? ☐ 5

e. Does your development provide cycle storage? (Standard space requirements are set out in the the Council's Parking Standards - DM DPD Appendix 4) ☑ 2

If so, for how many bicycles?
Is this shown on the site plans? ☑ -

f. Will the development create or improve links with local and wider transport networks? If yes, please provide details. ☐ 2

Subtotal 7

Please give any additional relevant comments to the Transport Section below

Cycle storage is shown on the application drawings.

4 BIODIVERSITY

4.1 Minimising the threat to biodiversity from new buildings, lighting, hard surfacing and people

a. Does your development involve the loss of an ecological feature or habitat, including a loss of garden or other green space? (Indicate if yes) ☐ *-2*

If so, please state how much in sqm? sqm

b. Does your development involve the removal of any tree(s)? (Indicate if yes) *-* ☐

If so, has a tree report been provided in support of your application? (Indicate if yes) *-* ☐

c. Does your development plan to add (and not remove) any tree(s) on site? (Indicate if yes) *-* ☐

d. Please indicate which features and/or habitats that your development will incorporate to improve on site biodiversity:

Pond, reedbed or extensive native planting	*6*	☐	Area provided:	sqm
An extensive green roof	*5*	☐	Area provided:	sqm
An intensive green roof	*4*	☐	Area provided:	sqm
Garden space	*4*	☑	Area provided:	sqm
Additional native and/or wildlife friendly planting to peripheral areas	*3*	☐	Area provided:	sqm
Additional planting to peripheral areas	*2*	☐	Area provided:	sqm
A living wall	*2*	☐	Area provided:	sqm
Bat boxes	*0.5*	☑		
Bird boxes	*0.5*	☑		
Other	*0.5*	☐		

Subtotal 5

Please give any additional relevant comments to the Biodiversity Section below

Private terraces are provided to ground floor apartments and private communal space is available.

5 FLOODING AND DRAINAGE

5.1 Mitigating the risks of flooding and other impacts of climate change in the borough

a. Is your site located in a high flood risk zone (Zone 3)? (Indicate if yes) ☐ *-2*

Have you submitted a Flood Risk Assessment? (Indicate if yes) ☐ *-*

b. Which of the following measures of the drainage hierarchy are incorporated onto your site? (tick all that apply)

Store rainwater for later use	☑	*5*
Use of infiltration techniques such as porous surfacing materials to allow drainage on-site	☑	*3*
Attenuate rainwater in ponds or open water features	☐	*4*
Store rainwater in tanks for gradual release to a watercourse	☐	*3*
Discharge rainwater directly to watercourse	☐	*2*
Discharge rainwater to surface water drain	☐	*1*
Discharge rainwater to combined sewer	☑	*0*

c. Please give the change in area of permeable surfacing which will result from your development proposal: sqm

Please provide details of the permeable surfacing below *please represent a loss in permeable area as a negative number*

Subtotal 8

Please give any additional relevant comments to the Flooding and Drainage Section below

Rainwater butts will be provided for landscape maintenance.

6 IMPROVING RESOURCE EFFICIENCY

6.1 Reduce waste generated and amount disposed of by landfill though increasing level of re-use and recycling

a. Will demolition be required on your site prior to construction? *[Points will only be awarded if 10% or greater of demolition waste is reused/recycled]* ☑ *1*

If so, what percentage of demolition waste will be reused in the new development? 20 %

What percentage of demolition waste will be recycled? 80 %

b. Does your site have any contaminated land? ☐ *1*

Have you submitted an assessment of the site contamination?	☑	*2*
Are plans in place to remediate the contamination?	☑	*2*
Have you submitted a remediation plan?	☑	*1*
Are plans in place to include composting on site?	☐	*1*

6.2 Reducing levels of water waste

a. Will the following measures of water conservation be incorporated into the development? (Please tick all that apply):

Fitting of water efficient taps, shower heads etc	☑	*1*
Use of water efficient A or B rated appliances	☑	*1*
Rainwater harvesting for internal use	☐	*4*
Greywater systems	☐	*4*
Fit a water meter	☑	*1*

Subtotal 8

Please give any additional relevant comments to the Improving Resource Efficiency Section below

7 ACCESSIBILITY

7.1 Ensure flexible adaptable and long-term use of structures

a. **If the development is residential,** will it meet the requirements of the nationally described space standard for internal space and layout? ☑ *1*

If the standards are not met, in the space below, please provide details of the functionality of the internal space and layout

The standards of the SPD will be met.

AND

b. **If the development is residential**, will it meet Building Regulation Requirement M4 (2) 'accessible and adaptable dwellings'? ☑ *2*

If this is not met, in the space below, please provide details of any accessibility measures included in the development.

For major residential developments, are 10% or more of the units in the development to Building Regulation Requirement M4 (3) 'wheelchair user dwellings'? ☐ *1*

OR

c. **If the development is non-residential,** does it comply with requirements included in Richmond's Design for Maximum Access SPG ☑ *2*

Please provide details of the accessibility measures specified in the Maximum Access SPG that will be included in the development

Subtotal 5

Please give any additional relevant comments to the Design Standards and Accessibility Section below

LBRUT Sustainable Construction Checklist- Scoring Matrix for *New Construction* **(Non-Residential and domestic refurb)**

TOTAL ***60***

Score	**Rating**	**Significance**
80 or more	*A+*	Project strives to achieve highest standard in energy efficient sustainable development
71-79	*A*	Makes a major contribution towards achieving sustainable development in Richmond
51-70	*B*	Helps to significantly improve the Borough's stock of sustainable developments
36-50	*C*	Minimal effort to increase sustainability beyond general compliance
35 or less	*FAIL*	Does not comply with SPD Policy

LBRUT Sustainable Construction Checklist- Scoring Matrix for New Construction **Residential new-build**

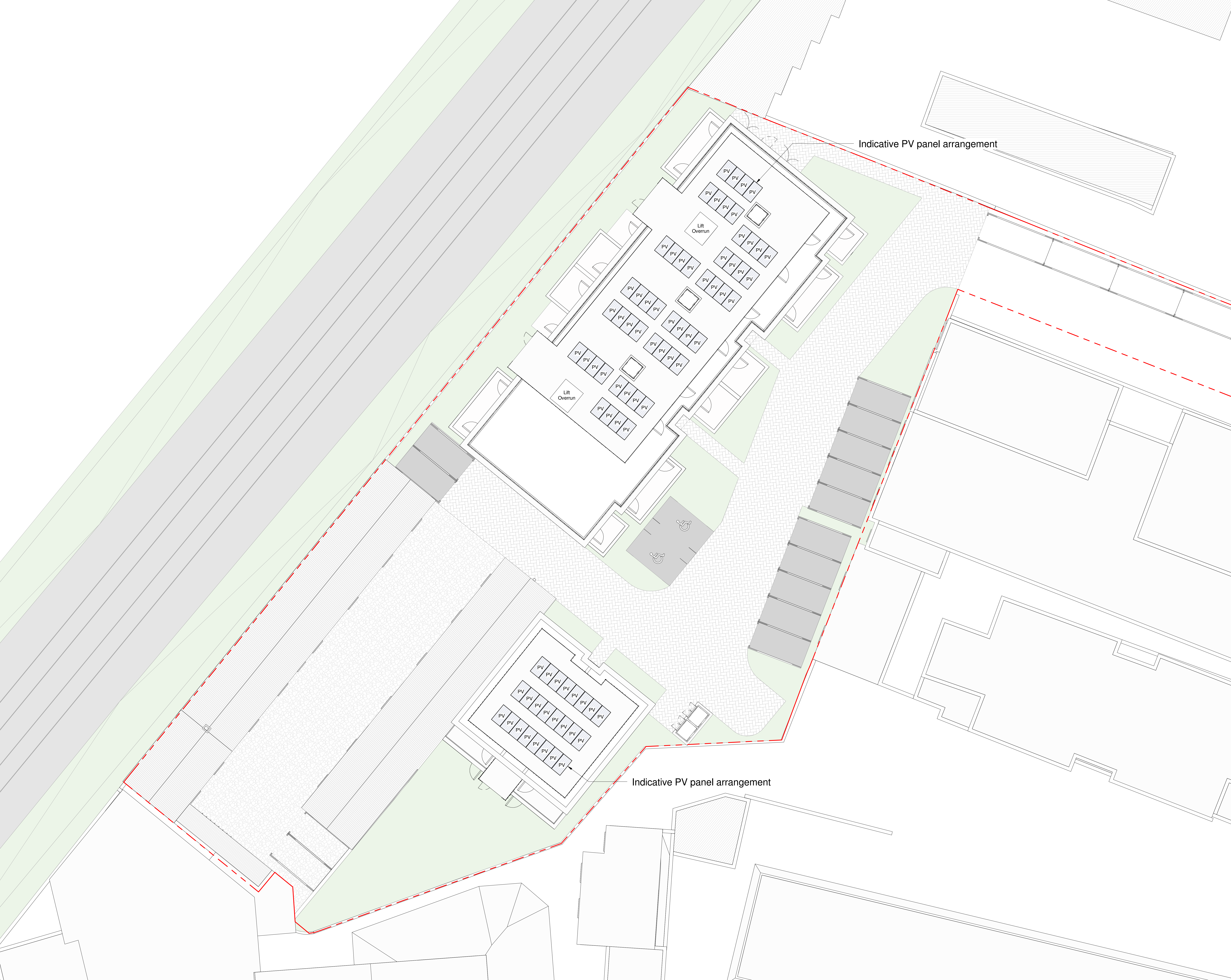
Score	**Rating**	**Significance**
81 or more	**A++**	Project strives to achieve highest standard in energy efficient sustainable development
64-80	*A+*	Project strives to achieve highest standard in energy efficient sustainable development
55-63	*A*	Makes a major contribution towards achieving sustainable development in Richmond
35-54	*B*	Helps to significantly improve the Borough's stock of sustainable developments
20-34	*C*	Minimal effort to increase sustainability beyond general compliance
19 or less	*FAIL*	Does not comply with SPD Policy

Authorisation:

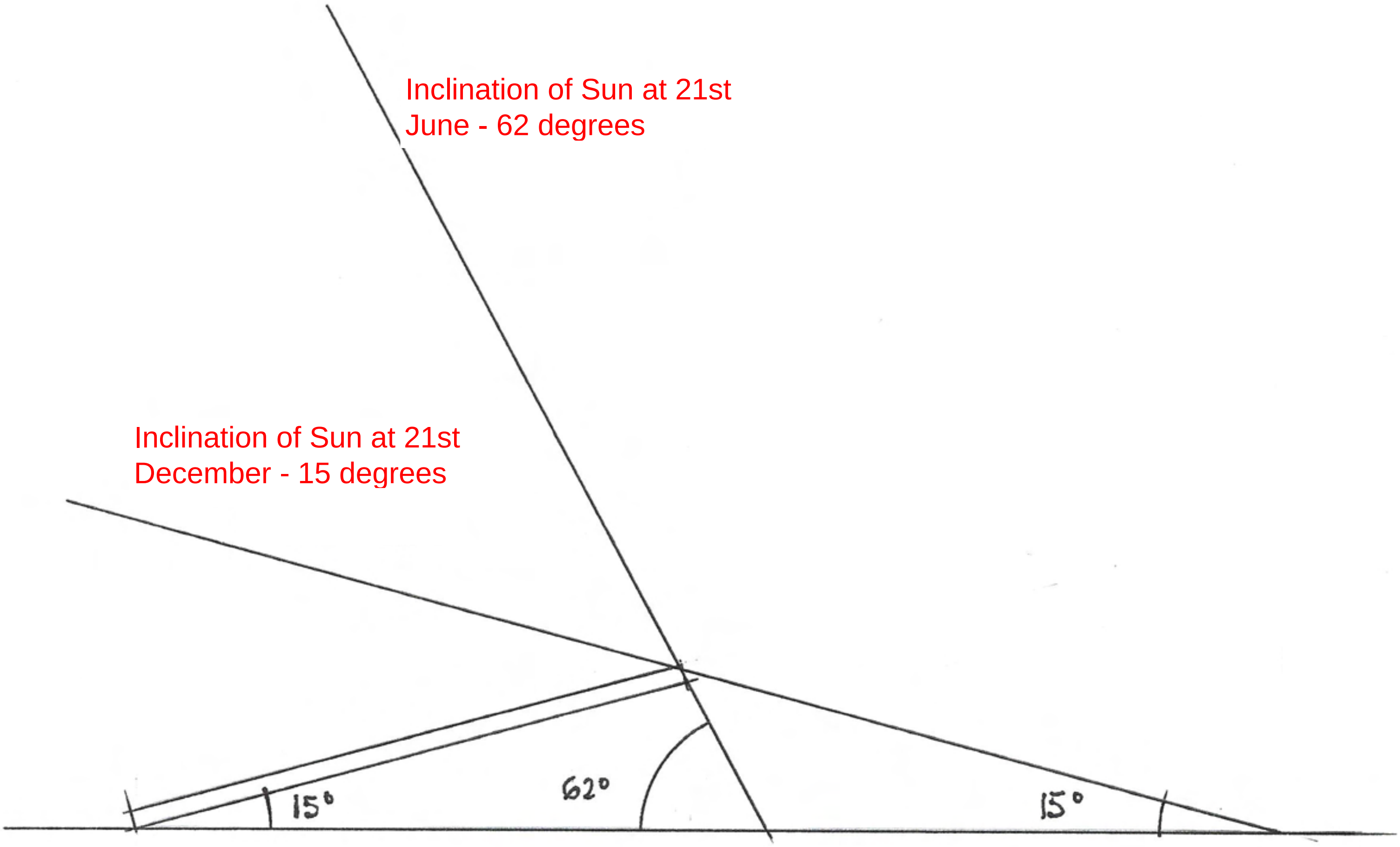
I herewith declare that I have filled in this form to the best of my knowledge

Signature ____________________ Date ______________

Appendix 3 – Roof Plan showing Indicative Photovoltaic Panel Locations


Indicative PV panel arrangement

Indicative PV panel arrangement



Inclination of Sun at 21st
June - 62 degrees

Inclination of Sun at 21st
December - 15 degrees

Photovoltaic Panel - 1.6m x
1.05m inclined at 15 degrees

Appendix 4 – Sample BRUKL Calculations – baseline

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Commercial Unit

As designed

Date: Fri Jun 22 17:39:12 2018

Administrative information

Building Details

Address:

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.4.b.0

Interface to calculation engine: iSBEM

Interface to calculation engine version: v5.4.b

BRUKL compliance check version: v5.4.b.0

Owner Details

Name: Information not provided by the user

Telephone number: Information not provided by the user

Address: Information not provided by the user, Information not provided by the user, Information not provided by the user

Certifier details

Name:

Telephone number:

Address:

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

1.1	CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	19.9
1.2	Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	19.9
1.3	Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	16.2
1.4	Are emissions from the building less than or equal to the target?	BER =< TER
1.5	Are as built details the same as used in the BER calculations?	Separate submission

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

2.a Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	External Wall
Floor	0.25	-	-	No floors in project
Roof	0.25	0.12	0.12	Roof
Windows***, roof windows, and rooflights	2.2	1.42	1.42	1.5m*FH
Personnel doors	2.2	2.18	2.18	Door 0.9m*2m
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

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

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

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

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

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

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

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

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	5

2.b Building services

The building services parameters listed below are expected to be checked by the BCO against guidance. No automatic checking is performed by the tool.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	0.9 to 0.95

1- Mech Extract - Toilet (3 Zones)

Heating seasonal efficiency	**Cooling nominal efficiency**	**SFP [W/(l/s)]**	**HR seasonal efficiency**
4	-	0.8	-
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system			YES

2- Nat Vent - Circulation

Heating seasonal efficiency	**Cooling nominal efficiency**	**SFP [W/(l/s)]**	**HR seasonal efficiency**
4	-	-	-
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system			YES

3- VRF with Mech Vent - Office (11 Zones)

Heating seasonal efficiency	**Cooling nominal efficiency**	**SFP [W/(l/s)]**	**HR seasonal efficiency**
0.9	3.5	1.5	0.7
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system			YES

1- Gas 90%

Heating seasonal efficiency	**Hot water storage loss factor [kWh/litre per day]**
0.9	0.29

Local mechanical ventilation and exhaust

Zone	**Supply/extract SFP [W/(l/s)]**	**HR seasonal efficiency**	**Exhaust SFP [W/(l/s)]**
B1_Office 20	1.5	-	-
B1_Office 22	1.5	-	-
B1_Office 23	1.5	-	-
B1_Toilet 10	-	-	0.8
B1_Toilet 11	-	-	0.8
B1_Toilet 12	-	-	0.8
B1_Office 54	1.5	-	-
B1_Office 55	1.5	-	-
B1_Office 56	1.5	-	-
B1_Office 57	1.5	-	-
B1_Office 58	1.5	-	-
B1_Office 59	1.5	-	-
B1_Office 60	1.5	-	-
B1_Office 61	1.5	-	-

General lighting and display lighting

Zone	**General lighting [W]**	**Display lamps efficacy [lm/W]**
B1_Circulation 10	70	-
B1_Circulation 11	120	-
B1_Circulation 13	30	-
B1_Office 20	500	-
B1_Office 22	550	-
B1_Office 23	290	-
B1_Toilet 10	60	-

General lighting and display lighting

Zone	General lighting [W]	Display lamps efficacy [lm/W]
B1_Toilet 11	90	-
B1_Toilet 12	90	-
B1_Office 54	30	-
B1_Office 55	190	-
B1_Office 56	10	-
B1_Office 57	60	-
B1_Office 58	10	-
B1_Office 59	10	-
B1_Office 60	10	-
B1_Office 61	20	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1_Office 20	NO (-55%)	YES
B1_Office 22	NO (-49%)	YES
B1_Office 23	NO (-77%)	NO
B1_Office 54	NO (-46%)	NO
B1_Office 55	NO (-1%)	YES
B1_Office 56	NO (-58%)	NO
B1_Office 57	NO (-63%)	NO
B1_Office 58	NO (-39%)	NO
B1_Office 59	NO (-52%)	NO
B1_Office 60	NO (-50%)	NO
B1_Office 61	NO (-41%)	NO

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

Separate submission

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

Separate submission

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	520	520
External area [m^2]	488	488
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	5	5
Average conductance [W/K]	283	295
Average U-value [W/m^2K]	0.58	0.61
Alpha value* [%]	5.92	5.92

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Telephone exchanges
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	8.95	7.93
Cooling	7.91	7.66
Auxiliary	7.1	5.96
Lighting	12.34	22.7
Hot water	4.24	2.84
Equipment*	35.63	35.63
TOTAL	**40.54**	**47.09**

* Energy used by equipment does not count towards the total for calculating emissions.

Energy Production by Technology [kWh/m^2]

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

Energy & CO_2 Emissions Summary

	Actual	Indicative Target
Heating + cooling demand [MJ/m^2]	130.97	132.08
Total consumption [kWh/m^2]	40.54	47.09
Total emissions [kg/m^2]	16.2	19.9

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity									
Actual	31.7	0	2.2	0	32.1	4	0	4	0
Notional	88	0	10.1	0	16.2	2.43	0	----	----
[ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity									
Actual	34.9	0	2.4	0	1.8	4	0	4	0
Notional	73.3	0	8.4	0	1.1	2.43	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity									
Actual	30.7	123.6	10.5	9.8	5.9	0.81	3.5	0	3.5
Notional	21.9	123.1	7.7	9.5	9.1	0.79	3.6	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.18	External Wall
Floor	0.2	-	No floors in project
Roof	0.15	0.12	Roof
Windows, roof windows, and rooflights	1.5	1.42	1.5m*FH
Personnel doors	1.5	2.18	Door 1.5m*2m
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)]

$U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	5

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

[redacted]

As designed

Date: Fri Dec 18 18:08:23 2015

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.4

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.4

BRUKL compliance check version: v5.2.d.2

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certifier details

Name: [redacted]

Telephone number: Phone

Address: Street Address, London, Postcode

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	18.1
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	18.1
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	16.1
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-Limit}}$	$U_{a\text{-Calc}}$	$U_{i\text{-Calc}}$	Surface where the maximum value occurs*
Wall**	0.35	0.13	0.13	5_000000:Surf[2]
Floor	0.25	0.12	0.12	5_000000:Surf[0]
Roof	0.25	0.12	0.12	5_000004:Surf[2]
Windows***, roof windows, and rooflights	2.2	1.4	1.4	5_000000:Surf[1]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

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

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

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

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

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

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

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

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

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- VRF heating and cooling (offices)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4.2	3.8	0	0	0.8
Standard value	2.5*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

2- VRF heating (toilets)

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4.2	80	0	0	0.8
Standard value	2.5*	3.2	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

1- Point of use electric heater

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	-
Standard value	1	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

Shell and core configuration

Zone	**Assumed shell?**
GL-offices	YES
GL- staircase	YES
GL-Elevator	YES
L01- offices	YES
L01- circulation	YES
L01- toilet	YES
L01- toilet	YES
L01- toilet	YES
L01- toilet	YES
GL- toilet	YES
GL- toilet	YES
GL- toilet	YES
GL- toilet	YES
GL- circulation	YES
GL- circulation	YES

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
GL-offices	75	-	-	1853

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
GL- staircase	-	75	-	117
GL-Elevator	-	75	-	53
L01- offices	75	-	-	2063
L01- circulation	-	75	-	81
L01- toilet	-	75	-	63
L01- toilet	-	75	-	57
L01- toilet	-	75	-	53
L01- toilet	-	75	-	63
GL- toilet	-	75	-	67
GL- toilet	-	75	-	53
GL- toilet	-	75	-	55
GL- toilet	-	75	-	55
GL- circulation	-	75	-	162
GL- circulation	-	75	-	31

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
GL-offices	NO (-47.9%)	NO
L01- offices	NO (-32.1%)	NO
L01- circulation	N/A	N/A
GL- toilet	N/A	N/A
GL- toilet	N/A	N/A
GL- toilet	N/A	N/A
GL- toilet	N/A	N/A
GL- circulation	NO (-34.2%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	498	498
External area [m²]	1212	1212
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	5	3
Average conductance [W/K]	384.8	572.38
Average U-value [W/m²K]	0.32	0.47
Alpha value* [%]	10.05	10

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	3.76	11.43
Cooling	9.04	5.5
Auxiliary	3.66	2.21
Lighting	13.07	15.15
Hot water	2.28	2.45
Equipment*	34.62	34.62
TOTAL**	**31.81**	**36.74**

* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	138.11	180.33
Primary energy* [kWh/m²]	106.47	139.55
Total emissions [kg/m²]	16.1	18.1

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	100.8	77.3	6.8	0.4	2.4	4.12	59.79	4.2	80
	Notional	177.6	84.8	19.3	6.2	2.8	2.56	3.79	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	55.7	93.9	3.8	11.6	3.9	4.12	2.24	4.2	3
	Notional	107.2	83.3	11.6	6.1	2.1	2.56	3.79	----	----

Key to terms

Heat dem [MJ/m2] = Heating energy demand
Cool dem [MJ/m2] = Cooling energy demand
Heat con [kWh/m2] = Heating energy consumption
Cool con [kWh/m2] = Cooling energy consumption
Aux con [kWh/m2] = Auxiliary energy consumption
Heat SSEFF = Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER = Cooling system seasonal energy efficiency ratio
Heat gen SSEFF = Heating generator seasonal efficiency
Cool gen SSEER = Cooling generator seasonal energy efficiency ratio
ST = System type
HS = Heat source
HFT = Heating fuel type
CFT = Cooling fuel type

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.11	5_000004:Surf[6]
Floor	0.2	0.12	5_000000:Surf[0]
Roof	0.15	0.12	5_000004:Surf[2]
Windows, roof windows, and rooflights	1.5	1.4	5_000000:Surf[1]
Personnel doors	1.5	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	No Vehicle access doors in building
High usage entrance doors	1.5	-	No High usage entrance doors in building

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

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

Appendix 5 – Sample SAP Calculations – baseline

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.3.11
Printed on 22 June 2018 at 10:46:59

Project Information:

Assessed By: ()

Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 50.6m²

Site Reference : Arlington Works, Twickenham

Plot Reference: Arlington 1 Bed GND 51

Address :

Client Details:

Name: Sharpes Refinery Service

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	17.42 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	16.05 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	36.6 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	32.2 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.43 (max. 2.00)	1.60 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Database: (rev 397, product index 016661):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Alpha
Model: InTec 34C
Model qualifier:
(Combi)
Efficiency 88.8 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	Time and temperature zone control by device in database	**OK**
Hot water controls:	No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	Medium	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: South East	4.41m^2
Windows facing: South East	4.41m^2
Windows facing: South East	1.08m^2
Ventilation rate:	3.00
Blinds/curtains:	None
	Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m^2K
Floors U-value	0.11 W/m^2K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.11

Property Address: Arlington 1 Bed GND 51

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	50.6	(1a)	x	2.3	(2a)	=	116.38	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.6	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	116.38	(5)

2. Ventilation rate:

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.17	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.32	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.4	0.4	0.39	0.35	0.34	0.3	0.3	0.29	0.32	0.34	0.36	0.37

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 2			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 3			1.08	x1/[1/(1.4)+ 0.04]		=	1.43			(27)
Floor			50.6	x	0.11	=	5.566			(28)
Walls	23.13	11.79	11.34	x	0.17	=	1.93			(29)
Total area of elements, m²			73.73							(31)
Party wall			18.76	x	0	=	0			(32)
Party ceiling			50.6							(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 23.64 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7821.48 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 4.57 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 28.22 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	22.32	22.2	22.08	21.52	21.42	20.93	20.93	20.84	21.12	21.42	21.63	21.85	(38)

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

(39)m=	50.54	50.42	50.3	49.74	49.64	49.15	49.15	49.06	49.34	49.64	49.85	50.07	

Average = Sum(39)$_{1…12}$ /12= 49.74 (39)

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

(40)m=	1	1	0.99	0.98	0.98	0.97	0.97	0.97	0.98	0.98	0.99	0.99

Average = $\text{Sum}(40)_{1\ldots12}$ /12= 0.98 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.71 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.76 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	82.24	79.25	76.25	73.26	70.27	67.28	67.28	70.27	73.26	76.25	79.25	82.24

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

Total = $\text{Sum}(44)_{1\ldots12}$ = 897.12 (44)

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

(45)m=	121.95	106.66	110.06	95.96	92.07	79.45	73.62	84.48	85.49	99.63	108.76	118.11

Total = $\text{Sum}(45)_{1\ldots12}$ = 1176.26 (45)

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

(46)m=	18.29	16	16.51	14.39	13.81	11.92	11.04	12.67	12.82	14.95	16.31	17.72	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	23.7	21.39	23.65	22.85	23.59	22.81	23.55	23.58	22.83	23.63	22.9	23.69	(61)

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

(62)m=	145.65	128.05	133.71	118.81	115.67	102.26	97.17	108.06	108.33	123.26	131.66	141.79	(62)

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

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

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

Output from water heater

(64)m=	145.65	128.05	133.71	118.81	115.67	102.26	97.17	108.06	108.33	123.26	131.66	141.79

Output from water heater (annual)$_{1…12}$ 1454.42 (64)

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

(65)m=	46.47	40.81	42.51	37.62	36.51	32.12	30.37	33.99	34.13	39.04	41.89	45.19	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	(66)

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

(67)m=	13.39	11.89	9.67	7.32	5.47	4.62	4.99	6.49	8.71	11.06	12.91	13.76	(67)

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

(68)m=	148.79	150.34	146.45	138.16	127.71	117.88	111.31	109.77	113.66	121.94	132.4	142.23	(68)

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

(69)m=	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	(71)

Water heating gains (Table 5)

(72)m=	62.46	60.73	57.14	52.25	49.08	44.61	40.82	45.68	47.41	52.47	58.18	60.74	(72)

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

(73)m=	276.26	274.58	264.87	249.35	233.87	218.73	208.74	213.56	221.4	237.09	255.1	268.35	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	4.41	x	36.79	x	0.63	x	0.7	=	49.59	(77)
Southeast 0.9x	0.77	x	4.41	x	36.79	x	0.63	x	0.7	=	49.59	(77)
Southeast 0.9x	0.77	x	1.08	x	36.79	x	0.63	x	0.7	=	12.14	(77)
Southeast 0.9x	0.77	x	4.41	x	62.67	x	0.63	x	0.7	=	84.47	(77)
Southeast 0.9x	0.77	x	4.41	x	62.67	x	0.63	x	0.7	=	84.47	(77)

Southeast	0.9x	0.77	x	1.08	x	62.67	x	0.63	x	0.7	=	20.69	(77)
Southeast	0.9x	0.77	x	4.41	x	85.75	x	0.63	x	0.7	=	115.57	(77)
Southeast	0.9x	0.77	x	4.41	x	85.75	x	0.63	x	0.7	=	115.57	(77)
Southeast	0.9x	0.77	x	1.08	x	85.75	x	0.63	x	0.7	=	28.3	(77)
Southeast	0.9x	0.77	x	4.41	x	106.25	x	0.63	x	0.7	=	143.2	(77)
Southeast	0.9x	0.77	x	4.41	x	106.25	x	0.63	x	0.7	=	143.2	(77)
Southeast	0.9x	0.77	x	1.08	x	106.25	x	0.63	x	0.7	=	35.07	(77)
Southeast	0.9x	0.77	x	4.41	x	119.01	x	0.63	x	0.7	=	160.4	(77)
Southeast	0.9x	0.77	x	4.41	x	119.01	x	0.63	x	0.7	=	160.4	(77)
Southeast	0.9x	0.77	x	1.08	x	119.01	x	0.63	x	0.7	=	39.28	(77)
Southeast	0.9x	0.77	x	4.41	x	118.15	x	0.63	x	0.7	=	159.24	(77)
Southeast	0.9x	0.77	x	4.41	x	118.15	x	0.63	x	0.7	=	159.24	(77)
Southeast	0.9x	0.77	x	1.08	x	118.15	x	0.63	x	0.7	=	39	(77)
Southeast	0.9x	0.77	x	4.41	x	113.91	x	0.63	x	0.7	=	153.52	(77)
Southeast	0.9x	0.77	x	4.41	x	113.91	x	0.63	x	0.7	=	153.52	(77)
Southeast	0.9x	0.77	x	1.08	x	113.91	x	0.63	x	0.7	=	37.6	(77)
Southeast	0.9x	0.77	x	4.41	x	104.39	x	0.63	x	0.7	=	140.69	(77)
Southeast	0.9x	0.77	x	4.41	x	104.39	x	0.63	x	0.7	=	140.69	(77)
Southeast	0.9x	0.77	x	1.08	x	104.39	x	0.63	x	0.7	=	34.46	(77)
Southeast	0.9x	0.77	x	4.41	x	92.85	x	0.63	x	0.7	=	125.14	(77)
Southeast	0.9x	0.77	x	4.41	x	92.85	x	0.63	x	0.7	=	125.14	(77)
Southeast	0.9x	0.77	x	1.08	x	92.85	x	0.63	x	0.7	=	30.65	(77)
Southeast	0.9x	0.77	x	4.41	x	69.27	x	0.63	x	0.7	=	93.36	(77)
Southeast	0.9x	0.77	x	4.41	x	69.27	x	0.63	x	0.7	=	93.36	(77)
Southeast	0.9x	0.77	x	1.08	x	69.27	x	0.63	x	0.7	=	22.86	(77)
Southeast	0.9x	0.77	x	4.41	x	44.07	x	0.63	x	0.7	=	59.4	(77)
Southeast	0.9x	0.77	x	4.41	x	44.07	x	0.63	x	0.7	=	59.4	(77)
Southeast	0.9x	0.77	x	1.08	x	44.07	x	0.63	x	0.7	=	14.55	(77)
Southeast	0.9x	0.77	x	4.41	x	31.49	x	0.63	x	0.7	=	42.44	(77)
Southeast	0.9x	0.77	x	4.41	x	31.49	x	0.63	x	0.7	=	42.44	(77)
Southeast	0.9x	0.77	x	1.08	x	31.49	x	0.63	x	0.7	=	10.39	(77)

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

(83)m=	111.32	189.62	259.45	321.47	360.07	357.47	344.64	315.84	280.93	209.57	133.34	95.27	(83)

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

(84)m=	387.59	464.2	524.32	570.82	593.95	576.2	553.38	529.4	502.33	446.66	388.44	363.62	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.87	0.73	0.54	0.39	0.42	0.65	0.91	0.98	1	(86)

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

(87)m=	20.12	20.32	20.56	20.8	20.94	20.99	21	21	20.98	20.79	20.41	20.08	(87)

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

(88)m=	20.08	20.09	20.09	20.1	20.1	20.11	20.11	20.11	20.1	20.1	20.1	20.09	(88)

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

(89)m=	0.99	0.98	0.94	0.84	0.67	0.47	0.31	0.34	0.58	0.87	0.98	0.99	(89)

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

(90)m=	18.93	19.21	19.55	19.88	20.05	20.1	20.11	20.11	20.09	19.87	19.34	18.88	(90)

fLA = Living area ÷ (4) = 0.49 (91)

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

(92)m=	19.52	19.76	20.05	20.34	20.49	20.54	20.55	20.55	20.53	20.32	19.87	19.47	(92)

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

(93)m=	19.52	19.76	20.05	20.34	20.49	20.54	20.55	20.55	20.53	20.32	19.87	19.47	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.94	0.85	0.7	0.5	0.35	0.38	0.61	0.88	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	383.5	451.85	491.08	484.89	413.62	289.14	193.73	202.99	308.36	393.97	379.02	360.8	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	769.13	749.15	681.49	568.81	436.32	292.03	194.02	203.49	317.05	482.6	636.47	764.65	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	286.91	199.79	141.67	60.42	16.89	0	0	0	0	65.94	185.36	300.47	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1257.44 (98)

Space heating requirement in kWh/m²/year 24.85 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		92.7	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	286.91	199.79	141.67	60.42	16.89	0	0	0	0	65.94	185.36	300.47	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	309.5	215.52	152.82	65.18	18.22	0	0	0	0	71.13	199.96	324.13	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1356.46 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

Water heating

Output from water heater (calculated above)

145.65	128.05	133.71	118.81	115.67	102.26	97.17	108.06	108.33	123.26	131.66	141.79

Efficiency of water heater 87 (216)

(217)m=	88.77	88.63	88.37	87.89	87.33	87	87	87	87	87.92	88.56	88.82	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	164.07	144.48	151.31	135.18	132.44	117.54	111.69	124.21	124.51	140.19	148.67	159.65

Total = Sum(219a)$_{1...12}$ = 1653.95 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1356.46	
Water heating fuel used		1653.95	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		236.49	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	293	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	357.25	(264)
Space and water heating	(261) + (262) + (263) + (264) =				650.25	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	122.74	(268)
Total CO2, kg/year			sum of (265)…(271) =		811.91	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		16.05	(273)
EI rating (section 14)					89	(274)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.3.11

Property Address: Arlington 1 Bed GND 51

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	50.6	(1a) x	2.3	(2a) =	116.38	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.6	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		116.38	(5)

2. Ventilation rate:

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.17	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.42	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.46	0.45	0.44	0.39	0.39	0.34	0.34	0.33	0.36	0.39	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.59	(24d)

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

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1	=	1.89			(26)
Windows Type 1			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 2			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 3			1.08	x1/[1/(1.4)+ 0.04]		=	1.43			(27)
Floor			50.6	x	0.13	=	6.578			(28)
Walls	23.13	11.79	11.34	x	0.18	=	2.04			(29)
Total area of elements, m²			73.73							(31)
Party wall			18.76	x	0	=	0			(32)
Party ceiling			50.6							(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 23.63 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 7821.48 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 4.85 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 28.48 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.22	23.06	22.91	22.19	22.06	21.43	21.43	21.32	21.67	22.06	22.33	22.61	(38)

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

(39)m=	51.7	51.55	51.39	50.67	50.54	49.92	49.92	49.8	50.16	50.54	50.81	51.1	

Average = Sum(39)$_{1\ldots12}$ /12= 50.67 (39)

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

(40)m=	1.02	1.02	1.02	1	1	0.99	0.99	0.98	0.99	1	1	1.01

Average = Sum(40)$_{1\ldots12}$ /12= 1 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.71 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.76 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	82.24	79.25	76.25	73.26	70.27	67.28	67.28	70.27	73.26	76.25	79.25	82.24	
										Total = Sum(44)$_{1\ldots12}$ =		897.12	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	121.95	106.66	110.06	95.96	92.07	79.45	73.62	84.48	85.49	99.63	108.76	118.11	
										Total = Sum(45)$_{1\ldots12}$ =		1176.26	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	18.29	16	16.51	14.39	13.81	11.92	11.04	12.67	12.82	14.95	16.31	17.72	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	41.91	36.47	38.86	36.13	35.81	33.18	34.29	35.81	36.13	38.86	39.08	41.91	(61)

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

(62)m=	163.86	143.14	148.92	132.09	127.88	112.63	107.91	120.3	121.62	138.49	147.84	160.01	(62)

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

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

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

Output from water heater

(64)m=	163.86	143.14	148.92	132.09	127.88	112.63	107.91	120.3	121.62	138.49	147.84	160.01	

Output from water heater (annual)$_{1\ldots12}$ 1624.7 (64)

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

(65)m=	51.03	44.58	46.31	40.94	39.57	34.71	33.05	37.04	37.46	42.84	45.93	49.75	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	(66)

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

(67)m=	13.39	11.89	9.67	7.32	5.47	4.62	4.99	6.49	8.71	11.06	12.91	13.76	(67)

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

(68)m=	148.79	150.34	146.45	138.16	127.71	117.88	111.31	109.77	113.66	121.94	132.4	142.23	(68)

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

(69)m=	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	(71)

Water heating gains (Table 5)

(72)m=	68.58	66.34	62.25	56.86	53.18	48.21	44.42	49.79	52.03	57.58	63.79	66.86	(72)

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

(73)m=	282.38	280.19	269.98	253.96	237.98	222.33	212.35	217.67	226.02	242.21	260.72	274.47	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	4.41	x	36.79	x	0.63	x	0.7	=	49.59	(77)
Southeast 0.9x	0.77	x	4.41	x	36.79	x	0.63	x	0.7	=	49.59	(77)
Southeast 0.9x	0.77	x	1.08	x	36.79	x	0.63	x	0.7	=	12.14	(77)
Southeast 0.9x	0.77	x	4.41	x	62.67	x	0.63	x	0.7	=	84.47	(77)
Southeast 0.9x	0.77	x	4.41	x	62.67	x	0.63	x	0.7	=	84.47	(77)

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Southeast	0.9x	0.77	x	1.08	x	62.67	x	0.63	x	0.7	=	20.69	(77)
Southeast	0.9x	0.77	x	4.41	x	85.75	x	0.63	x	0.7	=	115.57	(77)
Southeast	0.9x	0.77	x	4.41	x	85.75	x	0.63	x	0.7	=	115.57	(77)
Southeast	0.9x	0.77	x	1.08	x	85.75	x	0.63	x	0.7	=	28.3	(77)
Southeast	0.9x	0.77	x	4.41	x	106.25	x	0.63	x	0.7	=	143.2	(77)
Southeast	0.9x	0.77	x	4.41	x	106.25	x	0.63	x	0.7	=	143.2	(77)
Southeast	0.9x	0.77	x	1.08	x	106.25	x	0.63	x	0.7	=	35.07	(77)
Southeast	0.9x	0.77	x	4.41	x	119.01	x	0.63	x	0.7	=	160.4	(77)
Southeast	0.9x	0.77	x	4.41	x	119.01	x	0.63	x	0.7	=	160.4	(77)
Southeast	0.9x	0.77	x	1.08	x	119.01	x	0.63	x	0.7	=	39.28	(77)
Southeast	0.9x	0.77	x	4.41	x	118.15	x	0.63	x	0.7	=	159.24	(77)
Southeast	0.9x	0.77	x	4.41	x	118.15	x	0.63	x	0.7	=	159.24	(77)
Southeast	0.9x	0.77	x	1.08	x	118.15	x	0.63	x	0.7	=	39	(77)
Southeast	0.9x	0.77	x	4.41	x	113.91	x	0.63	x	0.7	=	153.52	(77)
Southeast	0.9x	0.77	x	4.41	x	113.91	x	0.63	x	0.7	=	153.52	(77)
Southeast	0.9x	0.77	x	1.08	x	113.91	x	0.63	x	0.7	=	37.6	(77)
Southeast	0.9x	0.77	x	4.41	x	104.39	x	0.63	x	0.7	=	140.69	(77)
Southeast	0.9x	0.77	x	4.41	x	104.39	x	0.63	x	0.7	=	140.69	(77)
Southeast	0.9x	0.77	x	1.08	x	104.39	x	0.63	x	0.7	=	34.46	(77)
Southeast	0.9x	0.77	x	4.41	x	92.85	x	0.63	x	0.7	=	125.14	(77)
Southeast	0.9x	0.77	x	4.41	x	92.85	x	0.63	x	0.7	=	125.14	(77)
Southeast	0.9x	0.77	x	1.08	x	92.85	x	0.63	x	0.7	=	30.65	(77)
Southeast	0.9x	0.77	x	4.41	x	69.27	x	0.63	x	0.7	=	93.36	(77)
Southeast	0.9x	0.77	x	4.41	x	69.27	x	0.63	x	0.7	=	93.36	(77)
Southeast	0.9x	0.77	x	1.08	x	69.27	x	0.63	x	0.7	=	22.86	(77)
Southeast	0.9x	0.77	x	4.41	x	44.07	x	0.63	x	0.7	=	59.4	(77)
Southeast	0.9x	0.77	x	4.41	x	44.07	x	0.63	x	0.7	=	59.4	(77)
Southeast	0.9x	0.77	x	1.08	x	44.07	x	0.63	x	0.7	=	14.55	(77)
Southeast	0.9x	0.77	x	4.41	x	31.49	x	0.63	x	0.7	=	42.44	(77)
Southeast	0.9x	0.77	x	4.41	x	31.49	x	0.63	x	0.7	=	42.44	(77)
Southeast	0.9x	0.77	x	1.08	x	31.49	x	0.63	x	0.7	=	10.39	(77)

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

(83)m=	111.32	189.62	259.45	321.47	360.07	357.47	344.64	315.84	280.93	209.57	133.34	95.27	(83)

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

(84)m=	393.71	469.81	529.43	575.43	598.05	579.8	556.99	533.51	506.95	451.78	394.06	369.74	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.95	0.87	0.73	0.54	0.39	0.43	0.66	0.91	0.98	0.99	(86)

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

(87)m=	20.1	20.3	20.54	20.79	20.94	20.99	21	21	20.97	20.78	20.39	20.07	(87)

TER WorkSheet: New dwelling design stage

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

(88)m=	20.07	20.07	20.07	20.08	20.08	20.09	20.09	20.1	20.09	20.08	20.08	20.08	(88)

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

(89)m=	0.99	0.98	0.94	0.84	0.68	0.47	0.31	0.34	0.58	0.87	0.98	0.99	(89)

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

(90)m=	18.88	19.17	19.51	19.85	20.03	20.09	20.09	20.1	20.07	19.85	19.31	18.84	(90)

fLA = Living area ÷ (4) = 0.49 (91)

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

(92)m=	19.48	19.73	20.02	20.32	20.48	20.53	20.54	20.54	20.52	20.31	19.85	19.44	(92)

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

(93)m=	19.48	19.73	20.02	20.32	20.48	20.53	20.54	20.54	20.52	20.31	19.85	19.44	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.94	0.85	0.7	0.51	0.35	0.39	0.62	0.88	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	389.34	457.09	495.99	489.85	418.96	293.02	196.38	205.69	312.5	398.45	384.19	366.69	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	785.07	764.2	694.79	578.52	443.66	296.22	196.72	206.25	321.89	490.59	647.65	778.9	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	294.42	206.37	147.91	63.84	18.37	0	0	0	0	68.55	189.69	306.69	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1295.85 (98)

Space heating requirement in kWh/m²/year 25.61 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	294.42	206.37	147.91	63.84	18.37	0	0	0	0	68.55	189.69	306.69	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	315.23	220.96	158.36	68.35	19.67	0	0	0	0	73.4	203.1	328.36	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1387.42 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

TER WorkSheet: New dwelling design stage

Water heating

Output from water heater (calculated above)

163.86	143.14	148.92	132.09	127.88	112.63	107.91	120.3	121.62	138.49	147.84	160.01

Efficiency of water heater 80.3 (216)

(217)m=	86.51	85.97	85.03	83.33	81.44	80.3	80.3	80.3	80.3	83.38	85.68	86.66	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	189.41	166.49	175.13	158.5	157.02	140.27	134.38	149.81	151.46	166.09	172.55	184.64

Total = Sum(219a)$_{1...12}$ = 1945.76 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1387.42	
Water heating fuel used		1945.76	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		236.49	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	299.68	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	420.28	(264)
Space and water heating	(261) + (262) + (263) + (264) =				719.97	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	122.74	(268)
Total CO2, kg/year			sum of (265)…(271) =		881.63	(272)

TER = 17.42 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.3.11
Printed on 22 June 2018 at 10:46:56

Project Information:

Assessed By: () **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 50.6m²

Site Reference : Arlington Works, Twickenham **Plot Reference:** Arlington 1 Bed MID 51

Address :

Client Details:

Name: Sharpes Refinery Service

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	15.29 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	14.44 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	25.8 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	25.4 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.43 (max. 2.00)	1.60 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Database: (rev 397, product index 016661):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Alpha
Model: InTec 34C
Model qualifier:
(Combi)
Efficiency 88.8 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	Time and temperature zone control by device in database	**OK**
Hot water controls:	No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	Medium	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: South East	4.41m^2
Windows facing: South East	4.41m^2
Windows facing: South East	1.08m^2
Ventilation rate:	3.00
Blinds/curtains:	None Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m^{2}K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.11

Property Address: Arlington 1 Bed MID 51

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	50.6	(1a)	x	2.3	(2a)	=	116.38	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.6	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	116.38	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 20 ÷ (5) = 0.17 (8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.37	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.32	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

DER WorkSheet: New dwelling design stage

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

0.4	0.4	0.39	0.35	0.34	0.3	0.3	0.29	0.32	0.34	0.36	0.37

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 2			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 3			1.08	x1/[1/(1.4)+ 0.04]		=	1.43			(27)
Walls	23.13	11.79	11.34	x	0.17	=	1.93			(29)
Total area of elements, m²			23.13							(31)
Party wall			18.76	x	0	=	0			(32)
Party floor			50.6							(32a)
Party ceiling			50.6							(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 18.08 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 5544.48 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 3.67 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 21.74 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	22.32	22.2	22.08	21.52	21.42	20.93	20.93	20.84	21.12	21.42	21.63	21.85	(38)

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

(39)m=	44.07	43.95	43.83	43.27	43.16	42.68	42.68	42.59	42.87	43.16	43.38	43.6	

Average = Sum(39)$_{1…12}$ /12= 43.27 (39)

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

(40)m=	0.87	0.87	0.87	0.86	0.85	0.84	0.84	0.84	0.85	0.85	0.86	0.86	

Average = Sum(40)$_{1…12}$ /12= 0.86 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.71 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.76 (43)

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

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

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

(44)m=	82.24	79.25	76.25	73.26	70.27	67.28	67.28	70.27	73.26	76.25	79.25	82.24	

Total = Sum(44)$_{1…12}$ = 897.12 (44)

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

(45)m=	121.95	106.66	110.06	95.96	92.07	79.45	73.62	84.48	85.49	99.63	108.76	118.11	

Total = Sum(45)$_{1…12}$ = 1176.26 (45)

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

(46)m=	18.29	16	16.51	14.39	13.81	11.92	11.04	12.67	12.82	14.95	16.31	17.72	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

DER WorkSheet: New dwelling design stage

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

(61)m=	23.7	21.39	23.65	22.85	23.59	22.81	23.55	23.58	22.83	23.63	22.9	23.69	(61)

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

(62)m=	145.65	128.05	133.71	118.81	115.67	102.26	97.17	108.06	108.33	123.26	131.66	141.79	(62)

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

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

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

Output from water heater

(64)m=	145.65	128.05	133.71	118.81	115.67	102.26	97.17	108.06	108.33	123.26	131.66	141.79

Output from water heater (annual)$_{1…12}$ 1454.42 (64)

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

(65)m=	46.47	40.81	42.51	37.62	36.51	32.12	30.37	33.99	34.13	39.04	41.89	45.19	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	(66)

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

(67)m=	13.39	11.89	9.67	7.32	5.47	4.62	4.99	6.49	8.71	11.06	12.91	13.76	(67)

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

(68)m=	148.79	150.34	146.45	138.16	127.71	117.88	111.31	109.77	113.66	121.94	132.4	142.23	(68)

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

(69)m=	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	(71)

Water heating gains (Table 5)

(72)m=	62.46	60.73	57.14	52.25	49.08	44.61	40.82	45.68	47.41	52.47	58.18	60.74	(72)

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

(73)m=	276.26	274.58	264.87	249.35	233.87	218.73	208.74	213.56	221.4	237.09	255.1	268.35	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast	0.9x	0.77	x	4.41	x	36.79	x	0.63	x	0.7	=	49.59	(77)
Southeast	0.9x	0.77	x	4.41	x	36.79	x	0.63	x	0.7	=	49.59	(77)
Southeast	0.9x	0.77	x	1.08	x	36.79	x	0.63	x	0.7	=	12.14	(77)
Southeast	0.9x	0.77	x	4.41	x	62.67	x	0.63	x	0.7	=	84.47	(77)
Southeast	0.9x	0.77	x	4.41	x	62.67	x	0.63	x	0.7	=	84.47	(77)

Southeast	0.9x	0.77	x	1.08	x	62.67	x	0.63	x	0.7	=	20.69	(77)
Southeast	0.9x	0.77	x	4.41	x	85.75	x	0.63	x	0.7	=	115.57	(77)
Southeast	0.9x	0.77	x	4.41	x	85.75	x	0.63	x	0.7	=	115.57	(77)
Southeast	0.9x	0.77	x	1.08	x	85.75	x	0.63	x	0.7	=	28.3	(77)
Southeast	0.9x	0.77	x	4.41	x	106.25	x	0.63	x	0.7	=	143.2	(77)
Southeast	0.9x	0.77	x	4.41	x	106.25	x	0.63	x	0.7	=	143.2	(77)
Southeast	0.9x	0.77	x	1.08	x	106.25	x	0.63	x	0.7	=	35.07	(77)
Southeast	0.9x	0.77	x	4.41	x	119.01	x	0.63	x	0.7	=	160.4	(77)
Southeast	0.9x	0.77	x	4.41	x	119.01	x	0.63	x	0.7	=	160.4	(77)
Southeast	0.9x	0.77	x	1.08	x	119.01	x	0.63	x	0.7	=	39.28	(77)
Southeast	0.9x	0.77	x	4.41	x	118.15	x	0.63	x	0.7	=	159.24	(77)
Southeast	0.9x	0.77	x	4.41	x	118.15	x	0.63	x	0.7	=	159.24	(77)
Southeast	0.9x	0.77	x	1.08	x	118.15	x	0.63	x	0.7	=	39	(77)
Southeast	0.9x	0.77	x	4.41	x	113.91	x	0.63	x	0.7	=	153.52	(77)
Southeast	0.9x	0.77	x	4.41	x	113.91	x	0.63	x	0.7	=	153.52	(77)
Southeast	0.9x	0.77	x	1.08	x	113.91	x	0.63	x	0.7	=	37.6	(77)
Southeast	0.9x	0.77	x	4.41	x	104.39	x	0.63	x	0.7	=	140.69	(77)
Southeast	0.9x	0.77	x	4.41	x	104.39	x	0.63	x	0.7	=	140.69	(77)
Southeast	0.9x	0.77	x	1.08	x	104.39	x	0.63	x	0.7	=	34.46	(77)
Southeast	0.9x	0.77	x	4.41	x	92.85	x	0.63	x	0.7	=	125.14	(77)
Southeast	0.9x	0.77	x	4.41	x	92.85	x	0.63	x	0.7	=	125.14	(77)
Southeast	0.9x	0.77	x	1.08	x	92.85	x	0.63	x	0.7	=	30.65	(77)
Southeast	0.9x	0.77	x	4.41	x	69.27	x	0.63	x	0.7	=	93.36	(77)
Southeast	0.9x	0.77	x	4.41	x	69.27	x	0.63	x	0.7	=	93.36	(77)
Southeast	0.9x	0.77	x	1.08	x	69.27	x	0.63	x	0.7	=	22.86	(77)
Southeast	0.9x	0.77	x	4.41	x	44.07	x	0.63	x	0.7	=	59.4	(77)
Southeast	0.9x	0.77	x	4.41	x	44.07	x	0.63	x	0.7	=	59.4	(77)
Southeast	0.9x	0.77	x	1.08	x	44.07	x	0.63	x	0.7	=	14.55	(77)
Southeast	0.9x	0.77	x	4.41	x	31.49	x	0.63	x	0.7	=	42.44	(77)
Southeast	0.9x	0.77	x	4.41	x	31.49	x	0.63	x	0.7	=	42.44	(77)
Southeast	0.9x	0.77	x	1.08	x	31.49	x	0.63	x	0.7	=	10.39	(77)

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

(83)m=	111.32	189.62	259.45	321.47	360.07	357.47	344.64	315.84	280.93	209.57	133.34	95.27	(83)

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

(84)m=	387.59	464.2	524.32	570.82	593.95	576.2	553.38	529.4	502.33	446.66	388.44	363.62	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.93	0.82	0.66	0.47	0.34	0.37	0.58	0.87	0.98	0.99	(86)

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

(87)m=	20.31	20.5	20.71	20.9	20.98	21	21	21	20.99	20.88	20.56	20.27	(87)

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

(88)m=	20.19	20.19	20.2	20.21	20.21	20.22	20.22	20.22	20.21	20.21	20.2	20.2	(88)

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

(89)m=	0.99	0.97	0.91	0.79	0.61	0.42	0.28	0.31	0.52	0.83	0.97	0.99	(89)

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

(90)m=	19.28	19.56	19.85	20.1	20.19	20.21	20.22	20.22	20.21	20.08	19.65	19.23	(90)

fLA = Living area ÷ (4) = 0.49 (91)

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

(92)m=	19.79	20.02	20.28	20.49	20.58	20.6	20.6	20.6	20.6	20.48	20.1	19.75	(92)

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

(93)m=	19.79	20.02	20.28	20.49	20.58	20.6	20.6	20.6	20.6	20.48	20.1	19.75	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.92	0.8	0.63	0.44	0.31	0.34	0.55	0.84	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	382.82	448.65	480.64	458.52	374.78	255.4	170.79	178.93	275.65	377.14	376.58	360.4	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	682.7	664.59	603.77	501.56	383.25	256.14	170.85	179.03	278.41	426.31	564.02	677.82	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	223.11	145.11	91.61	30.99	6.3	0	0	0	0	36.58	134.96	236.16	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 904.81 (98)

Space heating requirement in kWh/m²/year 17.88 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		92.7	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	223.11	145.11	91.61	30.99	6.3	0	0	0	0	36.58	134.96	236.16	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	240.68	156.54	98.82	33.43	6.79	0	0	0	0	39.46	145.58	254.76	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 976.07 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10....12}$= 0 (215)

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Water heating

Output from water heater (calculated above)

145.65	128.05	133.71	118.81	115.67	102.26	97.17	108.06	108.33	123.26	131.66	141.79

Efficiency of water heater 87 (216)

(217)m=	88.61	88.41	88.08	87.55	87.14	87	87	87	87	87.6	88.35	88.67	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	164.36	144.83	151.81	135.71	132.74	117.54	111.69	124.21	124.51	140.7	149.03	159.91

Total = Sum(219a)$_{1\ldots12}$ = 1657.06 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			976.07	
Water heating fuel used			1657.06	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			236.49	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	210.83	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	357.93	(264)
Space and water heating	(261) + (262) + (263) + (264) =				568.76	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	122.74	(268)
Total CO2, kg/year			sum of (265)…(271) =		730.42	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		14.44	(273)
EI rating (section 14)					90	(274)

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User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.3.11

Property Address: Arlington 1 Bed MID 51

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	50.6	(1a)	x	2.3	(2a)	=	116.38	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	50.6	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	116.38	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 20 ÷ (5) = 0.17 (8)

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

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

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

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

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

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

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

Percentage of windows and doors draught stripped 0 (14)

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

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

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

If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) 0.42 (18)

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

Number of sides sheltered 2 (19)

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

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.36 (21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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

0.46	0.45	0.44	0.39	0.39	0.34	0.34	0.33	0.36	0.39	0.4	0.42

Calculate effective air change rate for the applicable case

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.59	(24d)

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

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.56	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1	=	1.89			(26)
Windows Type 1			4.41		x1/[1/(1.4)+ 0.04]	=	5.85			(27)
Windows Type 2			4.41		x1/[1/(1.4)+ 0.04]	=	5.85			(27)
Windows Type 3			1.08		x1/[1/(1.4)+ 0.04]	=	1.43			(27)
Walls	23.13	11.79	11.34	x	0.18	=	2.04			(29)
Total area of elements, m²			23.13							(31)
Party wall			18.76	x	0	=	0			(32)
Party floor			50.6							(32a)
Party ceiling			50.6							(32b)

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

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	17.06	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	5544.48	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K	2.44	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	19.5	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.22	23.06	22.91	22.19	22.06	21.43	21.43	21.32	21.67	22.06	22.33	22.61	(38)

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

(39)m=	42.72	42.56	42.41	41.69	41.56	40.93	40.93	40.82	41.17	41.56	41.83	42.11	

Average = Sum(39)$_{1…12}$ /12= 41.69 (39)

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

(40)m=	0.84	0.84	0.84	0.82	0.82	0.81	0.81	0.81	0.81	0.82	0.83	0.83

Average = Sum(40)$_{1…12}$ /12= 0.82 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.71 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 74.76 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	82.24	79.25	76.25	73.26	70.27	67.28	67.28	70.27	73.26	76.25	79.25	82.24	
											Total = Sum(44)$_{1…12}$ =	897.12	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	121.95	106.66	110.06	95.96	92.07	79.45	73.62	84.48	85.49	99.63	108.76	118.11	
											Total = Sum(45)$_{1…12}$ =	1176.26	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	18.29	16	16.51	14.39	13.81	11.92	11.04	12.67	12.82	14.95	16.31	17.72	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	41.91	36.47	38.86	36.13	35.81	33.18	34.29	35.81	36.13	38.86	39.08	41.91	(61)

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

(62)m=	163.86	143.14	148.92	132.09	127.88	112.63	107.91	120.3	121.62	138.49	147.84	160.01	(62)

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

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

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

Output from water heater

(64)m=	163.86	143.14	148.92	132.09	127.88	112.63	107.91	120.3	121.62	138.49	147.84	160.01	

Output from water heater (annual)$_{1\ldots12}$ 1624.7 (64)

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

(65)m=	51.03	44.58	46.31	40.94	39.57	34.71	33.05	37.04	37.46	42.84	45.93	49.75	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	85.39	(66)

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

(67)m=	13.39	11.89	9.67	7.32	5.47	4.62	4.99	6.49	8.71	11.06	12.91	13.76	(67)

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

(68)m=	148.79	150.34	146.45	138.16	127.71	117.88	111.31	109.77	113.66	121.94	132.4	142.23	(68)

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

(69)m=	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	31.54	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	-68.31	(71)

Water heating gains (Table 5)

(72)m=	68.58	66.34	62.25	56.86	53.18	48.21	44.42	49.79	52.03	57.58	63.79	66.86	(72)

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

(73)m=	282.38	280.19	269.98	253.96	237.98	222.33	212.35	217.67	226.02	242.21	260.72	274.47	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	4.41	x	36.79	x	0.63	x	0.7	=	49.59	(77)
Southeast 0.9x	0.77	x	4.41	x	36.79	x	0.63	x	0.7	=	49.59	(77)
Southeast 0.9x	0.77	x	1.08	x	36.79	x	0.63	x	0.7	=	12.14	(77)
Southeast 0.9x	0.77	x	4.41	x	62.67	x	0.63	x	0.7	=	84.47	(77)
Southeast 0.9x	0.77	x	4.41	x	62.67	x	0.63	x	0.7	=	84.47	(77)

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Southeast	0.9x	0.77	x	1.08	x	62.67	x	0.63	x	0.7	=	20.69	(77)
Southeast	0.9x	0.77	x	4.41	x	85.75	x	0.63	x	0.7	=	115.57	(77)
Southeast	0.9x	0.77	x	4.41	x	85.75	x	0.63	x	0.7	=	115.57	(77)
Southeast	0.9x	0.77	x	1.08	x	85.75	x	0.63	x	0.7	=	28.3	(77)
Southeast	0.9x	0.77	x	4.41	x	106.25	x	0.63	x	0.7	=	143.2	(77)
Southeast	0.9x	0.77	x	4.41	x	106.25	x	0.63	x	0.7	=	143.2	(77)
Southeast	0.9x	0.77	x	1.08	x	106.25	x	0.63	x	0.7	=	35.07	(77)
Southeast	0.9x	0.77	x	4.41	x	119.01	x	0.63	x	0.7	=	160.4	(77)
Southeast	0.9x	0.77	x	4.41	x	119.01	x	0.63	x	0.7	=	160.4	(77)
Southeast	0.9x	0.77	x	1.08	x	119.01	x	0.63	x	0.7	=	39.28	(77)
Southeast	0.9x	0.77	x	4.41	x	118.15	x	0.63	x	0.7	=	159.24	(77)
Southeast	0.9x	0.77	x	4.41	x	118.15	x	0.63	x	0.7	=	159.24	(77)
Southeast	0.9x	0.77	x	1.08	x	118.15	x	0.63	x	0.7	=	39	(77)
Southeast	0.9x	0.77	x	4.41	x	113.91	x	0.63	x	0.7	=	153.52	(77)
Southeast	0.9x	0.77	x	4.41	x	113.91	x	0.63	x	0.7	=	153.52	(77)
Southeast	0.9x	0.77	x	1.08	x	113.91	x	0.63	x	0.7	=	37.6	(77)
Southeast	0.9x	0.77	x	4.41	x	104.39	x	0.63	x	0.7	=	140.69	(77)
Southeast	0.9x	0.77	x	4.41	x	104.39	x	0.63	x	0.7	=	140.69	(77)
Southeast	0.9x	0.77	x	1.08	x	104.39	x	0.63	x	0.7	=	34.46	(77)
Southeast	0.9x	0.77	x	4.41	x	92.85	x	0.63	x	0.7	=	125.14	(77)
Southeast	0.9x	0.77	x	4.41	x	92.85	x	0.63	x	0.7	=	125.14	(77)
Southeast	0.9x	0.77	x	1.08	x	92.85	x	0.63	x	0.7	=	30.65	(77)
Southeast	0.9x	0.77	x	4.41	x	69.27	x	0.63	x	0.7	=	93.36	(77)
Southeast	0.9x	0.77	x	4.41	x	69.27	x	0.63	x	0.7	=	93.36	(77)
Southeast	0.9x	0.77	x	1.08	x	69.27	x	0.63	x	0.7	=	22.86	(77)
Southeast	0.9x	0.77	x	4.41	x	44.07	x	0.63	x	0.7	=	59.4	(77)
Southeast	0.9x	0.77	x	4.41	x	44.07	x	0.63	x	0.7	=	59.4	(77)
Southeast	0.9x	0.77	x	1.08	x	44.07	x	0.63	x	0.7	=	14.55	(77)
Southeast	0.9x	0.77	x	4.41	x	31.49	x	0.63	x	0.7	=	42.44	(77)
Southeast	0.9x	0.77	x	4.41	x	31.49	x	0.63	x	0.7	=	42.44	(77)
Southeast	0.9x	0.77	x	1.08	x	31.49	x	0.63	x	0.7	=	10.39	(77)

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

(83)m=	111.32	189.62	259.45	321.47	360.07	357.47	344.64	315.84	280.93	209.57	133.34	95.27	(83)

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

(84)m=	393.71	469.81	529.43	575.43	598.05	579.8	556.99	533.51	506.95	451.78	394.06	369.74	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.97	0.92	0.81	0.63	0.45	0.32	0.35	0.56	0.85	0.97	0.99	(86)

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

(87)m=	20.36	20.55	20.75	20.92	20.98	21	21	21	20.99	20.9	20.61	20.33	(87)

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

(88)m=	20.22	20.22	20.22	20.23	20.23	20.25	20.25	20.25	20.24	20.23	20.23	20.23	(88)

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

(89)m=	0.99	0.96	0.9	0.77	0.59	0.4	0.27	0.29	0.5	0.81	0.97	0.99	(89)

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

(90)m=	19.38	19.64	19.92	20.15	20.22	20.24	20.25	20.25	20.24	20.14	19.74	19.34	(90)

fLA = Living area ÷ (4) = 0.49 (91)

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

(92)m=	19.86	20.09	20.33	20.53	20.6	20.62	20.62	20.62	20.61	20.52	20.17	19.83	(92)

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

(93)m=	19.86	20.09	20.33	20.53	20.6	20.62	20.62	20.62	20.61	20.52	20.17	19.83	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.96	0.91	0.78	0.61	0.42	0.3	0.32	0.53	0.83	0.96	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	388.23	452.11	480.28	451.12	363.83	245.84	164.44	172.15	266.31	373.1	380.24	366.01	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	664.88	646.57	586.6	484.8	369.79	246.29	164.47	172.21	268.11	412.07	546.75	658.07	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	205.83	130.68	79.1	24.25	4.43	0	0	0	0	28.99	119.89	217.29	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 810.47 (98)

Space heating requirement in kWh/m²/year 16.02 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	205.83	130.68	79.1	24.25	4.43	0	0	0	0	28.99	119.89	217.29	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	220.38	139.91	84.69	25.97	4.75	0	0	0	0	31.04	128.36	232.65	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 867.74 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

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Water heating

Output from water heater (calculated above)

163.86	143.14	148.92	132.09	127.88	112.63	107.91	120.3	121.62	138.49	147.84	160.01

Efficiency of water heater 80.3 (216)

(217)m=	85.63	84.82	83.54	81.72	80.6	80.3	80.3	80.3	80.3	81.88	84.53	85.82	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	191.37	168.75	178.27	161.64	158.66	140.27	134.38	149.81	151.46	169.13	174.9	186.45

Total = $\mathrm{Sum}(219a)_{1\ldots12}$ = 1965.08 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		867.74	
Water heating fuel used		1965.08	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		236.49	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	187.43	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	424.46	(264)
Space and water heating	(261) + (262) + (263) + (264) =				611.89	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	122.74	(268)
Total CO2, kg/year			sum of (265)…(271) =		773.55	(272)

TER = 15.29 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.3.11
Printed on 22 June 2018 at 10:46:54

Project Information:

Assessed By: () **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 76.1m²

Site Reference : Arlington Works, Twickenham **Plot Reference:** Arlington 3 Bed GND 76

Address :

Client Details:

Name: Sharpes Refinery Service

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	17.25 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	15.56 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	45.5 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	37.8 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.42 (max. 2.00)	1.60 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Database: (rev 397, product index 016661):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Alpha
Model: InTec 34C
Model qualifier:
(Combi)
Efficiency 88.8 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder

6 Controls

Space heating controls	Time and temperature zone control by device in database	**OK**
Hot water controls:	No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	Medium	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: North West	4.41m²
Windows facing: North West	4.41m²
Windows facing: South East	4.41m²
Windows facing: South West	2.52m²
Ventilation rate:	3.00
Blinds/curtains:	None Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K
Floors U-value	0.11 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.3.11

Property Address: Arlington 3 Bed GND 76

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	76.1	(1a) x	2.3	(2a) =	175.03	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.1	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	175.03	(5)

2. Ventilation rate:

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

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 20 ÷ (5) = 0.11 (8)

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

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

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

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

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

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

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

Percentage of windows and doors draught stripped 0 (14)

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 4 (17)

If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) 0.31 (18)

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

Number of sides sheltered 2 (19)

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

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.27 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.34	0.33	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31

Calculate effective air change rate for the applicable case

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

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

(25)m=	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 2			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 3			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 4			2.52	x1/[1/(1.4)+ 0.04]		=	3.34			(27)
Floor			76.1	x	0.11	=	8.370999			(28)
Walls	56.36	17.64	38.72	x	0.17	=	6.58			(29)
Total area of elements, m²			132.46							(31)
Party wall			38.24	x	0	=	0			(32)
Party ceiling			76.1							(32b)

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

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	38.86	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	15713.95	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		8.22	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	47.07	(37)

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

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

DER WorkSheet: New dwelling design stage

(38)m=	32.23	32.1	31.97	31.37	31.26	30.74	30.74	30.64	30.94	31.26	31.49	31.73	(38)

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

(39)m=	79.3	79.17	79.05	78.45	78.34	77.81	77.81	77.72	78.02	78.34	78.56	78.8	

Average = Sum(39)$_{1...12}$ /12= 78.45 (39)

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

(40)m=	1.04	1.04	1.04	1.03	1.03	1.02	1.02	1.02	1.03	1.03	1.03	1.04	

Average = Sum(40)$_{1...12}$ /12= 1.03 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.38 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 90.84 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	99.92	96.29	92.65	89.02	85.39	81.75	81.75	85.39	89.02	92.65	96.29	99.92	

Total = Sum(44)$_{1...12}$ = 1090.04 (44)

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

(45)m=	148.18	129.6	133.73	116.59	111.87	96.54	89.46	102.65	103.88	121.06	132.15	143.5	

Total = Sum(45)$_{1...12}$ = 1429.21 (45)

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

(46)m=	22.23	19.44	20.06	17.49	16.78	14.48	13.42	15.4	15.58	18.16	19.82	21.53	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	23.84	21.5	23.77	22.95	23.68	22.88	23.62	23.66	22.92	23.73	23.02	23.82	(61)

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

(62)m=	172.01	151.1	157.5	139.54	135.56	119.42	113.07	126.31	126.8	144.79	155.17	167.33	(62)

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

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

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

Output from water heater

(64)m=	172.01	151.1	157.5	139.54	135.56	119.42	113.07	126.31	126.8	144.79	155.17	167.33	

Output from water heater (annual)$_{1…12}$ | 1708.6 | (64)

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

(65)m=	55.23	48.47	50.41	44.5	43.12	37.82	35.65	40.05	40.27	46.19	49.69	53.67	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	(66)

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

(67)m=	18.89	16.78	13.65	10.33	7.72	6.52	7.04	9.16	12.29	15.61	18.21	19.42	(67)

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

(68)m=	211.1	213.29	207.77	196.02	181.18	167.24	157.93	155.74	161.26	173.01	187.84	201.78	(68)

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

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	(71)

Water heating gains (Table 5)

(72)m=	74.23	72.12	67.75	61.81	57.96	52.53	47.92	53.83	55.93	62.08	69.02	72.14	(72)

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

(73)m=	365.99	363.96	350.94	329.93	308.63	288.06	274.66	280.49	291.25	312.46	336.84	355.11	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	4.41	x	36.79	x	0.63	x	0.7	=	49.59	(77)
Southeast 0.9x	0.77	x	4.41	x	62.67	x	0.63	x	0.7	=	84.47	(77)

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Southeast	0.9x	0.77	x	4.41	x	85.75	x	0.63	x	0.7	=	115.57	(77)
Southeast	0.9x	0.77	x	4.41	x	106.25	x	0.63	x	0.7	=	143.2	(77)
Southeast	0.9x	0.77	x	4.41	x	119.01	x	0.63	x	0.7	=	160.4	(77)
Southeast	0.9x	0.77	x	4.41	x	118.15	x	0.63	x	0.7	=	159.24	(77)
Southeast	0.9x	0.77	x	4.41	x	113.91	x	0.63	x	0.7	=	153.52	(77)
Southeast	0.9x	0.77	x	4.41	x	104.39	x	0.63	x	0.7	=	140.69	(77)
Southeast	0.9x	0.77	x	4.41	x	92.85	x	0.63	x	0.7	=	125.14	(77)
Southeast	0.9x	0.77	x	4.41	x	69.27	x	0.63	x	0.7	=	93.36	(77)
Southeast	0.9x	0.77	x	4.41	x	44.07	x	0.63	x	0.7	=	59.4	(77)
Southeast	0.9x	0.77	x	4.41	x	31.49	x	0.63	x	0.7	=	42.44	(77)
Southwest	0.9x	0.77	x	2.52	x	36.79		0.63	x	0.7	=	28.34	(79)
Southwest	0.9x	0.77	x	2.52	x	62.67		0.63	x	0.7	=	48.27	(79)
Southwest	0.9x	0.77	x	2.52	x	85.75		0.63	x	0.7	=	66.04	(79)
Southwest	0.9x	0.77	x	2.52	x	106.25		0.63	x	0.7	=	81.83	(79)
Southwest	0.9x	0.77	x	2.52	x	119.01		0.63	x	0.7	=	91.66	(79)
Southwest	0.9x	0.77	x	2.52	x	118.15		0.63	x	0.7	=	90.99	(79)
Southwest	0.9x	0.77	x	2.52	x	113.91		0.63	x	0.7	=	87.73	(79)
Southwest	0.9x	0.77	x	2.52	x	104.39		0.63	x	0.7	=	80.4	(79)
Southwest	0.9x	0.77	x	2.52	x	92.85		0.63	x	0.7	=	71.51	(79)
Southwest	0.9x	0.77	x	2.52	x	69.27		0.63	x	0.7	=	53.35	(79)
Southwest	0.9x	0.77	x	2.52	x	44.07		0.63	x	0.7	=	33.94	(79)
Southwest	0.9x	0.77	x	2.52	x	31.49		0.63	x	0.7	=	24.25	(79)
Northwest	0.9x	0.77	x	4.41	x	11.28	x	0.85	x	0.7	=	20.52	(81)
Northwest	0.9x	0.77	x	4.41	x	11.28	x	0.85	x	0.7	=	20.52	(81)
Northwest	0.9x	0.77	x	4.41	x	22.97	x	0.85	x	0.7	=	41.76	(81)
Northwest	0.9x	0.77	x	4.41	x	22.97	x	0.85	x	0.7	=	41.76	(81)
Northwest	0.9x	0.77	x	4.41	x	41.38	x	0.85	x	0.7	=	75.24	(81)
Northwest	0.9x	0.77	x	4.41	x	41.38	x	0.85	x	0.7	=	75.24	(81)
Northwest	0.9x	0.77	x	4.41	x	67.96	x	0.85	x	0.7	=	123.57	(81)
Northwest	0.9x	0.77	x	4.41	x	67.96	x	0.85	x	0.7	=	123.57	(81)
Northwest	0.9x	0.77	x	4.41	x	91.35	x	0.85	x	0.7	=	166.1	(81)
Northwest	0.9x	0.77	x	4.41	x	91.35	x	0.85	x	0.7	=	166.1	(81)
Northwest	0.9x	0.77	x	4.41	x	97.38	x	0.85	x	0.7	=	177.08	(81)
Northwest	0.9x	0.77	x	4.41	x	97.38	x	0.85	x	0.7	=	177.08	(81)
Northwest	0.9x	0.77	x	4.41	x	91.1	x	0.85	x	0.7	=	165.66	(81)
Northwest	0.9x	0.77	x	4.41	x	91.1	x	0.85	x	0.7	=	165.66	(81)
Northwest	0.9x	0.77	x	4.41	x	72.63	x	0.85	x	0.7	=	132.06	(81)
Northwest	0.9x	0.77	x	4.41	x	72.63	x	0.85	x	0.7	=	132.06	(81)
Northwest	0.9x	0.77	x	4.41	x	50.42	x	0.85	x	0.7	=	91.68	(81)
Northwest	0.9x	0.77	x	4.41	x	50.42	x	0.85	x	0.7	=	91.68	(81)
Northwest	0.9x	0.77	x	4.41	x	28.07	x	0.85	x	0.7	=	51.04	(81)

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Northwest	0.9x	0.77	x	4.41	x	28.07	x	0.85	x	0.7	=	51.04	(81)
Northwest	0.9x	0.77	x	4.41	x	14.2	x	0.85	x	0.7	=	25.82	(81)
Northwest	0.9x	0.77	x	4.41	x	14.2	x	0.85	x	0.7	=	25.82	(81)
Northwest	0.9x	0.77	x	4.41	x	9.21	x	0.85	x	0.7	=	16.76	(81)
Northwest	0.9x	0.77	x	4.41	x	9.21	x	0.85	x	0.7	=	16.76	(81)

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

(83)m=	118.96	216.26	332.1	472.17	584.26	604.4	572.56	485.22	380.02	248.78	144.97	100.2	(83)

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

(84)m=	484.95	580.22	683.04	802.1	892.89	892.45	847.22	765.71	671.27	561.24	481.81	455.31	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.91	0.75	0.55	0.4	0.46	0.74	0.96	0.99	1	(86)

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

(87)m=	19.94	20.12	20.4	20.72	20.92	20.99	21	21	20.95	20.65	20.23	19.9	(87)

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

(88)m=	20.05	20.05	20.05	20.06	20.06	20.06	20.06	20.07	20.06	20.06	20.06	20.05	(88)

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

(89)m=	1	0.99	0.97	0.88	0.69	0.47	0.32	0.37	0.66	0.94	0.99	1	(89)

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

(90)m=	18.64	18.9	19.29	19.75	19.99	20.06	20.06	20.06	20.02	19.66	19.06	18.59	(90)

fLA = Living area ÷ (4) = | 0.33 | (91)

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

(92)m=	19.07	19.3	19.66	20.07	20.3	20.36	20.37	20.37	20.33	19.99	19.44	19.02	(92)

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

(93)m=	19.07	19.3	19.66	20.07	20.3	20.36	20.37	20.37	20.33	19.99	19.44	19.02	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.96	0.88	0.71	0.5	0.35	0.4	0.69	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	482.6	572.95	657.71	706.34	631.7	443.46	292.88	307.37	460.15	524.85	476.52	453.7	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1170.96	1140.02	1039.9	875.93	673.52	448.49	293.43	308.58	485.84	735.25	969.64	1167.74	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	512.14	381.07	284.35	122.1	31.11	0	0	0	0	156.54	355.04	531.25	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 2373.6 | (98)

Space heating requirement in kWh/m²/year | 31.19 | (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system 0 (201)

Fraction of space heat from main system(s) (202) = 1 – (201) = 1 (202)

Fraction of total heating from main system 1 (204) = (202) × [1 – (203)] = 1 (204)

Efficiency of main space heating system 1 92.7 (206)

Efficiency of secondary/supplementary heating system, % 0 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)	512.14	381.07	284.35	122.1	31.11	0	0	0	0	156.54	355.04	531.25	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	552.47	411.08	306.74	131.71	33.56	0	0	0	0	168.86	383	573.08	(211)

Total (kWh/year) =$\text{Sum}(211)_{1...5,10....12}$= 2560.51 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =$\text{Sum}(215)_{1...5,10....12}$= 0 (215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Output from water heater (calculated above)	172.01	151.1	157.5	139.54	135.56	119.42	113.07	126.31	126.8	144.79	155.17	167.33	
Efficiency of water heater													87 (216)
(217)m=	89.01	88.92	88.72	88.24	87.49	87	87	87	87	88.38	88.86	89.04	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(219)m=	193.26	169.94	177.53	158.14	154.94	137.26	129.97	145.19	145.74	163.83	174.62	187.93

Total = $\text{Sum}(219a)_{1...12}$ = 1938.34 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2560.51	
Water heating fuel used		1938.34	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		75	(231)
Electricity for lighting		333.64	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	553.07	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	418.68	(264)
Space and water heating	(261) + (262) + (263) + (264) =				971.75	(265)

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Electricity for pumps, fans and electric keep-hot	(231) x		0.519	=	38.93	(267)
Electricity for lighting	(232) x		0.519	=	173.16	(268)
Total CO2, kg/year		sum of (265)…(271) =			1183.83	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =			15.56	(273)
El rating (section 14)					87	(274)

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.3.11

Property Address: Arlington 3 Bed GND 76

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	76.1	(1a) x	2.3	(2a) =	175.03	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.1	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	175.03	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.17	(8)

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

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

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

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.42	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.36	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.46	0.45	0.44	0.39	0.39	0.34	0.34	0.33	0.36	0.39	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

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

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1	=	1.89			(26)
Windows Type 1			4.41	x	1/[1/(1.4)+ 0.04]	=	5.85			(27)
Windows Type 2			4.41	x	1/[1/(1.4)+ 0.04]	=	5.85			(27)
Windows Type 3			4.41	x	1/[1/(1.4)+ 0.04]	=	5.85			(27)
Windows Type 4			2.52	x	1/[1/(1.4)+ 0.04]	=	3.34			(27)
Floor			76.1	x	0.13	=	9.893			(28)
Walls	56.36	17.64	38.72	x	0.18	=	6.97			(29)
Total area of elements, m²			132.46							(31)
Party wall			38.24	x	0	=	0			(32)
Party ceiling			76.1							(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 39.63 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 15713.95 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 7.53 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 47.16 (37)

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

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

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(38)m=	34.9	34.67	34.44	33.36	33.16	32.22	32.22	32.05	32.59	33.16	33.57	34	(38)

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

(39)m=	82.07	81.83	81.6	80.53	80.33	79.39	79.39	79.21	79.75	80.33	80.73	81.16	

Average = Sum(39)$_{1…12}$ /12= 80.53 (39)

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

(40)m=	1.08	1.08	1.07	1.06	1.06	1.04	1.04	1.04	1.05	1.06	1.06	1.07	

Average = Sum(40)$_{1…12}$ /12= 1.06 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.38 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 90.84 (43)

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

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

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

(44)m=	99.92	96.29	92.65	89.02	85.39	81.75	81.75	85.39	89.02	92.65	96.29	99.92	

Total = Sum(44)$_{1…12}$ = 1090.04 (44)

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

(45)m=	148.18	129.6	133.73	116.59	111.87	96.54	89.46	102.65	103.88	121.06	132.15	143.5	

Total = Sum(45)$_{1…12}$ = 1429.21 (45)

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

(46)m=	22.23	19.44	20.06	17.49	16.78	14.48	13.42	15.4	15.58	18.16	19.82	21.53	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	50.92	44.32	47.22	43.9	43.51	40.32	41.66	43.51	43.9	47.22	47.48	50.92	(61)

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

(62)m=	199.1	173.92	180.95	160.49	155.39	136.85	131.12	146.16	147.78	168.28	179.63	194.42	(62)

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

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

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

Output from water heater

(64)m=	199.1	173.92	180.95	160.49	155.39	136.85	131.12	146.16	147.78	168.28	179.63	194.42

Output from water heater (annual)$_{1\ldots12}$	1974.08	(64)

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

(65)m=	62	54.17	56.27	49.74	48.08	42.18	40.16	45.01	45.51	52.06	55.81	60.44	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	(66)

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

(67)m=	18.89	16.78	13.65	10.33	7.72	6.52	7.04	9.16	12.29	15.61	18.21	19.42	(67)

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

(68)m=	211.1	213.29	207.77	196.02	181.18	167.24	157.93	155.74	161.26	173.01	187.84	201.78	(68)

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

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	(71)

Water heating gains (Table 5)

(72)m=	83.33	80.61	75.63	69.09	64.62	58.58	53.98	60.5	63.21	69.97	77.51	81.24	(72)

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

(73)m=	375.09	372.45	358.82	337.2	315.29	294.11	280.72	287.16	298.53	320.35	345.34	364.21	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	4.41	x	36.79	x	0.63	x	0.7	=	49.59	(77)
Southeast 0.9x	0.77	x	4.41	x	62.67	x	0.63	x	0.7	=	84.47	(77)

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Southeast	0.9x	0.77	x	4.41	x	85.75	x	0.63	x	0.7	=	115.57	(77)
Southeast	0.9x	0.77	x	4.41	x	106.25	x	0.63	x	0.7	=	143.2	(77)
Southeast	0.9x	0.77	x	4.41	x	119.01	x	0.63	x	0.7	=	160.4	(77)
Southeast	0.9x	0.77	x	4.41	x	118.15	x	0.63	x	0.7	=	159.24	(77)
Southeast	0.9x	0.77	x	4.41	x	113.91	x	0.63	x	0.7	=	153.52	(77)
Southeast	0.9x	0.77	x	4.41	x	104.39	x	0.63	x	0.7	=	140.69	(77)
Southeast	0.9x	0.77	x	4.41	x	92.85	x	0.63	x	0.7	=	125.14	(77)
Southeast	0.9x	0.77	x	4.41	x	69.27	x	0.63	x	0.7	=	93.36	(77)
Southeast	0.9x	0.77	x	4.41	x	44.07	x	0.63	x	0.7	=	59.4	(77)
Southeast	0.9x	0.77	x	4.41	x	31.49	x	0.63	x	0.7	=	42.44	(77)
Southwest	0.9x	0.77	x	2.52	x	36.79		0.63	x	0.7	=	28.34	(79)
Southwest	0.9x	0.77	x	2.52	x	62.67		0.63	x	0.7	=	48.27	(79)
Southwest	0.9x	0.77	x	2.52	x	85.75		0.63	x	0.7	=	66.04	(79)
Southwest	0.9x	0.77	x	2.52	x	106.25		0.63	x	0.7	=	81.83	(79)
Southwest	0.9x	0.77	x	2.52	x	119.01		0.63	x	0.7	=	91.66	(79)
Southwest	0.9x	0.77	x	2.52	x	118.15		0.63	x	0.7	=	90.99	(79)
Southwest	0.9x	0.77	x	2.52	x	113.91		0.63	x	0.7	=	87.73	(79)
Southwest	0.9x	0.77	x	2.52	x	104.39		0.63	x	0.7	=	80.4	(79)
Southwest	0.9x	0.77	x	2.52	x	92.85		0.63	x	0.7	=	71.51	(79)
Southwest	0.9x	0.77	x	2.52	x	69.27		0.63	x	0.7	=	53.35	(79)
Southwest	0.9x	0.77	x	2.52	x	44.07		0.63	x	0.7	=	33.94	(79)
Southwest	0.9x	0.77	x	2.52	x	31.49		0.63	x	0.7	=	24.25	(79)
Northwest	0.9x	0.77	x	4.41	x	11.28	x	0.63	x	0.7	=	15.21	(81)
Northwest	0.9x	0.77	x	4.41	x	11.28	x	0.63	x	0.7	=	15.21	(81)
Northwest	0.9x	0.77	x	4.41	x	22.97	x	0.63	x	0.7	=	30.95	(81)
Northwest	0.9x	0.77	x	4.41	x	22.97	x	0.63	x	0.7	=	30.95	(81)
Northwest	0.9x	0.77	x	4.41	x	41.38	x	0.63	x	0.7	=	55.77	(81)
Northwest	0.9x	0.77	x	4.41	x	41.38	x	0.63	x	0.7	=	55.77	(81)
Northwest	0.9x	0.77	x	4.41	x	67.96	x	0.63	x	0.7	=	91.59	(81)
Northwest	0.9x	0.77	x	4.41	x	67.96	x	0.63	x	0.7	=	91.59	(81)
Northwest	0.9x	0.77	x	4.41	x	91.35	x	0.63	x	0.7	=	123.11	(81)
Northwest	0.9x	0.77	x	4.41	x	91.35	x	0.63	x	0.7	=	123.11	(81)
Northwest	0.9x	0.77	x	4.41	x	97.38	x	0.63	x	0.7	=	131.25	(81)
Northwest	0.9x	0.77	x	4.41	x	97.38	x	0.63	x	0.7	=	131.25	(81)
Northwest	0.9x	0.77	x	4.41	x	91.1	x	0.63	x	0.7	=	122.78	(81)
Northwest	0.9x	0.77	x	4.41	x	91.1	x	0.63	x	0.7	=	122.78	(81)
Northwest	0.9x	0.77	x	4.41	x	72.63	x	0.63	x	0.7	=	97.88	(81)
Northwest	0.9x	0.77	x	4.41	x	72.63	x	0.63	x	0.7	=	97.88	(81)
Northwest	0.9x	0.77	x	4.41	x	50.42	x	0.63	x	0.7	=	67.95	(81)
Northwest	0.9x	0.77	x	4.41	x	50.42	x	0.63	x	0.7	=	67.95	(81)
Northwest	0.9x	0.77	x	4.41	x	28.07	x	0.63	x	0.7	=	37.83	(81)

Northwest	0.9x	0.77	x	4.41	x	28.07	x	0.63	x	0.7	=	37.83	(81)
Northwest	0.9x	0.77	x	4.41	x	14.2	x	0.63	x	0.7	=	19.13	(81)
Northwest	0.9x	0.77	x	4.41	x	14.2	x	0.63	x	0.7	=	19.13	(81)
Northwest	0.9x	0.77	x	4.41	x	9.21	x	0.63	x	0.7	=	12.42	(81)
Northwest	0.9x	0.77	x	4.41	x	9.21	x	0.63	x	0.7	=	12.42	(81)

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

(83)m=	108.34	194.64	293.15	408.21	498.28	512.73	486.81	416.85	332.56	222.36	131.6	91.53	(83)

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

(84)m=	483.43	567.09	651.97	745.41	813.57	806.84	767.53	704.01	631.09	542.71	476.94	455.74	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.93	0.81	0.61	0.45	0.51	0.78	0.96	0.99	1	(86)

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

(87)m=	19.89	20.06	20.32	20.65	20.88	20.98	21	20.99	20.93	20.61	20.19	19.86	(87)

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

(88)m=	20.02	20.02	20.02	20.04	20.04	20.05	20.05	20.05	20.04	20.04	20.03	20.03	(88)

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

(89)m=	1	0.99	0.97	0.91	0.75	0.53	0.36	0.41	0.7	0.95	0.99	1	(89)

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

(90)m=	18.54	18.78	19.16	19.63	19.93	20.03	20.05	20.05	19.99	19.59	18.98	18.5	(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	18.98	19.2	19.54	19.97	20.24	20.35	20.36	20.36	20.3	19.92	19.38	18.95	(92)

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

(93)m=	18.98	19.2	19.54	19.97	20.24	20.35	20.36	20.36	20.3	19.92	19.38	18.95	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.97	0.91	0.76	0.55	0.39	0.44	0.73	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	481.12	560.77	632.44	676.74	621.46	446.95	297.31	311.39	458.22	512.47	472.01	454.11	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1204.92	1170.36	1064.43	891.19	686.27	456.1	298.38	313.53	494.23	748.87	991.32	1197.14	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	538.5	409.65	321.4	154.41	48.21	0	0	0	0	175.89	373.9	552.81	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2574.77 (98)

Space heating requirement in kWh/m²/year 33.83 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	538.5	409.65	321.4	154.41	48.21	0	0	0	0	175.89	373.9	552.81		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	576.56	438.59	344.11	165.32	51.62	0	0	0	0	188.32	400.33	591.87		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2756.72	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	199.1	173.92	180.95	160.49	155.39	136.85	131.12	146.16	147.78	168.28	179.63	194.42		
Efficiency of water heater													80.3	(216)
(217)m=	87.43	87.13	86.48	84.95	82.48	80.3	80.3	80.3	80.3	85.16	86.85	87.54		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	227.72	199.6	209.23	188.92	188.39	170.43	163.28	182.02	184.03	197.59	206.82	222.11		
Total = Sum(219a)$_{1...12}$ =													2340.14	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2756.72	
Water heating fuel used			2340.14	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			333.64	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	595.45	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	505.47	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1100.92	(265)

TER WorkSheet: New dwelling design stage

Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	173.16	(268)
Total CO2, kg/year			sum of (265)…(271) =		1313	(272)

TER = 17.25 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.3.11
Printed on 22 June 2018 at 10:46:52

Project Information:

Assessed By: ()
Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE
Total Floor Area: 76.1m²
Site Reference : Arlington Works, Twickenham
Plot Reference: Arlington 3 Bed MID 76
Address :

Client Details:

Name: Sharpes Refinery Service
Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	15.03 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	13.79 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	34.3 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	30.3 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.42 (max. 2.00)	1.60 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:

Database: (rev 397, product index 016661):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Alpha
Model: InTec 34C
Model qualifier:
(Combi)
Efficiency 88.8 % SEDBUK2009
Minimum 88.0 % OK

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder

6 Controls

Space heating controls	Time and temperature zone control by device in database	**OK**
Hot water controls:	No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	Medium	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: North West	4.41m²
Windows facing: North West	4.41m²
Windows facing: South East	4.41m²
Windows facing: South West	2.52m²
Ventilation rate:	3.00
Blinds/curtains:	None Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.3.11

Property Address: Arlington 3 Bed MID 76

Address :

1. Overall dwelling dimensions:

	Area(m²)			**Av. Height(m)**			**Volume(m³)**	
Ground floor	76.1	(1a)	x	2.3	(2a)	=	175.03	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.1	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =			175.03	(5)

2. Ventilation rate:

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.11	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.31	(18)

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

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

DER WorkSheet: New dwelling design stage

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

0.34	0.33	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31

Calculate effective air change rate for the applicable case

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

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

(25)m=	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 2			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 3			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 4			2.52	x1/[1/(1.4)+ 0.04]		=	3.34			(27)
Walls	56.36	17.64	38.72	x	0.17	=	6.58			(29)
Total area of elements, m²			56.36							(31)
Party wall			38.24	x	0	=	0			(32)
Party floor			76.1							(32a)
Party ceiling			76.1							(32b)

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

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	30.49	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	12289.45	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		6.01	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	36.5	(37)

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

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

DER WorkSheet: New dwelling design stage

(38)m=	32.23	32.1	31.97	31.37	31.26	30.74	30.74	30.64	30.94	31.26	31.49	31.73	(38)

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

(39)m=	68.73	68.6	68.47	67.87	67.76	67.24	67.24	67.14	67.44	67.76	67.99	68.22	

Average = Sum(39)$_{1…12}$ /12= 67.87 (39)

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

(40)m=	0.9	0.9	0.9	0.89	0.89	0.88	0.88	0.88	0.89	0.89	0.89	0.9	

Average = Sum(40)$_{1…12}$ /12= 0.89 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.38 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 90.84 (43)

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

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

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

(44)m=	99.92	96.29	92.65	89.02	85.39	81.75	81.75	85.39	89.02	92.65	96.29	99.92	

Total = Sum(44)$_{1…12}$ = 1090.04 (44)

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

(45)m=	148.18	129.6	133.73	116.59	111.87	96.54	89.46	102.65	103.88	121.06	132.15	143.5	

Total = Sum(45)$_{1…12}$ = 1429.21 (45)

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

(46)m=	22.23	19.44	20.06	17.49	16.78	14.48	13.42	15.4	15.58	18.16	19.82	21.53	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	23.84	21.5	23.77	22.95	23.68	22.88	23.62	23.66	22.92	23.73	23.02	23.82	(61)

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

(62)m=	172.01	151.1	157.5	139.54	135.56	119.42	113.07	126.31	126.8	144.79	155.17	167.33	(62)

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

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

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

Output from water heater

(64)m=	172.01	151.1	157.5	139.54	135.56	119.42	113.07	126.31	126.8	144.79	155.17	167.33

Output from water heater (annual)$_{1…12}$	1708.6	(64)

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

(65)m=	55.23	48.47	50.41	44.5	43.12	37.82	35.65	40.05	40.27	46.19	49.69	53.67	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	(66)

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

(67)m=	18.89	16.78	13.65	10.33	7.72	6.52	7.04	9.16	12.29	15.61	18.21	19.42	(67)

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

(68)m=	211.1	213.29	207.77	196.02	181.18	167.24	157.93	155.74	161.26	173.01	187.84	201.78	(68)

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

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	(71)

Water heating gains (Table 5)

(72)m=	74.23	72.12	67.75	61.81	57.96	52.53	47.92	53.83	55.93	62.08	69.02	72.14	(72)

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

(73)m=	365.99	363.96	350.94	329.93	308.63	288.06	274.66	280.49	291.25	312.46	336.84	355.11	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	4.41	x	36.79	x	0.63	x	0.7	=	49.59	(77)
Southeast 0.9x	0.77	x	4.41	x	62.67	x	0.63	x	0.7	=	84.47	(77)

DER WorkSheet: New dwelling design stage

Southeast	0.9x	0.77	x	4.41	x	85.75	x	0.63	x	0.7	=	115.57	(77)
Southeast	0.9x	0.77	x	4.41	x	106.25	x	0.63	x	0.7	=	143.2	(77)
Southeast	0.9x	0.77	x	4.41	x	119.01	x	0.63	x	0.7	=	160.4	(77)
Southeast	0.9x	0.77	x	4.41	x	118.15	x	0.63	x	0.7	=	159.24	(77)
Southeast	0.9x	0.77	x	4.41	x	113.91	x	0.63	x	0.7	=	153.52	(77)
Southeast	0.9x	0.77	x	4.41	x	104.39	x	0.63	x	0.7	=	140.69	(77)
Southeast	0.9x	0.77	x	4.41	x	92.85	x	0.63	x	0.7	=	125.14	(77)
Southeast	0.9x	0.77	x	4.41	x	69.27	x	0.63	x	0.7	=	93.36	(77)
Southeast	0.9x	0.77	x	4.41	x	44.07	x	0.63	x	0.7	=	59.4	(77)
Southeast	0.9x	0.77	x	4.41	x	31.49	x	0.63	x	0.7	=	42.44	(77)
Southwest	0.9x	0.77	x	2.52	x	36.79		0.63	x	0.7	=	28.34	(79)
Southwest	0.9x	0.77	x	2.52	x	62.67		0.63	x	0.7	=	48.27	(79)
Southwest	0.9x	0.77	x	2.52	x	85.75		0.63	x	0.7	=	66.04	(79)
Southwest	0.9x	0.77	x	2.52	x	106.25		0.63	x	0.7	=	81.83	(79)
Southwest	0.9x	0.77	x	2.52	x	119.01		0.63	x	0.7	=	91.66	(79)
Southwest	0.9x	0.77	x	2.52	x	118.15		0.63	x	0.7	=	90.99	(79)
Southwest	0.9x	0.77	x	2.52	x	113.91		0.63	x	0.7	=	87.73	(79)
Southwest	0.9x	0.77	x	2.52	x	104.39		0.63	x	0.7	=	80.4	(79)
Southwest	0.9x	0.77	x	2.52	x	92.85		0.63	x	0.7	=	71.51	(79)
Southwest	0.9x	0.77	x	2.52	x	69.27		0.63	x	0.7	=	53.35	(79)
Southwest	0.9x	0.77	x	2.52	x	44.07		0.63	x	0.7	=	33.94	(79)
Southwest	0.9x	0.77	x	2.52	x	31.49		0.63	x	0.7	=	24.25	(79)
Northwest	0.9x	0.77	x	4.41	x	11.28	x	0.85	x	0.7	=	20.52	(81)
Northwest	0.9x	0.77	x	4.41	x	11.28	x	0.85	x	0.7	=	20.52	(81)
Northwest	0.9x	0.77	x	4.41	x	22.97	x	0.85	x	0.7	=	41.76	(81)
Northwest	0.9x	0.77	x	4.41	x	22.97	x	0.85	x	0.7	=	41.76	(81)
Northwest	0.9x	0.77	x	4.41	x	41.38	x	0.85	x	0.7	=	75.24	(81)
Northwest	0.9x	0.77	x	4.41	x	41.38	x	0.85	x	0.7	=	75.24	(81)
Northwest	0.9x	0.77	x	4.41	x	67.96	x	0.85	x	0.7	=	123.57	(81)
Northwest	0.9x	0.77	x	4.41	x	67.96	x	0.85	x	0.7	=	123.57	(81)
Northwest	0.9x	0.77	x	4.41	x	91.35	x	0.85	x	0.7	=	166.1	(81)
Northwest	0.9x	0.77	x	4.41	x	91.35	x	0.85	x	0.7	=	166.1	(81)
Northwest	0.9x	0.77	x	4.41	x	97.38	x	0.85	x	0.7	=	177.08	(81)
Northwest	0.9x	0.77	x	4.41	x	97.38	x	0.85	x	0.7	=	177.08	(81)
Northwest	0.9x	0.77	x	4.41	x	91.1	x	0.85	x	0.7	=	165.66	(81)
Northwest	0.9x	0.77	x	4.41	x	91.1	x	0.85	x	0.7	=	165.66	(81)
Northwest	0.9x	0.77	x	4.41	x	72.63	x	0.85	x	0.7	=	132.06	(81)
Northwest	0.9x	0.77	x	4.41	x	72.63	x	0.85	x	0.7	=	132.06	(81)
Northwest	0.9x	0.77	x	4.41	x	50.42	x	0.85	x	0.7	=	91.68	(81)
Northwest	0.9x	0.77	x	4.41	x	50.42	x	0.85	x	0.7	=	91.68	(81)
Northwest	0.9x	0.77	x	4.41	x	28.07	x	0.85	x	0.7	=	51.04	(81)

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Northwest 0.9x	0.77	x	4.41	x	28.07	x	0.85	x	0.7	=	51.04	(81)
Northwest 0.9x	0.77	x	4.41	x	14.2	x	0.85	x	0.7	=	25.82	(81)
Northwest 0.9x	0.77	x	4.41	x	14.2	x	0.85	x	0.7	=	25.82	(81)
Northwest 0.9x	0.77	x	4.41	x	9.21	x	0.85	x	0.7	=	16.76	(81)
Northwest 0.9x	0.77	x	4.41	x	9.21	x	0.85	x	0.7	=	16.76	(81)

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

(83)m=	118.96	216.26	332.1	472.17	584.26	604.4	572.56	485.22	380.02	248.78	144.97	100.2	(83)

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

(84)m=	484.95	580.22	683.04	802.1	892.89	892.45	847.22	765.71	671.27	561.24	481.81	455.31	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.87	0.68	0.48	0.35	0.4	0.67	0.94	0.99	1	(86)

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

(87)m=	20.14	20.32	20.57	20.84	20.97	21	21	21	20.98	20.77	20.4	20.1	(87)

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

(88)m=	20.16	20.17	20.17	20.17	20.18	20.18	20.18	20.18	20.18	20.18	20.17	20.17	(88)

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

(89)m=	1	0.99	0.96	0.84	0.63	0.42	0.28	0.33	0.6	0.92	0.99	1	(89)

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

(90)m=	19.02	19.27	19.63	20	20.15	20.18	20.18	20.18	20.16	19.92	19.39	18.97	(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	19.39	19.61	19.94	20.28	20.42	20.45	20.45	20.45	20.43	20.2	19.72	19.34	(92)

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

(93)m=	19.39	19.61	19.94	20.28	20.42	20.45	20.45	20.45	20.43	20.2	19.72	19.34	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.95	0.84	0.64	0.44	0.31	0.35	0.62	0.92	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	482.48	571.8	651.05	677	574.51	391.89	258.77	271.69	417.38	514.08	475.76	453.67	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1036.79	1009.26	920.27	772.16	590.79	393.22	258.88	271.97	427.05	650.39	858.09	1032.92	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	412.41	293.97	200.3	68.52	12.11	0	0	0	0	101.42	275.28	430.97	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1794.98 (98)

Space heating requirement in kWh/m²/year 23.59 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		92.7	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	412.41	293.97	200.3	68.52	12.11	0	0	0	0	101.42	275.28	430.97		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	444.88	317.12	216.08	73.91	13.06	0	0	0	0	109.4	296.96	464.9		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1936.33	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	172.01	151.1	157.5	139.54	135.56	119.42	113.07	126.31	126.8	144.79	155.17	167.33		
Efficiency of water heater													87	(216)
(217)m=	88.89	88.76	88.49	87.87	87.22	87	87	87	87	88.09	88.71	88.93		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	193.52	170.23	177.98	158.81	155.43	137.26	129.97	145.19	145.74	164.36	174.92	188.16		
Total = Sum(219a)$_{1...12}$ =													1941.57	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1936.33	
Water heating fuel used			1941.57	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			333.64	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	418.25	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	419.38	(264)
Space and water heating	(261) + (262) + (263) + (264) =			837.63	(265)

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Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	173.16	(268)
Total CO2, kg/year			sum of (265)…(271) =		1049.71	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		13.79	(273)
EI rating (section 14)					88	(274)

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User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version: Version: 1.0.3.11

Property Address: Arlington 3 Bed MID 76

Address :

1. Overall dwelling dimensions:

	Area(m²)		**Av. Height(m)**		**Volume(m³)**	
Ground floor	76.1	(1a) x	2.3	(2a) =	175.03	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.1	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		175.03	(5)

2. Ventilation rate:

	main heating		**secondary heating**		**other**		**total**		**m³ per hour**	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 30 ÷ (5) = 0.17 (8)

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

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

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

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

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

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

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

Percentage of windows and doors draught stripped 0 (14)

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

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

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

If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) 0.42 (18)

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

Number of sides sheltered 2 (19)

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

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.36 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.46	0.45	0.44	0.39	0.39	0.34	0.34	0.33	0.36	0.39	0.4	0.42

Calculate effective air change rate for the applicable case

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

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

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

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

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

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

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

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1	=	1.89			(26)
Windows Type 1			4.41		x1/[1/(1.4)+ 0.04]	=	5.85			(27)
Windows Type 2			4.41		x1/[1/(1.4)+ 0.04]	=	5.85			(27)
Windows Type 3			4.41		x1/[1/(1.4)+ 0.04]	=	5.85			(27)
Windows Type 4			2.52		x1/[1/(1.4)+ 0.04]	=	3.34			(27)
Walls	56.36	17.64	38.72	x	0.18	=	6.97			(29)
Total area of elements, m²			56.36							(31)
Party wall			38.24	x	0	=	0			(32)
Party floor			76.1							(32a)
Party ceiling			76.1							(32b)

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

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

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	29.74	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	12289.45	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		4	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	33.74	(37)

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

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

(38)m=	34.9	34.67	34.44	33.36	33.16	32.22	32.22	32.05	32.59	33.16	33.57	34	(38)

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

(39)m=	68.64	68.4	68.18	67.1	66.9	65.96	65.96	65.79	66.32	66.9	67.3	67.73

Average = Sum(39)$_{1…12}$ /12= 67.1 (39)

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

(40)m=	0.9	0.9	0.9	0.88	0.88	0.87	0.87	0.86	0.87	0.88	0.88	0.89

Average = Sum(40)$_{1…12}$ /12= 0.88 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.38 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 90.84 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(44)m=	99.92	96.29	92.65	89.02	85.39	81.75	81.75	85.39	89.02	92.65	96.29	99.92

Total = Sum(44)$_{1…12}$ = 1090.04 (44)

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

(45)m=	148.18	129.6	133.73	116.59	111.87	96.54	89.46	102.65	103.88	121.06	132.15	143.5

Total = Sum(45)$_{1…12}$ = 1429.21 (45)

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

(46)m=	22.23	19.44	20.06	17.49	16.78	14.48	13.42	15.4	15.58	18.16	19.82	21.53	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	50.92	44.32	47.22	43.9	43.51	40.32	41.66	43.51	43.9	47.22	47.48	50.92	(61)

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

(62)m=	199.1	173.92	180.95	160.49	155.39	136.85	131.12	146.16	147.78	168.28	179.63	194.42	(62)

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

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

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

Output from water heater

(64)m=	199.1	173.92	180.95	160.49	155.39	136.85	131.12	146.16	147.78	168.28	179.63	194.42

Output from water heater (annual)$_{1...12}$	1974.08	(64)

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

(65)m=	62	54.17	56.27	49.74	48.08	42.18	40.16	45.01	45.51	52.06	55.81	60.44	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	(66)

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

(67)m=	18.89	16.78	13.65	10.33	7.72	6.52	7.04	9.16	12.29	15.61	18.21	19.42	(67)

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

(68)m=	211.1	213.29	207.77	196.02	181.18	167.24	157.93	155.74	161.26	173.01	187.84	201.78	(68)

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

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	(71)

Water heating gains (Table 5)

(72)m=	83.33	80.61	75.63	69.09	64.62	58.58	53.98	60.5	63.21	69.97	77.51	81.24	(72)

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

(73)m=	375.09	372.45	358.82	337.2	315.29	294.11	280.72	287.16	298.53	320.35	345.34	364.21	(73)

6. Solar gains:

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

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast 0.9x	0.77	x	4.41	x	36.79	x	0.63	x	0.7	=	49.59	(77)
Southeast 0.9x	0.77	x	4.41	x	62.67	x	0.63	x	0.7	=	84.47	(77)

TER WorkSheet: New dwelling design stage

Southeast	0.9x	0.77	x	4.41	x	85.75	x	0.63	x	0.7	=	115.57	(77)
Southeast	0.9x	0.77	x	4.41	x	106.25	x	0.63	x	0.7	=	143.2	(77)
Southeast	0.9x	0.77	x	4.41	x	119.01	x	0.63	x	0.7	=	160.4	(77)
Southeast	0.9x	0.77	x	4.41	x	118.15	x	0.63	x	0.7	=	159.24	(77)
Southeast	0.9x	0.77	x	4.41	x	113.91	x	0.63	x	0.7	=	153.52	(77)
Southeast	0.9x	0.77	x	4.41	x	104.39	x	0.63	x	0.7	=	140.69	(77)
Southeast	0.9x	0.77	x	4.41	x	92.85	x	0.63	x	0.7	=	125.14	(77)
Southeast	0.9x	0.77	x	4.41	x	69.27	x	0.63	x	0.7	=	93.36	(77)
Southeast	0.9x	0.77	x	4.41	x	44.07	x	0.63	x	0.7	=	59.4	(77)
Southeast	0.9x	0.77	x	4.41	x	31.49	x	0.63	x	0.7	=	42.44	(77)
Southwest	0.9x	0.77	x	2.52	x	36.79		0.63	x	0.7	=	28.34	(79)
Southwest	0.9x	0.77	x	2.52	x	62.67		0.63	x	0.7	=	48.27	(79)
Southwest	0.9x	0.77	x	2.52	x	85.75		0.63	x	0.7	=	66.04	(79)
Southwest	0.9x	0.77	x	2.52	x	106.25		0.63	x	0.7	=	81.83	(79)
Southwest	0.9x	0.77	x	2.52	x	119.01		0.63	x	0.7	=	91.66	(79)
Southwest	0.9x	0.77	x	2.52	x	118.15		0.63	x	0.7	=	90.99	(79)
Southwest	0.9x	0.77	x	2.52	x	113.91		0.63	x	0.7	=	87.73	(79)
Southwest	0.9x	0.77	x	2.52	x	104.39		0.63	x	0.7	=	80.4	(79)
Southwest	0.9x	0.77	x	2.52	x	92.85		0.63	x	0.7	=	71.51	(79)
Southwest	0.9x	0.77	x	2.52	x	69.27		0.63	x	0.7	=	53.35	(79)
Southwest	0.9x	0.77	x	2.52	x	44.07		0.63	x	0.7	=	33.94	(79)
Southwest	0.9x	0.77	x	2.52	x	31.49		0.63	x	0.7	=	24.25	(79)
Northwest	0.9x	0.77	x	4.41	x	11.28	x	0.63	x	0.7	=	15.21	(81)
Northwest	0.9x	0.77	x	4.41	x	11.28	x	0.63	x	0.7	=	15.21	(81)
Northwest	0.9x	0.77	x	4.41	x	22.97	x	0.63	x	0.7	=	30.95	(81)
Northwest	0.9x	0.77	x	4.41	x	22.97	x	0.63	x	0.7	=	30.95	(81)
Northwest	0.9x	0.77	x	4.41	x	41.38	x	0.63	x	0.7	=	55.77	(81)
Northwest	0.9x	0.77	x	4.41	x	41.38	x	0.63	x	0.7	=	55.77	(81)
Northwest	0.9x	0.77	x	4.41	x	67.96	x	0.63	x	0.7	=	91.59	(81)
Northwest	0.9x	0.77	x	4.41	x	67.96	x	0.63	x	0.7	=	91.59	(81)
Northwest	0.9x	0.77	x	4.41	x	91.35	x	0.63	x	0.7	=	123.11	(81)
Northwest	0.9x	0.77	x	4.41	x	91.35	x	0.63	x	0.7	=	123.11	(81)
Northwest	0.9x	0.77	x	4.41	x	97.38	x	0.63	x	0.7	=	131.25	(81)
Northwest	0.9x	0.77	x	4.41	x	97.38	x	0.63	x	0.7	=	131.25	(81)
Northwest	0.9x	0.77	x	4.41	x	91.1	x	0.63	x	0.7	=	122.78	(81)
Northwest	0.9x	0.77	x	4.41	x	91.1	x	0.63	x	0.7	=	122.78	(81)
Northwest	0.9x	0.77	x	4.41	x	72.63	x	0.63	x	0.7	=	97.88	(81)
Northwest	0.9x	0.77	x	4.41	x	72.63	x	0.63	x	0.7	=	97.88	(81)
Northwest	0.9x	0.77	x	4.41	x	50.42	x	0.63	x	0.7	=	67.95	(81)
Northwest	0.9x	0.77	x	4.41	x	50.42	x	0.63	x	0.7	=	67.95	(81)
Northwest	0.9x	0.77	x	4.41	x	28.07	x	0.63	x	0.7	=	37.83	(81)

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Northwest 0.9x 0.77 x 4.41 x 28.07 x 0.63 x 0.7 = 37.83 (81)
Northwest 0.9x 0.77 x 4.41 x 14.2 x 0.63 x 0.7 = 19.13 (81)
Northwest 0.9x 0.77 x 4.41 x 14.2 x 0.63 x 0.7 = 19.13 (81)
Northwest 0.9x 0.77 x 4.41 x 9.21 x 0.63 x 0.7 = 12.42 (81)
Northwest 0.9x 0.77 x 4.41 x 9.21 x 0.63 x 0.7 = 12.42 (81)

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

(83)m=	108.34	194.64	293.15	408.21	498.28	512.73	486.81	416.85	332.56	222.36	131.6	91.53	(83)

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

(84)m=	483.43	567.09	651.97	745.41	813.57	806.84	767.53	704.01	631.09	542.71	476.94	455.74	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.97	0.9	0.73	0.52	0.38	0.43	0.7	0.94	0.99	1	(86)

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

(87)m=	20.14	20.3	20.54	20.81	20.96	21	21	21	20.98	20.76	20.4	20.12	(87)

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

(88)m=	20.17	20.17	20.17	20.18	20.19	20.2	20.2	20.2	20.19	20.19	20.18	20.18	(88)

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

(89)m=	1	0.99	0.96	0.87	0.67	0.46	0.31	0.35	0.63	0.92	0.99	1	(89)

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

(90)m=	19.02	19.25	19.6	19.97	20.15	20.19	20.2	20.2	20.17	19.92	19.41	18.99	(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	19.39	19.6	19.91	20.25	20.41	20.46	20.46	20.46	20.44	20.2	19.73	19.36	(92)

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

(93)m=	19.39	19.6	19.91	20.25	20.41	20.46	20.46	20.46	20.44	20.2	19.73	19.36	(93)

8. Space heating requirement

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

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

Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.96	0.87	0.69	0.48	0.33	0.38	0.65	0.92	0.99	1	(94)

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

(95)m=	481.01	559.66	626.44	649.37	560.52	384.42	254.43	266.79	408.96	501.15	471.16	454.09	(95)

Monthly average external temperature from Table 8

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

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

(97)m=	1035.46	1005.4	913.99	761.59	582.99	386.31	254.59	267.14	420.34	641.93	850.21	1026.56	(97)

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

(98)m=	412.52	299.53	213.94	80.8	16.71	0	0	0	0	104.74	272.92	425.92	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1827.08 (98)

Space heating requirement in kWh/m²/year 24.01 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	412.52	299.53	213.94	80.8	16.71	0	0	0	0	104.74	272.92	425.92		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	441.67	320.7	229.06	86.51	17.89	0	0	0	0	112.14	292.21	456.02		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													1956.19	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	199.1	173.92	180.95	160.49	155.39	136.85	131.12	146.16	147.78	168.28	179.63	194.42		
Efficiency of water heater													80.3	(216)
(217)m=	86.84	86.41	85.47	83.42	81.18	80.3	80.3	80.3	80.3	83.9	86.1	86.97		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	229.26	201.27	211.7	192.39	191.41	170.43	163.28	182.02	184.03	200.58	208.63	223.55		
Total = Sum(219a)$_{1...12}$ =													2358.55	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1956.19	
Water heating fuel used			2358.55	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			333.64	(232)

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

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	422.54	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	509.45	(264)
Space and water heating	(261) + (262) + (263) + (264) =				931.98	(265)

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Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	173.16	(268)
Total CO2, kg/year			sum of (265)…(271) =		1144.07	(272)

TER = 15.03 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.3.11
Printed on 22 June 2018 at 10:46:50

Project Information:

Assessed By: () **Building Type:** Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 76.1m²

Site Reference : Arlington Works, Twickenham **Plot Reference:** Arlington 3 Bed TOP 76

Address :

Client Details:

Name: Sharpes Refinery Service

Address :

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating system: Mains gas
Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER)	16.67 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	15.82 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	42.5 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	39.0 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.42 (max. 2.00)	1.60 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Database: (rev 397, product index 016661): Boiler systems with radiators or underfloor heating - mains gas Brand name: Alpha Model: InTec 34C Model qualifier: (Combi) Efficiency 88.8 % SEDBUK2009	
	Minimum 88.0 %	OK
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	Time and temperature zone control by device in database	**OK**
Hot water controls:	No cylinder	
Boiler interlock:	Yes	**OK**

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100.0%	
Minimum	75.0%	**OK**

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames valley):	Medium	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: North West	4.41m²
Windows facing: North West	4.41m²
Windows facing: South East	4.41m²
Windows facing: South West	2.52m²
Ventilation rate:	3.00
Blinds/curtains:	None Closed 100% of daylight hours

10 Key features

Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**

Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.3.11

Property Address: Arlington 3 Bed TOP 76

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	76.1	(1a)	x	2.3	(2a)	=	175.03	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.1	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	175.03	(5)

2. Ventilation rate:

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.11	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.31	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.27	(21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.34	0.33	0.33	0.29	0.29	0.25	0.25	0.25	0.27	0.29	0.3	0.31

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(24d)

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

(25)m=	0.56	0.56	0.55	0.54	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1.6	=	3.024			(26)
Windows Type 1			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 2			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 3			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 4			2.52	x1/[1/(1.4)+ 0.04]		=	3.34			(27)
Walls	56.36	17.64	38.72	x	0.17	=	6.58			(29)
Roof	76.1	0	76.1	x	0.16	=	12.18			(30)
Total area of elements, m²			132.46							(31)
Party wall			38.24	x	0	=	0			(32)
Party floor			76.1							(32a)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 42.66 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 11452.35 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.01 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 48.67 (37)

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

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

DER WorkSheet: New dwelling design stage

(38)m=	32.23	32.1	31.97	31.37	31.26	30.74	30.74	30.64	30.94	31.26	31.49	31.73	(38)

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

(39)m=	80.9	80.77	80.65	80.05	79.94	79.41	79.41	79.32	79.62	79.94	80.16	80.4	

Average = Sum(39)$_{1...12}$ /12= 80.05 (39)

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

(40)m=	1.06	1.06	1.06	1.05	1.05	1.04	1.04	1.04	1.05	1.05	1.05	1.06

Average = Sum(40)$_{1...12}$ /12= 1.05 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.38 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 90.84 (43)

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

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

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

(44)m=	99.92	96.29	92.65	89.02	85.39	81.75	81.75	85.39	89.02	92.65	96.29	99.92

Total = Sum(44)$_{1...12}$ = 1090.04 (44)

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

(45)m=	148.18	129.6	133.73	116.59	111.87	96.54	89.46	102.65	103.88	121.06	132.15	143.5

Total = Sum(45)$_{1...12}$ = 1429.21 (45)

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

(46)m=	22.23	19.44	20.06	17.49	16.78	14.48	13.42	15.4	15.58	18.16	19.82	21.53	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	23.84	21.5	23.77	22.95	23.68	22.88	23.62	23.66	22.92	23.73	23.02	23.82	(61)

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

(62)m=	172.01	151.1	157.5	139.54	135.56	119.42	113.07	126.31	126.8	144.79	155.17	167.33	(62)

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

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

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

Output from water heater

(64)m=	172.01	151.1	157.5	139.54	135.56	119.42	113.07	126.31	126.8	144.79	155.17	167.33

Output from water heater (annual)$_{1...12}$	1708.6	(64)

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

(65)m=	55.23	48.47	50.41	44.5	43.12	37.82	35.65	40.05	40.27	46.19	49.69	53.67	(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	(66)

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

(67)m=	18.89	16.78	13.65	10.33	7.72	6.52	7.04	9.16	12.29	15.61	18.21	19.42	(67)

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

(68)m=	211.1	213.29	207.77	196.02	181.18	167.24	157.93	155.74	161.26	173.01	187.84	201.78	(68)

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

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	(71)

Water heating gains (Table 5)

(72)m=	74.23	72.12	67.75	61.81	57.96	52.53	47.92	53.83	55.93	62.08	69.02	72.14	(72)

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

(73)m=	365.99	363.96	350.94	329.93	308.63	288.06	274.66	280.49	291.25	312.46	336.84	355.11	(73)

6. Solar gains:

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

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast	0.9x	0.77	x	4.41	x	36.79	x	0.63	x	0.7	=	49.59	(77)
Southeast	0.9x	0.77	x	4.41	x	62.67	x	0.63	x	0.7	=	84.47	(77)

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Southeast	0.9x	0.77	x	4.41	x	85.75	x	0.63	x	0.7	=	115.57	(77)
Southeast	0.9x	0.77	x	4.41	x	106.25	x	0.63	x	0.7	=	143.2	(77)
Southeast	0.9x	0.77	x	4.41	x	119.01	x	0.63	x	0.7	=	160.4	(77)
Southeast	0.9x	0.77	x	4.41	x	118.15	x	0.63	x	0.7	=	159.24	(77)
Southeast	0.9x	0.77	x	4.41	x	113.91	x	0.63	x	0.7	=	153.52	(77)
Southeast	0.9x	0.77	x	4.41	x	104.39	x	0.63	x	0.7	=	140.69	(77)
Southeast	0.9x	0.77	x	4.41	x	92.85	x	0.63	x	0.7	=	125.14	(77)
Southeast	0.9x	0.77	x	4.41	x	69.27	x	0.63	x	0.7	=	93.36	(77)
Southeast	0.9x	0.77	x	4.41	x	44.07	x	0.63	x	0.7	=	59.4	(77)
Southeast	0.9x	0.77	x	4.41	x	31.49	x	0.63	x	0.7	=	42.44	(77)
Southwest	0.9x	0.77	x	2.52	x	36.79		0.63	x	0.7	=	28.34	(79)
Southwest	0.9x	0.77	x	2.52	x	62.67		0.63	x	0.7	=	48.27	(79)
Southwest	0.9x	0.77	x	2.52	x	85.75		0.63	x	0.7	=	66.04	(79)
Southwest	0.9x	0.77	x	2.52	x	106.25		0.63	x	0.7	=	81.83	(79)
Southwest	0.9x	0.77	x	2.52	x	119.01		0.63	x	0.7	=	91.66	(79)
Southwest	0.9x	0.77	x	2.52	x	118.15		0.63	x	0.7	=	90.99	(79)
Southwest	0.9x	0.77	x	2.52	x	113.91		0.63	x	0.7	=	87.73	(79)
Southwest	0.9x	0.77	x	2.52	x	104.39		0.63	x	0.7	=	80.4	(79)
Southwest	0.9x	0.77	x	2.52	x	92.85		0.63	x	0.7	=	71.51	(79)
Southwest	0.9x	0.77	x	2.52	x	69.27		0.63	x	0.7	=	53.35	(79)
Southwest	0.9x	0.77	x	2.52	x	44.07		0.63	x	0.7	=	33.94	(79)
Southwest	0.9x	0.77	x	2.52	x	31.49		0.63	x	0.7	=	24.25	(79)
Northwest	0.9x	0.77	x	4.41	x	11.28	x	0.85	x	0.7	=	20.52	(81)
Northwest	0.9x	0.77	x	4.41	x	11.28	x	0.85	x	0.7	=	20.52	(81)
Northwest	0.9x	0.77	x	4.41	x	22.97	x	0.85	x	0.7	=	41.76	(81)
Northwest	0.9x	0.77	x	4.41	x	22.97	x	0.85	x	0.7	=	41.76	(81)
Northwest	0.9x	0.77	x	4.41	x	41.38	x	0.85	x	0.7	=	75.24	(81)
Northwest	0.9x	0.77	x	4.41	x	41.38	x	0.85	x	0.7	=	75.24	(81)
Northwest	0.9x	0.77	x	4.41	x	67.96	x	0.85	x	0.7	=	123.57	(81)
Northwest	0.9x	0.77	x	4.41	x	67.96	x	0.85	x	0.7	=	123.57	(81)
Northwest	0.9x	0.77	x	4.41	x	91.35	x	0.85	x	0.7	=	166.1	(81)
Northwest	0.9x	0.77	x	4.41	x	91.35	x	0.85	x	0.7	=	166.1	(81)
Northwest	0.9x	0.77	x	4.41	x	97.38	x	0.85	x	0.7	=	177.08	(81)
Northwest	0.9x	0.77	x	4.41	x	97.38	x	0.85	x	0.7	=	177.08	(81)
Northwest	0.9x	0.77	x	4.41	x	91.1	x	0.85	x	0.7	=	165.66	(81)
Northwest	0.9x	0.77	x	4.41	x	91.1	x	0.85	x	0.7	=	165.66	(81)
Northwest	0.9x	0.77	x	4.41	x	72.63	x	0.85	x	0.7	=	132.06	(81)
Northwest	0.9x	0.77	x	4.41	x	72.63	x	0.85	x	0.7	=	132.06	(81)
Northwest	0.9x	0.77	x	4.41	x	50.42	x	0.85	x	0.7	=	91.68	(81)
Northwest	0.9x	0.77	x	4.41	x	50.42	x	0.85	x	0.7	=	91.68	(81)
Northwest	0.9x	0.77	x	4.41	x	28.07	x	0.85	x	0.7	=	51.04	(81)

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Northwest	0.9x	0.77	x	4.41	x	28.07	x	0.85	x	0.7	=	51.04	(81)
Northwest	0.9x	0.77	x	4.41	x	14.2	x	0.85	x	0.7	=	25.82	(81)
Northwest	0.9x	0.77	x	4.41	x	14.2	x	0.85	x	0.7	=	25.82	(81)
Northwest	0.9x	0.77	x	4.41	x	9.21	x	0.85	x	0.7	=	16.76	(81)
Northwest	0.9x	0.77	x	4.41	x	9.21	x	0.85	x	0.7	=	16.76	(81)

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

(83)m=	118.96	216.26	332.1	472.17	584.26	604.4	572.56	485.22	380.02	248.78	144.97	100.2	(83)

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

(84)m=	484.95	580.22	683.04	802.1	892.89	892.45	847.22	765.71	671.27	561.24	481.81	455.31	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.91	0.76	0.56	0.41	0.47	0.75	0.96	0.99	1	(86)

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

(87)m=	19.91	20.09	20.37	20.7	20.92	20.99	21	21	20.94	20.63	20.2	19.87	(87)

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

(88)m=	20.03	20.03	20.03	20.04	20.04	20.05	20.05	20.05	20.05	20.04	20.04	20.04	(88)

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

(89)m=	1	0.99	0.97	0.88	0.7	0.48	0.32	0.38	0.67	0.94	0.99	1	(89)

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

(90)m=	18.58	18.84	19.24	19.71	19.97	20.04	20.05	20.05	20	19.62	19.01	18.53	(90)

fLA = Living area ÷ (4) = 0.33 (91)

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

(92)m=	19.02	19.25	19.61	20.03	20.28	20.35	20.36	20.36	20.31	19.95	19.4	18.97	(92)

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

(93)m=	19.02	19.25	19.61	20.03	20.28	20.35	20.36	20.36	20.31	19.95	19.4	18.97	(93)

8. Space heating requirement

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

Utilisation factor for gains, hm:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m=	1	0.99	0.96	0.88	0.72	0.51	0.35	0.41	0.69	0.94	0.99	1	(94)

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

(95)m=	482.6	573.05	658.37	709.52	638.91	450.75	297.85	312.52	465.61	525.95	476.59	453.69	(95)

Monthly average external temperature from Table 8

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

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

(97)m=	1190.78	1159.33	1057.54	891.14	685.68	456.66	298.52	313.97	494.45	747.7	986.09	1187.66	(97)

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

(98)m=	526.89	393.98	296.98	130.76	34.8	0	0	0	0	164.98	366.84	546.07	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2461.3 (98)

Space heating requirement in kWh/m²/year 32.34 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		92.7	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	526.89	393.98	296.98	130.76	34.8	0	0	0	0	164.98	366.84	546.07		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	568.38	425	320.36	141.06	37.54	0	0	0	0	177.97	395.73	589.07		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													2655.13	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	172.01	151.1	157.5	139.54	135.56	119.42	113.07	126.31	126.8	144.79	155.17	167.33		
Efficiency of water heater													87	(216)
(217)m=	89.02	88.93	88.75	88.29	87.54	87	87	87	87	88.42	88.88	89.05		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	193.23	169.9	177.47	158.06	154.85	137.26	129.97	145.19	145.74	163.76	174.58	187.9		
Total = Sum(219a)$_{1...12}$ =													1937.92	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2655.13	
Water heating fuel used			1937.92	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			333.64	(232)

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

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	573.51	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	418.59	(264)
Space and water heating	(261) + (262) + (263) + (264) =			992.1	(265)

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Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	173.16	(268)
Total CO2, kg/year			sum of (265)…(271) =		1204.18	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		15.82	(273)
EI rating (section 14)					87	(274)

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User Details:

Assessor Name: **Stroma Number:**

Software Name: Stroma FSAP 2012 **Software Version:** Version: 1.0.3.11

Property Address: Arlington 3 Bed TOP 76

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	76.1	(1a) x	2.3	(2a) =	175.03	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	76.1	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		175.03	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							3	x 10 =	30	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 30 ÷ (5) = 0.17 (8)

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

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

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

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

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

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

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

Percentage of windows and doors draught stripped 0 (14)

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

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

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

If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) 0.42 (18)

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

Number of sides sheltered 2 (19)

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

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.36 (21)

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

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

Wind Factor (22a)m = (22)m ÷ 4

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

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

0.46	0.45	0.44	0.39	0.39	0.34	0.34	0.33	0.36	0.39	0.4	0.42

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

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

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

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

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

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

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

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

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

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

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

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

(24d)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

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

(25)m=	0.6	0.6	0.6	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.89	x	1	=	1.89			(26)
Windows Type 1			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 2			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 3			4.41	x1/[1/(1.4)+ 0.04]		=	5.85			(27)
Windows Type 4			2.52	x1/[1/(1.4)+ 0.04]		=	3.34			(27)
Walls	56.36	17.64	38.72	x	0.18	=	6.97			(29)
Roof	76.1	0	76.1	x	0.13	=	9.89			(30)
Total area of elements, m²			132.46							(31)
Party wall			38.24	x	0	=	0			(32)
Party floor			76.1							(32a)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 39.63 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 11452.35 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 4 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 43.63 (37)

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

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

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(38)m=	34.9	34.67	34.44	33.36	33.16	32.22	32.22	32.05	32.59	33.16	33.57	34	(38)

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

(39)m=	78.53	78.3	78.07	76.99	76.79	75.85	75.85	75.68	76.21	76.79	77.2	77.62	

Average = Sum(39)$_{1…12}$ /12= 76.99 (39)

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

(40)m=	1.03	1.03	1.03	1.01	1.01	1	1	0.99	1	1.01	1.01	1.02	

Average = Sum(40)$_{1…12}$ /12= 1.01 (40)

Number of days in month (Table 1a)

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

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.38 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 90.84 (43)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	99.92	96.29	92.65	89.02	85.39	81.75	81.75	85.39	89.02	92.65	96.29	99.92	

Total = Sum(44)$_{1…12}$ = 1090.04 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	148.18	129.6	133.73	116.59	111.87	96.54	89.46	102.65	103.88	121.06	132.15	143.5	

Total = Sum(45)$_{1…12}$ = 1429.21 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	22.23	19.44	20.06	17.49	16.78	14.48	13.42	15.4	15.58	18.16	19.82	21.53	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

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Primary circuit loss (annual) from Table 3	0	(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	50.92	44.32	47.22	43.9	43.51	40.32	41.66	43.51	43.9	47.22	47.48	50.92	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	199.1	173.92	180.95	160.49	155.39	136.85	131.12	146.16	147.78	168.28	179.63	194.42	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	199.1	173.92	180.95	160.49	155.39	136.85	131.12	146.16	147.78	168.28	179.63	194.42	

Output from water heater (annual)$_{1\ldots12}$	1974.08	(64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	62	54.17	56.27	49.74	48.08	42.18	40.16	45.01	45.51	52.06	55.81	60.44	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	119.23	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	18.89	16.78	13.65	10.33	7.72	6.52	7.04	9.16	12.29	15.61	18.21	19.42	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	211.1	213.29	207.77	196.02	181.18	167.24	157.93	155.74	161.26	173.01	187.84	201.78	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	34.92	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	-95.39	(71)

Water heating gains (Table 5)

(72)m=	83.33	80.61	75.63	69.09	64.62	58.58	53.98	60.5	63.21	69.97	77.51	81.24	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	375.09	372.45	358.82	337.2	315.29	294.11	280.72	287.16	298.53	320.35	345.34	364.21	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast	0.9x	0.77	x	4.41	x	36.79	x	0.63	x	0.7	=	49.59	(77)
Southeast	0.9x	0.77	x	4.41	x	62.67	x	0.63	x	0.7	=	84.47	(77)

Southeast	0.9x	0.77	x	4.41	x	85.75	x	0.63	x	0.7	=	115.57	(77)
Southeast	0.9x	0.77	x	4.41	x	106.25	x	0.63	x	0.7	=	143.2	(77)
Southeast	0.9x	0.77	x	4.41	x	119.01	x	0.63	x	0.7	=	160.4	(77)
Southeast	0.9x	0.77	x	4.41	x	118.15	x	0.63	x	0.7	=	159.24	(77)
Southeast	0.9x	0.77	x	4.41	x	113.91	x	0.63	x	0.7	=	153.52	(77)
Southeast	0.9x	0.77	x	4.41	x	104.39	x	0.63	x	0.7	=	140.69	(77)
Southeast	0.9x	0.77	x	4.41	x	92.85	x	0.63	x	0.7	=	125.14	(77)
Southeast	0.9x	0.77	x	4.41	x	69.27	x	0.63	x	0.7	=	93.36	(77)
Southeast	0.9x	0.77	x	4.41	x	44.07	x	0.63	x	0.7	=	59.4	(77)
Southeast	0.9x	0.77	x	4.41	x	31.49	x	0.63	x	0.7	=	42.44	(77)
Southwest	0.9x	0.77	x	2.52	x	36.79		0.63	x	0.7	=	28.34	(79)
Southwest	0.9x	0.77	x	2.52	x	62.67		0.63	x	0.7	=	48.27	(79)
Southwest	0.9x	0.77	x	2.52	x	85.75		0.63	x	0.7	=	66.04	(79)
Southwest	0.9x	0.77	x	2.52	x	106.25		0.63	x	0.7	=	81.83	(79)
Southwest	0.9x	0.77	x	2.52	x	119.01		0.63	x	0.7	=	91.66	(79)
Southwest	0.9x	0.77	x	2.52	x	118.15		0.63	x	0.7	=	90.99	(79)
Southwest	0.9x	0.77	x	2.52	x	113.91		0.63	x	0.7	=	87.73	(79)
Southwest	0.9x	0.77	x	2.52	x	104.39		0.63	x	0.7	=	80.4	(79)
Southwest	0.9x	0.77	x	2.52	x	92.85		0.63	x	0.7	=	71.51	(79)
Southwest	0.9x	0.77	x	2.52	x	69.27		0.63	x	0.7	=	53.35	(79)
Southwest	0.9x	0.77	x	2.52	x	44.07		0.63	x	0.7	=	33.94	(79)
Southwest	0.9x	0.77	x	2.52	x	31.49		0.63	x	0.7	=	24.25	(79)
Northwest	0.9x	0.77	x	4.41	x	11.28	x	0.63	x	0.7	=	15.21	(81)
Northwest	0.9x	0.77	x	4.41	x	11.28	x	0.63	x	0.7	=	15.21	(81)
Northwest	0.9x	0.77	x	4.41	x	22.97	x	0.63	x	0.7	=	30.95	(81)
Northwest	0.9x	0.77	x	4.41	x	22.97	x	0.63	x	0.7	=	30.95	(81)
Northwest	0.9x	0.77	x	4.41	x	41.38	x	0.63	x	0.7	=	55.77	(81)
Northwest	0.9x	0.77	x	4.41	x	41.38	x	0.63	x	0.7	=	55.77	(81)
Northwest	0.9x	0.77	x	4.41	x	67.96	x	0.63	x	0.7	=	91.59	(81)
Northwest	0.9x	0.77	x	4.41	x	67.96	x	0.63	x	0.7	=	91.59	(81)
Northwest	0.9x	0.77	x	4.41	x	91.35	x	0.63	x	0.7	=	123.11	(81)
Northwest	0.9x	0.77	x	4.41	x	91.35	x	0.63	x	0.7	=	123.11	(81)
Northwest	0.9x	0.77	x	4.41	x	97.38	x	0.63	x	0.7	=	131.25	(81)
Northwest	0.9x	0.77	x	4.41	x	97.38	x	0.63	x	0.7	=	131.25	(81)
Northwest	0.9x	0.77	x	4.41	x	91.1	x	0.63	x	0.7	=	122.78	(81)
Northwest	0.9x	0.77	x	4.41	x	91.1	x	0.63	x	0.7	=	122.78	(81)
Northwest	0.9x	0.77	x	4.41	x	72.63	x	0.63	x	0.7	=	97.88	(81)
Northwest	0.9x	0.77	x	4.41	x	72.63	x	0.63	x	0.7	=	97.88	(81)
Northwest	0.9x	0.77	x	4.41	x	50.42	x	0.63	x	0.7	=	67.95	(81)
Northwest	0.9x	0.77	x	4.41	x	50.42	x	0.63	x	0.7	=	67.95	(81)
Northwest	0.9x	0.77	x	4.41	x	28.07	x	0.63	x	0.7	=	37.83	(81)

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Northwest	0.9x	0.77	x	4.41	x	28.07	x	0.63	x	0.7	=	37.83	(81)
Northwest	0.9x	0.77	x	4.41	x	14.2	x	0.63	x	0.7	=	19.13	(81)
Northwest	0.9x	0.77	x	4.41	x	14.2	x	0.63	x	0.7	=	19.13	(81)
Northwest	0.9x	0.77	x	4.41	x	9.21	x	0.63	x	0.7	=	12.42	(81)
Northwest	0.9x	0.77	x	4.41	x	9.21	x	0.63	x	0.7	=	12.42	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	108.34	194.64	293.15	408.21	498.28	512.73	486.81	416.85	332.56	222.36	131.6	91.53	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	483.43	567.09	651.97	745.41	813.57	806.84	767.53	704.01	631.09	542.71	476.94	455.74	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.93	0.79	0.59	0.43	0.49	0.76	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.95	20.12	20.38	20.69	20.91	20.99	21	21	20.94	20.65	20.24	19.93	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.06	20.06	20.06	20.07	20.08	20.09	20.09	20.09	20.08	20.08	20.07	20.07	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.97	0.9	0.73	0.51	0.34	0.4	0.69	0.94	0.99	1	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.66	18.9	19.28	19.72	19.99	20.08	20.09	20.09	20.04	19.67	19.09	18.63	(90)

fLA = Living area ÷ (4) = 0.33 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.09	19.3	19.64	20.04	20.29	20.38	20.39	20.39	20.34	19.99	19.47	19.05	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.09	19.3	19.64	20.04	20.29	20.38	20.39	20.39	20.34	19.99	19.47	19.05	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	1	0.99	0.97	0.9	0.75	0.53	0.37	0.43	0.71	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	481.12	560.59	631.35	671.41	608.09	431.6	286.41	300.15	447.16	510.35	471.87	454.12	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1161.15	1127.77	1025.64	857.91	659.76	438.08	287.11	301.58	475.29	721.4	954.92	1153.08	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	505.94	381.14	293.36	134.28	38.44	0	0	0	0	157.03	347.79	520.02	(98)

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2378 (98)

Space heating requirement in kWh/m²/year 31.25 (99)

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9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		93.4	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	505.94	381.14	293.36	134.28	38.44	0	0	0	0	157.03	347.79	520.02		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	541.69	408.08	314.08	143.77	41.15	0	0	0	0	168.12	372.37	556.77		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													2546.04	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	199.1	173.92	180.95	160.49	155.39	136.85	131.12	146.16	147.78	168.28	179.63	194.42		
Efficiency of water heater													80.3	(216)
(217)m=	87.3	86.97	86.26	84.61	82.12	80.3	80.3	80.3	80.3	84.88	86.69	87.41		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	228.06	199.97	209.77	189.69	189.22	170.43	163.28	182.02	184.03	198.26	207.22	222.43		
Total = Sum(219a)$_{1...12}$ =													2344.39	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2546.04	
Water heating fuel used			2344.39	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			333.64	(232)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	549.94	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	506.39	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1056.33	(265)

TER WorkSheet: New dwelling design stage

Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	173.16	(268)
Total CO2, kg/year		sum of (265)…(271) =		1268.41	(272)

TER = 16.67 (273)

Appendix 6 – Details of an Air Source Heat Pump

Heating

Product Information

PUHZ-(H)W50-140VHA(2)/YHA2(-BS)
Ecodan Monobloc Air Source Heat Pumps

Making a
World of
Difference

Designed to meet the demands of today's heating needs

Our range of Ecodan monobloc air source heat pumps includes 5, 8.5, 11.2 and 14kW sizes. Now with the ability to cascade up to six units of the same output, Ecodan monobloc systems offer a capacity range from 5 through to 84kW. Designed to suit a wide number of applications, these models offer a viable solution for the varying requirements that domestic and small commercial applications demand.

Key Features

- Self-contained unit, only requiring water and electric connections
- No need for gas supply, flues or ventilation
- Single phase power supply with a low starting current (3 phase available for 14kW)
- Low maintenance and quiet operation
- Operates with outside temperatures as low as -25°C
- Multiple unit connection
- Hybrid function, for use with conventional boilers
- 2-zone energy efficient space heating control
- Available as a standalone, packaged or semi packaged system
- Energy monitoring as standard
- Coastal protection models available (-BS)

Application Examples

- The vast majority of UK homes
- Small Retail Outlets
- Dental / Doctor's Surgeries
- Public Sector / Commercial Buildings

Manufactured in the UK
PUHZ-W85VHA2

MELCloud

Qualified for Energy Technology List
www.eca.gov.uk

QUIET MARK

APPROVED PRODUCT
MCS
BRE GLOBAL CERTIFICATION

Certificate Number: MCS HP0002
Product Type: Heat Pumps
Product Reference: PUHZ-W50VHA2-(BS), PUHZ-W85VHA2-(BS)
PUHZ-W112VHA-(BS), PUHZ-HW140VHA2/YHA2-(BS)

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Renewable Heating Technology

Heating

Product Information

PUHZ-(H)W50-140VHA(2)/YHA2(-BS)

Ecodan Monobloc Air Source Heat Pumps

Making a
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OUTDOOR UNIT		PUHZ-W50VHA2(-BS)	PUHZ-W85VHA2(-BS)	PUHZ-W112VHA(-BS)	PUHZ-HW140VHA2(-BS)	PUHZ-HW140YHA2(-BS)
HEAT PUMP SPACE HEATER - 55˚C	ErP Rating	A++	A++	A++	A++	A++
	η_s	127%	128%	125%	126%	126%
	SCOP	3.25	3.27	3.20	3.22	3.22
HEAT PUMP SPACE HEATER - 35˚C	ErP Rating	A++	A++	A++	A++	A++
	η_s	162%	162%	164%	157%	157%
	SCOP	4.12	4.12	4.18	3.99	3.99
HEAT PUMP COMBINATION HEATER - Large Profile[*1]	ErP Rating	A	A	A	A	A
	η_{wh}	99%	97%	100%	96%	96%
HEATING[*2] (A-3/W35)	Capacity (kW)	4.8	8.3	11.0	14.0	14.0
	Power Input (kW)	1.63	2.96	3.65	4.81	4.81
	COP	2.95	2.80	3.01	2.91	2.91
OPERATING AMBIENT TEMPERATURE (°C DB)		-15 ~ +35°C	-20 ~ +35°C	-20 ~ +35°C	-25 ~ +35°C	-25 ~ +35°C
SOUND PRESSURE LEVEL AT 1M (dBA)[*3*4]		45	48	53	53	53
LOW NOISE MODE (dBA)[*3]		40	42	46	46	46
WATER DATA	Pipework Size (mm)	22	22	28	28	28
	Flow Rate (l/min)	14.3	25.8	32.1	40.1	40.1
	Water Pressure Drop (kPa)	12	13.5	6.3	9	9
DIMENSIONS (mm)[*7]	Width	950	950	1020	1020	1020
	Depth	330+30[*5]	330+30[*5]	330+30[*5]	330+30[*5]	330+30[*5]
	Height	740	943	1350	1350	1350
WEIGHT (kg)		64	77	133	134	148
ELECTRICAL DATA	Electrical Supply	220-240v, 50Hz	220-240v, 50Hz	220-240v, 50Hz	220-240v, 50Hz	380-415v, 50Hz
	Phase	Single	Single	Single	Single	3
	Nominal Running Current [MAX] (A)	5.4 [13]	10.3 [23]	11.2 [29.5]	14.9 [35]	5.1 [13]
	Fuse Rating - MCB Sizes (A)[*6]	16	25	32	40	16

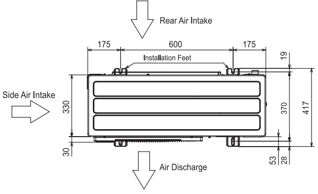
*1 Combination with EHPT20X-MHCW Cylinder
*2 Under normal heating conditions at outdoor temp: -3°CDB / -4°CWB, outlet water temp 35°C, inlet water temp 30°C.
*3 Under normal heating conditions at outdoor temp: 7°CDB / 6°CWB, outlet water temp 35°C, inlet water temp 30°C as tested to BS EN14511.
*4 Sound power level of the PUHZ-W50VHA2 is 61dBA, PUHZ-W85VHA2 is 62.5dBA, PUHZ-W112VHA is 65dBA, PUHZ-HW140VHA2 is 65.5dBA, PUHZ-HW140YHA2 is 67.5dBA. Tested to BS EN12102.
*5 Grille.
*6 MCB Sizes BS EN60898-2 & BS EN60947-2.
*7 Flow Temperature Controller (FTC) for standalone systems PAC-IF062B-E Dimensions WxDxH (mm) - 520x150x450

η_s is the seasonal space heating energy efficiency (SSHEE) η_{wh} is the water heating energy efficiency

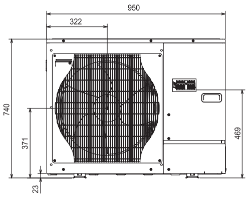
DIMENSIONS

PUHZ-W50VHA2(-BS)

Upper View

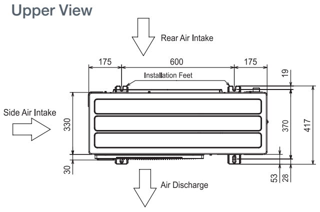


Front View

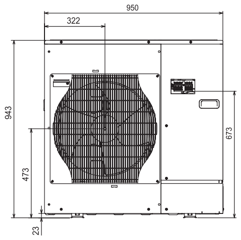


PUHZ-W85VHA2(-BS)

Upper View

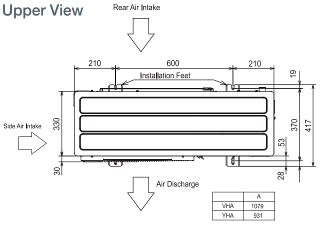


Front View

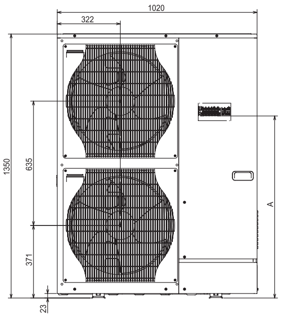


PUHZ-(H)W112-140VHA(2) / YHA2(-BS)

Upper View



Front View



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