Energy & Sustainability Statement

Best Court
119 East Road
London
E15 3QS

21st June 2021

Prepared for:

Thomas-McBrien
RFSK
2 Butcher Row
London E14 8DS

Contents

Appendices

1.0 Executive Summary

The proposed development project at Best Court involves the redevelopment of the existing site to create a terrace of 8 new dwellings arranged over 3 stories.

It has been designed to achieve the highest of environmental performance standards following the Energy Hierarchy as set down by the London Plan and the London Borough of Newham's local plan policies.

The report takes on board the latest GLA guidance on writing energy statements as well as taking into account matters raised with the newly adopted London Plan.

eb7 Sustainability Ltd have been appointed to develop a strategy and advise how the proposed development of new build apartments will comply with these requirements.

A 'Lean, Clean, Green' has been adopted and the development achieves an overall improvement (DER/TER) in regulated emissions at over **71%** above Part L 2013 standard, through the adoption of high standards of insulation, heat pump driven heating and hot water systems and a roof mounted PV array.

Taking into account the embedded carbon within the demolition and construction works, the development still achieves an overall reduction in its construction and operation carbon footprint at over **19%.**

As such, this non-major domestic development will meet with both Local Plan and London Plan requirements.

2.0 The Site & Proposal

The site is currently occupied an existing residential block, arranged over 3 floors.

The proposal for the site includes the demolition of the existing building and redevelopment of the site to create a terrace of 8 residential units, with associated refuse storage, cycle storage, and amenity space.

2.1 Local Planning Context

The project sits within the London Borough of Newham (Newham).

Newham's Local Plan 2018 combines and updates the Borough's previous Core Strategy (2012) and Detailed Sites & Policies DPD (2016).

Key polices are:-

SC1 - Environmental Resilience

Proposals that address the following strategic principles, spatial strategy and design and technical criteria will be supported:

1. Strategic Principles:

a. In design, construction, and operation, development must respond to the known effects of climate change, including the likelihood of extreme weather events, geohazard risks, increased water scarcity and warmer temperatures;

b. Development must be resource-efficient, recognising the increasing pressure on resources due to population growth and environmental stress as well as the economic opportunities of 'waste';

c. Bolster the Council's wider resilience agenda, development will promote local production (notably food growing), procurement, and labour (see J3);

d. Ameliorate past environmental degradation, (as evident in water quality, habitat loss and contaminated land) to enhance site potential and minimise future degradation;

e. Encourage the take-up of opportunities to improve resource efficiency in existing homes and buildings through retrofitting, subject to the sensitivities identified in SP5; and

f. Development should take advantage of linked opportunities in sustainable design and minimise conflict between different strands, notably through:

i. The biodiversity, pollution control and flood-reduction benefits of surface water attenuation measures as per the SUDS hierarchy (see SC3);

ii. The temperature-regulation and surface water attenuation benefits of biodiversity enhancements (see SC4);

iii. Avoiding conflict with air quality objectives (see SC5);

iv. The opportunity to integrate food growing, including consideration as a temporary use.

3. Design and technical criteria:

a. Development will achieve at least the following standards (Table 11), or equivalent standards within updated/replacement schemes:

- Residential - London Plan Zero Carbon As per policy SC2

b. All development will incorporate water efficiency measures to achieve a consumption target of 105 litres or less per head per day (residential) or 'excellent' Wat 01 rating (non-residential development the subject of a BREEAM assessment);

c. Where contamination is known or suspected, proposals will include adequate investigation of land contamination with remedial works agreed prior to the start of development. Reference to CLR11 Model Procedures for the Management of Land Contamination or subsequent updates should be made;

d. Development should demonstrate that the risks of overheating have been addressed through design and construction choices, particularly in the case of high density and public realm schemes and in relation to energy and glazing solutions; and

e. Landscaping schemes will demonstrate consideration of climate change effects through planting choices that are resilient to higher temperatures and scarce water supply.

SC2 - Energy and Zero Carbon

Proposals that address the following strategic principles, spatial strategy and design and technical criteria will be supported:

1. Strategic Principles:

a. All development will minimise and reduce carbon emissions by following the lean, clean, green energy hierarchy; all Major development will meet London Plan Zero Carbon targets; and

b. Energy planning should contribute to the Council's Resilience agenda in relation to costs and service level in the ongoing provision of energy.

2. Spatial Strategy:

a. The development and expansion of decentralised energy networks (including low-carbon generation, storage and transmission infrastructure) will be a central component of the scale of growth within the Arc of Opportunity; and

b. Development should be configured to maximise the use of natural and waste energy sources including sunlight/daylight and (where feasible) ground / air / water / waste heat, where otherwise acceptable in terms of environmental impacts.

3. Design and technical criteria:

a. All development is encouraged to incorporate Smart Meter technology that allows occupants to monitor and manage their energy usage. Major development will be required to commit to carrying out post-construction audits demonstrating compliance with CO2 reduction targets and incorporate Smart Meters that deliver monitoring data to the Local Authority for a minimum period of 3 years post-occupation;

b. Statements setting out how development complies with the above strategic principles and spatial strategy should be provided; all Major development should be accompanied by an Energy Strategy/Assessment that:

i. Conforms to latest GLA guidance (currently Energy Planning – March 2016) and requirements/guidance concerning Zero Carbon;

ii. Prioritises connection to heat networks (where they exist or planned development is known) and confirms appropriate mechanisms will be put in place to ensure end customers are protected in respect of the price of energy and level of service provided;

iii. Provides for connection to heat networks in future where connection is not made prior to occupation (including detail of any required retrofitting);

iv. Demonstrates compliance with air quality standards, including the emissions standards for renewable and low-carbon plant set out in London Plan guidance;

and

v. Confirms that the risks of overheating have been addressed through the design of the development, as per policy SC1.

c. Developments connecting to heat networks will provide evidence of ongoing management mechanisms, ensuring end customers are protected in respect of the price of energy and level of service.

2.2 The London Plan

Chapter 9 deals with Sustainable Infrastructure:-

Policy SI1 Improving air quality

A London's air quality should be significantly improved and exposure to poor air quality, especially for vulnerable people, should be reduced:

Development proposals should not:

a) lead to further deterioration of existing poor air quality

b) create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits

c) reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality

d) create unacceptable risk of high levels of exposure to poor air quality.

5) Air Quality Assessments (AQAs) should be submitted with all major developments, unless they can demonstrate that transport and building emissions will be less than the previous or existing use.

Policy SI2 Minimising greenhouse gas emissions

A Major development should be net zero-carbon. This means reducing carbon dioxide emissions from construction and operation, and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

1) Be lean: use less energy and manage demand during construction and operation.

2) Be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly. Development in Heat Network Priority Areas should follow the heating hierarchy in Policy SI3 Energy infrastructure.

3) Be green: generate, store and use renewable energy on-site.

B Major development should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy and will be expected to monitor and report on energy performance.

C In meeting the zero-carbon target a minimum on-site reduction of at least 35 per cent beyond Building Regulations is expected. Residential development should aim to achieve 10 per cent, and non-residential development should aim to achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided:

1) through a cash in lieu contribution to the relevant borough's carbon offset fund, and/or

2) off-site provided that an alternative proposal is identified and delivery is certain.

Policy SI3 Energy infrastructure

D Major development proposals within Heat Network Priority Areas should have a communal heating system

1) the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

a) connect to local existing or planned heat networks

b) use available local secondary heat sources (in conjunction with heat pump, if required, and a lower temperature heating system)

c) generate clean heat and/or power from zero-emission sources

d) use fuel cells (if using natural gas in areas where legal air quality limits are exceeded all development proposals must provide evidence to show that any emissions related to energy generation will be equivalent or lower than those of an ultra-low NOx gas boiler)

e) use low emission combined heat and power (CHP) (in areas where legal air quality limits are exceeded all development proposals must provide evidence to show that any emissions related to energy generation will be equivalent or lower than those of an ultra-low NOx gas boiler)

f) use ultra-low NOx gas boilers.

2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that there is no significant impact on local air quality.

3) Where a heat network is planned but not yet in existence the development should be designed for connection at a later date.

Policy SI4 Managing heat risk

A Development proposals should minimise internal heat gain and the impacts of the urban heat island through design, layout, orientation and materials.

B Major development proposals should demonstrate through an energy strategy how they will reduce the potential for overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

1) minimise internal heat generation through energy efficient design

2) reduce the amount of heat entering a building through orientation, shading, albedo, fenestration, insulation and the provision of green roofs and walls

3) manage the heat within the building through exposed internal thermal mass and high ceilings

4) provide passive ventilation

5) provide mechanical ventilation

6) Provide active cooling systems.

Policy SI5 Water infrastructure

C Development proposals should:

1) minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)

2) achieve at least the BREEAM excellent standard (commercial development)

3) be encouraged to incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future proofing.

2.3 Reporting Strategy

The project at Best Court – at 8 units – would be considered a non-major scheme and this report is informed accordingly.

The project will comply with the above noted local plan requirements in so much as they apply to the non-major scheme.

However, design team at utilising SAP10 emissions data, in line with the latest GLA guidance on the preparation of energy statements (April 2020).

3.0 Baseline energy results

The first stage of the Mayor's Energy Hierarchy is to consider the baseline energy model.

The following section details the baseline energy requirements for the development – the starting point when considering the energy hierarchy.

3.1 New Build Dwellings

The baseline emission levels – the Target Emission Rate (TER) - is obtained by applying the design to a reference 'notional' building the characteristics of which are set by regulations – SAP2012; The new Part L Building Regulations 2013 came into force on April 2014 and introduced a completely new notional dwelling as detailed below:-

Table 4 Summary of concurrent notional dwelling specification

Element or System	Values
Opening areas (windows and doors)	Same as actual dwelling up to a maximum proportion of 25% of total floor area [1]
External Walls (including opaque elements of curtain walls) [6]	0.18 W/m²K
Party Walls	0.0 W/m²K
Floor	0.13 W/m²K
Roof	0.13 W/m²K
Windows, roof windows, glazed rooflights and glazed doors	1.4 W/m²K [2] (Whole window U-value)
	g-value = 0.63 [3]
Opaque doors	1.0 W/m²K
Semi glazed doors	1.2 W/m²K
Air tightness	5.0 m³/hr/m²
Linear thermal transmittance	Standardised psi values – See SAP Appendix R, except use of y=0.05 W/m²K if the default value of y=0.15 W/m²K is used in the actual dwelling
Ventilation type	Natural (with extract fans) [4]
Air conditioning	None

Element or System	Values
Heating System	Mains gas If combi boiler in actual dwelling, combi boiler; otherwise regular boiler Radiators
	Room sealed
	Fan flue
	SEDBUK 2009 89.5% efficient
Controls	Time and temperature zone control [5] Weather compensation
	Modulating boiler with interlock
Hot water storage system	Heated by boiler (regular or combi as above) If cylinder specified in actual dwelling, volume of cylinder in actual dwelling. If combi boiler, no cylinder. Otherwise 150 litres. Located in heated space. Thermostat controlled Separate time control for space and water heating
Primary Pipework	Fully Insulated
Hot water cylinder loss factor (if specified)	Declared loss factor equal or better than 0.85 x (0.2 + 0.051 V2/3) kWh/day
Secondary Space Heating	None
Low Energy Lighting	100% Low Energy Lighting
Thermal Mass Parameter	Medium (TMP=250)

SAP first creates the notional reference building, based upon the same shape and form as the proposed dwelling and applies the above the characteristics as defined in SAP2012.

Once all of the baseline emission rates have been calculated in line with the above Government approved methodologies, they are considered as stage 'zero' of the energy hierarchy as described earlier and Target Emission Rate sets the benchmark for the worst performing, but legally permissible, development.

For the project at Best Court, a sample of 3 houses has been selected at mid and end terrace to offer a representative selection to enable an accurate figure for emissions/m^2 which can then be applied to the full gross internal residential floor area.

All emissions data in then converted to SAP10 emissions via the use of the GLA SAP10 conversion spreadsheet – attached at **Appendix D**.

3.2 Unregulated Energy Use

The baseline un-regulated energy use for cooking & appliances in the residential units have been calculated using the SAP Section 16 methodology; the same calculation used for Code for Sustainable Homes (CfSH) Ene 7.

Appliances = E_A = 207.8 X (TFA X N)$^{0.4714}$

Cooking = (119 + 24N)/TFA

N = no of occupant SAP table 1B

TFA – Total Floor Areas

The SAP10 emissions associated with unregulated energy use per sqm is summarised in Table 1 below

Table 1 – Unregulated Energy Use

Unit	CO_2 emissions - Unregulated Energy Use SAP2012 Kg/sqm	CO_2 emissions - Unregulated Energy Use SAP10 Kg/sq
Sample 1	15.15	6.82
Sample 2	15.15	6.82
Sample 3	15.15	6.82

The un-regulated emission rates are added to the baseline regulated emission rates (as calculated under 3.1 above) in order to set the total baseline emission rates before then applying the energy hierarchy in line with The London Plan and Newham policies.

3.3 Demolition and construction impacts

At pre-application stage, there was a specific request for the project to consider:-

"A future application should demonstrate that pollutants released through the demolition and construction period will be successfully offset"

In order to establish the level of pollutants (CO_2), this project has considered the environmental impact via the methodology set out in the Mayor's Whole Life-Cycle Carbon Assessments Guidance - Consultation Draft - October 2018

The framework for appraising the environmental impacts of the built environment is provided by BS EN 15978: 2011: (Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method). It sets out the principles and calculation method for whole life assessment of the environmental impacts from built projects based on life-cycle assessment.

Underpinning BS EN 15978 is the RICS Professional Statement: Whole Life Carbon assessment for the built environment (referred to as the RICS PS for the remainder of this guidance)4. The RICS PS serves as a guide to the practical implementation of the BS EN 15978 principles. It sets out technical details and calculation requirements.

Accordingly, the assessment of the demolition and construction site works - Category A5 Site - follows BS EN 15978 using the RICS PS as the methodology for the WLC assessment, specifically:-

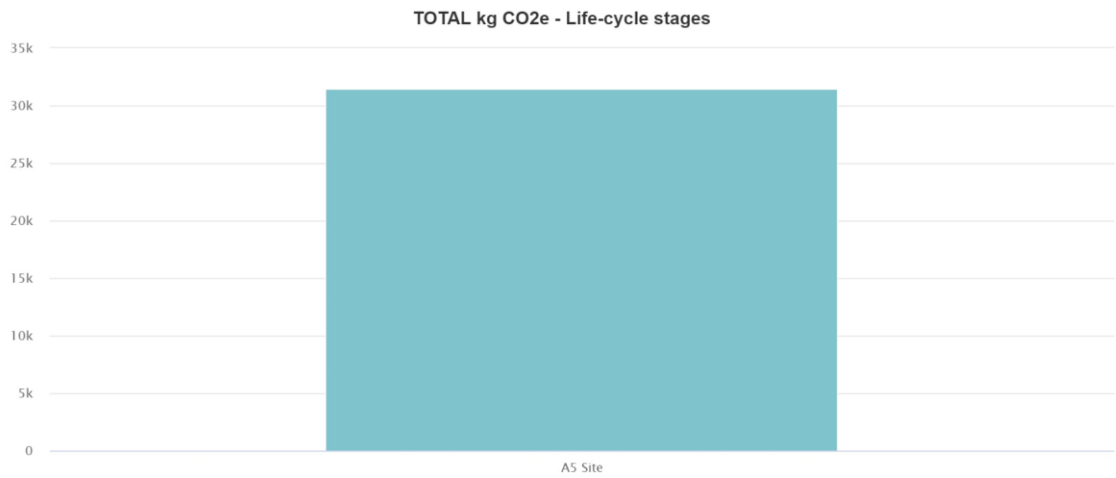
- RICS category major demolition works - average deconstruction and demolition process - based upon a gross internal area of the existing structure at 385m^2
- Average Site Impacts per project value (RICS2020), based upon construction costs at £2.25million.

Gathering and managing all the necessary whole life carbon information relating to each element of the life cycle is a very detailed and complex process. Fortunately, this is a well-studied topic and there are various databases and tools available which have been developed with this data integrated to allow for representative calculations to be made. The tool eb7 used to undertake the LCA is OneClick LCA.

One Click LCA is an online Building Life-Cycle Assessment software. It is an industry-leading platform that is used by many construction industry firms, such as Foster+Partners, Skanska, WSP, Ramboll, Saint-Gobain and Bouygues Construction.

One Click LCA is compliant with BREEAM UK NC 2018 and can achieve up to 10 Mat 01 credits; it has the highest rated LCA software for BREEAM, with a verified maximal Mat 01 score of 100%. The tool is also third-party verified for EN 15978, ISO 21931-1, ISO 21929-1 and for input data for ISO 14040/44 and EN 15804 standards.

The calculations suggest a carbon cost for the demolition and construction works at 31.5tonnes CO_2 (see One Click LCA output below)



This figure will be utilised in the final carbon offset calcualtions

3.4 Baseline Results

The baseline building results for the operation carbon emissions have been calculated, converted to SAP10 emission standards and are presented in Table 2 below.

The Baseline SAP outputs (which summarise the key data) are attached at **Appendix A**, with the conversion calculations at **Appendix D.**

Table 2 – Baseline energy consumption and CO2 emissions

Unit	Target Emission Rate (regulated energy use) Kg/sqm	Unregulated Energy Use Kg/sqm	Total baseline emissions Kg/sqm	Total baseline emissions Kg
Sample 1	16.70	6.82	23.55	2121.67
Sample 2	15.80	6.82	22.58	2033.99
Sample 3	16.70	6.82	23.55	2121.67
Development Total				**16725**

4.0 Design for energy efficiency

The first step in the Mayor's 'Energy Hierarchy' as laid out in Chapter 9 of The London Plan, requests that buildings be designed to use improved energy efficiency measures – Be Lean. This will reduce demand for heating, cooling, and lighting, and therefore reduce operational costs while also minimizing associated carbon dioxide emissions.

This section sets out the measures included within the design of the development, to reduce the demand for energy, both gas and electricity (not including energy from renewable sources). The table at the end of this section details the amount of energy used and CO_2 produced by the building after the energy efficiency measures have been included. From these figures the overall reduction in CO_2 emissions, as a result of passive design measures, can be calculated. To achieve reductions in energy demand the following measures have been included within the design and specification of the building:

4.1 Passive Design

The National Planning Policy Framework emphasises the need to take account of climate change over the longer term and plan new developments to avoid increased vulnerability to the range of impacts arising from climate change. The UK Climate Impacts Programme 2009 projections suggest that by the 2080's the UK is likely to experience summer temperatures that are up to 4.2°C higher than they are today.

Accordingly, designers are to ensure buildings are designed and constructed to be comfortable in higher temperatures, without resorting to energy intensive air conditioning.

In line with current GLA Guidance, the project at Best Court has had been designed to ensure the building is not vulnerable to overheating; to instigate consideration of the risk of overheating with the proposed development, the design team have followed the guidance within the London Plan, which consider the control of overheating using the Cooling Hierarchy:-

1. **minimise internal heat generation through energy efficient design**

The project will be designed to best practice thermal insulation levels as noted, full details of which are noted under 4.3 below.

Not only does good insulation assist in reducing heat losses in the winter, it has a significant impact on preventing heat travelling through the build fabric during the summer.

2. **reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and wall**

The development site is in a suburban townscape, with an east-west orientation. To the east and west are 3 storey dwelling that will offer an element of shading to the main ground floor living areas from the morning and evening sun.

The livings areas to the main block have the benefit of large glazed areas arranged to the east and west – thus avoiding the peak southern aspect, while also introducing natural daylight and attracting useful solar gain.

There is no directly south facing glazing, avoiding the impact of excessive solar gain from the peak summer sun.

Across the scheme, the glazing to the secondary spaces – bedrooms and bathrooms – is much reduced in keeping with the reduced heat demand associated.

Glazing specification has been a significant consideration as part of the overheating risk mitigation and the specified new glazing will achieve a g-value of 0.55 or better in order to further assist in reducing any limited overheating risk.

3. **manage the heat within the building through exposed internal thermal mass and high ceilings**

All houses are designed with floor to floor heights at circa 2.4m.

The new build structure is expected to be a traditional brick/block, offering significant thermal mass able to absorb heat during the summer months, which can then be ventilated during the evening or overnight.

4. **passive ventilation**

Given the relatively quiet suburban location, all glazing is designed to have opening areas to introduce high levels of natural levels of "purge" ventilation to further assist in the reduction of overheating risks in appropriate areas.

All units have the ability to cross ventilate.

5. **mechanical ventilation**

Given the strategy outlined above, there is no requirement to introduce mechanical ventilation; the project is to be naturally ventilated in line with AD Part F System 1.

4.2 Heating System

The notional heating system considered under the "be lean – use less energy" section of the Energy Hierarchy, will consist of high efficiency condensing gas boilers providing under floor heating and domestic hot water to the project

- High efficiency boiler – (89%+ SEDBUK efficiency) & load compensation.
- Insulated primary pipework

To increase the efficiency in the use of the heating system, the following controls will be used to eliminate needless firing of the boilers.

- Boilers fitted with load compensation and delayed start thermostats.

4.3 Fabric heat loss

Insulation measures will be utilised to ensure the calculated U-values exceed the Building Regulations minima, with specific guidance taken from the design team: -

- New wall constructions will be of a traditional brick/block construction and will target a U-Value of 0.18w/m^{2}k or better.
- New pitched roof constructions are to be of a warm-roof type, achieving a U-Value of 0.12w/m^{2}k.
- The newly laid floors will achieve a minimum u value of 0.14/0.15w/m^{2}k subject to perimeter/area ratios

Glazing

- The new glazing for windows and doors will be triple glazed with an area weighted average U-Value of 1.2w/m^{2}K or better.

Air Tightness

- The project be tested to 5m^3/hr/m^2 in line with best practice for naturally ventilated dwellings.

Construction Details

- Heat loss via non-repeating thermal bridging within the new build elements will be minimised by the use of Accredited Construction Details for these new build units. An overall Y-Value <0.07 is targeted.

4.4 Ventilation

As noted above, the project is to be 100% naturally ventilated in line with AD Part F System 1; background (trickle) ventilation, with purge ventilation via opening windows and intermittent extracts to wet rooms.

4.5 Lighting and appliances

The development will incorporate high efficiency light fittings utilising LED lamps.

The use of LED lighting will also minimise the internal gains commonly associated with tungsten and fluorescent lighting systems and thereby further reduce the potential for the houses to overheat.

4.6 Energy efficiency results

The above data has been used to update the SAP models, the Dwelling Emission Rate outputs of which are attached at **Appendix B**, whilst Table 3 sets out the total emissions using SAP10 data.

Table 3 – Energy Efficient emission levels

Unit	Emission Rate (regulated energy use) Kg/sqm	Unregulated Energy Use Kg/sqm	Total baseline emissions Kg/sqm	Total baseline emissions Kg
Sample 1	14.70	6.82	21.52	1938.37
Sample 2	13.80	6.82	20.63	1858.27
Sample 3	14.70	6.82	21.52	1938.37
Development Total				**15280**

The results show that the energy efficiency measures introduced have resulted in the reduction in CO_2 emissions from the development of **8.64%.**

Regulated emissions have been reduced by **12.23%** via the passive design measures highlighted above - in line with London Plan requirements for Major schemes.

5.0 Supplying Energy Efficiently

The second stage in the Mayor's 'Energy Hierarchy' is to ensure efficient and low carbon energy supply – Be Clean. In particular, this concerns provision of decentralised energy where practical and appropriate.

5.1 Community Heating/Combined Heat and Power (CHP)

The London Plan, Chapter 9, requires that major developments exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly. Development in Heat Network Priority Areas should follow the heating hierarchy in Policy SI3 Energy infrastructure.

Therefore, this report must consider the availability of heat networks in the Newham area The extract from the London Heat Map (reproduced below) identifies that the site is within the Heat Network Priority Area.

Extract from London Heat Map

Clearly there is no potential for the project site to connect to a DEN at any time in the foreseeable future.

As a non-major scheme, there is no obligation to be designed to be DEN connection ready, however, the chosen wet heating system would be compatible with a DEN connection; in particular, the LTHW heating system would provide the necessary flow and (low) return temperatures compatible with DEN connections.

In the medium term, the design team must consider the potential of a stand alone communal system.

5.2 On-site CHP/District Heating

A community heating network comprises a series of insulated pipes used to deliver heat, in the form of hot water or steam, to a number of different locations or dwellings. They range from small, providing heat to a house and a couple of holiday cottages for example, to large scale systems supplying housing estates or blocks of flats.

The heat production facility for a DH scheme is generally considered to include heat only boilers (HOB) and/or the production of both electricity and heat i.e. CHP.

CHP systems are essentially fossil fuel fired electricity generators that use the heat by-product to provide space and water heating. The electricity generated can be used directly within the host buildings or sold to electricity suppliers on the national grid.

CHP is, as a rule of thumb, is only operated as a base load as, depending on the technology, it may be difficult and/or inefficient to operate according to daily variations in demand. In a well-designed district heating network heat from CHP will provide between 60% and 80% of the annual baseline heat (heating and hot water) requirement with heat-only boiler plants providing the peak load and back-up. To maximise efficiency of the engine it needs to run for at least 17 hours a day; therefore, the heat load needs to be present for this period.

Clearly, as a small scale residential development, with only the limited year round DHW demand to support a CHP installation (approx. 2-4 hours per day in the May – October period), the economy of scale, in terms of year-round demand, simply isn't present and as such the potential use of on-site CHP is very limited.

We must also consider the net carbon benefits from such a system as the de-carbonisation of national grid dilutes the benefits obtained from the higher efficiency of larger-scale CHP led system.

Reference is made to the latest CIBSE Symposium on the topic; "An operational lifetime assessment of the carbon performance of gas fired CHP led district heating" (2016). This paper sets out a calculation methodology to determine the greenhouse gas emissions associated with district heat networks which use gas fired CHP as a heat source.

Currently, Part L calculations and CHP emissions savings are based on the grid based emission rate taken from the SAP 2012 3-year average - 519g/KwhCO2; SAP 2012 introduced a 15-year average at 381g/KwhCO2 to assist designers considering the longer term impacts.

Such a difference will markedly affect the relative calculated performance of a gas CHP engine versus a heat only gas boiler.

The CIBSE paper further advises that "Using a typical good practice assumption of 40% thermal efficiency of the CHP, the threshold for net benefit is a grid carbon factor of around 338 gCO2/kWh. Below that threshold, CHP is found to be worse than a gas boiler and grid electricity."

DECC provides data for treating energy and emissions in their guidance; this provides projections of grid emissions factors over the next 85 years. With the rapid and recent introduction of renewable technologies to the grid – wind power and PV - DECC's "Green Book" guidance projects that grid carbon intensity will reach 338 gCO2/kWh by 2017/18 and will reach 300gCO_2/kWh by 2018/19.

SAP10 data, be utilised within this report, uses a figure of 233 gCO_2/kWh.

So it can be surmised, that by the time an CHP led boiler system at 140 Fortis Green has reached maturity over the next couple of years, the carbon benefits will already have been lost.

However, this report must also consider the potential for heat only boilers to drive a community heating system; in more recent times, the difference between the actual and assumed efficiency of DH networks has come under the spotlight from a number of different sources.

Indeed, in a recent studies collated by Innovate UK in the Building Data Exchange, inappropriately installed community heating systems were suffering heat losses of 50% or more.

However, when it comes to small scale networks as least, it is becoming very apparent that there is a difference between theoretical and real-world system efficiencies.

In the CBSE Technical symposium "CHP and District Heating - how efficient are these technologies?" (2011), further commentary is made on this issue.

This paper defines an 'equivalent heat efficiency' parameter and a CO_2 content of heat supply to enable Combined Heat and Power (CHP) to be compared to boilers and heat pumps

This report identifies and acknowledge that the heat losses within a well-designed DH network will be at minimum of 15%, so immediately it can be seen that, a large scale modular boiler system offering gross efficiencies at circa 96%, will be less efficient than a local condensing boiler with a gross efficiency of 92%-93% at point of delivery.

It can be summarised, an a small scale 8 unit scheme with no future DEN potential connection, the installation of a centralised LTHW system would be counter-productive.

6.0 Renewable Energy Options

The final element of the Mayor's 'Energy Hierarchy' requires development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible – Be Green.

Renewable energy can be defined as energy taken from naturally occurring or renewable sources, such as sunlight, wind, wave's tides, geothermal etc. Harnessing these energy sources can involve a direct use of natural energy, such as solar water heating panels, or it can be a more indirect process, such as the use of Biofuels produced from plants, which have harnessed and embodied the suns energy through photosynthesis.

The energy efficiency measures and the sourcing the energy efficiently outlined above have the most significant impact on the heating and hot water energy requirements for the development, and the associated reduction in gas consumption.

This section then sets out the feasibility of implementing different energy technologies in consideration of: -

- Potential for Carbon savings
- Capital costs
- Running costs
- Payback period as a result of energy saved/Government incentives
- Maturity/availability of technology
- Reliability of the technology and need for back up or alternative systems.

6.1 Government incentives

6.1.1 Renewable Heat Incentive

The Renewable Heat Incentive (RHI) was formally withdrawn to non-domestic applications (i.e. developer lead applications) in March 2021.

6.2 Wind turbines

Wind turbines come in two main types'- horizontal axis and vertical axis. The more traditional horizontal axis systems rotate around the central pivot to face into the wind, whilst vertical axis systems work with wind from all directions.

The potential application of wind energy technologies at a particular site is dependent upon a variety of factors. But mainly these are: -

- Wind speed
- Wind turbulence
- Visual impact
- Noise impact
- Impact upon ecology

The availability and consistency of wind in urban environments is largely dependent upon the proximity, scale and orientation of surrounding obstructions. The site is flanked by other properties at 3 stories in all directions. To overcome these obstructions and to receive practical amounts of non-turbulent wind, the blades of a wind turbine would need to be placed significantly above the roof level of the surrounding buildings and the proposed project at Best Court itself.

It is inconceivable that any wind turbines of this size would be considered acceptable in this location.

6.3 Solar Energy

The proposed development has areas of low pitched roof that could accommodate solar panels orientated to the south.

In general, the roofs will have an unrestricted aspect, so there is scope therefore to site solar photovoltaic (PV) or water heating equipment at roof level.

6.3.1 Solar water heating

Solar water heating panels come in two main types; flat plate collectors and evacuated tubes. Flat plate collectors feed water, or other types of fluid used specifically to carry heat, through a roof mounted collector and into a hot water storage tank. Evacuated tube collectors are slightly more advanced as they employ sealed vacuum tubes, which capture and harness the heat more effectively.

Both collector types can capture heat whether the sky is overcast or clear. Depending on location, approximately 900–1100 kWh of solar energy falls on each m^2 of unshaded UK roof surface annually. The usable energy output per m^2 of solar panel as a result of this amount of insolation ranges from between 380 – 550 kWh/yr.

Solar hot water systems are of course, displacing gas for DHW provision (as noted above), and due to the low cost of gas as a source of energy, solar thermal systems tend to have a very poor pay back model unless there is a reliable and consultant demand for hot water; a medium size residential scheme simply does not provide this

Accordingly, given the limited roof space available and the strategy to off-set the electrical use, solar PV may be a stronger candidate (see below) and offer a greater return in terms of a return on investment.

6.3.2 Photovoltaics (PV)

A 1kWp (1 kilowatt peak) system in the UK could be expected to produce between 790-800kWh of electricity per year based upon a south east orientation according to SAP2005 methodology used by the Microgeneration Certification Scheme (MCS). The figure given in the London Renewables Toolkit is 783 kWh per year for a development in London.

Despite the withdrawal of the Feed in Tariff, the returns on PV installations can still achieve levels at 3-4% via the reduction in electricity consumption – becoming more significant as electricity costs rise.

Accordingly, the design team are proposing the use of an 32 panels array located on the south west facing pitched roofs; 4 panels per dwelling - a total array at 10.56Kwp, producing some 8,694.56Kwh/annum.

6.4 Biomass heating

Biomass is a term given to fuel derived directly from biological sources for example rapeseed oil, wood chip/pellets or gas from anaerobic digestion. It can only be considered as a renewable energy source if the carbon dioxide emitted from burning the fuel is later recaptured in reproducing the fuel source (i.e. trees that are grown to become wood fuel, capture carbon as they grow).

Biomass heating systems require space to site a boiler and fuel hopper along with a supply of fuel – which can be very bulky items. There also needs to be a local source of biomass fuel that can be delivered on a regular basis. There are also issues with fuel storage and delivery which mitigate against this technology. There is inadequate space at ground floor level for a fuel store and limited access for delivery lorries.

Additionally, a boiler of this type would replace the need for a conventional gas boiler and therefore offset all the gas energy typically used for space and water heating. However, biomass releases high levels of NO_x emissions and particulate matters, as well as other pollutants and would therefore have to be considered carefully against the high standard of air quality requirements in and around Newham's Borough main road AQMAs. Accordingly, the use of biomass is not considered appropriate for this project.

6.6 Ground source heat pump

All heat pump technologies utilise electricity as the primary fuel source – in this case displacing gas, as such, the overall reduction in emissions when using this technology can be less effective when opposed to a technology that is actually displacing electricity.

Ground source heating or cooling requires a source of consistent ground temperature, which could be a vertical borehole or a spread of pipework loops and a 'heat pump'. The system uses a loop of fluid to collect the more constant temperature in the ground and transport it to a heat pump. In a cooling system this principle works in reverse and the heat is distributed into the ground.

The heat pump then generates increased temperatures by 'condensing' the heat taken from the ground, producing hot water temperatures in the region of 45°C. This water can then be used as pre-heated water for a conventional boiler or to provide space heating with an under-floor heating system.

The use of a ground source heating/cooling system will therefore require:

- Vertical borehole or ground loop
- Use of under floor heating
- Space for heat pump unit

Clearly, there is insufficient land area to install low level collector loops, leaving deep bore GSHP as the only potential option.

Normally the boreholes would need to be 6 to 8 metres apart and a 100-metre-deep borehole will only provide about 5kw of heat. The borehole should also be formed around 3m away from the perimeter of the building and most specialists don't recommend using the structural boreholes.

Clearly, in the case of the proposed development, there is little scope for the locating of the ground collector devices and as such, ground source heating cannot be considered.

6.7 Air source heat pump

Air source heating or cooling also employs the principle of a heat pump. This time either, upgrading the ambient external air temperature to provide higher temperatures for water and space heating, or taking warmth from within the building and dissipating it to the outdoor air.

It must be remembered that heat pumps utilise grid based electricity, so calculations base the benefits on SAP10 emissions data

Assuming a seasonal system efficiency of 320% (Coefficient of Performance of 3.2) and that the air source heat pump will replace 100% of the space heating/hot water demand, then the system would reduce the overall CO_2 emissions by approximately 60%. The table below demonstrates, on the assumption of a demand of 1000Kwh/year for heating and hot water.

Table 4 – ASHP Performance

Type of Array	Energy Consumption (Kwh/yr.)	Emission factor ($kgCO_2$/Kwh)	Total CO_2 emissions (kg/annum)
90% efficient gas boiler	11111	0.210	2333
320% efficient ASHP	2813	0.233	655
100% efficient immersion (back-up)	1000	0.233	233

A theoretical carbon saving of 60%

Accordingly, the design team are proposing the use of air source heat pump systems located in specific plant areas adjacent to each dwelling to service the heating requirements for the houses via internally mounted hydro-box units – providing heating and hot water.

6.8 Final Emissions Calculation

Given the outcome of the feasibility study above, the developer is proposing the use the above noted air source heat pump system for the heating and DHW requirements and a roof mounted PV array

The final table – Table 5 – summarises the final outputs from the SAP models; attached at **Appendix C.**

Table 5 – "Be Green" emission levels

Unit	Emission Rate (regulated energy use) Kg/sqm	Unregulated Energy Use Kg/sqm	Total baseline emissions Kg/sqm	Total baseline emissions Kg
Sample 1	4.70	6.82	11.52	1038.04
Sample 2	4.50	6.82	11.36	1023.53
Sample 3	4.70	6.82	11.52	1038.04
Development Total				**8258**

The data at Table 5 confirms that overall emissions – including unregulated energy use - have been reduced by **50.62%** over and above the baseline model, with a **45.96%** reduction in emissions directly from the use of energy generating and renewable technologies, i.e. over and above the energy efficient model.

Excluding the un-regulated use, i.e. considering emissions controlled under AD Part L, then the final reduction in DER/TER equates to **71.65%.**

7.0 Sustainable Design & Construction

The Sustainability credentials of the proposed residential development are set out below; based on the assessment criteria developed by the Building Research Establishment

Materials

New build construction techniques will be considered against the BRE Green Guide to ensure that, where practical, the most environmentally friendly construction techniques are deployed.

Construction materials will be sourced from suppliers capable of demonstrating a culture of responsible sourcing via environmental management certification, such as BES6001

Insulation materials will be selected that demonstrate the use of blowing agents with a low global warming potential, specifically, a rating of 5 or less. Additionally, all insulants used will demonstrate responsible sourcing of material and key processes.

The principle contractor with be required to produce a site waste management plan and sustainable procure plan, in line with BREEAM requirements – this will include a pre-demolition audit to identify demolition materials to reuse on-site or salvage appropriate materials to enable their reuse or recycling off-site. The procurement plan will follow the waste hierarchy Reduce; Reuse & Recycle.

A Site Waste Management Plan (SWMP) will be developed prior to commencement of development stage to inform the adoption of good practice waste minimisation in design. This will set targets to minimise the generation of non-hazardous construction waste using the sustainable procurement plan to avoid over-ordering and to use just-in-time delivery policies.

Operational waste and recycling – appropriate internal and external storage space will be provided to ensure that residents can sort, store and dispose of waste and recyclable materials in line with Greenwich's collection policies.

Pollution

The contractor will also monitor the use of energy and water use during the construction phase and incorporate best site practices to reduce the potential for air (dust) and ground water pollution.

The completed dwellings will use zero emission heat pump systems for heating and hot water.

The main contractor will be required to register the site with the Considerate Constructors Scheme and achieve a best practice score of 25 or more.

To void the issue of noise pollution, the development will comply with Building Regulations Part E, providing a good level of sound insulation between the proposed development and surrounding buildings.

Energy

The dwelling will incorporate renewables technologies as noted in the main report above.

The new homes will also be supplied with a Home User Guide offering practical advice on how to use the home economically and efficiently, including specific advise on how to reduce unregulated energy uses.

This will be further enhanced by the installation of smart energy metering, enabling occupants to accurately assess their energy usage and thereby, manage it; specifically aligning with local plan policy SC2.

Water

The development minimise water use as far as practicable by incorporating appropriate water efficiency and water recycling measures. The applicants will ensure that all dwellings meet the required level of 105 litres maximum daily allowable usage per person in accordance with Level 4 of the Code for Sustainable Homes.

A sample Part G internal water use calculation is attached at **Appendix E**.

Sustainable Urban Drainage (SuDs)

The existing site is currently made up entirely of building and hard surfaces. Accordingly, the introduction of new planted areas and green roof areas will help to reduce the levels of surface water run-off.

A formal flood risk assessment and SuDs strategy is submitted under separate cover

Ecology and Biodiversity

Clearly, the existing site is 100% previously developed - building and car parking areas - so any improvement on this situation would increase biodiversity.

The development will offer private amenity space capable of being planted, and owners will be encouraged to install bird boxes.

8.0 Conclusions

This report has detailed the baseline energy requirements for the proposed development, the reduction in energy demand as a result of energy efficiency measures and the potential to achieve further CO_2 reductions using renewable energy technologies.

The baseline results have shown that if the development was built to a standard to meet only the minimum requirements of current building regulations, the total amount of CO_2 emissions would be **16725Kg/year**.

Following the introduction of passive energy efficiency measures into the development, as detailed in section 4, the total amount of CO_2 emissions would be reduced to **15280Kg/year.**

There is also a requirement to reduce CO_2 emissions across the development using renewable or low-carbon energy sources. Therefore, the report has considered the feasibility of the following technologies:

- Wind turbines
- Solar hot water
- Photovoltaic systems
- Biomass heating
- CHP (Combined heat and power)
- Ground & Air source heating

The results of the assessment of suitable technologies relative to the nature, locations and type of development suggest that the most suitable solution to meeting reduction in CO_2 emissions would be the use of heat pump technology for the generation of heating and hot water for the project, alongside a roof mounted 10.56kwp PV array.

This has been used in the SAP models (reproduced at **Appendix C**) for the development which have also been detailed above in Table 5, which show a final gross emission level of **8258Kg/year**, representing a total reduction in emission over the baseline model, taking into account unregulated energy, of **50.62%.**

In addition, the final SAP outputs at **Appendix C** demonstrate that the building achieves an overall improvement in regulated emissions over the Building Regulations Part L standards for regulated emissions of minimum of **71.65%.**

Finally, taking into account the calculated carbon emissions associated with the demolition and construction process under **section 3.3** (above) and adding this to the baseline operational emissions, a total of **43.32t**, then the operational reduction at **8.47t** represents an overall **19.55%,** in line with best practice for non-major schemes.

Accordingly, it has been demonstrated that the impacts of demolition and construction works can be fully offset.

Tables 6 & 7 Demonstrate how the Best Court project complies with the London Plan requirements and the GLA guidance relating to zero carbon development.

Table 6 – Carbon Emission Reductions – Domestic Buildings

Key	Tonnes/annum
Baseline CO_2 emissions (Part L 2013 of the Building Regulations Compliant Development)	11.82
CO2 emissions after energy demand reduction (be lean)	10.37
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean)	0.00
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean) AND renewable energy (be green)	3.35

Table 7 – Regulated Emissions Savings – domestic Buildings

	Regulated Carbon Dioxide Savings	
	(Tonnes CO2 per annum)	%
Savings from energy demand reduction	1.45	12.28
Savings from heat network	0.00	0.00
Savings from renewable energy	7.02	59.39
Total Cumulative Savings	8.47	71.66
	(Tonnes CO_2)	
Carbon Shortfall	3.35	
Cumulative savings for off-set payment	100.5	
Cash-in-lieu Contribution	£N/A	

Appendix A

Baseline/Un-regulated Energy Use:-

SAP Outputs & Target Emission Rates

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
Printed on 16 June 2021 at 14:55:17

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** End-terrace House

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 90.08m²

Site Reference : 119 East Road -BASE **Plot Reference:** Sample 1

Address :

Client Details:

Name:

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)	18.63 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	16.53 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	56.7 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	50.1 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.12 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (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	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas
Data from manufacturer
Combi boiler
Efficiency 89.5 % SEDBUK2009
Minimum 88.0 % **OK**

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	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):	Slight	**OK**
Based on:		
Overshading:	Average or unknown	
Windows facing: North West	7.55m²	
Windows facing: South East	8.19m²	
Windows facing: South West	0.55m²	
Roof windows facing: North West	1.01m²	
Ventilation rate:	4.00	

10 Key features

Roofs U-value	0.12 W/m²K
Party Walls U-value	0 W/m²K

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Neil Ingham	**Stroma Number:**	STRO010943
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Sample 1

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	33.34	(1a)	x	2.4	(2a)	=	80.02	(3a)
First floor	33.34	(1b)	x	2.7	(2b)	=	90.02	(3b)
Second floor	23.4	(1c)	x	2.26	(2c)	=	52.88	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.08	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	222.92	(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) =	0.13	(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)	0.38	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.38	(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

TER WorkSheet: New dwelling design stage

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

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

0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.38	0.41	0.43	0.45

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=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(24d)

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(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			2.28	x	1	=	2.28			(26)
Windows Type 1			7.55		x1/[1/(1.4)+ 0.04]	=	10.01			(27)
Windows Type 2			8.19		x1/[1/(1.4)+ 0.04]	=	10.86			(27)
Windows Type 3			0.55		x1/[1/(1.4)+ 0.04]	=	0.73			(27)
Rooflights			1.01		x1/[1/(1.7) + 0.04]	=	1.717			(27b)
Floor			33.34	x	0.13	=	4.3342			(28)
Walls Type1	128.68	18.57	110.11	x	0.18	=	19.82			(29)
Walls Type2	6.62	0	6.62	x	0.18	=	1.19			(29)
Roof Type1	25.59	1.01	24.58	x	0.13	=	3.2			(30)
Roof Type2	6.22	0	6.22	x	0.13	=	0.81			(30)
Roof Type3	3.72	0	3.72	x	0.13	=	0.48			(30)
Total area of elements, m²			204.17							(31)
Party wall			39.26	x	0	=	0			(32)
Internal wall **			95.5							(32c)
Internal floor			56.74							(32d)
Internal ceiling			56.74							(32e)

** 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) = 55.32 (33)

TER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	14802.44	(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		11.44	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	66.75	(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=	45.62	45.28	44.94	43.36	43.07	41.69	41.69	41.44	42.22	43.07	43.67	44.29	(38)

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

(39)m=	112.38	112.04	111.7	110.12	109.82	108.45	108.45	108.19	108.98	109.82	110.42	111.05	

Average = $Sum(39)_{1…12}$ /12= 110.12 (39)

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

(40)m=	1.25	1.24	1.24	1.22	1.22	1.2	1.2	1.2	1.21	1.22	1.23	1.23	

Average = $Sum(40)_{1…12}$ /12= 1.22 (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 2.63 (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 96.59 (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=	106.25	102.38	98.52	94.66	90.79	86.93	86.93	90.79	94.66	98.52	102.38	106.25	

Total = $Sum(44)_{1…12}$ = 1159.04 (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=	157.56	137.8	142.2	123.97	118.95	102.65	95.12	109.15	110.45	128.72	140.51	152.59	

Total = $Sum(45)_{1…12}$ = 1519.69 (45)

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

(46)m=	23.63	20.67	21.33	18.6	17.84	15.4	14.27	16.37	16.57	19.31	21.08	22.89	(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:

TER WorkSheet: New dwelling design stage

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=	50.96	46.03	50.2	46.68	46.27	42.87	44.3	46.27	46.68	50.2	49.32	50.96	(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=	208.52	183.83	192.4	170.65	165.22	145.52	139.42	155.42	157.13	178.93	189.83	203.55	(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)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	208.52	183.83	192.4	170.65	165.22	145.52	139.42	155.42	157.13	178.93	189.83	203.55	

Output from water heater (annual)$_{1...12}$ — 2090.41 (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=	65.13	57.33	59.83	52.89	51.12	44.85	42.7	47.86	48.4	55.35	59.05	63.48	(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=	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	(66)

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

(67)m=	21.55	19.14	15.56	11.78	8.81	7.44	8.03	10.44	14.02	17.8	20.77	22.15	(67)

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

(68)m=	239.22	241.71	235.45	222.13	205.32	189.52	178.97	176.49	182.74	196.06	212.87	228.67	(68)

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

(69)m=	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	(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=	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	(71)

Water heating gains (Table 5)

(72)m=	87.54	85.31	80.42	73.46	68.71	62.29	57.39	64.33	67.22	74.4	82.01	85.32	(72)

TER WorkSheet: New dwelling design stage

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

(73)m=	413.71	411.55	396.84	372.78	348.24	324.65	309.8	316.66	329.38	353.66	381.06	401.53	(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	8.19	x	36.79	x	0.63	x	0.7	=	92.09	(77)
Southeast 0.9x	0.77	x	8.19	x	62.67	x	0.63	x	0.7	=	156.87	(77)
Southeast 0.9x	0.77	x	8.19	x	85.75	x	0.63	x	0.7	=	214.64	(77)
Southeast 0.9x	0.77	x	8.19	x	106.25	x	0.63	x	0.7	=	265.94	(77)
Southeast 0.9x	0.77	x	8.19	x	119.01	x	0.63	x	0.7	=	297.88	(77)
Southeast 0.9x	0.77	x	8.19	x	118.15	x	0.63	x	0.7	=	295.73	(77)
Southeast 0.9x	0.77	x	8.19	x	113.91	x	0.63	x	0.7	=	285.11	(77)
Southeast 0.9x	0.77	x	8.19	x	104.39	x	0.63	x	0.7	=	261.29	(77)
Southeast 0.9x	0.77	x	8.19	x	92.85	x	0.63	x	0.7	=	232.41	(77)
Southeast 0.9x	0.77	x	8.19	x	69.27	x	0.63	x	0.7	=	173.37	(77)
Southeast 0.9x	0.77	x	8.19	x	44.07	x	0.63	x	0.7	=	110.31	(77)
Southeast 0.9x	0.77	x	8.19	x	31.49	x	0.63	x	0.7	=	78.81	(77)
Southwest0.9x	0.77	x	0.55	x	36.79		0.63	x	0.7	=	6.18	(79)
Southwest0.9x	0.77	x	0.55	x	62.67		0.63	x	0.7	=	10.53	(79)
Southwest0.9x	0.77	x	0.55	x	85.75		0.63	x	0.7	=	14.41	(79)
Southwest0.9x	0.77	x	0.55	x	106.25		0.63	x	0.7	=	17.86	(79)
Southwest0.9x	0.77	x	0.55	x	119.01		0.63	x	0.7	=	20	(79)
Southwest0.9x	0.77	x	0.55	x	118.15		0.63	x	0.7	=	19.86	(79)
Southwest0.9x	0.77	x	0.55	x	113.91		0.63	x	0.7	=	19.15	(79)
Southwest0.9x	0.77	x	0.55	x	104.39		0.63	x	0.7	=	17.55	(79)
Southwest0.9x	0.77	x	0.55	x	92.85		0.63	x	0.7	=	15.61	(79)
Southwest0.9x	0.77	x	0.55	x	69.27		0.63	x	0.7	=	11.64	(79)
Southwest0.9x	0.77	x	0.55	x	44.07		0.63	x	0.7	=	7.41	(79)
Southwest0.9x	0.77	x	0.55	x	31.49		0.63	x	0.7	=	5.29	(79)
Northwest 0.9x	0.77	x	7.55	x	11.28	x	0.63	x	0.7	=	26.03	(81)
Northwest 0.9x	0.77	x	7.55	x	22.97	x	0.63	x	0.7	=	52.99	(81)
Northwest 0.9x	0.77	x	7.55	x	41.38	x	0.63	x	0.7	=	95.48	(81)
Northwest 0.9x	0.77	x	7.55	x	67.96	x	0.63	x	0.7	=	156.8	(81)
Northwest 0.9x	0.77	x	7.55	x	91.35	x	0.63	x	0.7	=	210.77	(81)
Northwest 0.9x	0.77	x	7.55	x	97.38	x	0.63	x	0.7	=	224.7	(81)
Northwest 0.9x	0.77	x	7.55	x	91.1	x	0.63	x	0.7	=	210.2	(81)
Northwest 0.9x	0.77	x	7.55	x	72.63	x	0.63	x	0.7	=	167.58	(81)
Northwest 0.9x	0.77	x	7.55	x	50.42	x	0.63	x	0.7	=	116.34	(81)
Northwest 0.9x	0.77	x	7.55	x	28.07	x	0.63	x	0.7	=	64.76	(81)

TER WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	7.55	x	14.2	x	0.63	x	0.7	=	32.76	(81)
Northwest 0.9x	0.77	x	7.55	x	9.21	x	0.63	x	0.7	=	21.26	(81)
Rooflights 0.9x	1	x	1.01	x	16.37	x	0.63	x	0.7	=	6.56	(82)
Rooflights 0.9x	1	x	1.01	x	33.68	x	0.63	x	0.7	=	13.5	(82)
Rooflights 0.9x	1	x	1.01	x	62.13	x	0.63	x	0.7	=	24.91	(82)
Rooflights 0.9x	1	x	1.01	x	104.87	x	0.63	x	0.7	=	42.04	(82)
Rooflights 0.9x	1	x	1.01	x	143.66	x	0.63	x	0.7	=	57.59	(82)
Rooflights 0.9x	1	x	1.01	x	154.33	x	0.63	x	0.7	=	61.87	(82)
Rooflights 0.9x	1	x	1.01	x	143.9	x	0.63	x	0.7	=	57.69	(82)
Rooflights 0.9x	1	x	1.01	x	113.05	x	0.63	x	0.7	=	45.32	(82)
Rooflights 0.9x	1	x	1.01	x	76.56	x	0.63	x	0.7	=	30.69	(82)
Rooflights 0.9x	1	x	1.01	x	41.49	x	0.63	x	0.7	=	16.63	(82)
Rooflights 0.9x	1	x	1.01	x	20.65	x	0.63	x	0.7	=	8.28	(82)
Rooflights 0.9x	1	x	1.01	x	13.34	x	0.63	x	0.7	=	5.35	(82)

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

(83)m=	130.87	233.9	349.43	482.64	586.24	602.16	572.15	491.73	395.04	266.41	158.75	110.71	(83)

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

(84)m=	544.59	645.45	746.27	855.42	934.48	926.81	881.95	808.39	724.42	620.07	539.81	512.25	(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	0.99	0.95	0.86	0.69	0.53	0.59	0.84	0.97	1	1	(86)

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

(87)m=	19.63	19.81	20.09	20.47	20.78	20.95	20.99	20.98	20.85	20.45	19.97	19.61	(87)

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

(88)m=	19.88	19.89	19.89	19.9	19.9	19.92	19.92	19.92	19.91	19.9	19.9	19.89	(88)

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

(89)m=	1	0.99	0.98	0.94	0.81	0.6	0.4	0.46	0.77	0.96	0.99	1	(89)

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

(90)m=	18.07	18.33	18.74	19.28	19.69	19.88	19.91	19.91	19.8	19.26	18.58	18.04	(90)

fLA = Living area ÷ (4) = 0.27 (91)

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

(92)m=	18.5	18.73	19.11	19.61	19.99	20.17	20.21	20.2	20.08	19.59	18.96	18.47	(92)

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

(93)m=	18.5	18.73	19.11	19.61	19.99	20.17	20.21	20.2	20.08	19.59	18.96	18.47	(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

Utilisation factor for gains, hm:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m=	1	0.99	0.98	0.93	0.82	0.62	0.44	0.5	0.78	0.96	0.99	1	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	542.31	639.39	728.45	795.52	762.89	575.41	386.78	403.65	566.64	593.47	535.18	510.63	(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=	1595.36	1549.59	1408.52	1178.93	910.08	604.23	391.05	411.41	652.21	986.86	1309.5	1584.49	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	783.47	611.65	505.97	276.06	109.51	0	0	0	0	292.68	557.51	798.95

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3935.8 (98)

Space heating requirement in kWh/m²/year 43.69 (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)	783.47	611.65	505.97	276.06	109.51	0	0	0	0	292.68	557.51	798.95		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	838.83	654.88	541.73	295.56	117.25	0	0	0	0	313.36	596.91	855.41		(211)
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													4213.92	(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)	208.52	183.83	192.4	170.65	165.22	145.52	139.42	155.42	157.13	178.93	189.83	203.55		
Efficiency of water heater													80.3	(216)
(217)m=	88.07	87.85	87.37	86.26	84.04	80.3	80.3	80.3	80.3	86.28	87.6	88.15		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	236.76	209.26	220.21	197.85	196.59	181.22	173.62	193.55	195.68	207.37	216.69	230.91		
Total = Sum(219a)$_{1...12}$ =													2459.72	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		4213.92	
Water heating fuel used		2459.72	
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			380.53	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			7129.17	(338)

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	=	910.21	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	531.3	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1441.51	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	197.49	(268)
Total CO2, kg/year		sum of (265)…(271) =		1677.93	(272)

TER = 18.63 (273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
Printed on 16 June 2021 at 14:55:16

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Mid-terrace House

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 90.08m²

Site Reference : 119 East Road -BASE **Plot Reference:** Sample 2

Address :

Client Details:

Name:

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)	17.63 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	15.62 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	51.6 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	45.8 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.12 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (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	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas
Data from manufacturer
Combi boiler
Efficiency 89.5 % SEDBUK2009
Minimum 88.0 % **OK**

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	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	7.55m²
Windows facing: South East	8.19m²
Windows facing: South West	0.55m²
Roof windows facing: North West	1.01m²
Ventilation rate:	4.00

10 Key features

Roofs U-value	0.12 W/m²K
Party Walls U-value	0 W/m²K

TER WorkSheet: New dwelling design stage

User Details:			
Assessor Name:	Neil Ingham	**Stroma Number:**	STRO010943
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Sample 2

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	33.34	(1a)	x	2.4	(2a)	=	80.02	(3a)
First floor	33.34	(1b)	x	2.7	(2b)	=	90.02	(3b)
Second floor	23.4	(1c)	x	2.26	(2c)	=	52.88	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.08	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	222.92	(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) =	0.13	(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)		0.38	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.38	(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

TER WorkSheet: New dwelling design stage

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

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

0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.38	0.41	0.43	0.45

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=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(24d)

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(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			2.28	x	1	=	2.28			(26)
Windows Type 1			7.55	x1/[1/(1.4)+ 0.04]		=	10.01			(27)
Windows Type 2			8.19	x1/[1/(1.4)+ 0.04]		=	10.86			(27)
Windows Type 3			0.55	x1/[1/(1.4)+ 0.04]		=	0.73			(27)
Rooflights			1.01	x1/[1/(1.7) + 0.04]		=	1.717			(27b)
Floor			33.34	x	0.13	=	4.3342			(28)
Walls Type1	90.38	18.57	71.81	x	0.18	=	12.93			(29)
Walls Type2	6.62	0	6.62	x	0.18	=	1.19			(29)
Roof Type1	25.59	1.01	24.58	x	0.13	=	3.2			(30)
Roof Type2	6.22	0	6.22	x	0.13	=	0.81			(30)
Roof Type3	3.72	0	3.72	x	0.13	=	0.48			(30)
Total area of elements, m²			165.87							(31)
Party wall			77.56	x	0	=	0			(32)
Internal wall **			95.5							(32c)
Internal floor			56.74							(32d)
Internal ceiling			56.74							(32e)

** 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) = 48.42 (33)

TER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	14227.94	(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		11.02	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	59.44	(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=	45.62	45.28	44.94	43.36	43.07	41.69	41.69	41.44	42.22	43.07	43.67	44.29	(38)

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

(39)m=	105.07	104.72	104.39	102.81	102.51	101.13	101.13	100.88	101.66	102.51	103.11	103.74	

Average = $Sum(39)_{1…12}$ /12= 102.81 (39)

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

(40)m=	1.17	1.16	1.16	1.14	1.14	1.12	1.12	1.12	1.13	1.14	1.14	1.15	

Average = $Sum(40)_{1…12}$ /12= 1.14 (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 — 2.63 (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 — 96.59 (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=	106.25	102.38	98.52	94.66	90.79	86.93	86.93	90.79	94.66	98.52	102.38	106.25	

Total = $Sum(44)_{1…12}$ = 1159.04 (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=	157.56	137.8	142.2	123.97	118.95	102.65	95.12	109.15	110.45	128.72	140.51	152.59	

Total = $Sum(45)_{1…12}$ = 1519.69 (45)

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

(46)m=	23.63	20.67	21.33	18.6	17.84	15.4	14.27	16.37	16.57	19.31	21.08	22.89	(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:

TER WorkSheet: New dwelling design stage

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=	50.96	46.03	50.2	46.68	46.27	42.87	44.3	46.27	46.68	50.2	49.32	50.96	(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=	208.52	183.83	192.4	170.65	165.22	145.52	139.42	155.42	157.13	178.93	189.83	203.55	(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)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	208.52	183.83	192.4	170.65	165.22	145.52	139.42	155.42	157.13	178.93	189.83	203.55	

Output from water heater (annual) 1…12 — 2090.41 (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=	65.13	57.33	59.83	52.89	51.12	44.85	42.7	47.86	48.4	55.35	59.05	63.48	(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=	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	(66)

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

(67)m=	21.55	19.14	15.56	11.78	8.81	7.44	8.03	10.44	14.02	17.8	20.77	22.15	(67)

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

(68)m=	239.22	241.71	235.45	222.13	205.32	189.52	178.97	176.49	182.74	196.06	212.87	228.67	(68)

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

(69)m=	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	(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=	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	(71)

Water heating gains (Table 5)

(72)m=	87.54	85.31	80.42	73.46	68.71	62.29	57.39	64.33	67.22	74.4	82.01	85.32	(72)

TER WorkSheet: New dwelling design stage

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

(73)m=	413.71	411.55	396.84	372.78	348.24	324.65	309.8	316.66	329.38	353.66	381.06	401.53	(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	8.19	x	36.79	x	0.63	x	0.7	=	92.09	(77)
Southeast 0.9x	0.77	x	8.19	x	62.67	x	0.63	x	0.7	=	156.87	(77)
Southeast 0.9x	0.77	x	8.19	x	85.75	x	0.63	x	0.7	=	214.64	(77)
Southeast 0.9x	0.77	x	8.19	x	106.25	x	0.63	x	0.7	=	265.94	(77)
Southeast 0.9x	0.77	x	8.19	x	119.01	x	0.63	x	0.7	=	297.88	(77)
Southeast 0.9x	0.77	x	8.19	x	118.15	x	0.63	x	0.7	=	295.73	(77)
Southeast 0.9x	0.77	x	8.19	x	113.91	x	0.63	x	0.7	=	285.11	(77)
Southeast 0.9x	0.77	x	8.19	x	104.39	x	0.63	x	0.7	=	261.29	(77)
Southeast 0.9x	0.77	x	8.19	x	92.85	x	0.63	x	0.7	=	232.41	(77)
Southeast 0.9x	0.77	x	8.19	x	69.27	x	0.63	x	0.7	=	173.37	(77)
Southeast 0.9x	0.77	x	8.19	x	44.07	x	0.63	x	0.7	=	110.31	(77)
Southeast 0.9x	0.77	x	8.19	x	31.49	x	0.63	x	0.7	=	78.81	(77)
Southwest 0.9x	0.77	x	0.55	x	36.79		0.63	x	0.7	=	6.18	(79)
Southwest 0.9x	0.77	x	0.55	x	62.67		0.63	x	0.7	=	10.53	(79)
Southwest 0.9x	0.77	x	0.55	x	85.75		0.63	x	0.7	=	14.41	(79)
Southwest 0.9x	0.77	x	0.55	x	106.25		0.63	x	0.7	=	17.86	(79)
Southwest 0.9x	0.77	x	0.55	x	119.01		0.63	x	0.7	=	20	(79)
Southwest 0.9x	0.77	x	0.55	x	118.15		0.63	x	0.7	=	19.86	(79)
Southwest 0.9x	0.77	x	0.55	x	113.91		0.63	x	0.7	=	19.15	(79)
Southwest 0.9x	0.77	x	0.55	x	104.39		0.63	x	0.7	=	17.55	(79)
Southwest 0.9x	0.77	x	0.55	x	92.85		0.63	x	0.7	=	15.61	(79)
Southwest 0.9x	0.77	x	0.55	x	69.27		0.63	x	0.7	=	11.64	(79)
Southwest 0.9x	0.77	x	0.55	x	44.07		0.63	x	0.7	=	7.41	(79)
Southwest 0.9x	0.77	x	0.55	x	31.49		0.63	x	0.7	=	5.29	(79)
Northwest 0.9x	0.77	x	7.55	x	11.28	x	0.63	x	0.7	=	26.03	(81)
Northwest 0.9x	0.77	x	7.55	x	22.97	x	0.63	x	0.7	=	52.99	(81)
Northwest 0.9x	0.77	x	7.55	x	41.38	x	0.63	x	0.7	=	95.48	(81)
Northwest 0.9x	0.77	x	7.55	x	67.96	x	0.63	x	0.7	=	156.8	(81)
Northwest 0.9x	0.77	x	7.55	x	91.35	x	0.63	x	0.7	=	210.77	(81)
Northwest 0.9x	0.77	x	7.55	x	97.38	x	0.63	x	0.7	=	224.7	(81)
Northwest 0.9x	0.77	x	7.55	x	91.1	x	0.63	x	0.7	=	210.2	(81)
Northwest 0.9x	0.77	x	7.55	x	72.63	x	0.63	x	0.7	=	167.58	(81)
Northwest 0.9x	0.77	x	7.55	x	50.42	x	0.63	x	0.7	=	116.34	(81)
Northwest 0.9x	0.77	x	7.55	x	28.07	x	0.63	x	0.7	=	64.76	(81)

Northwest 0.9x	0.77	x	7.55	x	14.2	x	0.63	x	0.7	=	32.76	(81)
Northwest 0.9x	0.77	x	7.55	x	9.21	x	0.63	x	0.7	=	21.26	(81)
Rooflights 0.9x	1	x	1.01	x	16.37	x	0.63	x	0.7	=	6.56	(82)
Rooflights 0.9x	1	x	1.01	x	33.68	x	0.63	x	0.7	=	13.5	(82)
Rooflights 0.9x	1	x	1.01	x	62.13	x	0.63	x	0.7	=	24.91	(82)
Rooflights 0.9x	1	x	1.01	x	104.87	x	0.63	x	0.7	=	42.04	(82)
Rooflights 0.9x	1	x	1.01	x	143.66	x	0.63	x	0.7	=	57.59	(82)
Rooflights 0.9x	1	x	1.01	x	154.33	x	0.63	x	0.7	=	61.87	(82)
Rooflights 0.9x	1	x	1.01	x	143.9	x	0.63	x	0.7	=	57.69	(82)
Rooflights 0.9x	1	x	1.01	x	113.05	x	0.63	x	0.7	=	45.32	(82)
Rooflights 0.9x	1	x	1.01	x	76.56	x	0.63	x	0.7	=	30.69	(82)
Rooflights 0.9x	1	x	1.01	x	41.49	x	0.63	x	0.7	=	16.63	(82)
Rooflights 0.9x	1	x	1.01	x	20.65	x	0.63	x	0.7	=	8.28	(82)
Rooflights 0.9x	1	x	1.01	x	13.34	x	0.63	x	0.7	=	5.35	(82)

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

(83)m=	130.87	233.9	349.43	482.64	586.24	602.16	572.15	491.73	395.04	266.41	158.75	110.71	(83)

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

(84)m=	544.59	645.45	746.27	855.42	934.48	926.81	881.95	808.39	724.42	620.07	539.81	512.25	(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	0.95	0.84	0.66	0.5	0.56	0.82	0.97	1	1	(86)

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

(87)m=	19.74	19.91	20.19	20.55	20.83	20.96	20.99	20.99	20.89	20.52	20.07	19.72	(87)

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

(88)m=	19.95	19.95	19.95	19.97	19.97	19.98	19.98	19.98	19.98	19.97	19.96	19.96	(88)

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

(89)m=	1	0.99	0.98	0.93	0.79	0.57	0.39	0.44	0.75	0.96	0.99	1	(89)

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

(90)m=	18.27	18.53	18.93	19.44	19.81	19.96	19.98	19.98	19.89	19.41	18.76	18.24	(90)

fLA = Living area ÷ (4) = 0.27 (91)

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

(92)m=	18.67	18.9	19.27	19.74	20.08	20.23	20.26	20.25	20.16	19.71	19.11	18.65	(92)

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

(93)m=	18.67	18.9	19.27	19.74	20.08	20.23	20.26	20.25	20.16	19.71	19.11	18.65	(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	0.97	0.92	0.8	0.59	0.42	0.48	0.76	0.95	0.99	1	(94)

TER WorkSheet: New dwelling design stage

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	542.39	639.35	727.58	790.13	746.08	550.56	367.24	384.07	552.05	591.56	535.16	510.71	(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=	1510.01	1466.57	1333.14	1114.78	859.45	569.67	369.75	388.84	616.39	934	1238.72	1498.49	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	719.91	555.89	450.53	233.75	84.35	0	0	0	0	254.78	506.56	734.91

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3540.68 (98)

Space heating requirement in kWh/m²/year 39.31 (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)	719.91	555.89	450.53	233.75	84.35	0	0	0	0	254.78	506.56	734.91		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	770.78	595.17	482.37	250.27	90.31	0	0	0	0	272.78	542.35	786.85		(211)
Total (kWh/year) =$Sum(211)_{1...5,10....12}$=													3790.87	(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)	208.52	183.83	192.4	170.65	165.22	145.52	139.42	155.42	157.13	178.93	189.83	203.55		
Efficiency of water heater													80.3	(216)
(217)m=	87.92	87.66	87.12	85.84	83.45	80.3	80.3	80.3	80.3	85.94	87.4	88		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	237.18	209.71	220.85	198.79	197.99	181.22	173.62	193.55	195.68	208.2	217.19	231.3		
Total = $Sum(219a)_{1...12}$ =													2465.27	(219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3790.87	
Water heating fuel used		2465.27	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)

TER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			380.53	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			6711.67	(338)

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	=	818.83	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	532.5	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1351.33	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	197.49	(268)
Total CO2, kg/year		sum of (265)…(271) =		1587.75	(272)

TER =	17.63	(273)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
Printed on 16 June 2021 at 14:55:15

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** End-terrace House

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 90.08m²

Site Reference : 119 East Road -BASE **Plot Reference:** Sample 3

Address :

Client Details:

Name:

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)	18.63 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	16.53 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	56.7 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	50.1 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	**OK**
Party wall	0.00 (max. 0.20)	-	**OK**
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	**OK**
Roof	0.11 (max. 0.20)	0.12 (max. 0.35)	**OK**
Openings	1.20 (max. 2.00)	1.20 (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	5.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system:	Boiler systems with radiators or underfloor heating - mains gas Data from manufacturer Combi boiler Efficiency 89.5 % SEDBUK2009 Minimum 88.0 %	**OK**
Secondary heating system:	None	

5 Cylinder insulation

Hot water Storage:	No cylinder	**N/A**

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	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):	Slight	**OK**
Based on:		
Overshading:	Average or unknown	
Windows facing: North West	7.55m²	
Windows facing: South East	8.19m²	
Windows facing: South West	0.55m²	
Roof windows facing: North West	1.01m²	
Ventilation rate:	4.00	

10 Key features

Roofs U-value	0.12 W/m²K
Party Walls U-value	0 W/m²K

TER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Neil Ingham	**Stroma Number:**	STRO010943
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Sample 3

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	33.34	(1a)	x	2.4	(2a)	=	80.02	(3a)
First floor	33.34	(1b)	x	2.7	(2b)	=	90.02	(3b)
Second floor	23.4	(1c)	x	2.26	(2c)	=	52.88	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.08	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	222.92	(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) =	0.13	(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)	0.38	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.38	(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

TER WorkSheet: New dwelling design stage

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

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

0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.38	0.41	0.43	0.45

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=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(24d)

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(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			2.28	x	1	=	2.28			(26)
Windows Type 1			7.55	x1/[1/(1.4)+ 0.04]		=	10.01			(27)
Windows Type 2			8.19	x1/[1/(1.4)+ 0.04]		=	10.86			(27)
Windows Type 3			0.55	x1/[1/(1.4)+ 0.04]		=	0.73			(27)
Rooflights			1.01	x1/[1/(1.7) + 0.04]		=	1.717			(27b)
Floor			33.34	x	0.13	=	4.3342			(28)
Walls Type1	128.68	18.57	110.11	x	0.18	=	19.82			(29)
Walls Type2	6.62	0	6.62	x	0.18	=	1.19			(29)
Roof Type1	25.59	1.01	24.58	x	0.13	=	3.2			(30)
Roof Type2	6.22	0	6.22	x	0.13	=	0.81			(30)
Roof Type3	3.72	0	3.72	x	0.13	=	0.48			(30)
Total area of elements, m²			204.17							(31)
Party wall			39.26	x	0	=	0			(32)
Internal wall **			95.5							(32c)
Internal floor			56.74							(32d)
Internal ceiling			56.74							(32e)

** 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) = 55.32 (33)

TER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 14802.44 (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 11.44 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 66.75 (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=	45.62	45.28	44.94	43.36	43.07	41.69	41.69	41.44	42.22	43.07	43.67	44.29	(38)

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

(39)m=	112.38	112.04	111.7	110.12	109.82	108.45	108.45	108.19	108.98	109.82	110.42	111.05

Average = Sum(39)$_{1…12}$ /12= 110.12 (39)

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

(40)m=	1.25	1.24	1.24	1.22	1.22	1.2	1.2	1.2	1.21	1.22	1.23	1.23

Average = Sum(40)$_{1…12}$ /12= 1.22 (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 2.63 (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 96.59 (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=	106.25	102.38	98.52	94.66	90.79	86.93	86.93	90.79	94.66	98.52	102.38	106.25

Total = Sum(44)$_{1…12}$ = 1159.04 (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=	157.56	137.8	142.2	123.97	118.95	102.65	95.12	109.15	110.45	128.72	140.51	152.59

Total = Sum(45)$_{1…12}$ = 1519.69 (45)

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

(46)m=	23.63	20.67	21.33	18.6	17.84	15.4	14.27	16.37	16.57	19.31	21.08	22.89	(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:

TER WorkSheet: New dwelling design stage

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=	50.96	46.03	50.2	46.68	46.27	42.87	44.3	46.27	46.68	50.2	49.32	50.96	(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=	208.52	183.83	192.4	170.65	165.22	145.52	139.42	155.42	157.13	178.93	189.83	203.55	(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)
FHRS	0	0	0	0	0	0	0	0	0	0	0	0	(63) (G2)

Output from water heater

(64)m=	208.52	183.83	192.4	170.65	165.22	145.52	139.42	155.42	157.13	178.93	189.83	203.55	

Output from water heater (annual)$_{1...12}$ — 2090.41 (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=	65.13	57.33	59.83	52.89	51.12	44.85	42.7	47.86	48.4	55.35	59.05	63.48	(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=	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	21.55	19.14	15.56	11.78	8.81	7.44	8.03	10.44	14.02	17.8	20.77	22.15	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	239.22	241.71	235.45	222.13	205.32	189.52	178.97	176.49	182.74	196.06	212.87	228.67	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	(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=	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	(71)
Water heating gains (Table 5)													
(72)m=	87.54	85.31	80.42	73.46	68.71	62.29	57.39	64.33	67.22	74.4	82.01	85.32	(72)

TER WorkSheet: New dwelling design stage

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

(73)m=	413.71	411.55	396.84	372.78	348.24	324.65	309.8	316.66	329.38	353.66	381.06	401.53	(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	8.19	x	36.79	x	0.63	x	0.7	=	92.09	(77)
Southeast 0.9x	0.77	x	8.19	x	62.67	x	0.63	x	0.7	=	156.87	(77)
Southeast 0.9x	0.77	x	8.19	x	85.75	x	0.63	x	0.7	=	214.64	(77)
Southeast 0.9x	0.77	x	8.19	x	106.25	x	0.63	x	0.7	=	265.94	(77)
Southeast 0.9x	0.77	x	8.19	x	119.01	x	0.63	x	0.7	=	297.88	(77)
Southeast 0.9x	0.77	x	8.19	x	118.15	x	0.63	x	0.7	=	295.73	(77)
Southeast 0.9x	0.77	x	8.19	x	113.91	x	0.63	x	0.7	=	285.11	(77)
Southeast 0.9x	0.77	x	8.19	x	104.39	x	0.63	x	0.7	=	261.29	(77)
Southeast 0.9x	0.77	x	8.19	x	92.85	x	0.63	x	0.7	=	232.41	(77)
Southeast 0.9x	0.77	x	8.19	x	69.27	x	0.63	x	0.7	=	173.37	(77)
Southeast 0.9x	0.77	x	8.19	x	44.07	x	0.63	x	0.7	=	110.31	(77)
Southeast 0.9x	0.77	x	8.19	x	31.49	x	0.63	x	0.7	=	78.81	(77)
Southwest 0.9x	0.77	x	0.55	x	36.79		0.63	x	0.7	=	6.18	(79)
Southwest 0.9x	0.77	x	0.55	x	62.67		0.63	x	0.7	=	10.53	(79)
Southwest 0.9x	0.77	x	0.55	x	85.75		0.63	x	0.7	=	14.41	(79)
Southwest 0.9x	0.77	x	0.55	x	106.25		0.63	x	0.7	=	17.86	(79)
Southwest 0.9x	0.77	x	0.55	x	119.01		0.63	x	0.7	=	20	(79)
Southwest 0.9x	0.77	x	0.55	x	118.15		0.63	x	0.7	=	19.86	(79)
Southwest 0.9x	0.77	x	0.55	x	113.91		0.63	x	0.7	=	19.15	(79)
Southwest 0.9x	0.77	x	0.55	x	104.39		0.63	x	0.7	=	17.55	(79)
Southwest 0.9x	0.77	x	0.55	x	92.85		0.63	x	0.7	=	15.61	(79)
Southwest 0.9x	0.77	x	0.55	x	69.27		0.63	x	0.7	=	11.64	(79)
Southwest 0.9x	0.77	x	0.55	x	44.07		0.63	x	0.7	=	7.41	(79)
Southwest 0.9x	0.77	x	0.55	x	31.49		0.63	x	0.7	=	5.29	(79)
Northwest 0.9x	0.77	x	7.55	x	11.28	x	0.63	x	0.7	=	26.03	(81)
Northwest 0.9x	0.77	x	7.55	x	22.97	x	0.63	x	0.7	=	52.99	(81)
Northwest 0.9x	0.77	x	7.55	x	41.38	x	0.63	x	0.7	=	95.48	(81)
Northwest 0.9x	0.77	x	7.55	x	67.96	x	0.63	x	0.7	=	156.8	(81)
Northwest 0.9x	0.77	x	7.55	x	91.35	x	0.63	x	0.7	=	210.77	(81)
Northwest 0.9x	0.77	x	7.55	x	97.38	x	0.63	x	0.7	=	224.7	(81)
Northwest 0.9x	0.77	x	7.55	x	91.1	x	0.63	x	0.7	=	210.2	(81)
Northwest 0.9x	0.77	x	7.55	x	72.63	x	0.63	x	0.7	=	167.58	(81)
Northwest 0.9x	0.77	x	7.55	x	50.42	x	0.63	x	0.7	=	116.34	(81)
Northwest 0.9x	0.77	x	7.55	x	28.07	x	0.63	x	0.7	=	64.76	(81)

Northwest	0.9x	0.77	x	7.55	x	14.2	x	0.63	x	0.7	=	32.76	(81)
Northwest	0.9x	0.77	x	7.55	x	9.21	x	0.63	x	0.7	=	21.26	(81)
Rooflights	0.9x	1	x	1.01	x	16.37	x	0.63	x	0.7	=	6.56	(82)
Rooflights	0.9x	1	x	1.01	x	33.68	x	0.63	x	0.7	=	13.5	(82)
Rooflights	0.9x	1	x	1.01	x	62.13	x	0.63	x	0.7	=	24.91	(82)
Rooflights	0.9x	1	x	1.01	x	104.87	x	0.63	x	0.7	=	42.04	(82)
Rooflights	0.9x	1	x	1.01	x	143.66	x	0.63	x	0.7	=	57.59	(82)
Rooflights	0.9x	1	x	1.01	x	154.33	x	0.63	x	0.7	=	61.87	(82)
Rooflights	0.9x	1	x	1.01	x	143.9	x	0.63	x	0.7	=	57.69	(82)
Rooflights	0.9x	1	x	1.01	x	113.05	x	0.63	x	0.7	=	45.32	(82)
Rooflights	0.9x	1	x	1.01	x	76.56	x	0.63	x	0.7	=	30.69	(82)
Rooflights	0.9x	1	x	1.01	x	41.49	x	0.63	x	0.7	=	16.63	(82)
Rooflights	0.9x	1	x	1.01	x	20.65	x	0.63	x	0.7	=	8.28	(82)
Rooflights	0.9x	1	x	1.01	x	13.34	x	0.63	x	0.7	=	5.35	(82)

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

(83)m=	130.87	233.9	349.43	482.64	586.24	602.16	572.15	491.73	395.04	266.41	158.75	110.71	(83)

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

(84)m=	544.59	645.45	746.27	855.42	934.48	926.81	881.95	808.39	724.42	620.07	539.81	512.25	(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	0.99	0.95	0.86	0.69	0.53	0.59	0.84	0.97	1	1	(86)

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

(87)m=	19.63	19.81	20.09	20.47	20.78	20.95	20.99	20.98	20.85	20.45	19.97	19.61	(87)

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

(88)m=	19.88	19.89	19.89	19.9	19.9	19.92	19.92	19.92	19.91	19.9	19.9	19.89	(88)

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

(89)m=	1	0.99	0.98	0.94	0.81	0.6	0.4	0.46	0.77	0.96	0.99	1	(89)

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

(90)m=	18.07	18.33	18.74	19.28	19.69	19.88	19.91	19.91	19.8	19.26	18.58	18.04	(90)

fLA = Living area ÷ (4) = | 0.27 | (91)

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

(92)m=	18.5	18.73	19.11	19.61	19.99	20.17	20.21	20.2	20.08	19.59	18.96	18.47	(92)

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

(93)m=	18.5	18.73	19.11	19.61	19.99	20.17	20.21	20.2	20.08	19.59	18.96	18.47	(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=	1	0.99	0.98	0.93	0.82	0.62	0.44	0.5	0.78	0.96	0.99	1	(94)

TER WorkSheet: New dwelling design stage

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	542.31	639.39	728.45	795.52	762.89	575.41	386.78	403.65	566.64	593.47	535.18	510.63	(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=	1595.36	1549.59	1408.52	1178.93	910.08	604.23	391.05	411.41	652.21	986.86	1309.5	1584.49	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	783.47	611.65	505.97	276.06	109.51	0	0	0	0	292.68	557.51	798.95

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3935.8 (98)

Space heating requirement in kWh/m²/year 43.69 (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)	783.47	611.65	505.97	276.06	109.51	0	0	0	0	292.68	557.51	798.95	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	838.83	654.88	541.73	295.56	117.25	0	0	0	0	313.36	596.91	855.41	(211)

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 4213.92 (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)

208.52	183.83	192.4	170.65	165.22	145.52	139.42	155.42	157.13	178.93	189.83	203.55

Efficiency of water heater 80.3 (216)

(217)m=	88.07	87.85	87.37	86.26	84.04	80.3	80.3	80.3	80.3	86.28	87.6	88.15	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	236.76	209.26	220.21	197.85	196.59	181.22	173.62	193.55	195.68	207.37	216.69	230.91

Total = $Sum(219a)_{1...12}$ = 2459.72 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		4213.92	
Water heating fuel used		2459.72	
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			380.53	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			7129.17	(338)

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	=	910.21	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	531.3	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1441.51	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	197.49	(268)
Total CO2, kg/year			sum of (265)…(271) =		1677.93	(272)

TER =	18.63	(273)

Appendix B

Energy Efficient Design:-

SAP Outputs & Dwelling Emission Rates

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
Printed on 16 June 2021 at 14:51:29

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** End-terrace House

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 90.08m²

Site Reference : 119 East Road -BASE **Plot Reference:** Sample 1

Address :

Client Details:

Name:

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)	18.63 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	16.53 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	56.7 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	50.1 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	**OK**
Party wall	0.00 (max. 0.20)	-	**OK**
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	**OK**
Roof	0.11 (max. 0.20)	0.12 (max. 0.35)	**OK**
Openings	1.20 (max. 2.00)	1.20 (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	5.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system:	Boiler systems with radiators or underfloor heating - mains gas Data from manufacturer Combi boiler Efficiency 89.5 % SEDBUK2009 Minimum 88.0 %	**OK**
Secondary heating system:	None	

5 Cylinder insulation

Hot water Storage:	No cylinder	
		N/A

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	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):	Slight	**OK**
Based on:		
Overshading:	Average or unknown	
Windows facing: North West	7.55m²	
Windows facing: South East	8.19m²	
Windows facing: South West	0.55m²	
Roof windows facing: North West	1.01m²	
Ventilation rate:	4.00	

10 Key features

Roofs U-value	0.12 W/m²K
Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Neil Ingham	**Stroma Number:**	STRO010943
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Sample 1

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	33.34	(1a)	x	2.4	(2a)	=	80.02	(3a)
First floor	33.34	(1b)	x	2.7	(2b)	=	90.02	(3b)
Second floor	23.4	(1c)	x	2.26	(2c)	=	52.88	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.08	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	222.92	(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) =	0.13	(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)	0.38	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.38	(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

DER WorkSheet: New dwelling design stage

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

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

0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.38	0.41	0.43	0.45

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=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(24d)

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(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			2.28	x	1.2	=	2.736			(26)
Windows Type 1			7.55	x1/[1/(1.2)+ 0.04]		=	8.65			(27)
Windows Type 2			8.19	x1/[1/(1.2)+ 0.04]		=	9.38			(27)
Windows Type 3			0.55	x1/[1/(1.2)+ 0.04]		=	0.63			(27)
Rooflights			1.01	x1/[1/(1.2) + 0.04]		=	1.212			(27b)
Floor			33.34	x	0.14	=	4.6676	110	3667.4	(28)
Walls Type1	128.68	18.57	110.11	x	0.18	=	19.82	60	6606.6	(29)
Walls Type2	6.62	0	6.62	x	0.18	=	1.19	9	59.58	(29)
Roof Type1	25.59	1.01	24.58	x	0.12	=	2.95	9	221.22	(30)
Roof Type2	6.22	0	6.22	x	0.1	=	0.62	9	55.98	(30)
Roof Type3	3.72	0	3.72	x	0.09	=	0.34	9	33.48	(30)
Total area of elements, m²			204.17							(31)
Party wall			39.26	x	0	=	0	45	1766.7	(32)
Internal wall **			95.5					9	859.5	(32c)
Internal floor			56.74					18	1021.32	(32d)
Internal ceiling			56.74					9	510.66	(32e)

** 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) = 52.14 (33)

DER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	14802.44	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	164.33	(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		17.27	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	69.41	(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=	45.62	45.28	44.94	43.36	43.07	41.69	41.69	41.44	42.22	43.07	43.67	44.29	(38)

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

(39)m=	115.03	114.69	114.35	112.77	112.48	111.1	111.1	110.85	111.63	112.48	113.08	113.7	

Average = Sum(39)$_{1…12}$ /12= 112.77 (39)

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

(40)m=	1.28	1.27	1.27	1.25	1.25	1.23	1.23	1.23	1.24	1.25	1.26	1.26	

Average = Sum(40)$_{1…12}$ /12= 1.25 (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 2.63 (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 96.59 (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=	106.25	102.38	98.52	94.66	90.79	86.93	86.93	90.79	94.66	98.52	102.38	106.25	

Total = Sum(44)$_{1…12}$ = 1159.04 (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=	157.56	137.8	142.2	123.97	118.95	102.65	95.12	109.15	110.45	128.72	140.51	152.59	

Total = Sum(45)$_{1…12}$ = 1519.69 (45)

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

(46)m=	23.63	20.67	21.33	18.6	17.84	15.4	14.27	16.37	16.57	19.31	21.08	22.89	(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:

DER WorkSheet: New dwelling design stage

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=	50.96	46.03	50.2	46.68	46.27	42.87	44.3	46.27	46.68	50.2	49.32	50.96	(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=	208.52	183.83	192.4	170.65	165.22	145.52	139.42	155.42	157.13	178.93	189.83	203.55	(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)
FHRS	110.33	100.81	101.04	91.82	62.31	3.19	2.99	3.34	3.37	93.58	101.01	108.85	(63) (G2)

Output from water heater

(64)m=	98.19	83.02	91.37	78.84	102.91	142.33	136.42	152.08	153.77	85.35	88.82	94.69	

Output from water heater (annual)$_{1...12}$ | 1307.78 | (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=	65.13	57.33	59.83	52.89	51.12	44.85	42.7	47.86	48.4	55.35	59.05	63.48	(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=	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	(66)

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

(67)m=	21.55	19.14	15.56	11.78	8.81	7.44	8.03	10.44	14.02	17.8	20.77	22.15	(67)

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

(68)m=	239.22	241.71	235.45	222.13	205.32	189.52	178.97	176.49	182.74	196.06	212.87	228.67	(68)

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

(69)m=	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	(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=	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	(71)

Water heating gains (Table 5)

(72)m=	87.54	85.31	80.42	73.46	68.71	62.29	57.39	64.33	67.22	74.4	82.01	85.32	(72)

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

(73)m=	413.71	411.55	396.84	372.78	348.24	324.65	309.8	316.66	329.38	353.66	381.06	401.53	(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	8.19	x	36.79	x	0.63	x	0.7	=	92.09	(77)
Southeast	0.9x	0.77	x	8.19	x	62.67	x	0.63	x	0.7	=	156.87	(77)
Southeast	0.9x	0.77	x	8.19	x	85.75	x	0.63	x	0.7	=	214.64	(77)
Southeast	0.9x	0.77	x	8.19	x	106.25	x	0.63	x	0.7	=	265.94	(77)
Southeast	0.9x	0.77	x	8.19	x	119.01	x	0.63	x	0.7	=	297.88	(77)
Southeast	0.9x	0.77	x	8.19	x	118.15	x	0.63	x	0.7	=	295.73	(77)
Southeast	0.9x	0.77	x	8.19	x	113.91	x	0.63	x	0.7	=	285.11	(77)
Southeast	0.9x	0.77	x	8.19	x	104.39	x	0.63	x	0.7	=	261.29	(77)
Southeast	0.9x	0.77	x	8.19	x	92.85	x	0.63	x	0.7	=	232.41	(77)
Southeast	0.9x	0.77	x	8.19	x	69.27	x	0.63	x	0.7	=	173.37	(77)
Southeast	0.9x	0.77	x	8.19	x	44.07	x	0.63	x	0.7	=	110.31	(77)
Southeast	0.9x	0.77	x	8.19	x	31.49	x	0.63	x	0.7	=	78.81	(77)
Southwest	0.9x	0.77	x	0.55	x	36.79		0.63	x	0.7	=	6.18	(79)
Southwest	0.9x	0.77	x	0.55	x	62.67		0.63	x	0.7	=	10.53	(79)
Southwest	0.9x	0.77	x	0.55	x	85.75		0.63	x	0.7	=	14.41	(79)
Southwest	0.9x	0.77	x	0.55	x	106.25		0.63	x	0.7	=	17.86	(79)
Southwest	0.9x	0.77	x	0.55	x	119.01		0.63	x	0.7	=	20	(79)
Southwest	0.9x	0.77	x	0.55	x	118.15		0.63	x	0.7	=	19.86	(79)
Southwest	0.9x	0.77	x	0.55	x	113.91		0.63	x	0.7	=	19.15	(79)
Southwest	0.9x	0.77	x	0.55	x	104.39		0.63	x	0.7	=	17.55	(79)
Southwest	0.9x	0.77	x	0.55	x	92.85		0.63	x	0.7	=	15.61	(79)
Southwest	0.9x	0.77	x	0.55	x	69.27		0.63	x	0.7	=	11.64	(79)
Southwest	0.9x	0.77	x	0.55	x	44.07		0.63	x	0.7	=	7.41	(79)
Southwest	0.9x	0.77	x	0.55	x	31.49		0.63	x	0.7	=	5.29	(79)
Northwest	0.9x	0.77	x	7.55	x	11.28	x	0.63	x	0.7	=	26.03	(81)
Northwest	0.9x	0.77	x	7.55	x	22.97	x	0.63	x	0.7	=	52.99	(81)
Northwest	0.9x	0.77	x	7.55	x	41.38	x	0.63	x	0.7	=	95.48	(81)
Northwest	0.9x	0.77	x	7.55	x	67.96	x	0.63	x	0.7	=	156.8	(81)
Northwest	0.9x	0.77	x	7.55	x	91.35	x	0.63	x	0.7	=	210.77	(81)
Northwest	0.9x	0.77	x	7.55	x	97.38	x	0.63	x	0.7	=	224.7	(81)
Northwest	0.9x	0.77	x	7.55	x	91.1	x	0.63	x	0.7	=	210.2	(81)
Northwest	0.9x	0.77	x	7.55	x	72.63	x	0.63	x	0.7	=	167.58	(81)
Northwest	0.9x	0.77	x	7.55	x	50.42	x	0.63	x	0.7	=	116.34	(81)
Northwest	0.9x	0.77	x	7.55	x	28.07	x	0.63	x	0.7	=	64.76	(81)

DER WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	7.55	x	14.2	x	0.63	x	0.7	=	32.76	(81)
Northwest 0.9x	0.77	x	7.55	x	9.21	x	0.63	x	0.7	=	21.26	(81)
Rooflights 0.9x	1	x	1.01	x	16.37	x	0.63	x	0.7	=	6.56	(82)
Rooflights 0.9x	1	x	1.01	x	33.68	x	0.63	x	0.7	=	13.5	(82)
Rooflights 0.9x	1	x	1.01	x	62.13	x	0.63	x	0.7	=	24.91	(82)
Rooflights 0.9x	1	x	1.01	x	104.87	x	0.63	x	0.7	=	42.04	(82)
Rooflights 0.9x	1	x	1.01	x	143.66	x	0.63	x	0.7	=	57.59	(82)
Rooflights 0.9x	1	x	1.01	x	154.33	x	0.63	x	0.7	=	61.87	(82)
Rooflights 0.9x	1	x	1.01	x	143.9	x	0.63	x	0.7	=	57.69	(82)
Rooflights 0.9x	1	x	1.01	x	113.05	x	0.63	x	0.7	=	45.32	(82)
Rooflights 0.9x	1	x	1.01	x	76.56	x	0.63	x	0.7	=	30.69	(82)
Rooflights 0.9x	1	x	1.01	x	41.49	x	0.63	x	0.7	=	16.63	(82)
Rooflights 0.9x	1	x	1.01	x	20.65	x	0.63	x	0.7	=	8.28	(82)
Rooflights 0.9x	1	x	1.01	x	13.34	x	0.63	x	0.7	=	5.35	(82)

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

(83)m=	130.87	233.9	349.43	482.64	586.24	602.16	572.15	491.73	395.04	266.41	158.75	110.71	(83)

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

(84)m=	544.59	645.45	746.27	855.42	934.48	926.81	881.95	808.39	724.42	620.07	539.81	512.25	(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	0.96	0.91	0.82	0.66	0.52	0.58	0.8	0.94	0.98	0.99	(86)

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

(87)m=	19.08	19.32	19.69	20.19	20.6	20.87	20.96	20.94	20.73	20.18	19.55	19.05	(87)

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

(88)m=	19.86	19.86	19.86	19.88	19.88	19.89	19.89	19.9	19.89	19.88	19.88	19.87	(88)

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

(89)m=	0.99	0.98	0.95	0.89	0.77	0.58	0.4	0.46	0.73	0.92	0.98	0.99	(89)

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

(90)m=	17.32	17.66	18.2	18.91	19.47	19.79	19.87	19.86	19.65	18.92	18.01	17.27	(90)

fLA = Living area ÷ (4) = 0.27 (91)

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

(92)m=	17.8	18.11	18.61	19.26	19.78	20.08	20.17	20.16	19.94	19.26	18.43	17.76	(92)

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

(93)m=	17.65	17.96	18.46	19.11	19.63	19.93	20.02	20.01	19.79	19.11	18.28	17.61	(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=	0.98	0.97	0.94	0.87	0.76	0.58	0.42	0.47	0.72	0.91	0.97	0.98	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	533.93	623.75	699.72	746.97	706.62	540.06	367.83	381.4	523.28	562.66	522.61	503.94	(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=	1535.61	1497.79	1367.68	1151.11	891.75	592.45	379.75	399.69	635.52	957.67	1263.78	1524.49	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	745.25	587.35	496.96	290.98	137.74	0	0	0	0	293.89	533.64	759.29	

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3845.1 (98)

Space heating requirement in kWh/m²/year 42.69 (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		90.4	(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)	745.25	587.35	496.96	290.98	137.74	0	0	0	0	293.89	533.64	759.29	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	824.39	649.73	549.74	321.88	152.36	0	0	0	0	325.1	590.31	839.92	(211)

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 4253.43 (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)

98.19	83.02	91.37	78.84	102.91	142.33	136.42	152.08	153.77	85.35	88.82	94.69

Efficiency of water heater 80.3 (216)

(217)m=	89.1	89.01	88.67	88.04	85.79	80.3	80.3	80.3	80.3	87.91	88.81	89.16	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	110.21	93.27	103.04	89.55	119.97	177.24	169.89	189.39	191.49	97.08	100.02	106.21

Total = $Sum(219a)_{1...12}$ = 1547.35 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		4253.43	
Water heating fuel used		1547.35	
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		380.53	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		6256.31	(338)

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	=	918.74	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	334.23	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1252.97	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	38.93	(267)
Electricity for lighting	(232)	x	0.519	=	197.49	(268)
Total CO2, kg/year			sum of (265)…(271) =		1489.39	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		16.53	(273)
EI rating (section 14)					85	(274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
Printed on 16 June 2021 at 14:51:28

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Mid-terrace House

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 90.08m²

Site Reference : 119 East Road -BASE **Plot Reference:** Sample 2

Address :

Client Details:

Name:

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)	17.63 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	15.62 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	51.6 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	45.8 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	**OK**
Party wall	0.00 (max. 0.20)	-	**OK**
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	**OK**
Roof	0.11 (max. 0.20)	0.12 (max. 0.35)	**OK**
Openings	1.20 (max. 2.00)	1.20 (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	5.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system:	Boiler systems with radiators or underfloor heating - mains gas Data from manufacturer Combi boiler Efficiency 89.5 % SEDBUK2009 Minimum 88.0 %	**OK**
Secondary heating system:	None	

5 Cylinder insulation

Hot water Storage:	No cylinder	
		N/A

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	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	7.55m²
Windows facing: South East	8.19m²
Windows facing: South West	0.55m²
Roof windows facing: North West	1.01m²
Ventilation rate:	4.00

10 Key features

Roofs U-value	0.12 W/m²K
Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Neil Ingham	**Stroma Number:**	STRO010943
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Sample 2

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	33.34	(1a)	x	2.4	(2a)	=	80.02	(3a)
First floor	33.34	(1b)	x	2.7	(2b)	=	90.02	(3b)
Second floor	23.4	(1c)	x	2.26	(2c)	=	52.88	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.08	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	222.92	(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) =	0.13	(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)	0.38	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.38	(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

DER WorkSheet: New dwelling design stage

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

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

0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.38	0.41	0.43	0.45

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=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(24d)

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(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			2.28	x	1.2	=	2.736			(26)
Windows Type 1			7.55	x1/[1/(1.2)+ 0.04]		=	8.65			(27)
Windows Type 2			8.19	x1/[1/(1.2)+ 0.04]		=	9.38			(27)
Windows Type 3			0.55	x1/[1/(1.2)+ 0.04]		=	0.63			(27)
Rooflights			1.01	x1/[1/(1.2) + 0.04]		=	1.212			(27b)
Floor			33.34	x	0.14	=	4.6676	110	3667.4	(28)
Walls Type1	90.38	18.57	71.81	x	0.18	=	12.93	60	4308.6	(29)
Walls Type2	6.62	0	6.62	x	0.18	=	1.19	9	59.58	(29)
Roof Type1	25.59	1.01	24.58	x	0.12	=	2.95	9	221.22	(30)
Roof Type2	6.22	0	6.22	x	0.1	=	0.62	9	55.98	(30)
Roof Type3	3.72	0	3.72	x	0.09	=	0.34	9	33.48	(30)
Total area of elements, m²			165.87							(31)
Party wall			77.56	x	0	=	0	45	3490.2	(32)
Internal wall **			95.5					9	859.5	(32c)
Internal floor			56.74					18	1021.32	(32d)
Internal ceiling			56.74					9	510.66	(32e)

** 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) = 45.24 (33)

DER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	14227.94	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	157.95	(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		16.86	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	62.1	(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=	45.62	45.28	44.94	43.36	43.07	41.69	41.69	41.44	42.22	43.07	43.67	44.29	(38)

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

(39)m=	107.72	107.38	107.04	105.46	105.17	103.79	103.79	103.53	104.32	105.17	105.77	106.39	

Average = Sum(39)$_{1…12}$ /12= 105.46 (39)

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

(40)m=	1.2	1.19	1.19	1.17	1.17	1.15	1.15	1.15	1.16	1.17	1.17	1.18	

Average = Sum(40)$_{1…12}$ /12= 1.17 (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 2.63 (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 96.59 (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=	106.25	102.38	98.52	94.66	90.79	86.93	86.93	90.79	94.66	98.52	102.38	106.25	

Total = Sum(44)$_{1…12}$ = 1159.04 (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=	157.56	137.8	142.2	123.97	118.95	102.65	95.12	109.15	110.45	128.72	140.51	152.59	

Total = Sum(45)$_{1…12}$ = 1519.69 (45)

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

(46)m=	23.63	20.67	21.33	18.6	17.84	15.4	14.27	16.37	16.57	19.31	21.08	22.89	(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:

DER WorkSheet: New dwelling design stage

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=	50.96	46.03	50.2	46.68	46.27	42.87	44.3	46.27	46.68	50.2	49.32	50.96	(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=	208.52	183.83	192.4	170.65	165.22	145.52	139.42	155.42	157.13	178.93	189.83	203.55	(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)
FHRS	109.24	100.07	100.28	91.39	52.91	3.19	2.99	3.34	3.37	93.16	100.31	107.81	(63) (G2)

Output from water heater

(64)m=	99.28	83.76	92.12	79.27	112.31	142.33	136.42	152.08	153.77	85.77	89.52	95.74	

Output from water heater (annual)1…12 | 1322.35 | (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=	65.13	57.33	59.83	52.89	51.12	44.85	42.7	47.86	48.4	55.35	59.05	63.48	(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=	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	(66)

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

(67)m=	21.55	19.14	15.56	11.78	8.81	7.44	8.03	10.44	14.02	17.8	20.77	22.15	(67)

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

(68)m=	239.22	241.71	235.45	222.13	205.32	189.52	178.97	176.49	182.74	196.06	212.87	228.67	(68)

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

(69)m=	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	(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=	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	(71)

Water heating gains (Table 5)

(72)m=	87.54	85.31	80.42	73.46	68.71	62.29	57.39	64.33	67.22	74.4	82.01	85.32	(72)

DER WorkSheet: New dwelling design stage

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

(73)m=	413.71	411.55	396.84	372.78	348.24	324.65	309.8	316.66	329.38	353.66	381.06	401.53	(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	8.19	x	36.79	x	0.63	x	0.7	=	92.09	(77)
Southeast 0.9x	0.77	x	8.19	x	62.67	x	0.63	x	0.7	=	156.87	(77)
Southeast 0.9x	0.77	x	8.19	x	85.75	x	0.63	x	0.7	=	214.64	(77)
Southeast 0.9x	0.77	x	8.19	x	106.25	x	0.63	x	0.7	=	265.94	(77)
Southeast 0.9x	0.77	x	8.19	x	119.01	x	0.63	x	0.7	=	297.88	(77)
Southeast 0.9x	0.77	x	8.19	x	118.15	x	0.63	x	0.7	=	295.73	(77)
Southeast 0.9x	0.77	x	8.19	x	113.91	x	0.63	x	0.7	=	285.11	(77)
Southeast 0.9x	0.77	x	8.19	x	104.39	x	0.63	x	0.7	=	261.29	(77)
Southeast 0.9x	0.77	x	8.19	x	92.85	x	0.63	x	0.7	=	232.41	(77)
Southeast 0.9x	0.77	x	8.19	x	69.27	x	0.63	x	0.7	=	173.37	(77)
Southeast 0.9x	0.77	x	8.19	x	44.07	x	0.63	x	0.7	=	110.31	(77)
Southeast 0.9x	0.77	x	8.19	x	31.49	x	0.63	x	0.7	=	78.81	(77)
Southwest 0.9x	0.77	x	0.55	x	36.79		0.63	x	0.7	=	6.18	(79)
Southwest 0.9x	0.77	x	0.55	x	62.67		0.63	x	0.7	=	10.53	(79)
Southwest 0.9x	0.77	x	0.55	x	85.75		0.63	x	0.7	=	14.41	(79)
Southwest 0.9x	0.77	x	0.55	x	106.25		0.63	x	0.7	=	17.86	(79)
Southwest 0.9x	0.77	x	0.55	x	119.01		0.63	x	0.7	=	20	(79)
Southwest 0.9x	0.77	x	0.55	x	118.15		0.63	x	0.7	=	19.86	(79)
Southwest 0.9x	0.77	x	0.55	x	113.91		0.63	x	0.7	=	19.15	(79)
Southwest 0.9x	0.77	x	0.55	x	104.39		0.63	x	0.7	=	17.55	(79)
Southwest 0.9x	0.77	x	0.55	x	92.85		0.63	x	0.7	=	15.61	(79)
Southwest 0.9x	0.77	x	0.55	x	69.27		0.63	x	0.7	=	11.64	(79)
Southwest 0.9x	0.77	x	0.55	x	44.07		0.63	x	0.7	=	7.41	(79)
Southwest 0.9x	0.77	x	0.55	x	31.49		0.63	x	0.7	=	5.29	(79)
Northwest 0.9x	0.77	x	7.55	x	11.28	x	0.63	x	0.7	=	26.03	(81)
Northwest 0.9x	0.77	x	7.55	x	22.97	x	0.63	x	0.7	=	52.99	(81)
Northwest 0.9x	0.77	x	7.55	x	41.38	x	0.63	x	0.7	=	95.48	(81)
Northwest 0.9x	0.77	x	7.55	x	67.96	x	0.63	x	0.7	=	156.8	(81)
Northwest 0.9x	0.77	x	7.55	x	91.35	x	0.63	x	0.7	=	210.77	(81)
Northwest 0.9x	0.77	x	7.55	x	97.38	x	0.63	x	0.7	=	224.7	(81)
Northwest 0.9x	0.77	x	7.55	x	91.1	x	0.63	x	0.7	=	210.2	(81)
Northwest 0.9x	0.77	x	7.55	x	72.63	x	0.63	x	0.7	=	167.58	(81)
Northwest 0.9x	0.77	x	7.55	x	50.42	x	0.63	x	0.7	=	116.34	(81)
Northwest 0.9x	0.77	x	7.55	x	28.07	x	0.63	x	0.7	=	64.76	(81)

DER WorkSheet: New dwelling design stage

Northwest	0.9x	0.77	x	7.55	x	14.2	x	0.63	x	0.7	=	32.76	(81)
Northwest	0.9x	0.77	x	7.55	x	9.21	x	0.63	x	0.7	=	21.26	(81)
Rooflights	0.9x	1	x	1.01	x	16.37	x	0.63	x	0.7	=	6.56	(82)
Rooflights	0.9x	1	x	1.01	x	33.68	x	0.63	x	0.7	=	13.5	(82)
Rooflights	0.9x	1	x	1.01	x	62.13	x	0.63	x	0.7	=	24.91	(82)
Rooflights	0.9x	1	x	1.01	x	104.87	x	0.63	x	0.7	=	42.04	(82)
Rooflights	0.9x	1	x	1.01	x	143.66	x	0.63	x	0.7	=	57.59	(82)
Rooflights	0.9x	1	x	1.01	x	154.33	x	0.63	x	0.7	=	61.87	(82)
Rooflights	0.9x	1	x	1.01	x	143.9	x	0.63	x	0.7	=	57.69	(82)
Rooflights	0.9x	1	x	1.01	x	113.05	x	0.63	x	0.7	=	45.32	(82)
Rooflights	0.9x	1	x	1.01	x	76.56	x	0.63	x	0.7	=	30.69	(82)
Rooflights	0.9x	1	x	1.01	x	41.49	x	0.63	x	0.7	=	16.63	(82)
Rooflights	0.9x	1	x	1.01	x	20.65	x	0.63	x	0.7	=	8.28	(82)
Rooflights	0.9x	1	x	1.01	x	13.34	x	0.63	x	0.7	=	5.35	(82)

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

(83)m=	130.87	233.9	349.43	482.64	586.24	602.16	572.15	491.73	395.04	266.41	158.75	110.71	(83)

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

(84)m=	544.59	645.45	746.27	855.42	934.48	926.81	881.95	808.39	724.42	620.07	539.81	512.25	(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	0.96	0.9	0.8	0.64	0.49	0.55	0.78	0.94	0.98	0.99	(86)

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

(87)m=	19.17	19.4	19.78	20.26	20.66	20.89	20.97	20.95	20.77	20.25	19.62	19.13	(87)

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

(88)m=	19.92	19.93	19.93	19.94	19.95	19.96	19.96	19.96	19.95	19.95	19.94	19.94	(88)

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

(89)m=	0.99	0.97	0.95	0.88	0.75	0.56	0.39	0.44	0.71	0.92	0.98	0.99	(89)

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

(90)m=	17.48	17.83	18.37	19.06	19.59	19.87	19.94	19.93	19.74	19.06	18.16	17.44	(90)

fLA = Living area ÷ (4) = 0.27 (91)

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

(92)m=	17.94	18.26	18.76	19.39	19.88	20.15	20.22	20.21	20.02	19.38	18.56	17.9	(92)

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

(93)m=	17.79	18.11	18.61	19.24	19.73	20	20.07	20.06	19.87	19.23	18.41	17.75	(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

Utilisation factor for gains, hm:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m=	0.98	0.96	0.93	0.86	0.74	0.56	0.4	0.45	0.7	0.9	0.96	0.98	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	532.87	621.54	695.04	736.7	688.7	518.8	351.11	364.84	508.79	557.1	520.86	503.11	(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=	1453.48	1418.24	1295.8	1090.3	844.23	560.39	360.24	379.03	602.3	907.73	1196.2	1441.75	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	684.93	535.38	446.97	254.6	115.72	0	0	0	0	260.87	486.24	698.35

Total per year (kWh/year) = $Sum(98)_{1...5,9...12}$ = 3483.05 (98)

Space heating requirement in kWh/m²/year 38.67 (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		90.4	(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)	684.93	535.38	446.97	254.6	115.72	0	0	0	0	260.87	486.24	698.35	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	757.67	592.23	494.43	281.63	128.01	0	0	0	0	288.57	537.88	772.51	(211)

Total (kWh/year) =$Sum(211)_{1...5,10....12}$= 3852.94 (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)

	99.28	83.76	92.12	79.27	112.31	142.33	136.42	152.08	153.77	85.77	89.52	95.74

Efficiency of water heater 80.3 (216)

(217)m=	88.98	88.89	88.5	87.78	85.13	80.3	80.3	80.3	80.3	87.67	88.67	89.05	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	111.57	94.23	104.09	90.3	131.93	177.24	169.89	189.39	191.49	97.83	100.97	107.51

Total = $Sum(219a)_{1...12}$ = 1566.44 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3852.94	
Water heating fuel used		1566.44	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)

DER WorkSheet: New dwelling design stage

boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		75	(231)
Electricity for lighting			380.53	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			5874.91	(338)

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	=	832.23	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	338.35	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1170.59	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	197.49	(268)
Total CO2, kg/year		sum of (265)…(271) =		1407	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		15.62	(273)
EI rating (section 14)				86	(274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
Printed on 16 June 2021 at 14:51:26

Project Information:

Assessed By: Neil Ingham (STRO010943)
Building Type: End-terrace House

Dwelling Details:

NEW DWELLING DESIGN STAGE
Total Floor Area: 90.08m²
Site Reference : 119 East Road -BASE
Plot Reference: Sample 3
Address :

Client Details:

Name:
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)	18.63 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	16.53 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	56.7 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	50.1 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.12 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (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	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Boiler systems with radiators or underfloor heating - mains gas
Data from manufacturer
Combi boiler
Efficiency 89.5 % SEDBUK2009
Minimum 88.0 % — OK

Secondary heating system: None

5 Cylinder insulation

Hot water Storage: No cylinder

N/A

Regulations Compliance Report

6 Controls

Space heating controls	TTZC by plumbing and electrical services	**OK**
Hot water controls:	No cylinder thermostat	
	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):	Slight	**OK**
Based on:		
Overshading:	Average or unknown	
Windows facing: North West	7.55m²	
Windows facing: South East	8.19m²	
Windows facing: South West	0.55m²	
Roof windows facing: North West	1.01m²	
Ventilation rate:	4.00	

10 Key features

Roofs U-value	0.12 W/m²K
Party Walls U-value	0 W/m²K

DER WorkSheet: New dwelling design stage

User Details:			
Assessor Name:	Neil Ingham	**Stroma Number:**	STRO010943
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Sample 3

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	33.34	(1a) x	2.4	(2a) =	80.02	(3a)
First floor	33.34	(1b) x	2.7	(2b) =	90.02	(3b)
Second floor	23.4	(1c) x	2.26	(2c) =	52.88	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.08	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	222.92	(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) =	0.13	(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)	0.38	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.38	(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

DER WorkSheet: New dwelling design stage

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

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

0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.38	0.41	0.43	0.45

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=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(24d)

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(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			2.28	x	1.2	=	2.736			(26)
Windows Type 1			7.55	x1/[1/(1.2)+ 0.04]		=	8.65			(27)
Windows Type 2			8.19	x1/[1/(1.2)+ 0.04]		=	9.38			(27)
Windows Type 3			0.55	x1/[1/(1.2)+ 0.04]		=	0.63			(27)
Rooflights			1.01	x1/[1/(1.2) + 0.04]		=	1.212			(27b)
Floor			33.34	x	0.14	=	4.6676	110	3667.4	(28)
Walls Type1	128.68	18.57	110.11	x	0.18	=	19.82	60	6606.6	(29)
Walls Type2	6.62	0	6.62	x	0.18	=	1.19	9	59.58	(29)
Roof Type1	25.59	1.01	24.58	x	0.12	=	2.95	9	221.22	(30)
Roof Type2	6.22	0	6.22	x	0.1	=	0.62	9	55.98	(30)
Roof Type3	3.72	0	3.72	x	0.09	=	0.34	9	33.48	(30)
Total area of elements, m²			204.17							(31)
Party wall			39.26	x	0	=	0	45	1766.7	(32)
Internal wall **			95.5					9	859.5	(32c)
Internal floor			56.74					18	1021.32	(32d)
Internal ceiling			56.74					9	510.66	(32e)

** 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) = 52.14 (33)

DER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 14802.44 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 164.33 (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 17.27 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 69.41 (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=	45.62	45.28	44.94	43.36	43.07	41.69	41.69	41.44	42.22	43.07	43.67	44.29	(38)

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

(39)m=	115.03	114.69	114.35	112.77	112.48	111.1	111.1	110.85	111.63	112.48	113.08	113.7

Average = Sum(39)$_{1…12}$ /12= 112.77 (39)

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

(40)m=	1.28	1.27	1.27	1.25	1.25	1.23	1.23	1.23	1.24	1.25	1.26	1.26

Average = Sum(40)$_{1…12}$ /12= 1.25 (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 2.63 (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 96.59 (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=	106.25	102.38	98.52	94.66	90.79	86.93	86.93	90.79	94.66	98.52	102.38	106.25

Total = Sum(44)$_{1…12}$ = 1159.04 (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=	157.56	137.8	142.2	123.97	118.95	102.65	95.12	109.15	110.45	128.72	140.51	152.59

Total = Sum(45)$_{1…12}$ = 1519.69 (45)

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

(46)m=	23.63	20.67	21.33	18.6	17.84	15.4	14.27	16.37	16.57	19.31	21.08	22.89	(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:

DER WorkSheet: New dwelling design stage

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=	50.96	46.03	50.2	46.68	46.27	42.87	44.3	46.27	46.68	50.2	49.32	50.96	(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=	208.52	183.83	192.4	170.65	165.22	145.52	139.42	155.42	157.13	178.93	189.83	203.55	(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)
FHRS	110.33	100.81	101.04	91.82	62.31	3.19	2.99	3.34	3.37	93.58	101.01	108.85	(63) (G2)

Output from water heater

(64)m=	98.19	83.02	91.37	78.84	102.91	142.33	136.42	152.08	153.77	85.35	88.82	94.69	

Output from water heater (annual)1…12 | 1307.78 | (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=	65.13	57.33	59.83	52.89	51.12	44.85	42.7	47.86	48.4	55.35	59.05	63.48	(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=	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	(66)

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

(67)m=	21.55	19.14	15.56	11.78	8.81	7.44	8.03	10.44	14.02	17.8	20.77	22.15	(67)

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

(68)m=	239.22	241.71	235.45	222.13	205.32	189.52	178.97	176.49	182.74	196.06	212.87	228.67	(68)

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

(69)m=	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	(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=	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	(71)

Water heating gains (Table 5)

(72)m=	87.54	85.31	80.42	73.46	68.71	62.29	57.39	64.33	67.22	74.4	82.01	85.32	(72)

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

(73)m=	413.71	411.55	396.84	372.78	348.24	324.65	309.8	316.66	329.38	353.66	381.06	401.53	(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	8.19	x	36.79	x	0.63	x	0.7	=	92.09	(77)
Southeast 0.9x	0.77	x	8.19	x	62.67	x	0.63	x	0.7	=	156.87	(77)
Southeast 0.9x	0.77	x	8.19	x	85.75	x	0.63	x	0.7	=	214.64	(77)
Southeast 0.9x	0.77	x	8.19	x	106.25	x	0.63	x	0.7	=	265.94	(77)
Southeast 0.9x	0.77	x	8.19	x	119.01	x	0.63	x	0.7	=	297.88	(77)
Southeast 0.9x	0.77	x	8.19	x	118.15	x	0.63	x	0.7	=	295.73	(77)
Southeast 0.9x	0.77	x	8.19	x	113.91	x	0.63	x	0.7	=	285.11	(77)
Southeast 0.9x	0.77	x	8.19	x	104.39	x	0.63	x	0.7	=	261.29	(77)
Southeast 0.9x	0.77	x	8.19	x	92.85	x	0.63	x	0.7	=	232.41	(77)
Southeast 0.9x	0.77	x	8.19	x	69.27	x	0.63	x	0.7	=	173.37	(77)
Southeast 0.9x	0.77	x	8.19	x	44.07	x	0.63	x	0.7	=	110.31	(77)
Southeast 0.9x	0.77	x	8.19	x	31.49	x	0.63	x	0.7	=	78.81	(77)
Southwest 0.9x	0.77	x	0.55	x	36.79		0.63	x	0.7	=	6.18	(79)
Southwest 0.9x	0.77	x	0.55	x	62.67		0.63	x	0.7	=	10.53	(79)
Southwest 0.9x	0.77	x	0.55	x	85.75		0.63	x	0.7	=	14.41	(79)
Southwest 0.9x	0.77	x	0.55	x	106.25		0.63	x	0.7	=	17.86	(79)
Southwest 0.9x	0.77	x	0.55	x	119.01		0.63	x	0.7	=	20	(79)
Southwest 0.9x	0.77	x	0.55	x	118.15		0.63	x	0.7	=	19.86	(79)
Southwest 0.9x	0.77	x	0.55	x	113.91		0.63	x	0.7	=	19.15	(79)
Southwest 0.9x	0.77	x	0.55	x	104.39		0.63	x	0.7	=	17.55	(79)
Southwest 0.9x	0.77	x	0.55	x	92.85		0.63	x	0.7	=	15.61	(79)
Southwest 0.9x	0.77	x	0.55	x	69.27		0.63	x	0.7	=	11.64	(79)
Southwest 0.9x	0.77	x	0.55	x	44.07		0.63	x	0.7	=	7.41	(79)
Southwest 0.9x	0.77	x	0.55	x	31.49		0.63	x	0.7	=	5.29	(79)
Northwest 0.9x	0.77	x	7.55	x	11.28	x	0.63	x	0.7	=	26.03	(81)
Northwest 0.9x	0.77	x	7.55	x	22.97	x	0.63	x	0.7	=	52.99	(81)
Northwest 0.9x	0.77	x	7.55	x	41.38	x	0.63	x	0.7	=	95.48	(81)
Northwest 0.9x	0.77	x	7.55	x	67.96	x	0.63	x	0.7	=	156.8	(81)
Northwest 0.9x	0.77	x	7.55	x	91.35	x	0.63	x	0.7	=	210.77	(81)
Northwest 0.9x	0.77	x	7.55	x	97.38	x	0.63	x	0.7	=	224.7	(81)
Northwest 0.9x	0.77	x	7.55	x	91.1	x	0.63	x	0.7	=	210.2	(81)
Northwest 0.9x	0.77	x	7.55	x	72.63	x	0.63	x	0.7	=	167.58	(81)
Northwest 0.9x	0.77	x	7.55	x	50.42	x	0.63	x	0.7	=	116.34	(81)
Northwest 0.9x	0.77	x	7.55	x	28.07	x	0.63	x	0.7	=	64.76	(81)

DER WorkSheet: New dwelling design stage

Northwest	0.9x	0.77	x	7.55	x	14.2	x	0.63	x	0.7	=	32.76	(81)
Northwest	0.9x	0.77	x	7.55	x	9.21	x	0.63	x	0.7	=	21.26	(81)
Rooflights	0.9x	1	x	1.01	x	16.37	x	0.63	x	0.7	=	6.56	(82)
Rooflights	0.9x	1	x	1.01	x	33.68	x	0.63	x	0.7	=	13.5	(82)
Rooflights	0.9x	1	x	1.01	x	62.13	x	0.63	x	0.7	=	24.91	(82)
Rooflights	0.9x	1	x	1.01	x	104.87	x	0.63	x	0.7	=	42.04	(82)
Rooflights	0.9x	1	x	1.01	x	143.66	x	0.63	x	0.7	=	57.59	(82)
Rooflights	0.9x	1	x	1.01	x	154.33	x	0.63	x	0.7	=	61.87	(82)
Rooflights	0.9x	1	x	1.01	x	143.9	x	0.63	x	0.7	=	57.69	(82)
Rooflights	0.9x	1	x	1.01	x	113.05	x	0.63	x	0.7	=	45.32	(82)
Rooflights	0.9x	1	x	1.01	x	76.56	x	0.63	x	0.7	=	30.69	(82)
Rooflights	0.9x	1	x	1.01	x	41.49	x	0.63	x	0.7	=	16.63	(82)
Rooflights	0.9x	1	x	1.01	x	20.65	x	0.63	x	0.7	=	8.28	(82)
Rooflights	0.9x	1	x	1.01	x	13.34	x	0.63	x	0.7	=	5.35	(82)

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

(83)m=	130.87	233.9	349.43	482.64	586.24	602.16	572.15	491.73	395.04	266.41	158.75	110.71	(83)

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

(84)m=	544.59	645.45	746.27	855.42	934.48	926.81	881.95	808.39	724.42	620.07	539.81	512.25	(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	0.96	0.91	0.82	0.66	0.52	0.58	0.8	0.94	0.98	0.99	(86)

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

(87)m=	19.08	19.32	19.69	20.19	20.6	20.87	20.96	20.94	20.73	20.18	19.55	19.05	(87)

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

(88)m=	19.86	19.86	19.86	19.88	19.88	19.89	19.89	19.9	19.89	19.88	19.88	19.87	(88)

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

(89)m=	0.99	0.98	0.95	0.89	0.77	0.58	0.4	0.46	0.73	0.92	0.98	0.99	(89)

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

(90)m=	17.32	17.66	18.2	18.91	19.47	19.79	19.87	19.86	19.65	18.92	18.01	17.27	(90)

fLA = Living area ÷ (4) = 0.27 (91)

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

(92)m=	17.8	18.11	18.61	19.26	19.78	20.08	20.17	20.16	19.94	19.26	18.43	17.76	(92)

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

(93)m=	17.65	17.96	18.46	19.11	19.63	19.93	20.02	20.01	19.79	19.11	18.28	17.61	(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=	0.98	0.97	0.94	0.87	0.76	0.58	0.42	0.47	0.72	0.91	0.97	0.98	(94)

DER WorkSheet: New dwelling design stage

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	533.93	623.75	699.72	746.97	706.62	540.06	367.83	381.4	523.28	562.66	522.61	503.94	(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=	1535.61	1497.79	1367.68	1151.11	891.75	592.45	379.75	399.69	635.52	957.67	1263.78	1524.49	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	745.25	587.35	496.96	290.98	137.74	0	0	0	0	293.89	533.64	759.29

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 3845.1 (98)

Space heating requirement in kWh/m²/year 42.69 (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		90.4	(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)	745.25	587.35	496.96	290.98	137.74	0	0	0	0	293.89	533.64	759.29	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	824.39	649.73	549.74	321.88	152.36	0	0	0	0	325.1	590.31	839.92	(211)

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 4253.43 (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)

	98.19	83.02	91.37	78.84	102.91	142.33	136.42	152.08	153.77	85.35	88.82	94.69

Efficiency of water heater 80.3 (216)

(217)m=	89.1	89.01	88.67	88.04	85.79	80.3	80.3	80.3	80.3	87.91	88.81	89.16	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	110.21	93.27	103.04	89.55	119.97	177.24	169.89	189.39	191.49	97.08	100.02	106.21

Total = Sum(219a)$_{1...12}$ = 1547.35 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		4253.43	
Water heating fuel used		1547.35	
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		380.53	(232)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		6256.31	(338)

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	=	918.74	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	334.23	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1252.97	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	38.93	(267)
Electricity for lighting	(232) x	0.519	=	197.49	(268)
Total CO2, kg/year		sum of (265)…(271) =		1489.39	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		16.53	(273)
El rating (section 14)				85	(274)

Appendix C

Generating energy on-site:-

Final SAP Outputs & Dwelling Emission Rates

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
Printed on 16 June 2021 at 14:57:17

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** End-terrace House

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 90.08m²

Site Reference : 119 East Road -GREEN **Plot Reference:** Sample 1

Address :

Client Details:

Name:

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: Electricity		
Fuel factor: 1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	26.96 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	10.48 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	56.7 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	50.1 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.12 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (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	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric
Mitsubishi ECODAN 8.5kW

Secondary heating system: None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 1.47 kWh/day	
	Permitted by DBSCG: 2.24 kWh/day	OK

Regulations Compliance Report

Primary pipework insulated:	Yes		OK

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
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	7.55m²
Windows facing: South East	8.19m²
Windows facing: South West	0.55m²
Roof windows facing: North West	1.01m²
Ventilation rate:	4.00

10 Key features

Roofs U-value	0.12 W/m²K
Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Neil Ingham	**Stroma Number:**	STRO010943
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Sample 1

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	33.34	(1a)	x	2.4	(2a)	=	80.02	(3a)
First floor	33.34	(1b)	x	2.7	(2b)	=	90.02	(3b)
Second floor	23.4	(1c)	x	2.26	(2c)	=	52.88	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.08	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	222.92	(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) =	0.13	(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)	0.38	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.38	(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

DER WorkSheet: New dwelling design stage

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

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

0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.38	0.41	0.43	0.45

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=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(24d)

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(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			2.28	x	1.2	=	2.736			(26)
Windows Type 1			7.55	x1/[1/(1.2)+ 0.04]		=	8.65			(27)
Windows Type 2			8.19	x1/[1/(1.2)+ 0.04]		=	9.38			(27)
Windows Type 3			0.55	x1/[1/(1.2)+ 0.04]		=	0.63			(27)
Rooflights			1.01	x1/[1/(1.2) + 0.04]		=	1.212			(27b)
Floor			33.34	x	0.14	=	4.6676	110	3667.4	(28)
Walls Type1	128.68	18.57	110.11	x	0.18	=	19.82	60	6606.6	(29)
Walls Type2	6.62	0	6.62	x	0.18	=	1.19	9	59.58	(29)
Roof Type1	25.59	1.01	24.58	x	0.12	=	2.95	9	221.22	(30)
Roof Type2	6.22	0	6.22	x	0.1	=	0.62	9	55.98	(30)
Roof Type3	3.72	0	3.72	x	0.09	=	0.34	9	33.48	(30)
Total area of elements, m²			204.17							(31)
Party wall			39.26	x	0	=	0	45	1766.7	(32)
Internal wall **			95.5					9	859.5	(32c)
Internal floor			56.74					18	1021.32	(32d)
Internal ceiling			56.74					9	510.66	(32e)

** 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) = 52.14 (33)

DER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	14802.44	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	164.33	(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		17.27	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	69.41	(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=	45.62	45.28	44.94	43.36	43.07	41.69	41.69	41.44	42.22	43.07	43.67	44.29	(38)

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

(39)m=	115.03	114.69	114.35	112.77	112.48	111.1	111.1	110.85	111.63	112.48	113.08	113.7	

Average = Sum(39)$_{1…12}$ /12= 112.77 (39)

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

(40)m=	1.28	1.27	1.27	1.25	1.25	1.23	1.23	1.23	1.24	1.25	1.26	1.26	

Average = Sum(40)$_{1…12}$ /12= 1.25 (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 — 2.63 (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 — 96.59 (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=	106.25	102.38	98.52	94.66	90.79	86.93	86.93	90.79	94.66	98.52	102.38	106.25	

Total = Sum(44)$_{1…12}$ = 1159.04 (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=	157.56	137.8	142.2	123.97	118.95	102.65	95.12	109.15	110.45	128.72	140.51	152.59	

Total = Sum(45)$_{1…12}$ = 1519.69 (45)

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

(46)m=	23.63	20.67	21.33	18.6	17.84	15.4	14.27	16.37	16.57	19.31	21.08	22.89	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		200	(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):		1.47	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.79	(50)

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

DER WorkSheet: New dwelling design stage

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)		0.79	(55)

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

(56)m=	24.61	22.23	24.61	23.81	24.61	23.81	24.61	24.61	23.81	24.61	23.81	24.61	(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=	24.61	22.23	24.61	23.81	24.61	23.81	24.61	24.61	23.81	24.61	23.81	24.61	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	205.43	181.04	190.07	170.3	166.83	148.98	142.99	157.02	156.78	176.59	186.84	200.46	(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)
FHRS	113.77	102.9	102.79	92.49	70.26	3.19	2.99	3.34	3.37	94.36	102.93	112.14	(63) (G2)

Output from water heater

(64)m=	91.66	78.14	87.28	77.81	96.56	145.78	140	153.68	153.41	82.23	83.91	88.31	

Output from water heater (annual)$_{1...12}$ — 1278.78 (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=	90.68	80.41	85.58	78.28	77.85	71.19	69.92	74.59	73.79	81.1	83.78	89.03	(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=	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	(66)

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

(67)m=	21.55	19.14	15.56	11.78	8.81	7.44	8.03	10.44	14.02	17.8	20.77	22.15	(67)

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

(68)m=	239.22	241.71	235.45	222.13	205.32	189.52	178.97	176.49	182.74	196.06	212.87	228.67	(68)

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

(69)m=	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	(71)

Water heating gains (Table 5)

(72)m=	121.89	119.66	115.02	108.72	104.64	98.88	93.98	100.25	102.48	109	116.36	119.67	(72)

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

(73)m=	445.06	442.9	428.44	405.04	381.17	358.24	343.39	349.59	361.64	385.26	412.41	432.88	(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	8.19	x	36.79	x	0.63	x	0.7	=	92.09	(77)
Southeast 0.9x	0.77	x	8.19	x	62.67	x	0.63	x	0.7	=	156.87	(77)
Southeast 0.9x	0.77	x	8.19	x	85.75	x	0.63	x	0.7	=	214.64	(77)
Southeast 0.9x	0.77	x	8.19	x	106.25	x	0.63	x	0.7	=	265.94	(77)
Southeast 0.9x	0.77	x	8.19	x	119.01	x	0.63	x	0.7	=	297.88	(77)
Southeast 0.9x	0.77	x	8.19	x	118.15	x	0.63	x	0.7	=	295.73	(77)
Southeast 0.9x	0.77	x	8.19	x	113.91	x	0.63	x	0.7	=	285.11	(77)
Southeast 0.9x	0.77	x	8.19	x	104.39	x	0.63	x	0.7	=	261.29	(77)
Southeast 0.9x	0.77	x	8.19	x	92.85	x	0.63	x	0.7	=	232.41	(77)
Southeast 0.9x	0.77	x	8.19	x	69.27	x	0.63	x	0.7	=	173.37	(77)
Southeast 0.9x	0.77	x	8.19	x	44.07	x	0.63	x	0.7	=	110.31	(77)
Southeast 0.9x	0.77	x	8.19	x	31.49	x	0.63	x	0.7	=	78.81	(77)
Southwest 0.9x	0.77	x	0.55	x	36.79		0.63	x	0.7	=	6.18	(79)
Southwest 0.9x	0.77	x	0.55	x	62.67		0.63	x	0.7	=	10.53	(79)
Southwest 0.9x	0.77	x	0.55	x	85.75		0.63	x	0.7	=	14.41	(79)
Southwest 0.9x	0.77	x	0.55	x	106.25		0.63	x	0.7	=	17.86	(79)
Southwest 0.9x	0.77	x	0.55	x	119.01		0.63	x	0.7	=	20	(79)
Southwest 0.9x	0.77	x	0.55	x	118.15		0.63	x	0.7	=	19.86	(79)
Southwest 0.9x	0.77	x	0.55	x	113.91		0.63	x	0.7	=	19.15	(79)
Southwest 0.9x	0.77	x	0.55	x	104.39		0.63	x	0.7	=	17.55	(79)
Southwest 0.9x	0.77	x	0.55	x	92.85		0.63	x	0.7	=	15.61	(79)
Southwest 0.9x	0.77	x	0.55	x	69.27		0.63	x	0.7	=	11.64	(79)
Southwest 0.9x	0.77	x	0.55	x	44.07		0.63	x	0.7	=	7.41	(79)
Southwest 0.9x	0.77	x	0.55	x	31.49		0.63	x	0.7	=	5.29	(79)
Northwest 0.9x	0.77	x	7.55	x	11.28	x	0.63	x	0.7	=	26.03	(81)
Northwest 0.9x	0.77	x	7.55	x	22.97	x	0.63	x	0.7	=	52.99	(81)
Northwest 0.9x	0.77	x	7.55	x	41.38	x	0.63	x	0.7	=	95.48	(81)
Northwest 0.9x	0.77	x	7.55	x	67.96	x	0.63	x	0.7	=	156.8	(81)
Northwest 0.9x	0.77	x	7.55	x	91.35	x	0.63	x	0.7	=	210.77	(81)
Northwest 0.9x	0.77	x	7.55	x	97.38	x	0.63	x	0.7	=	224.7	(81)
Northwest 0.9x	0.77	x	7.55	x	91.1	x	0.63	x	0.7	=	210.2	(81)
Northwest 0.9x	0.77	x	7.55	x	72.63	x	0.63	x	0.7	=	167.58	(81)
Northwest 0.9x	0.77	x	7.55	x	50.42	x	0.63	x	0.7	=	116.34	(81)
Northwest 0.9x	0.77	x	7.55	x	28.07	x	0.63	x	0.7	=	64.76	(81)

DER WorkSheet: New dwelling design stage

Northwest	0.9x	0.77	x	7.55	x	14.2	x	0.63	x	0.7	=	32.76	(81)
Northwest	0.9x	0.77	x	7.55	x	9.21	x	0.63	x	0.7	=	21.26	(81)
Rooflights	0.9x	1	x	1.01	x	16.37	x	0.63	x	0.7	=	6.56	(82)
Rooflights	0.9x	1	x	1.01	x	33.68	x	0.63	x	0.7	=	13.5	(82)
Rooflights	0.9x	1	x	1.01	x	62.13	x	0.63	x	0.7	=	24.91	(82)
Rooflights	0.9x	1	x	1.01	x	104.87	x	0.63	x	0.7	=	42.04	(82)
Rooflights	0.9x	1	x	1.01	x	143.66	x	0.63	x	0.7	=	57.59	(82)
Rooflights	0.9x	1	x	1.01	x	154.33	x	0.63	x	0.7	=	61.87	(82)
Rooflights	0.9x	1	x	1.01	x	143.9	x	0.63	x	0.7	=	57.69	(82)
Rooflights	0.9x	1	x	1.01	x	113.05	x	0.63	x	0.7	=	45.32	(82)
Rooflights	0.9x	1	x	1.01	x	76.56	x	0.63	x	0.7	=	30.69	(82)
Rooflights	0.9x	1	x	1.01	x	41.49	x	0.63	x	0.7	=	16.63	(82)
Rooflights	0.9x	1	x	1.01	x	20.65	x	0.63	x	0.7	=	8.28	(82)
Rooflights	0.9x	1	x	1.01	x	13.34	x	0.63	x	0.7	=	5.35	(82)

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

(83)m=	130.87	233.9	349.43	482.64	586.24	602.16	572.15	491.73	395.04	266.41	158.75	110.71	(83)

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

(84)m=	575.94	676.8	777.87	887.69	967.41	960.39	915.54	841.31	756.69	651.67	571.16	543.6	(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	0.96	0.91	0.8	0.65	0.5	0.56	0.78	0.94	0.98	0.99	(86)

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

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)

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

(88)m=	19.86	19.86	19.86	19.88	19.88	19.89	19.89	19.9	19.89	19.88	19.88	19.87	(88)

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

(89)m=	0.99	0.97	0.95	0.88	0.75	0.56	0.39	0.44	0.71	0.92	0.97	0.99	(89)

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

(90)m=	19.86	19.86	19.86	19.88	19.88	19.89	19.89	19.9	19.89	19.88	19.88	19.87	(90)

fLA = Living area ÷ (4) = | 0.27 | (91)

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

(92)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	(92)

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

(93)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	(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=	0.99	0.98	0.95	0.89	0.77	0.59	0.42	0.48	0.73	0.92	0.98	0.99	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	567.93	660.01	739.63	789.82	744.33	564.99	386.41	400.99	554.25	600.53	557.48	537.35	(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=	1825.6	1751.59	1563.73	1272.59	954.52	621.62	399.42	420.86	680.03	1078.25	1479.32	1816.79	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	935.71	733.54	613.13	347.59	156.38	0	0	0	0	355.43	663.73	951.9

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4757.41 (98)

Space heating requirement in kWh/m²/year 52.81 (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 1 257.28 (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)	935.71	733.54	613.13	347.59	156.38	0	0	0	0	355.43	663.73	951.9	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	363.7	285.12	238.31	135.11	60.78	0	0	0	0	138.15	257.98	369.99	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1849.15 (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)

91.66	78.14	87.28	77.81	96.56	145.78	140	153.68	153.41	82.23	83.91	88.31

Efficiency of water heater 188.96 (216)

(217)m=	188.96	188.96	188.96	188.96	188.96	188.96	188.96	188.96	188.96	188.96	188.96	188.96	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	48.51	41.35	46.19	41.18	51.1	77.15	74.09	81.33	81.19	43.52	44.41	46.74

Total = Sum(219a)$_{1...12}$ = 676.76 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1849.15	
Water heating fuel used		676.76	
Electricity for pumps, fans and electric keep-hot			
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	0	(231)

Electricity for lighting				380.53	(232)
Electricity generated by PVs				-1086.82	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =				1819.62	(338)

12a. CO_2 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	0.519	=	959.71	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.519	=	351.24	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1310.95	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	0	(267)
Electricity for lighting	(232) x	0.519	=	197.49	(268)
Energy saving/generation technologies Item 1		0.519	=	-564.06	(269)
Total CO2, kg/year		sum of (265)…(271) =		944.38	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		10.48	(273)
EI rating (section 14)				91	(274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
Printed on 16 June 2021 at 14:57:16

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** Mid-terrace House

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 90.08m²

Site Reference : 119 East Road -GREEN **Plot Reference:** Sample 2

Address :

Client Details:

Name:

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: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	25.42 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	10.13 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	51.6 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	45.8 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.12 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (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	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric
Mitsubishi ECODAN 8.5kW

Secondary heating system: None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 1.47 kWh/day	
	Permitted by DBSCG: 2.24 kWh/day	OK

Regulations Compliance Report

Primary pipework insulated:	Yes		OK

6 Controls

Space heating controls	TTZC by plumbing and electrical services	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
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	7.55m²
Windows facing: South East	8.19m²
Windows facing: South West	0.55m²
Roof windows facing: North West	1.01m²
Ventilation rate:	4.00

10 Key features

Roofs U-value	0.12 W/m²K
Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Neil Ingham	**Stroma Number:**	STRO010943
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Sample 2

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	33.34	(1a)	x	2.4	(2a)	=	80.02	(3a)
First floor	33.34	(1b)	x	2.7	(2b)	=	90.02	(3b)
Second floor	23.4	(1c)	x	2.26	(2c)	=	52.88	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.08	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	222.92	(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) =	0.13	(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)	0.38	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.38	(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

DER WorkSheet: New dwelling design stage

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

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

0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.38	0.41	0.43	0.45

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=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(24d)

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(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			2.28	x	1.2	=	2.736			(26)
Windows Type 1			7.55	x1/[1/(1.2)+ 0.04]		=	8.65			(27)
Windows Type 2			8.19	x1/[1/(1.2)+ 0.04]		=	9.38			(27)
Windows Type 3			0.55	x1/[1/(1.2)+ 0.04]		=	0.63			(27)
Rooflights			1.01	x1/[1/(1.2) + 0.04]		=	1.212			(27b)
Floor			33.34	x	0.14	=	4.6676	110	3667.4	(28)
Walls Type1	90.38	18.57	71.81	x	0.18	=	12.93	60	4308.6	(29)
Walls Type2	6.62	0	6.62	x	0.18	=	1.19	9	59.58	(29)
Roof Type1	25.59	1.01	24.58	x	0.12	=	2.95	9	221.22	(30)
Roof Type2	6.22	0	6.22	x	0.1	=	0.62	9	55.98	(30)
Roof Type3	3.72	0	3.72	x	0.09	=	0.34	9	33.48	(30)
Total area of elements, m²			165.87							(31)
Party wall			77.56	x	0	=	0	45	3490.2	(32)
Internal wall **			95.5					9	859.5	(32c)
Internal floor			56.74					18	1021.32	(32d)
Internal ceiling			56.74					9	510.66	(32e)

** 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) = 45.24 (33)

DER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	14227.94	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	157.95	(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		16.86	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	62.1	(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=	45.62	45.28	44.94	43.36	43.07	41.69	41.69	41.44	42.22	43.07	43.67	44.29	(38)

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

(39)m=	107.72	107.38	107.04	105.46	105.17	103.79	103.79	103.53	104.32	105.17	105.77	106.39	

Average = Sum(39)$_{1…12}$ /12= 105.46 (39)

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

(40)m=	1.2	1.19	1.19	1.17	1.17	1.15	1.15	1.15	1.16	1.17	1.17	1.18	

Average = Sum(40)$_{1…12}$ /12= 1.17 (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 — 2.63 (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 — 96.59 (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=	106.25	102.38	98.52	94.66	90.79	86.93	86.93	90.79	94.66	98.52	102.38	106.25	

Total = Sum(44)$_{1…12}$ = 1159.04 (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=	157.56	137.8	142.2	123.97	118.95	102.65	95.12	109.15	110.45	128.72	140.51	152.59	

Total = Sum(45)$_{1…12}$ = 1519.69 (45)

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

(46)m=	23.63	20.67	21.33	18.6	17.84	15.4	14.27	16.37	16.57	19.31	21.08	22.89	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		200	(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):		1.47	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.79	(50)

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

DER WorkSheet: New dwelling design stage

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)		0.79	(55)
Water storage loss calculated for each month	((56)m = (55) × (41)m		

(56)m=	24.61	22.23	24.61	23.81	24.61	23.81	24.61	24.61	23.81	24.61	23.81	24.61	(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=	24.61	22.23	24.61	23.81	24.61	23.81	24.61	24.61	23.81	24.61	23.81	24.61	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	205.43	181.04	190.07	170.3	166.83	148.98	142.99	157.02	156.78	176.59	186.84	200.46	(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)
FHRS	112.29	101.9	101.78	91.92	58.72	3.19	2.99	3.34	3.37	93.8	101.98	110.73	(63) (G2)

Output from water heater

(64)m=	93.14	79.14	88.29	78.38	108.1	145.78	140	153.68	153.41	82.79	84.86	89.73	

Output from water heater (annual)$_{1...12}$ — 1297.29 — (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=	90.68	80.41	85.58	78.28	77.85	71.19	69.92	74.59	73.79	81.1	83.78	89.03	(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=	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	21.55	19.14	15.56	11.78	8.81	7.44	8.03	10.44	14.02	17.8	20.77	22.15	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	239.22	241.71	235.45	222.13	205.32	189.52	178.97	176.49	182.74	196.06	212.87	228.67	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	(71)
Water heating gains (Table 5)													
(72)m=	121.89	119.66	115.02	108.72	104.64	98.88	93.98	100.25	102.48	109	116.36	119.67	(72)

DER WorkSheet: New dwelling design stage

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

(73)m=	445.06	442.9	428.44	405.04	381.17	358.24	343.39	349.59	361.64	385.26	412.41	432.88	(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	8.19	x	36.79	x	0.63	x	0.7	=	92.09	(77)
Southeast	0.9x	0.77	x	8.19	x	62.67	x	0.63	x	0.7	=	156.87	(77)
Southeast	0.9x	0.77	x	8.19	x	85.75	x	0.63	x	0.7	=	214.64	(77)
Southeast	0.9x	0.77	x	8.19	x	106.25	x	0.63	x	0.7	=	265.94	(77)
Southeast	0.9x	0.77	x	8.19	x	119.01	x	0.63	x	0.7	=	297.88	(77)
Southeast	0.9x	0.77	x	8.19	x	118.15	x	0.63	x	0.7	=	295.73	(77)
Southeast	0.9x	0.77	x	8.19	x	113.91	x	0.63	x	0.7	=	285.11	(77)
Southeast	0.9x	0.77	x	8.19	x	104.39	x	0.63	x	0.7	=	261.29	(77)
Southeast	0.9x	0.77	x	8.19	x	92.85	x	0.63	x	0.7	=	232.41	(77)
Southeast	0.9x	0.77	x	8.19	x	69.27	x	0.63	x	0.7	=	173.37	(77)
Southeast	0.9x	0.77	x	8.19	x	44.07	x	0.63	x	0.7	=	110.31	(77)
Southeast	0.9x	0.77	x	8.19	x	31.49	x	0.63	x	0.7	=	78.81	(77)
Southwest	0.9x	0.77	x	0.55	x	36.79		0.63	x	0.7	=	6.18	(79)
Southwest	0.9x	0.77	x	0.55	x	62.67		0.63	x	0.7	=	10.53	(79)
Southwest	0.9x	0.77	x	0.55	x	85.75		0.63	x	0.7	=	14.41	(79)
Southwest	0.9x	0.77	x	0.55	x	106.25		0.63	x	0.7	=	17.86	(79)
Southwest	0.9x	0.77	x	0.55	x	119.01		0.63	x	0.7	=	20	(79)
Southwest	0.9x	0.77	x	0.55	x	118.15		0.63	x	0.7	=	19.86	(79)
Southwest	0.9x	0.77	x	0.55	x	113.91		0.63	x	0.7	=	19.15	(79)
Southwest	0.9x	0.77	x	0.55	x	104.39		0.63	x	0.7	=	17.55	(79)
Southwest	0.9x	0.77	x	0.55	x	92.85		0.63	x	0.7	=	15.61	(79)
Southwest	0.9x	0.77	x	0.55	x	69.27		0.63	x	0.7	=	11.64	(79)
Southwest	0.9x	0.77	x	0.55	x	44.07		0.63	x	0.7	=	7.41	(79)
Southwest	0.9x	0.77	x	0.55	x	31.49		0.63	x	0.7	=	5.29	(79)
Northwest	0.9x	0.77	x	7.55	x	11.28	x	0.63	x	0.7	=	26.03	(81)
Northwest	0.9x	0.77	x	7.55	x	22.97	x	0.63	x	0.7	=	52.99	(81)
Northwest	0.9x	0.77	x	7.55	x	41.38	x	0.63	x	0.7	=	95.48	(81)
Northwest	0.9x	0.77	x	7.55	x	67.96	x	0.63	x	0.7	=	156.8	(81)
Northwest	0.9x	0.77	x	7.55	x	91.35	x	0.63	x	0.7	=	210.77	(81)
Northwest	0.9x	0.77	x	7.55	x	97.38	x	0.63	x	0.7	=	224.7	(81)
Northwest	0.9x	0.77	x	7.55	x	91.1	x	0.63	x	0.7	=	210.2	(81)
Northwest	0.9x	0.77	x	7.55	x	72.63	x	0.63	x	0.7	=	167.58	(81)
Northwest	0.9x	0.77	x	7.55	x	50.42	x	0.63	x	0.7	=	116.34	(81)
Northwest	0.9x	0.77	x	7.55	x	28.07	x	0.63	x	0.7	=	64.76	(81)

DER WorkSheet: New dwelling design stage

Northwest	0.9x	0.77	x	7.55	x	14.2	x	0.63	x	0.7	=	32.76	(81)
Northwest	0.9x	0.77	x	7.55	x	9.21	x	0.63	x	0.7	=	21.26	(81)
Rooflights	0.9x	1	x	1.01	x	16.37	x	0.63	x	0.7	=	6.56	(82)
Rooflights	0.9x	1	x	1.01	x	33.68	x	0.63	x	0.7	=	13.5	(82)
Rooflights	0.9x	1	x	1.01	x	62.13	x	0.63	x	0.7	=	24.91	(82)
Rooflights	0.9x	1	x	1.01	x	104.87	x	0.63	x	0.7	=	42.04	(82)
Rooflights	0.9x	1	x	1.01	x	143.66	x	0.63	x	0.7	=	57.59	(82)
Rooflights	0.9x	1	x	1.01	x	154.33	x	0.63	x	0.7	=	61.87	(82)
Rooflights	0.9x	1	x	1.01	x	143.9	x	0.63	x	0.7	=	57.69	(82)
Rooflights	0.9x	1	x	1.01	x	113.05	x	0.63	x	0.7	=	45.32	(82)
Rooflights	0.9x	1	x	1.01	x	76.56	x	0.63	x	0.7	=	30.69	(82)
Rooflights	0.9x	1	x	1.01	x	41.49	x	0.63	x	0.7	=	16.63	(82)
Rooflights	0.9x	1	x	1.01	x	20.65	x	0.63	x	0.7	=	8.28	(82)
Rooflights	0.9x	1	x	1.01	x	13.34	x	0.63	x	0.7	=	5.35	(82)

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

(83)m=	130.87	233.9	349.43	482.64	586.24	602.16	572.15	491.73	395.04	266.41	158.75	110.71	(83)

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

(84)m=	575.94	676.8	777.87	887.69	967.41	960.39	915.54	841.31	756.69	651.67	571.16	543.6	(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	0.89	0.78	0.62	0.48	0.53	0.76	0.93	0.98	0.99	(86)

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

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)

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

(88)m=	19.92	19.93	19.93	19.94	19.95	19.96	19.96	19.96	19.95	19.95	19.94	19.94	(88)

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

(89)m=	0.98	0.97	0.94	0.87	0.73	0.54	0.37	0.42	0.69	0.91	0.97	0.99	(89)

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

(90)m=	19.92	19.93	19.93	19.94	19.95	19.96	19.96	19.96	19.95	19.95	19.94	19.94	(90)

fLA = Living area ÷ (4) = 0.27 (91)

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

(92)m=	20.22	20.22	20.22	20.23	20.23	20.24	20.24	20.24	20.24	20.23	20.23	20.23	(92)

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

(93)m=	20.22	20.22	20.22	20.23	20.23	20.24	20.24	20.24	20.24	20.23	20.23	20.23	(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=	0.98	0.97	0.94	0.88	0.75	0.56	0.4	0.45	0.71	0.91	0.97	0.99	(94)

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	566.95	657.9	734.81	778.28	723.59	541.23	368.16	382.72	537.31	594.31	555.75	536.6	(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=	1714.62	1644.97	1468.77	1195.05	897.44	585.63	378.05	398	640.42	1013.12	1388.65	1704.97	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	853.87	663.31	546.07	300.07	129.34	0	0	0	0	311.6	599.69	869.27

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4273.21 (98)

Space heating requirement in kWh/m²/year 47.44 (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		240.46	(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)	853.87	663.31	546.07	300.07	129.34	0	0	0	0	311.6	599.69	869.27	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	355.1	275.85	227.09	124.79	53.79	0	0	0	0	129.58	249.39	361.5	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1777.1 (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)

93.14	79.14	88.29	78.38	108.1	145.78	140	153.68	153.41	82.79	84.86	89.73

Efficiency of water heater 188.96 (216)

(217)m=	188.96	188.96	188.96	188.96	188.96	188.96	188.96	188.96	188.96	188.96	188.96	188.96	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	49.29	41.88	46.73	41.48	57.21	77.15	74.09	81.33	81.19	43.81	44.91	47.49

Total = Sum(219a)$_{1...12}$ = 686.56 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1777.1	
Water heating fuel used			686.56	
Electricity for pumps, fans and electric keep-hot				
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		0	(231)

DER WorkSheet: New dwelling design stage

Electricity for lighting	380.53	(232)
Electricity generated by PVs	-1086.82	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	1757.36	(338)

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	0.519	=	922.31	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	356.32	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1278.64	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	0	(267)
Electricity for lighting	(232)	x	0.519	=	197.49	(268)
Energy saving/generation technologies Item 1			0.519	=	-564.06	(269)
Total CO2, kg/year			sum of (265)…(271) =		912.07	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		10.13	(273)
EI rating (section 14)					91	(274)

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
Printed on 16 June 2021 at 14:57:15

Project Information:

Assessed By: Neil Ingham (STRO010943) **Building Type:** End-terrace House

Dwelling Details:

NEW DWELLING DESIGN STAGE Total Floor Area: 90.08m²

Site Reference : 119 East Road -GREEN **Plot Reference:** Sample 3

Address :

Client Details:

Name:

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: Electricity
Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER)	26.96 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	10.48 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	56.7 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	50.1 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.12 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (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	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:

Heat pumps with radiators or underfloor heating - electric
Mitsubishi ECODAN 8.5kW

Secondary heating system: None

5 Cylinder insulation

Hot water Storage:	Measured cylinder loss: 1.47 kWh/day	
	Permitted by DBSCG: 2.24 kWh/day	OK

Regulations Compliance Report

Primary pipework insulated:	Yes		OK

6 Controls

Space heating controls	TTZC by plumbing and electrical services		OK
Hot water controls:	Cylinderstat		OK
	Independent timer for DHW		OK
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	7.55m²
Windows facing: South East	8.19m²
Windows facing: South West	0.55m²
Roof windows facing: North West	1.01m²
Ventilation rate:	4.00

10 Key features

Roofs U-value	0.12 W/m²K
Party Walls U-value	0 W/m²K
Photovoltaic array	

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:	Neil Ingham	**Stroma Number:**	STRO010943
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Sample 3

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	33.34	(1a)	x	2.4	(2a)	=	80.02	(3a)
First floor	33.34	(1b)	x	2.7	(2b)	=	90.02	(3b)
Second floor	23.4	(1c)	x	2.26	(2c)	=	52.88	(3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	90.08	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	222.92	(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) =	0.13	(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)	0.38	(18)

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

Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.38	(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

DER WorkSheet: New dwelling design stage

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

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

0.49	0.48	0.47	0.42	0.41	0.37	0.37	0.36	0.38	0.41	0.43	0.45

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=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(24d)

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

(25)m=	0.62	0.62	0.61	0.59	0.59	0.57	0.57	0.56	0.57	0.59	0.59	0.6	(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			2.28	x	1.2	=	2.736			(26)
Windows Type 1			7.55	x1/[1/(1.2)+ 0.04]		=	8.65			(27)
Windows Type 2			8.19	x1/[1/(1.2)+ 0.04]		=	9.38			(27)
Windows Type 3			0.55	x1/[1/(1.2)+ 0.04]		=	0.63			(27)
Rooflights			1.01	x1/[1/(1.2) + 0.04]		=	1.212			(27b)
Floor			33.34	x	0.14	=	4.6676	110	3667.4	(28)
Walls Type1	128.68	18.57	110.11	x	0.18	=	19.82	60	6606.6	(29)
Walls Type2	6.62	0	6.62	x	0.18	=	1.19	9	59.58	(29)
Roof Type1	25.59	1.01	24.58	x	0.12	=	2.95	9	221.22	(30)
Roof Type2	6.22	0	6.22	x	0.1	=	0.62	9	55.98	(30)
Roof Type3	3.72	0	3.72	x	0.09	=	0.34	9	33.48	(30)
Total area of elements, m²			204.17							(31)
Party wall			39.26	x	0	=	0	45	1766.7	(32)
Internal wall **			95.5					9	859.5	(32c)
Internal floor			56.74					18	1021.32	(32d)
Internal ceiling			56.74					9	510.66	(32e)

** 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) = 52.14 (33)

DER WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	14802.44	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	= (34) ÷ (4) =	164.33	(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		17.27	(36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss	(33) + (36) =	69.41	(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=	45.62	45.28	44.94	43.36	43.07	41.69	41.69	41.44	42.22	43.07	43.67	44.29	(38)

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

(39)m=	115.03	114.69	114.35	112.77	112.48	111.1	111.1	110.85	111.63	112.48	113.08	113.7	

Average = $Sum(39)_{1…12}$ /12= 112.77 (39)

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

(40)m=	1.28	1.27	1.27	1.25	1.25	1.23	1.23	1.23	1.24	1.25	1.26	1.26	

Average = $Sum(40)_{1…12}$ /12= 1.25 (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 — 2.63 (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 — 96.59 (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=	106.25	102.38	98.52	94.66	90.79	86.93	86.93	90.79	94.66	98.52	102.38	106.25	

Total = $Sum(44)_{1…12}$ = 1159.04 (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=	157.56	137.8	142.2	123.97	118.95	102.65	95.12	109.15	110.45	128.72	140.51	152.59	

Total = $Sum(45)_{1…12}$ = 1519.69 (45)

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

(46)m=	23.63	20.67	21.33	18.6	17.84	15.4	14.27	16.37	16.57	19.31	21.08	22.89	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel		200	(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):		1.47	(48)
Temperature factor from Table 2b		0.54	(49)
Energy lost from water storage, kWh/year	(48) x (49) =	0.79	(50)

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

DER WorkSheet: New dwelling design stage

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)		0.79	(55)

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

(56)m=	24.61	22.23	24.61	23.81	24.61	23.81	24.61	24.61	23.81	24.61	23.81	24.61	(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=	24.61	22.23	24.61	23.81	24.61	23.81	24.61	24.61	23.81	24.61	23.81	24.61	(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=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(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=	205.43	181.04	190.07	170.3	166.83	148.98	142.99	157.02	156.78	176.59	186.84	200.46	(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)
FHRS	113.77	102.9	102.79	92.49	70.26	3.19	2.99	3.34	3.37	94.36	102.93	112.14	(63) (G2)

Output from water heater

(64)m=	91.66	78.14	87.28	77.81	96.56	145.78	140	153.68	153.41	82.23	83.91	88.31	

Output from water heater (annual)1…12 | 1278.78 | (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=	90.68	80.41	85.58	78.28	77.85	71.19	69.92	74.59	73.79	81.1	83.78	89.03	(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=	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	131.34	(66)

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

(67)m=	21.55	19.14	15.56	11.78	8.81	7.44	8.03	10.44	14.02	17.8	20.77	22.15	(67)

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

(68)m=	239.22	241.71	235.45	222.13	205.32	189.52	178.97	176.49	182.74	196.06	212.87	228.67	(68)

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

(69)m=	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	36.13	(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)

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

(71)m=	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	-105.07	(71)

Water heating gains (Table 5)

(72)m=	121.89	119.66	115.02	108.72	104.64	98.88	93.98	100.25	102.48	109	116.36	119.67	(72)

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

(73)m=	445.06	442.9	428.44	405.04	381.17	358.24	343.39	349.59	361.64	385.26	412.41	432.88	(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	8.19	x	36.79	x	0.63	x	0.7	=	92.09	(77)
Southeast 0.9x	0.77	x	8.19	x	62.67	x	0.63	x	0.7	=	156.87	(77)
Southeast 0.9x	0.77	x	8.19	x	85.75	x	0.63	x	0.7	=	214.64	(77)
Southeast 0.9x	0.77	x	8.19	x	106.25	x	0.63	x	0.7	=	265.94	(77)
Southeast 0.9x	0.77	x	8.19	x	119.01	x	0.63	x	0.7	=	297.88	(77)
Southeast 0.9x	0.77	x	8.19	x	118.15	x	0.63	x	0.7	=	295.73	(77)
Southeast 0.9x	0.77	x	8.19	x	113.91	x	0.63	x	0.7	=	285.11	(77)
Southeast 0.9x	0.77	x	8.19	x	104.39	x	0.63	x	0.7	=	261.29	(77)
Southeast 0.9x	0.77	x	8.19	x	92.85	x	0.63	x	0.7	=	232.41	(77)
Southeast 0.9x	0.77	x	8.19	x	69.27	x	0.63	x	0.7	=	173.37	(77)
Southeast 0.9x	0.77	x	8.19	x	44.07	x	0.63	x	0.7	=	110.31	(77)
Southeast 0.9x	0.77	x	8.19	x	31.49	x	0.63	x	0.7	=	78.81	(77)
Southwest0.9x	0.77	x	0.55	x	36.79		0.63	x	0.7	=	6.18	(79)
Southwest0.9x	0.77	x	0.55	x	62.67		0.63	x	0.7	=	10.53	(79)
Southwest0.9x	0.77	x	0.55	x	85.75		0.63	x	0.7	=	14.41	(79)
Southwest0.9x	0.77	x	0.55	x	106.25		0.63	x	0.7	=	17.86	(79)
Southwest0.9x	0.77	x	0.55	x	119.01		0.63	x	0.7	=	20	(79)
Southwest0.9x	0.77	x	0.55	x	118.15		0.63	x	0.7	=	19.86	(79)
Southwest0.9x	0.77	x	0.55	x	113.91		0.63	x	0.7	=	19.15	(79)
Southwest0.9x	0.77	x	0.55	x	104.39		0.63	x	0.7	=	17.55	(79)
Southwest0.9x	0.77	x	0.55	x	92.85		0.63	x	0.7	=	15.61	(79)
Southwest0.9x	0.77	x	0.55	x	69.27		0.63	x	0.7	=	11.64	(79)
Southwest0.9x	0.77	x	0.55	x	44.07		0.63	x	0.7	=	7.41	(79)
Southwest0.9x	0.77	x	0.55	x	31.49		0.63	x	0.7	=	5.29	(79)
Northwest 0.9x	0.77	x	7.55	x	11.28	x	0.63	x	0.7	=	26.03	(81)
Northwest 0.9x	0.77	x	7.55	x	22.97	x	0.63	x	0.7	=	52.99	(81)
Northwest 0.9x	0.77	x	7.55	x	41.38	x	0.63	x	0.7	=	95.48	(81)
Northwest 0.9x	0.77	x	7.55	x	67.96	x	0.63	x	0.7	=	156.8	(81)
Northwest 0.9x	0.77	x	7.55	x	91.35	x	0.63	x	0.7	=	210.77	(81)
Northwest 0.9x	0.77	x	7.55	x	97.38	x	0.63	x	0.7	=	224.7	(81)
Northwest 0.9x	0.77	x	7.55	x	91.1	x	0.63	x	0.7	=	210.2	(81)
Northwest 0.9x	0.77	x	7.55	x	72.63	x	0.63	x	0.7	=	167.58	(81)
Northwest 0.9x	0.77	x	7.55	x	50.42	x	0.63	x	0.7	=	116.34	(81)
Northwest 0.9x	0.77	x	7.55	x	28.07	x	0.63	x	0.7	=	64.76	(81)

DER WorkSheet: New dwelling design stage

Northwest 0.9x	0.77	x	7.55	x	14.2	x	0.63	x	0.7	=	32.76	(81)
Northwest 0.9x	0.77	x	7.55	x	9.21	x	0.63	x	0.7	=	21.26	(81)
Rooflights 0.9x	1	x	1.01	x	16.37	x	0.63	x	0.7	=	6.56	(82)
Rooflights 0.9x	1	x	1.01	x	33.68	x	0.63	x	0.7	=	13.5	(82)
Rooflights 0.9x	1	x	1.01	x	62.13	x	0.63	x	0.7	=	24.91	(82)
Rooflights 0.9x	1	x	1.01	x	104.87	x	0.63	x	0.7	=	42.04	(82)
Rooflights 0.9x	1	x	1.01	x	143.66	x	0.63	x	0.7	=	57.59	(82)
Rooflights 0.9x	1	x	1.01	x	154.33	x	0.63	x	0.7	=	61.87	(82)
Rooflights 0.9x	1	x	1.01	x	143.9	x	0.63	x	0.7	=	57.69	(82)
Rooflights 0.9x	1	x	1.01	x	113.05	x	0.63	x	0.7	=	45.32	(82)
Rooflights 0.9x	1	x	1.01	x	76.56	x	0.63	x	0.7	=	30.69	(82)
Rooflights 0.9x	1	x	1.01	x	41.49	x	0.63	x	0.7	=	16.63	(82)
Rooflights 0.9x	1	x	1.01	x	20.65	x	0.63	x	0.7	=	8.28	(82)
Rooflights 0.9x	1	x	1.01	x	13.34	x	0.63	x	0.7	=	5.35	(82)

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

(83)m=	130.87	233.9	349.43	482.64	586.24	602.16	572.15	491.73	395.04	266.41	158.75	110.71	(83)

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

(84)m=	575.94	676.8	777.87	887.69	967.41	960.39	915.54	841.31	756.69	651.67	571.16	543.6	(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	0.96	0.91	0.8	0.65	0.5	0.56	0.78	0.94	0.98	0.99	(86)

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

(87)m=	21	21	21	21	21	21	21	21	21	21	21	21	(87)

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

(88)m=	19.86	19.86	19.86	19.88	19.88	19.89	19.89	19.9	19.89	19.88	19.88	19.87	(88)

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

(89)m=	0.99	0.97	0.95	0.88	0.75	0.56	0.39	0.44	0.71	0.92	0.97	0.99	(89)

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

(90)m=	19.86	19.86	19.86	19.88	19.88	19.89	19.89	19.9	19.89	19.88	19.88	19.87	(90)

fLA = Living area ÷ (4) = | 0.27 | (91)

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

(92)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	(92)

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

(93)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	(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=	0.99	0.98	0.95	0.89	0.77	0.59	0.42	0.48	0.73	0.92	0.98	0.99	(94)

DER WorkSheet: New dwelling design stage

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	567.93	660.01	739.63	789.82	744.33	564.99	386.41	400.99	554.25	600.53	557.48	537.35	(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=	1825.6	1751.59	1563.73	1272.59	954.52	621.62	399.42	420.86	680.03	1078.25	1479.32	1816.79	(97)

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

(98)m=	935.71	733.54	613.13	347.59	156.38	0	0	0	0	355.43	663.73	951.9

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4757.41 (98)

Space heating requirement in kWh/m²/year 52.81 (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		257.28	(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)	935.71	733.54	613.13	347.59	156.38	0	0	0	0	355.43	663.73	951.9	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	363.7	285.12	238.31	135.11	60.78	0	0	0	0	138.15	257.98	369.99	(211)

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1849.15 (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)

	91.66	78.14	87.28	77.81	96.56	145.78	140	153.68	153.41	82.23	83.91	88.31

Efficiency of water heater 188.96 (216)

(217)m=	188.96	188.96	188.96	188.96	188.96	188.96	188.96	188.96	188.96	188.96	188.96	188.96	(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	48.51	41.35	46.19	41.18	51.1	77.15	74.09	81.33	81.19	43.52	44.41	46.74

Total = Sum(219a)$_{1...12}$ = 676.76 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1849.15	
Water heating fuel used			676.76	
Electricity for pumps, fans and electric keep-hot				
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		0	(231)

DER WorkSheet: New dwelling design stage

Electricity for lighting	380.53	(232)
Electricity generated by PVs	-1086.82	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	1819.62	(338)

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	0.519	=	959.71	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.519	=	351.24	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1310.95	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	0	(267)
Electricity for lighting	(232)	x	0.519	=	197.49	(268)
Energy saving/generation technologies Item 1			0.519	=	-564.06	(269)
Total CO2, kg/year			sum of (265)…(271) =		944.38	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		10.48	(273)
EI rating (section 14)					91	(274)

Appendix D

SAP10

GLA SAP10 Conversions Spreadsheet

The applicant should complete all the light blue cells including information on the modelled units, the area per unit, the number of units, the baseline energy consumption figures, the TER and the TFEE.

SAP 2012 CO2 PERFORMANCE | SAP10 CO2 PERFORMANCE

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

DEMAND

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated TER 2012 (kgCO2 / m2)	VALIDATION CHECK: TER Worksheet TER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - TER WORKSHEET: Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.): Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)	REGULATED CO2 EMISSIONS PER UNIT: Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated TER SAP10 (kgCO2 / m2)	Fabric Energy Efficiency (FEE): Target Fabric Energy Efficiency (TFEE) (kWh/m²)
	TER Worksheet (Row 4)				TER Worksheet (Row 273)	TER Worksheet (Row 211)		TER Worksheet (Row 219)		TER Worksheet (Row 232)	TER Worksheet (Row 231)	N / A														
Sample 1	*90.08*	*1*	*90.08*	**18.6**	**18.6**	*4213.92*	*Natural Gas*	*2459.72*	*Natural Gas*	*380.53*	*75*		**910**	**531**	**197**	**39**		**1,678**	**885**	**517**	**89**	**17**		**1,508**	**16.7**	
Sample 2	*90.08*	*1*	*90.08*	**17.6**	**17.6**	*3790.87*	*Natural Gas*	*2465.27*	*Natural Gas*	*380.53*	*75*		**819**	**532**	**197**	**39**		**1,588**	**796**	**518**	**89**	**17**		**1,420**	**15.8**	
Sample 3	*90.08*	*1*	*90.08*	**18.6**	**18.6**	*4213.92*	*Natural Gas*	*2459.72*	*Natural Gas*	*380.53*	*75*		**910**	**531**	**197**	**39**		**1,678**	**885**	**517**	**89**	**17**		**1,508**	**16.7**	
Sum	270	3	270	18.3	-	12,219	N/A	7,385	N/A	1,142	225	0	2,639	1,595	592	117	0	*4,944*	2,566	1,551	266	52	0	*4,435*	16.4	0.00

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Building Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated TER 2012 (kgCO2 / m2)	VALIDATION CHECK: BRUKL TER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) TER - SOURCE: BRUKL OUTPUT: Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) TER - SOURCE: BRUKL.INP or *SIM.CSV FILE: Natural Gas	Grid Electricity	2012 CO2 emissions (kgCO2 p.a.)	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) - TER BRUKL: Natural Gas	Grid Electricity	REGULATED CO2 EMISSIONS: SAP10 CO2 emissions (kgCO2 p.a.)	BRUKL TER SAP10 (kgCO2 / m2)
													##############	##############		##############	##############		

Sum	0	0	0	-	0	0	0	0	0	0	0	0	0	N/A	N/A	N/A	*0*	0	0	N/A	N/A	N/A	*0*	#DIV/0!

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Total Area (m²)	Calculated TER 2012 (kgCO2 / m2)	-	REGULATED ENERGY CONSUMPTION								REGULATED CO2 EMISSIONS		REGULATED CO2 EMISSIONS PER UNIT	
				Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)		2012 CO2 emissions (kgCO2 p.a.)		SAP10 CO2 emissions (kgCO2 p.a.)	Calculated TER SAP10 (kgCO2 / m2)
Sum	270	18.3	-	12,219		7,385		1,142	225	0		*4,944*		*4,435*	16.4

The applicant should complete all the light blue cells including information on the 'be lean' energy consumption figures, the 'be lean' DER, the DFEE and the regulated energy demand of the 'be lean' scenario.

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated DER 2012 (kgCO2 / m2)	VALIDATION CHECK: DER Worksheet DER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE LEAN' SAP DER WORKSHEET: Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water	Lighting	Auxiliary	Cooling
					DER Sheet (Row 384)	DER Sheet [(Row 307a) ÷ (Row 367a x 0.01)]	Select fuel type	DER Sheet [(Row 310a) ÷ (Row 367a x 0.01)]	Select fuel type	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
Sample 1	90.08	1	90.08	16.5	16.5	4253.43	Natural Gas	1547.35	Natural Gas	380.53	75	0
Sample 2	90.08	1	90.08	15.6	15.6	3852.94	Natural Gas	1566.44	Natural Gas	380.53	75	0
Sample 3	90.08	1	90.08	16.5	16.5	4253.43	Natural Gas	1547.35	Natural Gas	380.53	75	0
Sum	270	3	270	16.2	-	12,360	N/A	4,661	N/A	1,142	225	0

SAP 2012 CO2 PERFORMANCE

Unit identifier	REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.): Space Heating	Domestic Hot Water	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)
Sample 1	919	334	197	39	0	1,489
Sample 2	832	338	197	39	0	1,407
Sample 3	919	334	197	39	0	1,489
Sum	2,670	1,007	592	117	0	4,386

SAP10 CO2 PERFORMANCE

Unit identifier	REGULATED CO2 EMISSIONS PER UNIT: Space Heating CO2 emissions (kgCO2 p.a.)	Domestic Hot Water CO2 emissions (kgCO2 p.a.)	Lighting CO2 emissions (kgCO2 p.a.)	Auxiliary CO2 emissions (kgCO2 p.a.)	Cooling CO2 emissions (kgCO2 p.a.)	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)
Sample 1	893	325	89	17	0	1,324	14.7
Sample 2	809	329	89	17	0	1,244	13.8
Sample 3	893	325	89	17	0	1,324	14.7
Sum	2,596	979	266	52	0	3,893	14.4

DOMESTIC ENERGY DEMAND DATA

Unit identifier	Fabric Energy Efficiency (FEE): Dwelling Fabric Energy Efficiency (DFEE) (kWh/m²)	REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.): Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Sample 1						
Sample 2						
Sample 3						
Sum	0.00	0	0	0	0	0

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Building Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK: Calculated BER 2012 (kgCO2 / m2)	VALIDATION CHECK: BRUKL BER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL OUTPUT: Space Heating (kWh/m² p.a.)	Fuel type Space Heating	Domestic Hot Water (kWh/m² p.a.)	Fuel type Domestic Hot Water	Lighting (kWh/m² p.a.)	Auxiliary (kWh/m² p.a.)	Cooling (kWh/m² p.a.)
Sum	0	0	0	#DIV/0!	-	0	N/A	0	N/A	0	0	0

Building Use	LATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE LEAN' BER - SOURCE: BRUKL.INP or *SIM.CSV: Natural Gas ##############	Grid Electricity ##############				2012 CO2 emissions (kgCO2 p.a.)
Sum	0	0	N/A	N/A	N/A	0

Building Use	REGULATED CO2 EMISSIONS PER UNIT: Natural Gas ##############	Grid Electricity ##############		SAP10 CO2 emissions (kgCO2 p.a.)	BRUKL BER SAP10 (kgCO2 / m2)	
						N/A
Sum	0	0		0	#DIV/0!	

NON-DOMESTIC ENERGY DEMAND

Building Use	REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.): Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Sum	0	0	0	0	0

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Total Area (m²)	Calculated BER 2012 (kgCO2 / m2)	-	REGULATED ENERGY CONSUMPTION: Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Sum	270	16.2	-	12,360		4,661		1,142	225	0

Use	REGULATED CO2 EMISSIONS: 2012 CO2 emissions (kgCO2 p.a.)	REGULATED CO2 EMISSIONS: SAP10 CO2 emissions (kgCO2 p.a.)	Calculated BER SAP10 (kgCO2 / m2)	N/A	REGULATED ENERGY DEMAND PER UNIT PER ANNUM (kWh p.a.): Space Heating (kWh p.a.)	Domestic Hot Water (kWh p.a.)	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Sum	4,386	3,893	14.4		0	0	0	0	0

The applicant should complete all the light blue cells including information on the 'be green' energy consumption figures and the 'be green' DER.

DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK Calculated DER 2012 (kgCO2 / m2)	DER Worksheet DER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION PER UNIT (kWh p.a.) - 'BE GREEN' SAP DER WORKSHEET Space Heating (Heat Source 1)	Fuel type Space Heating	Domestic Hot Water (Heat Source 1)	Fuel type Domestic Hot Water	Space Heating (Heat source 2) if applicable	Fuel type Space Heating	Domestic Hot Water (Heat source 2) if applicable	Fuel type Domestic Hot Water	Space and Domestic Hot Water from CHP if applicable	Fuel type CHP if applicable	Total Electricity generated by CHP (-) if applicable	Electricity generated by renewable (-) if applicable	Lighting	Auxiliary	Cooling
					DER Sheet (Row 384)	DER Sheet [Row 307b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 310b ÷ (Row 367b x 0.01)]	Select fuel type	DER Sheet [Row 307c ÷ (Row 367c x 0.01)]	Select fuel type	DER Sheet [Row 310c ÷ (Row 367c x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) ÷ (Row 362 x 0.01)]	Select fuel type	DER Sheet [(Row 307a + 310a) × (Row 361 ÷ 362)]	DER Sheet Row 380	DER Sheet Row 332	DER Sheet (Row 313 + 331)	DER Sheet Row 315
Sample 1	*90.08*	*1*	*90.08*	10.5	10.5	*1849.15*	*Grid Electricity*	*676.76*	*Grid Electricity*		*Grid Electricity*		*Grid Electricity*				*-1086.82*	*380.53*		
Sample 2	*90.08*	*1*	*90.08*	10.1	10.1	*1777.1*	*Grid Electricity*	*686.56*	*Grid Electricity*		*Grid Electricity*		*Grid Electricity*				*-1086.82*	*380.53*		
Sample 3	*90.08*	*1*	*90.08*	10.5	10.5	*1849.15*	*Grid Electricity*	*676.76*	*Grid Electricity*		*Grid Electricity*		*Grid Electricity*				*-1086.82*	*380.53*		
Sum	270	3	270	10.4	-	5,475	N/A	2,040	N/A	0	N/A	0	N/A	0	N/A	0	-3,260	1,142	0	0

SAP 2012 CO2 PERFORMANCE

Unit identifier	REGULATED CO2 EMISSIONS PER UNIT (kgCO2 p.a.) Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Electricity generated by renewable if applicable	Lighting	Auxiliary	Cooling	2012 CO2 emissions (kgCO2 p.a.)
Sample 1	960	351			-564	197			944
Sample 2	922	356			-564	197			912
Sample 3	960	351			-564	197			944
Sum	2,842	1,059	0	0	-1,692	592	0	0	*2,801*

SAP10 CO2 PERFORMANCE

Unit identifier	REGULATED CO2 EMISSIONS PER UNIT Space Heating	Domestic Hot Water	Space Heating and DHW from CHP if applicable	Electricity generated by CHP if applicable	Electricity generated by renewable if applicable	Lighting	Auxiliary	Cooling	SAP10 CO2 emissions (kgCO2 p.a.)	Calculated DER SAP10 (kgCO2 / m2)
Sample 1	431	158			-253	89			424	4.7
Sample 2	414	160			-253	89			409	4.5
Sample 3	431	158			-253	89			424	4.7
Sum	1,276	475	0	0	-760	266	0	0	*1,257*	4.7

NON-DOMESTIC ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Area per unit (m²)	Number of units	Total area represented by model (m²)	VALIDATION CHECK Calculated BER 2012 (kgCO2 / m2)	BRUKL BER 2012 (kgCO2 / m2)	REGULATED ENERGY CONSUMPTION BY END USE (kWh/m² p.a.) 'BE GREEN' BER - SOURCE: BRUKL OUTPUT Space Heating	Fuel type Space Heating	Domestic Hot Water	Fuel type Domestic Hot Water							Electricity generated by CHP (-) if applicable	Electricity generated by renewable technology (-) if applicable	Lighting	Auxiliary	Cooling
										N/A	N/A	N/A	N/A	N/A	N/A					
Sum	0	0	0	#DIV/0!	-	0	N/A	0	N/A							0	0	0	0	0

Use	REGULATED ENERGY CONSUMPTION BY FUEL TYPE (kWh/m² p.a.) 'BE GREEN' BER - SOURCE: BRUKL.INP or *SIM.CSV FILE Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) *if applicable*	Electricity generated by renewable technology (-) if applicable	Waste Heat From Power Station	Enter Carbon Factor 2	Enter Carbon Factor 3	2012 CO2 emissions (kgCO2 p.a.)
	#############	#############	#############	#############	#############	#############	#############	#############	
Sum	0	0	0	0	0	0	0	0	*0*

Use	REGULATED CO2 EMISSIONS PER UNIT Natural Gas	Grid Electricity	Bespoke DH Factor	Electricity generated by CHP (-) if applicable	Electricity generated by renewable technology (-) if applicable	Waste Heat From Power Station	Enter Carbon Factor 2	Enter Carbon Factor 3	SAP10 CO2 emissions	BRUKL BER SAP10 (kgCO2 / m2)
	#############	#############	#############	#############	#############	#############	#############	#############		
Sum	0	0	0	0	0	0	0	0	*0*	#DIV/0!

SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS

Use	Total Area (m²)	Calculated BER 2012 (kgCO2 / m2)	-	REGULATED CO2 EMISSIONS Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Space Heating (kWh p.a.)	N/A	Domestic Hot Water (kWh p.a.)	N/A	Space and Domestic Hot Water from CHP (kWh p.a.)	N/A	Electricity generated by CHP (kWh p.a.) *if applicable*	Electricity generated by renewable (kWh p.a.) *if applicable*	Lighting (kWh p.a.)	Auxiliary (kWh p.a.)	Cooling (kWh p.a.)
Sum	270	0.0	-	5,475		2,040		0		0		0		0	-3,260	1,142	0	0

Use	REGULATED CO2 EMISSIONS Space Heating CO2 emissions	Domestic Hot Water CO2 emissions	Space Heating and DHW from CHP CO2 emissions if applicable	Electricity generated by CHP CO2 savings if applicable	Electricity generated by renewable CO2 savings if applicable	Lighting CO2 emissions	Auxiliary CO2 emissions	Cooling CO2 emissions	2012 CO2 emissions
Sum	2,842	1,059	0	0	-1,692	592	0	0	*2,801*

Use	REGULATED CO2 EMISSIONS PER UNIT Space Heating CO2 emissions	Domestic Hot Water CO2 emissions	Space Heating and DHW from CHP CO2 emissions if applicable	Electricity generated by CHP CO2 savings if applicable	Electricity generated by renewable CO2 savings if applicable	Lighting CO2 emissions	Auxiliary CO2 emissions	Cooling CO2 emissions	SAP10 CO2 emissions	Calculated BER SAP10 (kgCO2 / m2)
Sum	1,276	475	0	0	-760	266	0	0	*1,257*	4.7

Appendix E

Part G

Internal Water Use Calculation

breglobal

Job no:	21385
Date:	May-21
Assessor name:	Neil Ingham
Registration no:	STRO010583
Development name:	119 East Road
Issue Date:	

Rainwater **Greywater** **Results**

WATER EFFICIENCY CALCULATOR FOR NEW DWELLINGS

(for use with the Code for Sustainable Homes issues Wat 1 for the May 2009 and subsequent versions)

Dwelling Description	119 East Road

1st step - Select from options below:

Is a Rain and/or Greywater system specified?	**No**
Is a shower AND bath present?	**Yes**
Has a washing machine been specified?	**No**
Has a dishwasher been specified?	**No**

2nd step - Build spreadsheet (click button below)

BUILD SPREADSHEET

As soon as this button is pressed the spreadsheet will change according to the options selected previously in the 1st step. Scroll down to see the changes.

3rd step - Enter consumption details for the specified fittings

TAPS (excluding kitchen taps)	**Fitting type**	**Flow rate (litres/min)**	**Number of fittings**
1	Basins	4.00	2
2			
3			
4			
		Proportionate flow rate (litres/min)	2.80
		Consumption / person / day (Litres)	**7.90**

BATHS		Fitting type	Capacity to overflow (litres)	Number of fittings
	1	Bath	150.00	1
	2			
	3			
	4			
			Proportionate capacity to overflow (litres)	105.00
			Consumption / person / day (Litres)	16.50

SHOWERS		Fitting type	Flow rate (litres/min)	Number of fittings
	1	Shower	8.00	1
	2			
	3			
	4			
			Proportionate flow rate (litres/min)	5.60
			Consumption / person / day (Litres)	34.96

DISHWASHER		
Where no dishwasher is specified, a default consumption figure of 1.25 litres per place setting is used.		
	Consumption / person / day (Litres)	4.50

WASHING MACHINES		Number of fittings
Where no washing machine is specified, a default consumption figure of 8.17 litres per kilogram of dry load is		

used.				
Where no washing machines have been specified but plumbing for future supply of grey/rainwater was installed, please enter details:				
			Consumption / person / day (Litres)	**17.16**

WC's	Fitting Type	Flush Type	Volume**	Number of fittings
1	Toilet	Full Flush	5.00	2
		Part Flush	3.00	
2		Full Flush		
		Part Flush		
3		Full Flush		
		Part Flush		
4		Full Flush		
		Part Flush		
			Average effective flushing volume (litres)	3.66
			Consumption / person / day (Litres)	**16.18**

KITCHEN SINK TAPS	Fitting Type	Flow rate (litres/minute)	Number of fittings
1	Kitchen	5.00	1
2			
3			
4			
		Proportionate flow rate (litres/min)	3.50
		Consumption / person / day (Litres)	**12.56**

WASTE DISPOSAL UNIT

Is a waste disposal unit specified for the dwelling?	No
Consumption / person / day (Litres)	**0.00**

WATER SOFTENER

Water Softener in use?	No
Total capacity used per regeneration (%)	

Water consumed per regeneration (litres)		
Average number of regeneration cycles per day (No.)		
Number of occupants served by the system (No.)		
Water consumed beyond 4% person / day (Litres)		**0.00**

4th step - Analyse Results

Go to Start

INTERNAL WATER CONSUMPTION		
NET INTERNAL WATER CONSUMPTION	(litres/person/day)	**109.76**
RAINWATER ONLY COLLECTION SAVING	(litres/person/day)	**0.00**
GREYWATER ONLY RECYCLING SAVING	(litres/person/day)	**0.00**
RAIN/GREYWATER COLLECTION SAVING (combined system)	(litres/person/day)	**0.00**
NORMALISATION FACTOR	(litres/person/day)	**0.91**
TOTAL WATER CONSUMPTION	(litres/person/day)	**99.9**
	CSH CREDITS ACHIEVED	**3**
	CSH MANDATORY LEVEL:	**Level 3/4**

17. K COMPLIANCE		
EXTERNAL WATER USE	(litres / person / day)	5.00
TOTAL WATER CONSUMPTION	(litres / person / day)	**104.9**
	17. K COMPLIANCE?	**Yes**

PRINTING: before printing please make sure that in "Page Setup" you have selected the page to be as "Landscape" and that the Scale has been set up to 75% (maximum)