HAWDEN
ENGINEERING MEP SOLUTIONS

Residential Scheme

106 Bexley Road
Erith
DA8 3SP

Mechanical and Electrical Building Services
Energy Strategy Report

FOR INFORMATION

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1. EXECUTIVE SUMMARY

This energy strategy has been provided in response to the planning conditions relating to the proposed development at 106 Bexley Road, Erith, DA8 3SP.

The energy strategy has been prepared in line with the requirements set out within the London Plan 2021 energy policies, including the energy hierarchy. The London Plan 2021 requires that all major developments should be net zero, which means reducing greenhouse gas emissions in operation and minising both annual and peak energy demand in accordance with the following energy hierarchy:

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

This has been achieved by passive design measures such as energy efficient lighting and ventilation, high levels of air tightness and increased insulating properties.

Step 2. Be Clean: exploit local energy resources and supply energy efficiently and cleanly

This has been reviewed and it has been demonstrated that heat networks or combined heat and power systems are not viable.

Step 3. Be Green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site. Note that a minimum on-site reduction of at least 35 per cent beyond Building Regulations is required. Where this cannot be achieved on-site, shortfalls should be made up through a cash in lieu contribution to the boroughs carbon offset fund or through off-site methods

This has been reviewed, with natural gas combination boilers complete with flue gas heat recovery serving the dwellings and photovoltaic technologies incorporated within the scheme.

A summary of the photovoltaic installations is shown below.

PV Area (m^2)	kWp	kWh/annum	Total CO_2 Savings ($kg\ CO_2/year$)
24.5	4.95	4,145	965

Table 1 – Proposed photovoltaic installations

Note that CO2 savings are based upon SAP 10 carbon factors.

Step 4. Be Seen: monitor, verify and report on energy performance

Each property shall be complete with smart energy meters. This report also includes expected energy costs for each of the dwellings.

To summarise, the energy strategy achieves a 42% reduction of carbon emissions beyond 2013 Building Regulations

It should be noted that the scheme shall need to offset the remaining CO_2 emissions between 42% and 100% through a financial contribution to the Council's Carbon Offset Fund (COF) which equates to £1,800 per tonne. The total contribution for the domestic areas is £17,825.

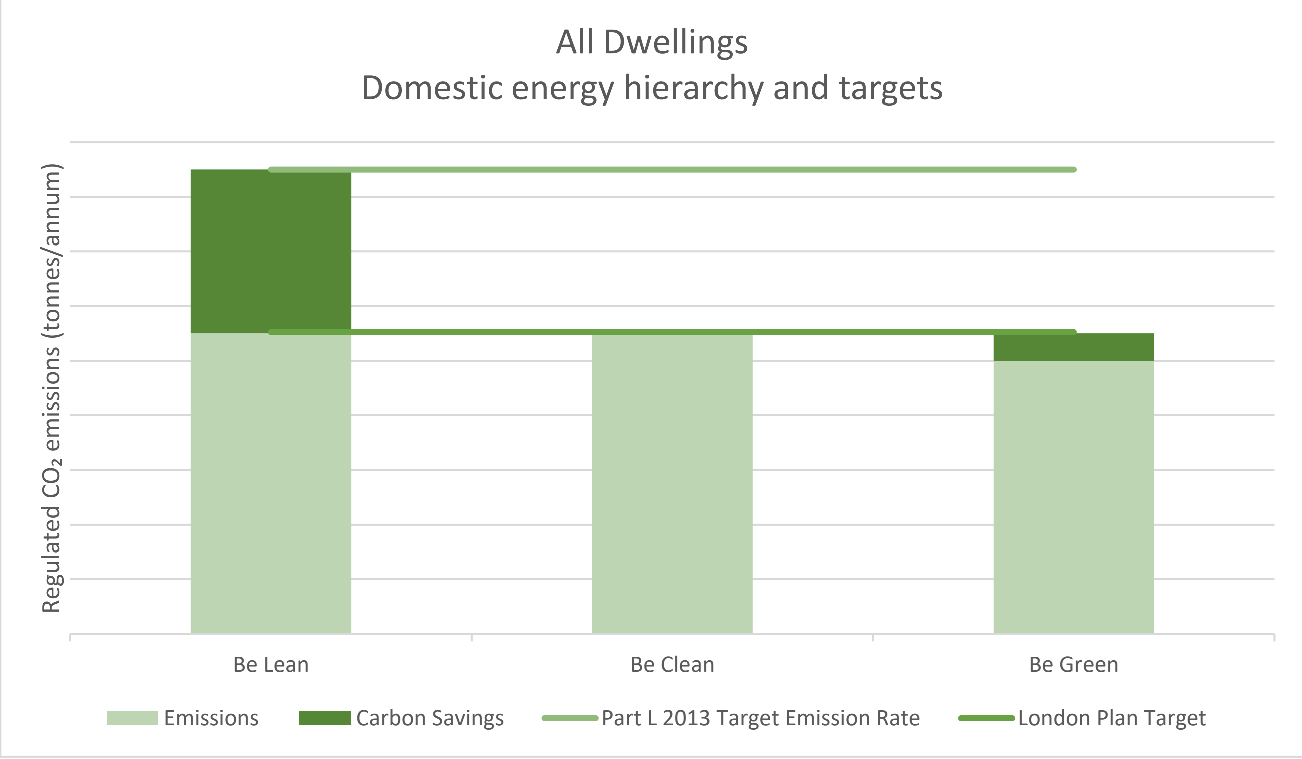

Figure 1 – Site total energy hierarchy and targets

2. INTRODUCTION

This report provides the energy strategy for the proposed development of a 16-dwelling apartment block at 106 Bexley Road, Erith, DA8 3SP. The energy strategy has been prepared in line with the requirements set out within the London Plan 2021 energy policies, including the energy hierarchy.

This report contains the following information, in accordance with the London Plan:

- A calculation of the energy demand and carbon emissions covered by Building Regulations;
- Proposals to reduce carbon emissions beyond Building Regulations, including offsetting arrangements
- The results of dynamic overheating modelling
- Proposals for demand side response
- Proposals explaining how the site has been future-proofed to achieve zero carbon on-site emissions by 2050
- Plans for monitoring and annual reporting of energy demand and carbon emissions post-construction
- Expected costs to occupants associated with the proposed energy strategy
- Feasibility of creating or connecting to heat networks.

This report shall be read in conjunction with all other relevant consultant's reports, including those associated with the air quality assessment.

3. SITE DESCRIPTION

The site currently has an existing building that shall be extended and converted to make way for the proposed 16 dwelling apartment block. The works are to be carried out in a single stage.

The provision of a 16-dwelling apartment block of four storeys including a basement floor. The apartments consist of 1-bed 2-person and 2-bed 3-person units.

The proposed site is shown in figure 1 below.

Figure 2 – Extract of Urban and Rural drawing B1353-102

As part of the planning application for the site, London Borough of Bexley Planning Application Requirements (17th October 2018) that an energy strategy be provided in line with the requirements of the The London Plan. Note that the guidance makes reference to the previous London Plan. An extract of the planning requirements is shown below:

- For major development proposals there are a number of London Plan requirements in respect of energy assessments, reduction of carbon emissions, sustainable design and construction, decentralised and renewable energy. The GLA guidance on preparing energy assessments should be followed when preparing energy assessments. Major developments are expected to prepare an energy strategy based upon the Mayors energy hierarchy adopting lean, clean, green principles. The assessment should demonstrate how the need for energy is to be minimised, and how it will be supplied to the particular development proposed. In accordance with the energy hierarchy in policy 5.2 of the London Plan, updated following the implementation of the 2013 Building

Regulations, developments should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible. This applies to both residential and nondomestic buildings.

- As set out in the Mayor's Housing SPG (2016), a zero carbon standard will be applied to all new major residential development. The energy strategy shall include measures to achieve zero regulated carbon emissions.
- Where it is clearly demonstrated that the specific target cannot be fully achieved onsite, at least a 35% reduction in regulated carbon emissions beyond the baseline set out in the 2013 Building Regulations (Part L) must be demonstrated. The remaining regulated carbon emissions between this 35% and zero carbon (up to 100%) are to be off-set through a cash-in-lieu contribution of £60 per tonne of regulated CO2 over a 30 year period, as recommended by London Plan guidance. The cash in lieu contribution will be secured through a S106 for the delivery of carbon dioxide savings elsewhere.
- From 2019 non-domestic buildings will also be required to achieve zero carbon in accordance with London Plan policy 5.2.
- Options for producing renewable energy should also be assessed and should directly relate to the particular site and the feasibility of installing the various measures. The layout of the scheme should ensure that there is sufficient space on site for any equipment and fuel storage, if required, and should investigate implications of fuel delivery. The potential site and form of buildings and flues should be included in the information submitted with the application. In cases where the form of renewable energy cannot be fully determined at time of application, feasible options must still be presented. It is unlikely to be possible to submit details for the compliance of a condition regarding energy efficiency / renewable energy where additional permissions may be required (e.g. for flues or buildings not in the original application).
- Energy Assessments also need to demonstrate that connection to existing or planned district heating networks, including a future connection to the Riverside Resource Recovery Facility district heating network has been prioritised and should demonstrate that the development is designed to connect to the existing or future district heating network. Relevant correspondence with local heat network operators should be provided to support this.

The energy strategy has been produced in line with the following documents:

- The London Plan March 2021;
- Bexley Heat Map Study March 2021;
- Greater London Authority Energy Assessment Guidance (October 2018);
- Mayor's Sustainable Design and Construction Supplementary Planning Guidance (SPG);
- Domestic Building Services Compliance Guide (2013 Edition – for use in England);
- GLA Carbon Emission Reporting Spreadsheet_v1.1.

Note that the energy strategy within this report relates to the full planning application.

4. CALCULATION METHODS

Carbon dioxide emission rates have been calculated as follows:

Dwellings

- Dwelling CO_2 Emissions Rate (DER) calculated through the Part L 2013 of the Building Regulations methodology SAP 2012 and the GLA Carbon Emission Reporting Spreadsheet v1.1 to take into account SAP 10 carbon emission factors. This is multiplied by the cumulative floor area for the particular dwelling type in question to give the related CO_2 emissions;
- Separately, emissions associated with non-Building Regulation elements (i.e. cooking and appliances) established by using BREDEM (BRE Domestic Energy Model) or CIBSE Benchmark data.

A summary of the modelling work output (i.e. DER worksheets for dwellings) and domestic energy consumption and CO_2 analysis screenshots have been provided within the appendix for each stage of the energy hierarchy.

The CO_2 emissions of all dwellings have then been summed to give the total regulated emissions for the domestic element of the development. These figures are expressed in tonnes per annum and included within the tables referenced GLA table 1 to 4.

5. ENERGY HEIRARCHY - DWELLINGS

To achieve the targets for minimising carbon dioxide emissions, the London Plan outlines a four-step energy hierarchy to guide developers on how they may design low or zero carbon development. The hierarchy consists of the following steps:

Step 1. Be lean: use less energy
Step 2. Be clean: supply energy efficiently
Step 3. Be green: use renewable energy
Step 4. Be seen: monitor usage

These steps are detailed and expanded upon within the following sections.

5.1 Demand Reduction - Be Lean

The first step is to 'be lean' by seeking to minimise the carbon dioxide emissions of a development by minimising energy consumption during its construction and occupation. This can be achieved by passive design measures such as orientation and site layout, natural ventilation and lighting high thermal mass and solar shading. In line with the first step of the energy hierarchy, insulating properties (U-values) of the building fabric shall be increased, high levels of air tightness shall be achieved, and efficient services and lighting to reduce energy demand in dwellings shall be provided.

Site Orientation

The final location of the proposed building has already been agreed and therefore the repositioning of any areas is not feasible.

Building Fabric

In order to satisfy the target emission rate, the building specification shall be considerably better than the guidelines set of by Building Regulations. If financially viable, the guideline figures should be reduced as much as practicable in order to reduce building heat losses and the overall CO_2 emissions of the site. The target U-values are as follows:

	U-Value (W/m²K)	
Element	Base	Be Lean
Glazing	1.4	1.2
Solid Doors	1.0	1.0
External wall	0.18	0.16
Exposed floors	0.13	0.11
Roof	0.13	0.11

Table 2 - Proposed U-Values

Thermal Bridging

Accredited Construction Details (ACD) shall be utilised to ensure the heat losses caused by thermal bridging are reduced as much as is practically possible. ACDs covering the lintels, sills, jambs, exposed floor, party floor between dwellings and party wall between dwellings shall be used as a minimum.

Air Tightness

Air tightness shall also affect the heat losses and therefore it is suggested that the building is constructed as 'tight' as possible. The target air permeability for the dwellings is $4m^3/h/m^2$ at 50Pa.

Water Usage

The water usage within the dwellings shall be designed to ensure that a maximum of 105 litres of water is consumed per person per day in line with the option requirement of Building Regulations Part G.

All showers and baths shall be provided with waste water heat recovery (WWHR).

Dwelling WWHR	Heatrae Sadia Megaflo SHRU 60

Table 3 – Proposed waste water heat recovery

Ventilation

The dwellings shall be provided with independent ventilation systems, comprising of a system 4 centralised heat recovery ventilation system with air being extracted from wet areas and kitchen via a network of ceiling mounted ductwork. Supply air shall be provided to the bedroom and living areas. The ventilation unit shall generally be located within a storage area and be complete with acoustic enclosure to ensure it does not cause nuisance to occupants.

The ventilation unit shall be complete with central controller that shall allow the user to set air flow rates accordingly.

The kitchen areas shall also be provided with recirculation hood, complete with the necessary filtration.

Dwelling MVHR	Vent Axia Sentinel Kinetic Advance S – Rigid insulated ductwork, approved installation scheme

Table 4 – Proposed ventilation systems

Lighting

To maximise the energy efficiency of the lighting, and to help reduce overall building emissions, 100% low energy LED lighting will be selected throughout. There are now very few instances where LED's for this type of installation do not represent the most viable option, and therefore, any consideration for alternatives will need to have a strong argument for justification.

All lighting within the dwellings shall be controlled manually. External lighting shall be controlled automatically, by photocell and timeclock override.

Controls

The controls of the mechanical and electrical systems shall be provided in line with the domestic compliance guide and shall be as follows:

Heating systems	System controls shall be wired so that when there is no demand for space heating or hot water, the boiler and pump are switched off; Dwellings with a total floor area above 150m^2 shall have at least two space heating zones, each with an independently controlled heating circuit; Dwellings with a total floor area ≤150m^2 may have a single space heating zone Each space heating circuit shall be provided with independent time control and individual networked radiator controls in each room on the circuit Where underfloor heating is provided, each room shall be a single heating zone with independent on/off time and temperature control.
Domestic hot water systems	Domestic hot water circuits shall be supplied instantaneously from the gas fired combination boiler and should be provided with independent time control and temperature control.
Ventilation	Time control.

Table 5 – Proposed control systems

Metering

Metering shall be provided to each dwelling, accessible by the occupants to monitor energy usage. Energy meters will be of the smart type.

5.2 Heating Infrastructure – Be Clean

The second step is to 'be clean' by seeking to supply the expected energy demands of a development as cleanly and efficiently as possible. The London Plan requires development proposals to evaluate the feasibility of decentralised energy systems (which may be fed by combined heat and power systems), and where possible to connect to existing district heating networks.

Combined Heat and Power (CHP)

A CHP unit is essentially a type of engine that uses gas to drive the engine which in turn generates electricity and heat. The heat is what is used to provide LTHW, whilst the electricity generated can be fed back into the buildings electrical supply and because of this, with the consequential saving of grid electricity, is classed as a renewable and brings benefits to the Part L energy assessment.

A CHP unit is generally slightly larger than a standalone conventional gas boiler, but not in so much as it would not fit within a conventional plant room. Although CHP is slightly less efficient in terms of gas usage than a conventional gas boiler, the generation of electricity outweighs this small loss in efficiency.

Due to the measures undertaken during the 'Be Lean' stage, the buildings are to be constructed to minimise fabric heat losses, therefore, the heat load for each of the apartments should be relatively low.

A CHP system relies on a constant, large and stable heat load to function at its most efficient and therefore become a viable technology for consideration. Due to the low, intermittent losses, CHP is not considered suitable for integration within this scheme. The carbon savings from CHP are now declining as a result of national grid electricity decarbonizing and there is evidence of adverse air quality impacts.

Heat Network

Currently, there are no existing or planned heat networks in the vicinity of the site, however the site does sit within a heat network priority area, as confirmed on the Mayor of London Heat Map (shown in figure 3 below). London Borough of Bexley Planning Application Requirements states '*that energy assessments need to demonstrate that connection to existing or planned district heating networks, including a future connection to the Riverside Resource Recovery Facility district heating network has been prioritised and should demonstrate that the development is designed to connect to the existing or future district heating network*'. The London Heat Map, as of July 2021, does not show any existing or proposed heat networks in the vicinity of the site. The site is also in excess of 2km away from the Riverside Resource Recovery Facility and therefore future connection to the district heat network is unlikely.

The adoption of a building community heating system has been rejected due to loss of accommodation due to an energy centre, requirement of a significant high rise flue in a residential area, infrastructure costs disproportionately high relative to number of units and the maintenance and administration costs for a small scale development represent an excessive service charge to occupants.

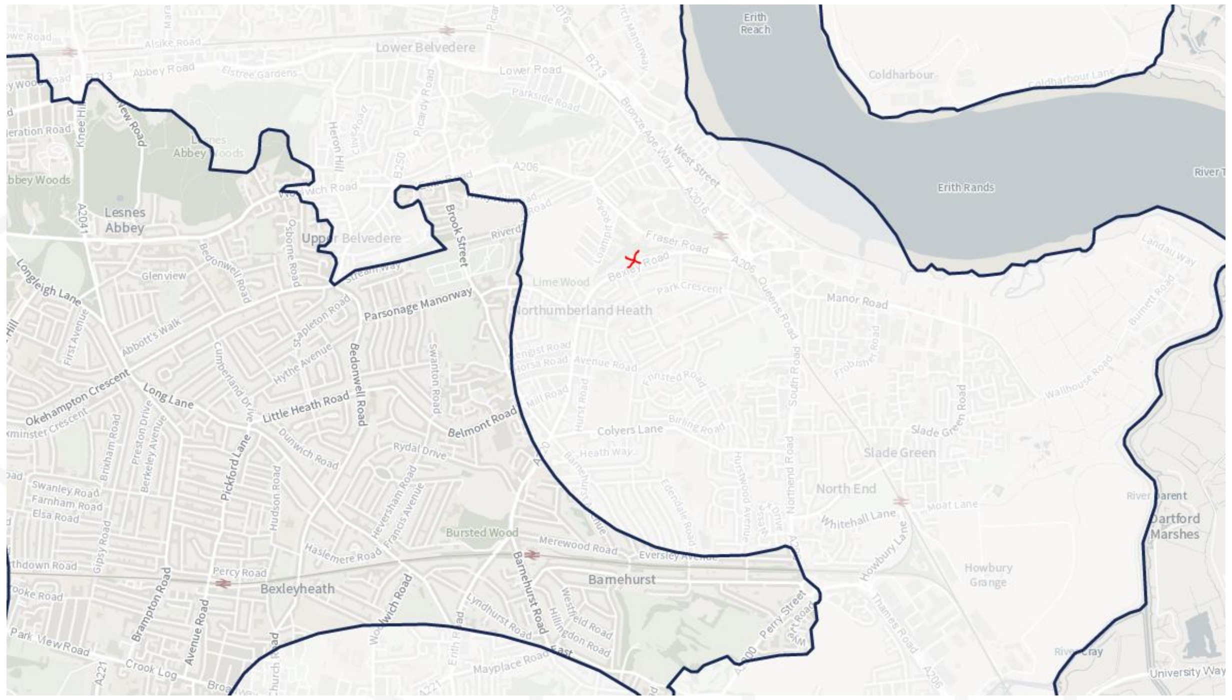

Figure 3 – Extract of London Heat Map

To ensure air quality standards are met any gas boilers to be installed shall be low Nitrogen Oxide (NOx) emitting in accordance with the GLA Appendix 6. Furthermore, this shall be coordinated with the air quality impact assessment or environmental impact assessment for the development where applicable. The following table shows the air quality impacts for the development.

Energy Source	Total Fuel Consumption (MWh/annum)
	Residential
Grid Electricity	78
Domestic / Communal Gas Boilers	43

Table 6 – Air quality impacts

5.3 Renewable Energy - Be Green

The third step of the hierarchy is to 'be green' by incorporating renewable energy technologies in developments. The Housing SPG states that developers should seek to utilise the following renewable energy technologies that are considered to be technically feasible in London, regardless of whether a 35% target has already been reached through earlier stages of the energy hierarchy:

Biomass

Biomass works in a similar way to a conventional boiler, except the fuel source used is generally wood chip or pellet based. The theory behind this type of system is that the CO_2 generated by the burning of the fuel, is offset by the 'plant matter' growing and absorbing CO_2 before it is cut down and turned into the chipping/pellet fuel. Again, this system does constitute as a renewable as the generated CO_2 is offset as described above and in fact, due to the carbon offset, is one of the best performing renewable alternatives available. Although this seems unlikely compared with for example an ASHP/GSHP that does not produce any CO_2 on site, these other options however run on grid electricity that is generally considered to be a 'dirty' alternative in the Part L energy assessment due to the 'embedded' CO_2 emitted from the power station generating the grid electricity.

Biomass systems have been rejected due to loss of accommodation for the provision of an energy centre, requirement of a significant high rise flue in a residential area, infrastructure costs disproportionately high relative to number of units and the maintenance and administration costs for a small scale development represent an excessive service charge to occupants.

Photovoltaics (PV)

Photovoltaics have a number of benefits, in that in terms of incorporating a renewable option, they can often be very competitive on cost against other methods. Additionally, as long as planning permits, and the site conditions are favorable, they are generally easily accommodated on the roof of the buildings they are serving. Additionally, PV panels are very low maintenance, and have a good life expectancy when compared to other technologies, which make them very popular where renewables are required. Against popular belief, PV will still work on cloudy days, though with much reduced efficiency.

Photovoltaic panels are proposed to maximise on-site renewable energy generation and further offset the development CO_2 emissions. The total photovoltaic array applied to the development is 4.95kWp (equating to an average of 0.3kWp per apartment). Figure 4 below shows the proposed PV layout facing south-east at an inclination of 30° mounted on the flat roof.

The London Plan states 'that all developments maximise opportunities for on-site electricity and heat production from solar technologies (photovoltaic and thermal) and use innovative building materials and smart technologies.' It is therefore recommended to provide photovoltaics at roof level.

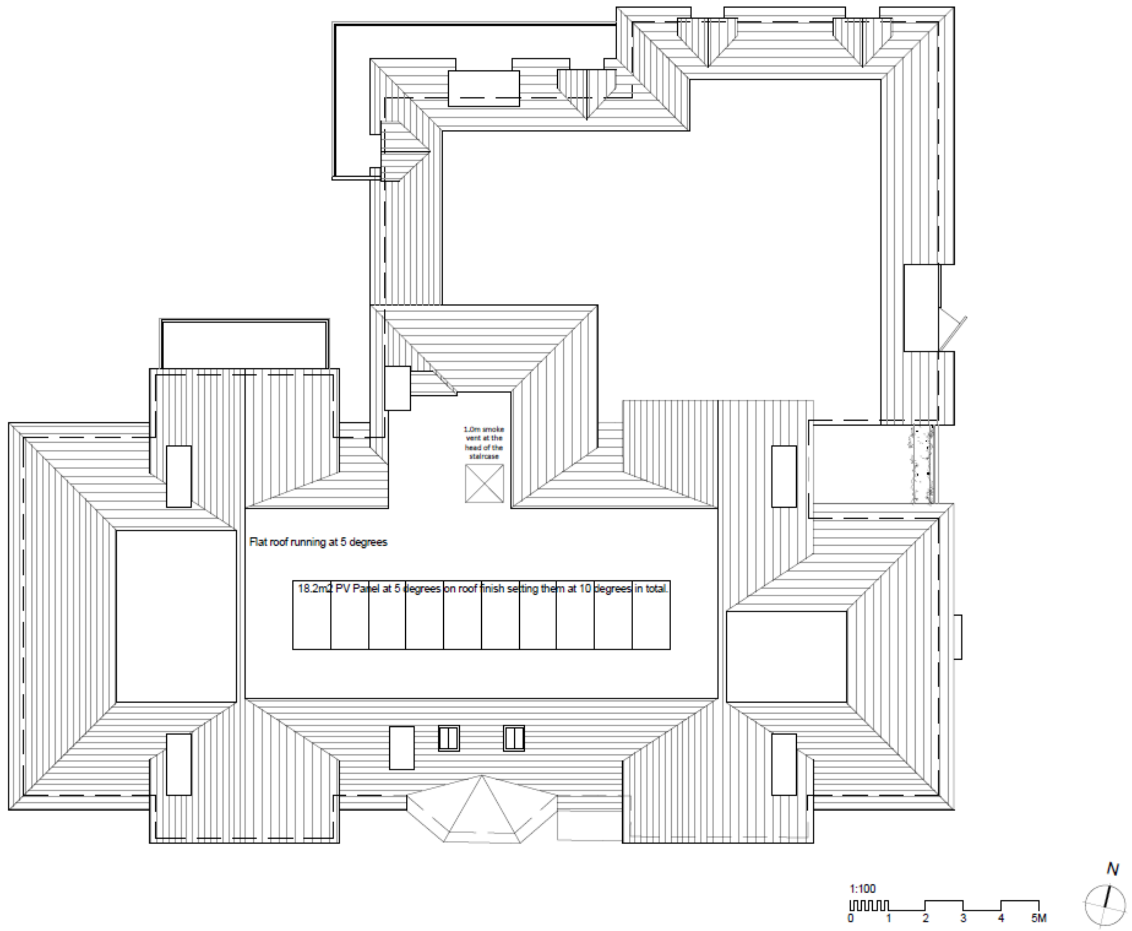

Figure 4 – Extract of Urban and Rural drawing A1353-108

The area surrounding the proposed development is predominantly 2-storey dwellings, therefore, the proposed PV installation on the third-floor roof level shall not be subject to solar shading and reduced outputs, see Figure 5 and 6 below for further details.

Figure 5 – Extract of Urban and Rural drawing B1353-111

Figure 6 – Site location

Solar water heating

Solar water heating utilise solar thermal panels, capturing solar energy and transferring this to a thermal store to generate domestic hot water and to displace the demand on the heating plant. The peak periods for the solar thermal systems to operate are during the summer period. Solar water heating has been discounted due to the lack of an energy centre to integrate the systems into. Also, roof space has been prioritised for photovoltaics.

Wind

Wind turbines use the force of the wind to drive a rotor and generator to produce electricity. In order to yield high electrical output, wind turbines require consistent air speeds and smooth laminar wind flow. Where wind flow is turbulent, a wind turbine will not operate effectively.

Monitoring of wind turbines in urban and suburban locations has shown in practice that the outputs can be greatly reduced by local wind turbulence effects, leading to low electricity generation and low CO_2 savings. Factors to consider in addition to the above are visual impact on the surroundings, noise, flicker and the impact on birds and bats.

Wind turbines have been rejected due to the potential nuisance to neighboring properties and the presence of existing trees that will affect turbine performance.

Air source heat pump (ASHP)

An ASHP works by converting heat within the air, on a refrigerant cycle, to generate low temperature hot water and could have worked particularly well here especially as ASHP's are generally well suited where the LTHW generated by the ASHP is used to feed an underfloor heating system as proposed here as underfloor heating systems generally run at much lower temperatures than a traditional wet radiator system. An ASHP is classified as a renewable and therefore would help reduce CO_2 emissions, which ultimately reduce the burden on other elements for improvements such as U-Values, other MEP services and/or renewables.

However, the ASHP unit itself needs to be situated externally, and dependent on size, can take up sizeable space. Often in residential apartment buildings, the ground space immediately around the building is often used for private external areas and shared gardens, meaning the ASHP cannot be located at ground level. The ASHP can of course be located at roof level, but this then becomes an aesthetic and/or maintenance consideration. Being situated externally, there is also the potential for noise, and although generally the units are not particularly noisy (generally on a par with an external air conditioning unit), they will always contribute noise that will be noticed by more people than other plant hidden away within an internal plant room.

The ASHPs do require an electrical supply that, depending on the size of the unit, can put a sizeable extra burden on the electricity supply. Lastly, as the ASHP works by drawing heat from the air, there are large temperature fluctuations over the course of the year and therefore the efficiency of the system differs between summer and winter. On the coldest parts of the year, the heat drawn from the air may be insufficient to meet the demand load and therefore additional heat generation may be required from another source which may actually necessitate a small gas supply to a gas boiler to provide top up when the ASHP is unable to perform optimally.

Ground source heat pump (GSHP)

A GSHP works in a similar fashion to an ASHP, but instead of taking heat from the air, the pump works by removing heat from the ground. This is achieved by burying a number of loop coils, and these can either be vertical or horizontal loops. The end result is very similar to an ASHP in that LTHW is generated, which again is particularly suitable for underfloor heating systems, with the same benefits of no gas supply required and the GSHP being classified as a renewable. Additional benefits are that the ground temperature remains relatively stable throughout the year, with minimal fluctuations, and therefore the system is easier to set up and modulate. Finally, unlike the ASHP, the plant is generally housed internally, normally within the plant room.

Again, the GSHP is not without its drawbacks and these can be more significant than the ASHP option. A GSHP that utilises horizontal loops for example, require a lot of land for the loops to be installed in and unless the site has access to this land, often negates the use of this technology. Apart from the fundamental issue of lack of space, the other stumbling block to implementing this technology here is cost, as generally there is a disproportionately large up-front capital cost when compared to other options.

The second option is to use a GSHP in conjunction with vertical bore hole drive loops, with these loops typically installed to depths anywhere in the region of 10m-25m+ depth dependent on the size of the system. This system has benefits over the horizontal loop solution as the complete system can be installed within footprint of the building. However, as with the horizontal loop system, the main drawback is the significant up-front capital cost when compared to other options.

GSHP has been discounted due to the lack of an energy centre to integrate the systems into.

Conclusion
Based upon the technologies noted above, we would recommend the use of roof mounted photovoltaics combined with a gas boiler. The assessment of carbon dioxide emissions in the following section incorporates these proposed technologies within the 'Be Green' stage. Details of the input data for the photovoltaic and gas boilers are shown in the table below.

Gas boilers	Worcester Bosch Greenstar 32CDi Compact ErP condensing gas combination boiler with an annual seasonal efficiency of 89.8% - installed complete with Worcester Bosch Greenstar Xtra flue gas heat recovery unit and Worcester Bosch Sense II weather compensator
Photovoltaics	4.95kWp (11No. 450Wp output PV panels), high efficiency panels, 30° tilt, south facing orientation, PV output goes to all apartments in proportion to floor area.

Table 7 - Proposed technologies

5.4 Monitor Usage - Be Seen

The final step of the hierarchy is 'be seen', which requires developments to verify and report on energy performance. This can be met through the provision of smart meters however the guidance also requests that a plan for monitoring and annual reporting of energy demand and carbon emissions post construction. To meet the final step of the hierarchy, the following is proposed.

Metering
Metering shall be provided to each dwelling, accessible by the occupants to monitor energy usage. Energy meters will be of the smart type.

Monitoring and Expected Costs
The London Plan requests a plan for monitoring and annual reporting of energy demand and carbon emissions post construction, however as these are residential dwellings with independent utility supplies there is no ability to enforce this. It is proposed to provide smart metering, which should allow the occupants to review their past usage (dependent on the energy supplier) and also include information within the homeowner manual on how to record and report energy usage.

The following benchmarks should be included within the homeowner manual for comparison purposes:

Unit/Plot No.	Energy Source	Energy Consumption (kWh/annum)	Energy cost (p/kWh)	Energy Cost (£/annum)	Carbon Factor (kgCO2/kWh)	CO_2 Emssions (kg CO_2/year)
1	Electricity	4954	21.4	1060	0.233	1154
	Gas	2402	4.09	98	0.21	504
2	Electricity	4464	21.4	955	0.233	1040
	Gas	561	4.09	23	0.21	118
3	Electricity	5569	21.4	1192	0.233	1298
	Gas	699	4.09	29	0.21	147
4	Electricity	4464	21.4	955	0.233	1040
	Gas	561	4.09	23	0.21	118
5	Electricity	4464	21.4	955	0.233	1040
	Gas	561	4.09	23	0.21	118
6	Electricity	4063	21.4	869	0.233	947
	Gas	425	4.09	17	0.21	89
7	Electricity	4464	21.4	955	0.233	1040
	Gas	2595	4.09	106	0.21	545
8	Electricity	3695	21.4	791	0.233	861
	Gas	387	4.09	16	0.21	81
9	Electricity	4472	21.4	957	0.233	1042
	Gas	562	4.09	23	0.21	118
10	Electricity	4823	21.4	1032	0.233	1124
	Gas	606	4.09	25	0.21	127
11	Electricity	5240	21.4	1121	0.233	1221
	Gas	658	4.09	27	0.21	138
12	Electricity	4472	21.4	957	0.233	1042
	Gas	562	4.09	23	0.21	118
13	Electricity	4505	21.4	964	0.233	1050
	Gas	472	4.09	19	0.21	99
14	Electricity	8699	21.4	1862	0.233	2027
	Gas	4757	4.09	195	0.21	999
15	Electricity	5439	21.4	1164	0.233	1267
	Gas	570	4.09	23	0.21	120
16	Electricity	5064	21.4	1084	0.233	1180
	Gas	530	4.09	22	0.21	111

Table 8 – Expected Costs and Carbon Emissions

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6. ASSESSMENT OF CARBON DIOXIDE EMISSIONS - DWELLINGS

The carbon dioxide emissions at each stage are shown in tables GLA table 1 and 2 and the associated graph below. These indicate that the passive design measures achieve a saving of 37% relative to the baseline. There is no saving associated with the 'Be Clean' stage due to heat networks and CHP technologies not being suitable for the site. Finally, the integration of photovoltaics provides a 6% saving relative to the 'Be Clean' stage.

		Carbon dioxide emissions for domestic buildings (Tonnes CO_2 per annum)	
		Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	A	17	70
After energy demand reduction	B	11	
After heat network/CHP	C	11	
After renewable energy	D	10	

GLA Table 1 - Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

		Regulated domestic carbon dioxide savings	
		(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	A-B	6	37
Savings from heat network/CHP	B-C	0	0
Savings from renewable energy	C-D	1	6
Cumulative on-site savings	A-D=E	7	42
Annual Savings from off-set payment	A-E=F	**10**	
		(Tonnes CO_2)	
Development's Service Life (30 years) CO_2 Emissions	F x 30 years = G	**297**	
		(£)	
Offset payment per tonne	H	£60	
Contribution to the Councils Carbon Offset Fund (COF)	G x H	**£17,825**	

GLA Table 2 - Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings

Note that the figures in the table above have been taken directly from the GLA Carbon Emission Report Spreadsheet, where they have been rounded up or down accordingly.

The cumulative savings provide a total carbon dioxide saving of 42%, which exceeds the 35% reduction of Part L 2013 as set out by the Mayor's London Plan. The scheme will need to "offset" any remaining CO_2 emissions between 42% and 100% through a financial contribution to the Council's Carbon Offset Fund (COF) which equates to £1800 per tonne (assumed 30-year lifetime of the developments services multiplied by the carbon dioxide offset price). The total contribution to the COF is £17,825.

A summary of the modelling work output is provided within the appendix.

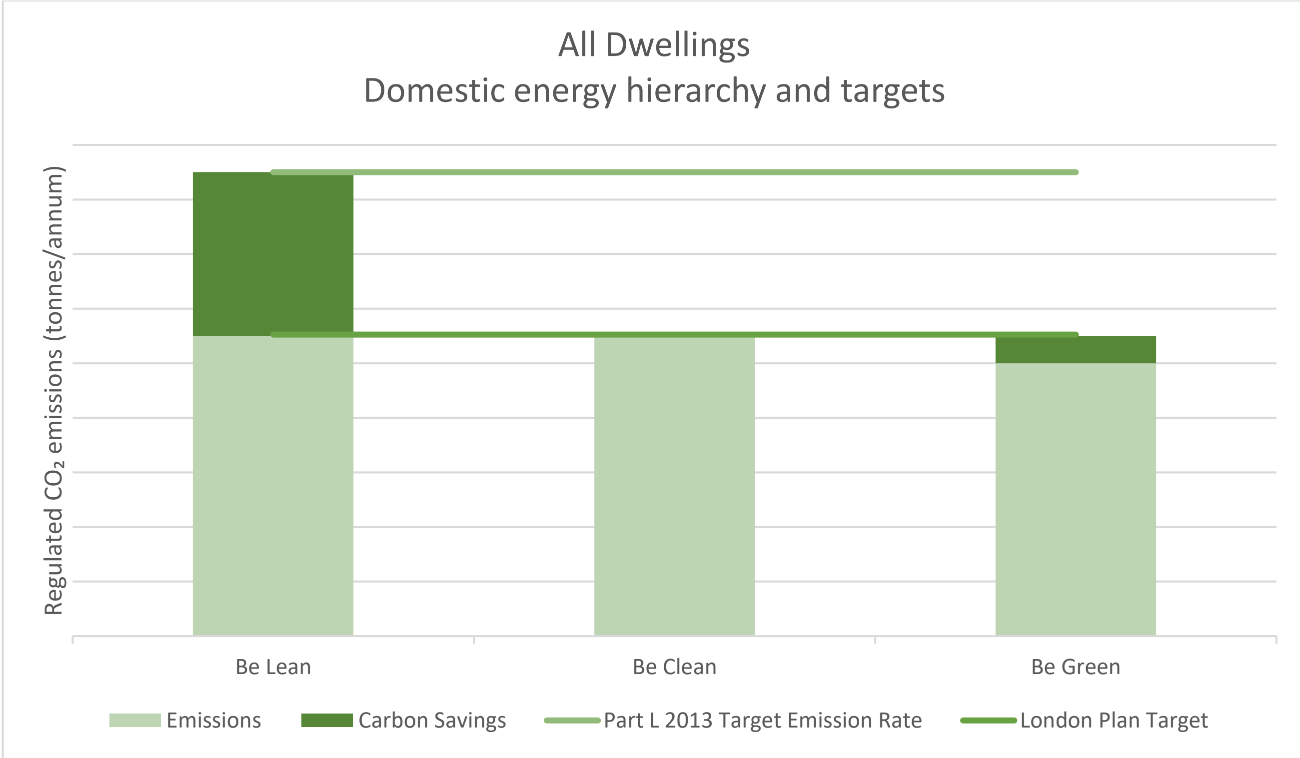

Figure 6 – Dwelling energy hierarchy and targets

Zero Carbon

As part of the requirements in London Plan, Policy SI 2 requests that proposals are made explaining how the site has been future proofed to achieve zero-carbon on-site emissions by 2050.

Indicative economic life expectancies of the proposed mechanical and electrical systems are noted in the table below:

Equipment	Economic life/years
Pipework	40-50
Boiler	10
Radiators/towel rails	20
Underfloor Heating	30
Extract fans	15
Ductwork	15
Light fittings	20
Cabling	25 +

Table 9 – Plant Life Expectancy

As indicated in the table above, the majority of systems will be beyond their economic life and likely to have been replaced by 2050. The only exceptions are the pipework, underfloor heating and the cabling systems. The use of underfloor heating will allow the occupants to provide either heat pump or hydrogen boilers when the proposed heat source is beyond its economic life, without major disruptions.

The proposed Worcester Bosch boilers are also ready for the expected national natural gas/hydrogen blend network modification

Note that it is recommended to review the boiler selection prior to the procurement to ensure that any specified equipment is suitable for use with the proposed hydrogen/natural gas changeover.

It has also been proposed to allow for a future plant room in the event that heat networks have been extended to a suitable position for connection to the site in the future.

Overheating calculations (see Section 7 Cooling and Overheating) have been undertaken using 2050 weather files.

7. COOLING AND OVERHEATING

In accordance with Policy SI 4 of the London Plan, measures are to be incorporated to reduce the demand for cooling. The cooling hierarchy is as follows:

Minimising internal heat generation through energy efficient design
Energy efficient measures shall be as per the 'Be Lean' sections above. One of the more important aspects is the provision of highly efficient LED lighting throughout the dwellings. Power densities of the lighting shall be extremely low. Coupled with daylight zoning to perimeter zones, heat gains from services equipment should be minimal.

Reducing amount of heat entering the building in summer
Double glazed windows, complete with low G-values shall be provided throughout the new development to minimise solar gains. Additional solar films shall be added where deemed appropriate.

Due to the nature of the buildings, it is expected that blinds are to be added to all rooms.

Use of thermal mass and high ceilings to manage the heat within the building
The height of the building is restricted to the architect's proposals and therefore the use of high ceilings to manage heat gains is unavailable.

Passive ventilation
Although the domestic areas shall be predominantly ventilated by mechanical means, all windows shall be openable to limit overheating further and glazing mounted trickle ventilators shall be provided to ensure sufficient make-up air.

Mechanical ventilation
Continuous mechanical extract ventilation shall be provided to ensure sufficient air movement within each apartment in accordance with Approved Document Part F.

Overheating risk analysis – Domestic Dwellings
The SAP Assessment documents are within the appendix of this document. The SAP documents outline any dwellings which are at risk of overheating, in line with Criterion 3 of Part L1A.

SAP Assessment calculations produced as part of this report show solar gains are within acceptable limits.

Supplementary planning guidance encourages developers to undertake dynamic modelling to assess the risk of overheating in their development. Such an assessment is an expectation of Policy SI 4 Managing Heat Risk of the London Plan.

A TM59 overheating study utilising 2050 weather files has been carried out for the development using IES Virtual Environment dynamic modelling software. Apartments 15 and 16 on the second floor were chosen due to its south facing position. Apartment 12 on the first floor was also modelled. The assessment passed with the previously mentioned u-values, sash windows, no blinds and windows open during the night.

Compliance is based upon passing both of the following two criteria:

a. For living rooms, kitchen and bedrooms: the number of hours during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3% of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance);
b. For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10pm to 7am shall not exceed 26°C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32hours, so 33 or more hours above 26°C will be recorded as a fail).

A summary of the results is shown in the table below:

Unit/Plot No.	Room	CIBSE TM52 Criterion 1: Hours of exceedance	Hours above 26°C (between 10pm and 7am)
12	Lounge/Dining/Kitchen	0	n/a
	Double Bedroom	0	0
	Single Bedroom	0	0
15	Lounge/Dining/Kitchen	0.5	n/a
	Double Bedroom	0	11
16	Lounge/Dining/Kitchen	0.6	n/a
	Double Bedroom	0	11

Table 10 – Overheating Analysis

8. APPENDICES

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
Printed on 15 July 2021 at 16:05:45

Project Information:

Assessed By: ()

Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 67.3m²

Site Reference : 106 Bexley Road

Plot Reference: Unit 1 - 1B 2P - Be Green

Address : 106 Bexley Road , Erith , DA8 3SP

Client Details:

Name: Kang

Address : Upna Ltd , 106 Bexley Road , Erith , DA8 3SP

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)	17.08 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	9.67 kg/m²	**OK**

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	39.4 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	31.0 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.16 (max. 0.30)	0.16 (max. 0.70)	**OK**
Party wall	0.00 (max. 0.20)	-	**OK**
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	**OK**
Roof	(no roof)		
Openings	1.16 (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	4.00 (design value)	
Maximum	10.0	**OK**

4 Heating efficiency

Main Heating system:

Database: (rev 479, product index 017513):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Worcester
Model: Greenstar
Model qualifier: 32CDi Compact ErP
(Combi)
Efficiency 89.8 % SEDBUK2009
Minimum 88.0 % **OK**

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder		

6 Controls

Space heating controls	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

Continuous supply and extract system		
Specific fan power:	0.39	
Maximum	1.5	OK
MVHR efficiency:	93%	
Minimum	70%	OK

9 Summertime temperature

Overheating risk (South East England):	Slight	OK

Based on:

Overshading:	Average or unknown
Windows facing: South	1.31m²
Windows facing: South	1.69m²
Windows facing: South	5.37m²
Ventilation rate:	3.00
Blinds/curtains:	None

10 Key features

Thermal bridging	0.035 W/m²K
Doors U-value	1 W/m²K
Party Walls U-value	0 W/m²K
Floors U-value	0.11 W/m²K
Photovoltaic array	

SAP Input

Property Details: Unit 1 - 1B 2P - Be Green

Address:	106 Bexley Road , Erith , DA8 3SP
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	13 July 2021
Date of certificate:	15 July 2021
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	479

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2021	
Floor Location:	Floor area:	Storey height:
Basement floor	67.3 m²	2.7 m
Living area:	29.9 m² (fraction 0.444)	
Front of dwelling faces:	South	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front Door	Manufacturer	Solid			Wood
South Window	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
South Window 2	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
South Window 3	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
Front Door	mm	0.7	0	1	1.91	1
South Window	16mm or more	0.7	0.63	1.2	1.31	1
South Window 2	16mm or more	0.7	0.63	1.2	1.69	1
South Window 3	16mm or more	0.7	0.63	1.2	5.37	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front Door		External Wall	North	0.91	2.1
South Window		External Wall	South	0.69	1.9
South Window 2		External Wall	South	0.9	1.875
South Window 3		External Wall	South	2.3	2.335

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
External Wall	41.31	10.28	31.03	0.16	0	False	N/A
Corridor Wall	16.74	0	16.74	0.16	0.4	False	N/A
External Floor	67.3			0.11			N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							
Party Wall	45.36						N/A
Party Ceiling	67.3						N/A

SAP Input

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0353

	Length	Psi-value		
[Approved]	4.865	0.3	E2	Other lintels (including other steel lintels)
[Approved]	1.59	0.04	E3	Sill
[Approved]	16.47	0.05	E4	Jamb
[Approved]	16.8	0.06	E18	Party wall between dwellings
	15.3	0.07	E22	Basement floor

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 1 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	3
Pressure test:	4

Main heating system:

Main heating system:

Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: Boiler Database
Database: (rev 479, product index 017513) Efficiency: Winter 87.2 % Summer: 90.7
Brand name: Worcester
Model: Greenstar
Model qualifier: 32CDi Compact ErP
(Combi boiler)
Systems with radiators
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Unknown
Boiler interlock: Yes
Weather Compensator

Main heating Control:

Main heating Control:

Time and temperature zone control by suitable arrangement of plumbing and electrical services
Control code: 2110

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating:

From main heating system
Water code: 901
Fuel :mains gas
No hot water cylinder
Flue Gas Heat Recovery System:
Database (rev 479, product index 060039)
Brand name: Alpha
Model: Intec
Model qualifier: 30GS/40GS+GasSaver-GS-1
Waste Water Heat Recovery System:

SAP Input

Total rooms with shower and/or bath: 1
Product index: 080106, Megaflo SHRU 60 System B
Number of mixer showers in rooms with a bath: 1
Number of mixer showers in rooms without a bath: 0
Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.3 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Unit 1 - 1B 2P - Be Green

Address : 106 Bexley Road , Erith , DA8 3SP

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	67.3	(1a) x	2.7	(2a) =	181.71	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67.3	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	181.71	(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							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.2	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.16	(21)

Infiltration rate modified for monthly wind speed

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

SAP WorkSheet: New dwelling design stage

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

0.2	0.19	0.19	0.17	0.17	0.15	0.15	0.14	0.16	0.17	0.17	0.18

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.05 (23c)

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

(24a)m=	0.3	0.3	0.29	0.28	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.29	(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	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.3	0.3	0.29	0.28	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.29	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.91	x	1	=	1.91			(26)
Windows Type 1			1.31	x1/[1/(1.2)+ 0.04]		=	1.5			(27)
Windows Type 2			1.69	x1/[1/(1.2)+ 0.04]		=	1.94			(27)
Windows Type 3			5.37	x1/[1/(1.2)+ 0.04]		=	6.15			(27)
Floor			67.3	x	0.11	=	7.403			(28)
Walls Type1	41.31	10.28	31.03	x	0.16	=	4.96			(29)
Walls Type2	16.74	0	16.74	x	0.15	=	2.52			(29)
Total area of elements, m²			125.35							(31)
Party wall			45.36	x	0	=	0			(32)
Party ceiling			67.3							(32b)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 26.38 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 17755.5 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 4.43 (36)

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

Total fabric heat loss (33) + (36) = 30.8 (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

SAP WorkSheet: New dwelling design stage

(38)m=	18.13	17.9	17.67	16.51	16.27	15.11	15.11	14.88	15.58	16.27	16.74	17.2	(38)

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

(39)m=	48.94	48.7	48.47	47.31	47.08	45.92	45.92	45.68	46.38	47.08	47.54	48.01	

Average = $Sum(39)_{1…12}$ /12= 47.25 (39)

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

(40)m=	0.73	0.72	0.72	0.7	0.7	0.68	0.68	0.68	0.69	0.7	0.71	0.71

Average = $Sum(40)_{1…12}$ /12= 0.7 (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 2.18 (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 85.95 (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=	94.54	91.1	87.67	84.23	80.79	77.35	77.35	80.79	84.23	87.67	91.1	94.54

Total = $Sum(44)_{1…12}$ = 1031.37 (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=	140.2	122.62	126.54	110.32	105.85	91.34	84.64	97.13	98.29	114.54	125.03	135.78

Total = $Sum(45)_{1…12}$ = 1352.29 (45)

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

(46)m=	21.03	18.39	18.98	16.55	15.88	13.7	12.7	14.57	14.74	17.18	18.76	20.37	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

SAP WorkSheet: New dwelling design stage

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=	24.91	22.5	24.91	24.11	24.91	24.11	24.91	24.91	24.11	24.91	24.11	24.91	(61)

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

(62)m=	165.12	145.13	151.45	134.43	130.77	115.45	109.56	122.04	122.4	139.46	149.14	160.69	(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	13.01	9.82	8.78	6.76	6.16	5.3	5.01	5.68	5.73	6.94	9.43	13.09	(63) (G2)
WWHRS	-31.27	-27.51	-28.08	-23.12	-21.48	-17.72	-15.01	-18.17	-18.7	-23.1	-26.74	-30.22	(63) (G10)

Output from water heater

(64)m=	119.93	106.97	113.68	103.67	102.22	91.55	88.62	97.28	97.09	108.51	112.09	116.48	

Output from water heater (annual)$_{1...12}$	1258.11	(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=	52.85	46.4	48.3	42.71	41.42	36.4	34.37	38.52	38.71	44.31	47.6	51.38	(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=	130.73	130.73	130.73	130.73	130.73	130.73	130.73	130.73	130.73	130.73	130.73	130.73	(66)

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

(67)m=	46.86	41.62	33.85	25.62	19.15	16.17	17.47	22.71	30.48	38.71	45.18	48.16	(67)

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

(68)m=	284.95	287.9	280.45	264.59	244.57	225.75	213.17	210.22	217.67	233.53	253.56	272.38	(68)

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

(69)m=	50.25	50.25	50.25	50.25	50.25	50.25	50.25	50.25	50.25	50.25	50.25	50.25	(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=	-87.15	-87.15	-87.15	-87.15	-87.15	-87.15	-87.15	-87.15	-87.15	-87.15	-87.15	-87.15	(71)

Water heating gains (Table 5)

(72)m=	71.03	69.04	64.92	59.32	55.68	50.55	46.2	51.78	53.76	59.56	66.11	69.05	(72)

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

(73)m=	499.66	495.4	476.05	446.36	416.23	389.3	373.67	381.54	398.74	428.63	461.67	486.42	(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)

South	0.9x	0.77	x	1.31	x	46.75	x	0.63	x	0.7	=	18.72	(78)
South	0.9x	0.77	x	1.69	x	46.75	x	0.63	x	0.7	=	24.15	(78)
South	0.9x	0.77	x	5.37	x	46.75	x	0.63	x	0.7	=	76.73	(78)
South	0.9x	0.77	x	1.31	x	76.57	x	0.63	x	0.7	=	30.65	(78)
South	0.9x	0.77	x	1.69	x	76.57	x	0.63	x	0.7	=	39.55	(78)
South	0.9x	0.77	x	5.37	x	76.57	x	0.63	x	0.7	=	125.66	(78)
South	0.9x	0.77	x	1.31	x	97.53	x	0.63	x	0.7	=	39.05	(78)
South	0.9x	0.77	x	1.69	x	97.53	x	0.63	x	0.7	=	50.37	(78)
South	0.9x	0.77	x	5.37	x	97.53	x	0.63	x	0.7	=	160.07	(78)
South	0.9x	0.77	x	1.31	x	110.23	x	0.63	x	0.7	=	44.13	(78)
South	0.9x	0.77	x	1.69	x	110.23	x	0.63	x	0.7	=	56.93	(78)
South	0.9x	0.77	x	5.37	x	110.23	x	0.63	x	0.7	=	180.91	(78)
South	0.9x	0.77	x	1.31	x	114.87	x	0.63	x	0.7	=	45.99	(78)
South	0.9x	0.77	x	1.69	x	114.87	x	0.63	x	0.7	=	59.33	(78)
South	0.9x	0.77	x	5.37	x	114.87	x	0.63	x	0.7	=	188.52	(78)
South	0.9x	0.77	x	1.31	x	110.55	x	0.63	x	0.7	=	44.26	(78)
South	0.9x	0.77	x	1.69	x	110.55	x	0.63	x	0.7	=	57.1	(78)
South	0.9x	0.77	x	5.37	x	110.55	x	0.63	x	0.7	=	181.42	(78)
South	0.9x	0.77	x	1.31	x	108.01	x	0.63	x	0.7	=	43.24	(78)
South	0.9x	0.77	x	1.69	x	108.01	x	0.63	x	0.7	=	55.79	(78)
South	0.9x	0.77	x	5.37	x	108.01	x	0.63	x	0.7	=	177.26	(78)
South	0.9x	0.77	x	1.31	x	104.89	x	0.63	x	0.7	=	41.99	(78)
South	0.9x	0.77	x	1.69	x	104.89	x	0.63	x	0.7	=	54.18	(78)
South	0.9x	0.77	x	5.37	x	104.89	x	0.63	x	0.7	=	172.15	(78)
South	0.9x	0.77	x	1.31	x	101.89	x	0.63	x	0.7	=	40.79	(78)
South	0.9x	0.77	x	1.69	x	101.89	x	0.63	x	0.7	=	52.62	(78)
South	0.9x	0.77	x	5.37	x	101.89	x	0.63	x	0.7	=	167.21	(78)
South	0.9x	0.77	x	1.31	x	82.59	x	0.63	x	0.7	=	33.06	(78)
South	0.9x	0.77	x	1.69	x	82.59	x	0.63	x	0.7	=	42.65	(78)
South	0.9x	0.77	x	5.37	x	82.59	x	0.63	x	0.7	=	135.53	(78)
South	0.9x	0.77	x	1.31	x	55.42	x	0.63	x	0.7	=	22.19	(78)
South	0.9x	0.77	x	1.69	x	55.42	x	0.63	x	0.7	=	28.62	(78)
South	0.9x	0.77	x	5.37	x	55.42	x	0.63	x	0.7	=	90.95	(78)
South	0.9x	0.77	x	1.31	x	40.4	x	0.63	x	0.7	=	16.17	(78)
South	0.9x	0.77	x	1.69	x	40.4	x	0.63	x	0.7	=	20.87	(78)
South	0.9x	0.77	x	5.37	x	40.4	x	0.63	x	0.7	=	66.3	(78)

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

(83)m=	119.59	195.86	249.49	281.98	293.84	282.78	276.29	268.32	260.62	211.25	141.76	103.34	(83)

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

(84)m=	619.25	691.25	725.54	728.34	710.07	672.08	649.97	649.86	659.36	639.88	603.43	589.75	(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=	0.97	0.93	0.87	0.75	0.61	0.44	0.31	0.32	0.48	0.74	0.92	0.97	(86)

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

(87)m=	20.67	20.78	20.89	20.97	20.99	21	21	21	21	20.97	20.84	20.65	(87)

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

(88)m=	20.32	20.32	20.32	20.34	20.34	20.36	20.36	20.36	20.35	20.34	20.34	20.33	(88)

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

(89)m=	0.96	0.91	0.84	0.72	0.57	0.39	0.27	0.28	0.44	0.7	0.9	0.97	(89)

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

(90)m=	19.89	20.06	20.19	20.3	20.34	20.36	20.36	20.36	20.35	20.32	20.14	19.87	(90)

fLA = Living area ÷ (4) = 0.44 (91)

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

(92)m=	20.24	20.38	20.5	20.6	20.63	20.64	20.64	20.64	20.64	20.61	20.45	20.22	(92)

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

(93)m=	20.24	20.38	20.5	20.6	20.63	20.64	20.64	20.64	20.64	20.61	20.45	20.22	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.96	0.92	0.85	0.73	0.59	0.41	0.29	0.3	0.46	0.72	0.9	0.96	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	591.98	632.82	616.67	535.13	417.11	277.26	185.6	193.87	302.84	458.21	545.63	568.7	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	779.93	753.93	678.72	553.4	420.3	277.43	185.61	193.88	303.25	471.21	634.83	768.94	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	139.84	81.38	46.17	13.16	2.38	0	0	0	0	9.67	64.22	148.98	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 505.8 (98)

Space heating requirement in kWh/m²/year 7.52 (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		93.7	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	139.84	81.38	46.17	13.16	2.38	0	0	0	0	9.67	64.22	148.98	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	149.24	86.85	49.27	14.04	2.53	0	0	0	0	10.32	68.54	159	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 539.81 (211)

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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)

119.93	106.97	113.68	103.67	102.22	91.55	88.62	97.28	97.09	108.51	112.09	116.48

Efficiency of water heater 87.2 (216)

(217)m=	89.05	88.68	88.18	87.58	87.28	87.2	87.2	87.2	87.2	87.48	88.44	89.13	(217)

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

(219)m=	134.68	120.63	128.92	118.37	117.12	104.99	101.63	111.56	111.34	124.05	126.74	130.68

Total = Sum(219a)$_{1...12}$ = 1430.72 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			539.81	
Water heating fuel used			1430.72	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		108.07		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		183.07	(231)
Electricity for lighting			331	(232)
Electricity generated by PVs			-259.09	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =			2225.51	(338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	18.79	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	49.79	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	24.15	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	43.66	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 256.38 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.96	(257)
SAP rating (Section 12)		86.62	(258)

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	=	116.6	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	309.04	(264)
Space and water heating	(261) + (262) + (263) + (264) =			425.63	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	95.01	(267)
Electricity for lighting	(232) x	0.519	=	171.79	(268)
Energy saving/generation technologies Item 1		0.519	=	-134.47	(269)
Total CO2, kg/year		sum of (265)…(271) =		557.97	(272)
CO2 emissions per m²		(272) ÷ (4) =		8.29	(273)
EI rating (section 14)				93	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	658.56	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	1745.48	(264)
Space and water heating	(261) + (262) + (263) + (264) =			2404.04	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	562.03	(267)
Electricity for lighting	(232) x	0	=	1016.18	(268)
Energy saving/generation technologies Item 1		3.07	=	-795.39	(269)
‘Total Primary Energy		sum of (265)…(271) =		3186.85	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		47.35	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Unit 1 - 1B 2P - Be Green

Address : 106 Bexley Road , Erith , DA8 3SP

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Basement	67.3	(1a) x	2.7	(2a) =	181.71	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	67.3	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	181.71	(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							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.2	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.78	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.16	(21)

Infiltration rate modified for monthly wind speed

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

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

0.2	0.19	0.19	0.17	0.17	0.15	0.15	0.14	0.16	0.17	0.17	0.18

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.05	(23c)

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

(24a)m=	0.3	0.3	0.29	0.28	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.29	(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	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.3	0.3	0.29	0.28	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.29	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.91	x	1	=	1.91			(26)
Windows Type 1			1.31	x1/[1/(1.2)+ 0.04]		=	1.5			(27)
Windows Type 2			1.69	x1/[1/(1.2)+ 0.04]		=	1.94			(27)
Windows Type 3			5.37	x1/[1/(1.2)+ 0.04]		=	6.15			(27)
Floor			67.3	x	0.11	=	7.403			(28)
Walls Type1	41.31	10.28	31.03	x	0.16	=	4.96			(29)
Walls Type2	16.74	0	16.74	x	0.15	=	2.52			(29)
Total area of elements, m²			125.35							(31)
Party wall			45.36	x	0	=	0			(32)
Party ceiling			67.3							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	26.38	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	17755.5	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		4.43	(36)
if details of thermal bridging are not known (36) = 0.05 x (31)			
Total fabric heat loss	(33) + (36) =	30.8	(37)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(38)m=	18.13	17.9	17.67	16.51	16.27	15.11	15.11	14.88	15.58	16.27	16.74	17.2	(38)

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

(39)m=	48.94	48.7	48.47	47.31	47.08	45.92	45.92	45.68	46.38	47.08	47.54	48.01	

Average = Sum(39)$_{1…12}$ /12= 47.25 (39)

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

(40)m=	0.73	0.72	0.72	0.7	0.7	0.68	0.68	0.68	0.69	0.7	0.71	0.71	

Average = Sum(40)$_{1…12}$ /12= 0.7 (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 2.18 (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 85.95 (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=	94.54	91.1	87.67	84.23	80.79	77.35	77.35	80.79	84.23	87.67	91.1	94.54	

Total = Sum(44)$_{1…12}$ = 1031.37 (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=	140.2	122.62	126.54	110.32	105.85	91.34	84.64	97.13	98.29	114.54	125.03	135.78	

Total = Sum(45)$_{1…12}$ = 1352.29 (45)

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

(46)m=	21.03	18.39	18.98	16.55	15.88	13.7	12.7	14.57	14.74	17.18	18.76	20.37	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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=	24.91	22.5	24.91	24.11	24.91	24.11	24.91	24.91	24.11	24.91	24.11	24.91	(61)

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

(62)m=	165.12	145.13	151.45	134.43	130.77	115.45	109.56	122.04	122.4	139.46	149.14	160.69	(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	15.98	12.35	10.71	7.57	6.36	5.3	5.01	5.68	5.73	7.71	11.9	15.96	(63) (G2)
WWHRS	-31.27	-27.51	-28.08	-23.12	-21.48	-17.72	-15.01	-18.17	-18.7	-23.1	-26.74	-30.22	(63) (G10)

Output from water heater

(64)m=	116.96	104.44	111.76	102.86	102.02	91.55	88.62	97.28	97.09	107.74	109.62	113.61	

Output from water heater (annual)$_{1...12}$ 1243.55 (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=	52.85	46.4	48.3	42.71	41.42	36.4	34.37	38.52	38.71	44.31	47.6	51.38	(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=	108.94	108.94	108.94	108.94	108.94	108.94	108.94	108.94	108.94	108.94	108.94	108.94	(66)

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

(67)m=	18.74	16.65	13.54	10.25	7.66	6.47	6.99	9.08	12.19	15.48	18.07	19.26	(67)

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

(68)m=	190.92	192.9	187.9	177.28	163.86	151.25	142.83	140.85	145.84	156.47	169.88	182.49	(68)

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

(69)m=	33.89	33.89	33.89	33.89	33.89	33.89	33.89	33.89	33.89	33.89	33.89	33.89	(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=	-87.15	-87.15	-87.15	-87.15	-87.15	-87.15	-87.15	-87.15	-87.15	-87.15	-87.15	-87.15	(71)

Water heating gains (Table 5)

(72)m=	71.03	69.04	64.92	59.32	55.68	50.55	46.2	51.78	53.76	59.56	66.11	69.05	(72)

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

(73)m=	339.37	337.27	325.05	305.52	285.88	266.96	254.7	260.39	270.48	290.19	312.75	329.49	(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)

South	0.9x	0.77	x	1.31	x	46.75	x	0.63	x	0.7	=	18.72	(78)
South	0.9x	0.77	x	1.69	x	46.75	x	0.63	x	0.7	=	24.15	(78)
South	0.9x	0.77	x	5.37	x	46.75	x	0.63	x	0.7	=	76.73	(78)
South	0.9x	0.77	x	1.31	x	76.57	x	0.63	x	0.7	=	30.65	(78)
South	0.9x	0.77	x	1.69	x	76.57	x	0.63	x	0.7	=	39.55	(78)
South	0.9x	0.77	x	5.37	x	76.57	x	0.63	x	0.7	=	125.66	(78)
South	0.9x	0.77	x	1.31	x	97.53	x	0.63	x	0.7	=	39.05	(78)
South	0.9x	0.77	x	1.69	x	97.53	x	0.63	x	0.7	=	50.37	(78)
South	0.9x	0.77	x	5.37	x	97.53	x	0.63	x	0.7	=	160.07	(78)
South	0.9x	0.77	x	1.31	x	110.23	x	0.63	x	0.7	=	44.13	(78)
South	0.9x	0.77	x	1.69	x	110.23	x	0.63	x	0.7	=	56.93	(78)
South	0.9x	0.77	x	5.37	x	110.23	x	0.63	x	0.7	=	180.91	(78)
South	0.9x	0.77	x	1.31	x	114.87	x	0.63	x	0.7	=	45.99	(78)
South	0.9x	0.77	x	1.69	x	114.87	x	0.63	x	0.7	=	59.33	(78)
South	0.9x	0.77	x	5.37	x	114.87	x	0.63	x	0.7	=	188.52	(78)
South	0.9x	0.77	x	1.31	x	110.55	x	0.63	x	0.7	=	44.26	(78)
South	0.9x	0.77	x	1.69	x	110.55	x	0.63	x	0.7	=	57.1	(78)
South	0.9x	0.77	x	5.37	x	110.55	x	0.63	x	0.7	=	181.42	(78)
South	0.9x	0.77	x	1.31	x	108.01	x	0.63	x	0.7	=	43.24	(78)
South	0.9x	0.77	x	1.69	x	108.01	x	0.63	x	0.7	=	55.79	(78)
South	0.9x	0.77	x	5.37	x	108.01	x	0.63	x	0.7	=	177.26	(78)
South	0.9x	0.77	x	1.31	x	104.89	x	0.63	x	0.7	=	41.99	(78)
South	0.9x	0.77	x	1.69	x	104.89	x	0.63	x	0.7	=	54.18	(78)
South	0.9x	0.77	x	5.37	x	104.89	x	0.63	x	0.7	=	172.15	(78)
South	0.9x	0.77	x	1.31	x	101.89	x	0.63	x	0.7	=	40.79	(78)
South	0.9x	0.77	x	1.69	x	101.89	x	0.63	x	0.7	=	52.62	(78)
South	0.9x	0.77	x	5.37	x	101.89	x	0.63	x	0.7	=	167.21	(78)
South	0.9x	0.77	x	1.31	x	82.59	x	0.63	x	0.7	=	33.06	(78)
South	0.9x	0.77	x	1.69	x	82.59	x	0.63	x	0.7	=	42.65	(78)
South	0.9x	0.77	x	5.37	x	82.59	x	0.63	x	0.7	=	135.53	(78)
South	0.9x	0.77	x	1.31	x	55.42	x	0.63	x	0.7	=	22.19	(78)
South	0.9x	0.77	x	1.69	x	55.42	x	0.63	x	0.7	=	28.62	(78)
South	0.9x	0.77	x	5.37	x	55.42	x	0.63	x	0.7	=	90.95	(78)
South	0.9x	0.77	x	1.31	x	40.4	x	0.63	x	0.7	=	16.17	(78)
South	0.9x	0.77	x	1.69	x	40.4	x	0.63	x	0.7	=	20.87	(78)
South	0.9x	0.77	x	5.37	x	40.4	x	0.63	x	0.7	=	66.3	(78)

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

(83)m=	119.59	195.86	249.49	281.98	293.84	282.78	276.29	268.32	260.62	211.25	141.76	103.34	(83)

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

(84)m=	458.96	533.13	574.54	587.5	579.72	549.73	530.99	528.71	531.1	501.45	454.5	432.83	(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

DER WorkSheet: New dwelling design stage

(86)m=	0.99	0.98	0.95	0.87	0.73	0.53	0.38	0.4	0.6	0.87	0.98	1	(86)

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

(87)m=	20.45	20.6	20.76	20.91	20.98	21	21	21	21	20.92	20.67	20.43	(87)

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

(88)m=	20.32	20.32	20.32	20.34	20.34	20.36	20.36	20.36	20.35	20.34	20.34	20.33	(88)

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

(89)m=	0.99	0.98	0.94	0.84	0.69	0.48	0.32	0.34	0.54	0.84	0.97	0.99	(89)

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

(90)m=	19.59	19.81	20.03	20.24	20.32	20.36	20.36	20.36	20.35	20.26	19.92	19.57	(90)

fLA = Living area ÷ (4) = | 0.44 | (91)

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

(92)m=	19.97	20.16	20.36	20.54	20.61	20.64	20.64	20.64	20.64	20.55	20.26	19.95	(92)

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

(93)m=	19.97	20.16	20.36	20.54	20.61	20.64	20.64	20.64	20.64	20.55	20.26	19.95	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.97	0.94	0.85	0.71	0.5	0.35	0.37	0.57	0.85	0.97	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	454.71	519.39	538.95	501.03	409.11	276.71	185.57	193.83	301.4	427.16	442.59	429.97	(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=	767	743.33	671.63	550.48	419.65	277.38	185.61	193.88	303.13	468.57	625.43	756.1	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	232.35	150.49	98.71	35.61	7.84	0	0	0	0	30.81	131.65	242.64	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 930.09 | (98)

Space heating requirement in kWh/m²/year | 13.82 | (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		93.7	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	232.35	150.49	98.71	35.61	7.84	0	0	0	0	30.81	131.65	242.64	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	247.97	160.61	105.35	38	8.36	0	0	0	0	32.88	140.5	258.96	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= | 992.62 | (211)

DER WorkSheet: New dwelling design stage

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)

116.96	104.44	111.76	102.86	102.02	91.55	88.62	97.28	97.09	107.74	109.62	113.61

Efficiency of water heater 87.2 (216)

(217)m=	89.5	89.23	88.81	88.07	87.44	87.2	87.2	87.2	87.2	87.95	89.08	89.55

(217)

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

(219)m=	130.68	117.05	125.84	116.78	116.68	104.99	101.63	111.56	111.34	122.5	123.06	126.86

Total = Sum(219a)$_{1...12}$ = 1408.98 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		992.62	
Water heating fuel used		1408.98	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	108.07		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	183.07	(231)
Electricity for lighting		331	(232)
Electricity generated by PVs		-259.09	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2656.59	(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	=	214.41	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	304.34	(264)
Space and water heating	(261) + (262) + (263) + (264) =			518.75	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	95.01	(267)
Electricity for lighting	(232) x	0.519	=	171.79	(268)
Energy saving/generation technologies Item 1		0.519	=	-134.47	(269)
Total CO2, kg/year		sum of (265)…(271) =		651.09	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		9.67	(273)
EI rating (section 14)				92	(274)

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 15 July 2021

Property Details: Unit 1 - 1B 2P - Be Green

Dwelling type:	Flat
Located in:	England
Region:	South East England
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	South
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	None
Ventilation rate during hot weather (ach):	3 (Windows open half the time)

Overheating Details:

Summer ventilation heat loss coefficient:	179.89	**(P1)**
Transmission heat loss coefficient:	30.8	
Summer heat loss coefficient:	210.7	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
South (South Window)	0	1
South (South Window 2)	0	1
South (South Window 3)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
South (South Window)	1	0.9	1	0.9	**(P8)**
South (South Window 2)	1	0.9	1	0.9	**(P8)**
South (South Window 3)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
South (South Window)	0.9 x	1.31	118.4	0.63	0.7	0.9	55.4	
South (South Window 2)	0.9 x	1.69	118.4	0.63	0.7	0.9	71.48	
South (South Window 3)	0.9 x	5.37	118.4	0.63	0.7	0.9	227.12	
						Total	354	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	386.3	370.67	378.54	
Total summer gains	753.66	724.67	722.96	**(P5)**
Summer gain/loss ratio	3.58	3.44	3.43	**(P6)**
Mean summer external temperature (South East England)	15.4	17.4	17.5	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	19.23	21.09	21.18	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Slight**	**Slight**	

Assessment of likelihood of high internal temperature: Slight

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
Printed on 15 July 2021 at 16:05:44

Project Information:

Assessed By: ()

Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 61m²

Site Reference : 106 Bexley Road

Plot Reference: Unit 7 - 2B 3P - Be Green

Address : 106 Bexley Road , Erith , DA8 3SP

Client Details:

Name: Kang

Address : Upna Ltd , 106 Bexley Road , Erith , DA8 3SP

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)	18.54 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	10.94 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	45.3 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	36.6 kWh/m²	
		OK

DRAFT

2 Fabric U-values

Element	Average	Highest	
External wall	0.16 (max. 0.30)	0.16 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.17 (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	4.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system:	Database: (rev 479, product index 017513): Boiler systems with radiators or underfloor heating - mains gas Brand name: Worcester Model: Greenstar Model qualifier: 32CDi Compact ErP (Combi) Efficiency 89.8 % SEDBUK2009 Minimum 88.0 %	OK
Secondary heating system:	None	

Regulations Compliance Report

5 Cylinder insulation

Hot water Storage:	No cylinder	

6 Controls

Space heating controls	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

Continuous supply and extract system		
Specific fan power:	0.39	
Maximum	1.5	**OK**
MVHR efficiency:	93%	
Minimum	70%	**OK**

9 Summertime temperature

Overheating risk (South East England):	Slight	**OK**

Based on:

Overshading:	Average or unknown
Windows facing: South	1.71m²
Windows facing: North	3.42m²
Windows facing: North	4.09m²
Ventilation rate:	3.00
Blinds/curtains:	None

10 Key features

Doors U-value	1 W/m²K
Party Walls U-value	0 W/m²K
Photovoltaic array	

SAP Input

Property Details: Unit 7 - 2B 3P - Be Green

Address:	106 Bexley Road , Erith , DA8 3SP
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	13 July 2021
Date of certificate:	15 July 2021
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	479

Property description:

Dwelling type:	Flat	
Detachment:		
Year Completed:	2021	
Floor Location:	Floor area:	Storey height:
Floor 0	61 m²	2.7 m
Living area:	26.4 m² (fraction 0.433)	
Front of dwelling faces:	East	

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front Door	Manufacturer	Solid			Wood
South Window	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
North Window	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
North Window 2	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
Front Door	mm	0.7	0	1	1.91	1
South Window	16mm or more	0.7	0.63	1.2	1.71	1
North Window	16mm or more	0.7	0.63	1.2	1.71	2
North Window 2	16mm or more	0.7	0.63	1.2	4.09	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front Door		External Wall	East	0.91	2.1
South Window		External Wall	South	0.9	1.9
North Window		External Wall	North	0.9	1.9
North Window 2		External Wall	North	1.475	2.775

Overshading:	Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
External Wall	66.42	11.13	55.29	0.16	0	False	N/A
Corridor Wall	7.83	0	7.83	0.16	0.4	False	N/A
<u>Internal Elements</u>							
<u>Party Elements</u>							
Party Wall	32.13						N/A
Party Ceiling	61						N/A
Party Floor	61						N/A

SAP Input

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0708

	Length	Psi-value		
[Approved]	5.23	0.3	E2	Other lintels (including other steel lintels)
[Approved]	2.7	0.04	E3	Sill
[Approved]	21.1	0.05	E4	Jamb
[Approved]	24.6	0.07	E7	Party floor between dwellings (in blocks of flats)
[Approved]	4.3	0.02	E9	Balcony between dwellings, wall insulation continuous
[Approved]	11.9	0.06	E18	Party wall between dwellings

Ventilation:

Pressure test: Yes (As designed)

Ventilation: Balanced with heat recovery
Number of wet rooms: Kitchen + 1
Ductwork: Insulation, rigid
Approved Installation Scheme: True

Number of chimneys: 0
Number of open flues: 0
Number of fans: 0
Number of passive stacks: 0
Number of sides sheltered: 1
Pressure test: 4

Main heating system:

Main heating system: Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: Boiler Database
Database: (rev 479, product index 017513) Efficiency: Winter 87.2 % Summer: 90.7
Brand name: Worcester
Model: Greenstar
Model qualifier: 32CDi Compact ErP
(Combi boiler)
Underfloor heating and radiators, pipes in insulated timber floor
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Unknown
Boiler interlock: Yes
Weather Compensator

Main heating Control:

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services
Control code: 2110

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating: From main heating system
Water code: 901
Fuel :mains gas
No hot water cylinder
Flue Gas Heat Recovery System:
Database (rev 479, product index 060035)
Brand name: Worcester
Model: Greenstar Xtra
Model qualifier: 2015

SAP Input

Waste Water Heat Recovery System:
Total rooms with shower and/or bath: 1
Product index: 080106, Megaflo SHRU 60 System B
Number of mixer showers in rooms with a bath: 1
Number of mixer showers in rooms without a bath: 0
Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.3 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Unit 7 - 2B 3P - Be Green

Address : 106 Bexley Road , Erith , DA8 3SP

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	61	(1a) x	2.7	(2a) =	164.7	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	164.7	(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							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

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

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

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

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

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.19	(21)

Infiltration rate modified for monthly wind speed

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

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

0.24	0.23	0.23	0.2	0.2	0.18	0.18	0.17	0.19	0.2	0.21	0.22

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.05	(23c)

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

(24a)m=	0.34	0.34	0.33	0.31	0.3	0.28	0.28	0.28	0.29	0.3	0.31	0.32	(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	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.34	0.34	0.33	0.31	0.3	0.28	0.28	0.28	0.29	0.3	0.31	0.32	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.91	x	1	=	1.91			(26)
Windows Type 1			1.71	x1/[1/(1.2)+ 0.04]		=	1.96			(27)
Windows Type 2			1.71	x1/[1/(1.2)+ 0.04]		=	1.96			(27)
Windows Type 3			4.09	x1/[1/(1.2)+ 0.04]		=	4.68			(27)
Walls Type1	66.42	11.13	55.29	x	0.16	=	8.85			(29)
Walls Type2	7.83	0	7.83	x	0.15	=	1.18			(29)
Total area of elements, m²			74.25							(31)
Party wall			32.13	x	0	=	0			(32)
Party floor			61							(32a)
Party ceiling			61							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	22.49	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	12222.7	(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		5.25	(36)

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

Total fabric heat loss	(33) + (36) =	27.75	(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

SAP WorkSheet: New dwelling design stage

(38)m=	18.51	18.26	18.01	16.75	16.5	15.25	15.25	14.99	15.75	16.5	17.01	17.51	(38)

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

(39)m=	46.26	46.01	45.76	44.5	44.25	42.99	42.99	42.74	43.49	44.25	44.75	45.25	

Average = $Sum(39)_{1…12}$ /12= 44.44 (39)

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

(40)m=	0.76	0.75	0.75	0.73	0.73	0.7	0.7	0.7	0.71	0.73	0.73	0.74	

Average = $Sum(40)_{1…12}$ /12= 0.73 (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 2.01 (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 81.93 (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=	90.13	86.85	83.57	80.29	77.02	73.74	73.74	77.02	80.29	83.57	86.85	90.13	

Total = $Sum(44)_{1…12}$ = 983.18 (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=	133.65	116.89	120.62	105.16	100.91	87.07	80.69	92.59	93.7	109.19	119.19	129.44	

Total = $Sum(45)_{1…12}$ = 1289.11 (45)

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

(46)m=	20.05	17.53	18.09	15.77	15.14	13.06	12.1	13.89	14.05	16.38	17.88	19.42	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	24.91	22.5	24.91	24.11	24.91	24.11	24.91	24.91	24.11	24.91	24.11	24.91	(61)

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

(62)m=	158.57	139.4	145.54	129.27	125.82	111.18	105.6	117.5	117.81	134.11	143.3	154.35	(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	13.56	11.36	11	8.94	8.31	7.19	6.8	7.71	7.77	9.34	11.2	13.3	(63) (G2)
WWHRS	-29.24	-25.72	-26.26	-21.63	-20.1	-16.59	-14.06	-17.01	-17.5	-21.62	-25.01	-28.26	(63) (G10)

Output from water heater

(64)m=	114.48	101.15	106.99	97.46	96.13	86.17	83.47	91.5	91.29	101.87	105.84	111.5

Output from water heater (annual)$_{1...12}$ | 1187.85 | (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=	50.67	44.49	46.34	40.99	39.78	34.98	33.06	37.01	37.18	42.54	45.66	49.27	(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=	120.59	120.59	120.59	120.59	120.59	120.59	120.59	120.59	120.59	120.59	120.59	120.59	(66)

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

(67)m=	41.27	36.66	29.81	22.57	16.87	14.24	15.39	20.01	26.85	34.09	39.79	42.42	(67)

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

(68)m=	261.88	264.6	257.75	243.17	224.77	207.47	195.92	193.2	200.05	214.63	233.03	250.33	(68)

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

(69)m=	49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07	(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=	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	(71)

Water heating gains (Table 5)

(72)m=	68.1	66.21	62.28	56.94	53.47	48.58	44.43	49.75	51.64	57.17	63.42	66.22	(72)

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

(73)m=	463.52	459.73	442.11	414.94	387.37	362.56	348.01	355.22	370.81	398.16	428.5	451.23	(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)

North	0.9x	0.77	x	1.71	x	10.63	x	0.63	x	0.7	=	11.11	(74)
North	0.9x	0.77	x	4.09	x	10.63	x	0.63	x	0.7	=	13.29	(74)
North	0.9x	0.77	x	1.71	x	20.32	x	0.63	x	0.7	=	21.24	(74)
North	0.9x	0.77	x	4.09	x	20.32	x	0.63	x	0.7	=	25.4	(74)
North	0.9x	0.77	x	1.71	x	34.53	x	0.63	x	0.7	=	36.09	(74)
North	0.9x	0.77	x	4.09	x	34.53	x	0.63	x	0.7	=	43.16	(74)
North	0.9x	0.77	x	1.71	x	55.46	x	0.63	x	0.7	=	57.97	(74)
North	0.9x	0.77	x	4.09	x	55.46	x	0.63	x	0.7	=	69.33	(74)
North	0.9x	0.77	x	1.71	x	74.72	x	0.63	x	0.7	=	78.09	(74)
North	0.9x	0.77	x	4.09	x	74.72	x	0.63	x	0.7	=	93.39	(74)
North	0.9x	0.77	x	1.71	x	79.99	x	0.63	x	0.7	=	83.6	(74)
North	0.9x	0.77	x	4.09	x	79.99	x	0.63	x	0.7	=	99.98	(74)
North	0.9x	0.77	x	1.71	x	74.68	x	0.63	x	0.7	=	78.05	(74)
North	0.9x	0.77	x	4.09	x	74.68	x	0.63	x	0.7	=	93.34	(74)
North	0.9x	0.77	x	1.71	x	59.25	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	4.09	x	59.25	x	0.63	x	0.7	=	74.06	(74)
North	0.9x	0.77	x	1.71	x	41.52	x	0.63	x	0.7	=	43.39	(74)
North	0.9x	0.77	x	4.09	x	41.52	x	0.63	x	0.7	=	51.89	(74)
North	0.9x	0.77	x	1.71	x	24.19	x	0.63	x	0.7	=	25.28	(74)
North	0.9x	0.77	x	4.09	x	24.19	x	0.63	x	0.7	=	30.24	(74)
North	0.9x	0.77	x	1.71	x	13.12	x	0.63	x	0.7	=	13.71	(74)
North	0.9x	0.77	x	4.09	x	13.12	x	0.63	x	0.7	=	16.4	(74)
North	0.9x	0.77	x	1.71	x	8.86	x	0.63	x	0.7	=	9.27	(74)
North	0.9x	0.77	x	4.09	x	8.86	x	0.63	x	0.7	=	11.08	(74)
South	0.9x	0.77	x	1.71	x	46.75	x	0.63	x	0.7	=	24.43	(78)
South	0.9x	0.77	x	1.71	x	76.57	x	0.63	x	0.7	=	40.01	(78)
South	0.9x	0.77	x	1.71	x	97.53	x	0.63	x	0.7	=	50.97	(78)
South	0.9x	0.77	x	1.71	x	110.23	x	0.63	x	0.7	=	57.61	(78)
South	0.9x	0.77	x	1.71	x	114.87	x	0.63	x	0.7	=	60.03	(78)
South	0.9x	0.77	x	1.71	x	110.55	x	0.63	x	0.7	=	57.77	(78)
South	0.9x	0.77	x	1.71	x	108.01	x	0.63	x	0.7	=	56.45	(78)
South	0.9x	0.77	x	1.71	x	104.89	x	0.63	x	0.7	=	54.82	(78)
South	0.9x	0.77	x	1.71	x	101.89	x	0.63	x	0.7	=	53.25	(78)
South	0.9x	0.77	x	1.71	x	82.59	x	0.63	x	0.7	=	43.16	(78)
South	0.9x	0.77	x	1.71	x	55.42	x	0.63	x	0.7	=	28.96	(78)
South	0.9x	0.77	x	1.71	x	40.4	x	0.63	x	0.7	=	21.11	(78)

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

(83)m=	48.84	86.65	130.22	184.91	231.52	241.35	227.84	190.8	148.53	98.68	59.07	41.46	(83)

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

(84)m=	512.36	546.39	572.33	599.85	618.89	603.92	575.85	546.02	519.34	496.83	487.57	492.69	(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=	0.98	0.97	0.93	0.83	0.65	0.45	0.33	0.36	0.57	0.84	0.96	0.98	(86)

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

(87)m=	20.55	20.65	20.78	20.93	20.99	21	21	21	21	20.93	20.74	20.54	(87)

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

(88)m=	20.29	20.29	20.3	20.31	20.32	20.34	20.34	20.34	20.33	20.32	20.31	20.3	(88)

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

(89)m=	0.98	0.96	0.92	0.8	0.61	0.41	0.28	0.31	0.52	0.81	0.95	0.98	(89)

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

(90)m=	19.71	19.85	20.04	20.24	20.31	20.34	20.34	20.34	20.33	20.25	19.99	19.71	(90)

fLA = Living area ÷ (4) = 0.43 (91)

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

(92)m=	20.07	20.19	20.36	20.54	20.6	20.62	20.62	20.63	20.62	20.54	20.32	20.07	(92)

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

(93)m=	20.07	20.19	20.36	20.54	20.6	20.62	20.62	20.63	20.62	20.54	20.32	20.07	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.97	0.96	0.92	0.81	0.63	0.43	0.3	0.33	0.54	0.82	0.95	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	499.24	523.37	525.23	483.87	388.7	258.7	172.97	180.58	282.05	407.88	461.47	482.1	(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=	729.66	703.58	634.18	517.91	393.92	258.94	172.98	180.6	283.43	440.03	591.51	718.05	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	171.43	121.1	81.06	24.51	3.88	0	0	0	0	23.92	93.62	175.54	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 695.07 (98)

Space heating requirement in kWh/m²/year 11.39 (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		93.7	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	171.43	121.1	81.06	24.51	3.88	0	0	0	0	23.92	93.62	175.54	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	182.96	129.25	86.51	26.16	4.14	0	0	0	0	25.53	99.92	187.35	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 741.81 (211)

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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)

114.48	101.15	106.99	97.46	96.13	86.17	83.47	91.5	91.29	101.87	105.84	111.5

Efficiency of water heater 87.2 (216)

(217)m=	89.27	89.07	88.68	87.88	87.33	87.2	87.2	87.2	87.2	87.84	88.81	89.31	(217)

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

(219)m=	128.24	113.56	120.65	110.9	110.08	98.82	95.72	104.93	104.69	115.96	119.18	124.85

Total = Sum(219a)$_{1...12}$ = 1347.59 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		741.81	
Water heating fuel used		1347.59	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	97.96		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	172.96	(231)
Electricity for lighting		291.56	(232)
Electricity generated by PVs		-259.09	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2294.83	(338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year		**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211)	x	3.48	x 0.01 =	25.81	(240)
Space heating - main system 2	(213)	x	0	x 0.01 =	0	(241)
Space heating - secondary	(215)	x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.48	x 0.01 =	46.9	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	22.81	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a						
Energy for lighting	(232)		13.19	x 0.01 =	38.46	(250)
Additional standing charges (Table 12)					120	(251)
	one of (233) to (235) x)		13.19	x 0.01 =	0	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 253.98 (255)

11a. SAP rating - individual heating systems

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Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.01	(257)
SAP rating (Section 12)		85.96	(258)

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	=	160.23	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	291.08	(264)
Space and water heating	(261) + (262) + (263) + (264) =				451.31	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	89.76	(267)
Electricity for lighting	(232)	x	0.519	=	151.32	(268)
Energy saving/generation technologies Item 1			0.519	=	-134.47	(269)
Total CO2, kg/year			sum of (265)…(271) =		557.93	(272)
CO2 emissions per m²			(272) ÷ (4) =		9.15	(273)
EI rating (section 14)					93	(274)

13a. Primary Energy

	Energy kWh/year		**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	905.01	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	1644.06	(264)
Space and water heating	(261) + (262) + (263) + (264) =				2549.07	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	530.97	(267)
Electricity for lighting	(232)	x	0	=	895.09	(268)
Energy saving/generation technologies Item 1			3.07	=	-795.39	(269)
‘Total Primary Energy			sum of (265)…(271) =		3179.74	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		52.13	(273)

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.41

Property Address: Unit 7 - 2B 3P - Be Green

Address : 106 Bexley Road , Erith , DA8 3SP

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	61	(1a) x	2.7	(2a) =	164.7	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	61	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	164.7	(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							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)				
Number of storeys in the dwelling (ns)			0	(9)
Additional infiltration		[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35				
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0	(12)
If no draught lobby, enter 0.05, else enter 0			0	(13)
Percentage of windows and doors draught stripped			0	(14)
Window infiltration		0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate		(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			4	(17)
If based on air permeability value, then (18) = [(17) ÷ 20]+(8), otherwise (18) = (16)			0.2	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used				
Number of sides sheltered			1	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor		(21) = (18) x (20) =	0.19	(21)

Infiltration rate modified for monthly wind speed

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

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

0.24	0.23	0.23	0.2	0.2	0.18	0.18	0.17	0.19	0.2	0.21	0.22

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.05	(23c)

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

(24a)m=	0.34	0.34	0.33	0.31	0.3	0.28	0.28	0.28	0.29	0.3	0.31	0.32	(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	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.34	0.34	0.33	0.31	0.3	0.28	0.28	0.28	0.29	0.3	0.31	0.32	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.91	x	1	=	1.91			(26)
Windows Type 1			1.71	x1/[1/(1.2)+ 0.04]		=	1.96			(27)
Windows Type 2			1.71	x1/[1/(1.2)+ 0.04]		=	1.96			(27)
Windows Type 3			4.09	x1/[1/(1.2)+ 0.04]		=	4.68			(27)
Walls Type1	66.42	11.13	55.29	x	0.16	=	8.85			(29)
Walls Type2	7.83	0	7.83	x	0.15	=	1.18			(29)
Total area of elements, m²			74.25							(31)
Party wall			32.13	x	0	=	0			(32)
Party floor			61							(32a)
Party ceiling			61							(32b)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	22.49	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	12222.7	(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		5.25	(36)

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

Total fabric heat loss	(33) + (36) =	27.75	(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=	18.51	18.26	18.01	16.75	16.5	15.25	15.25	14.99	15.75	16.5	17.01	17.51	(38)

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

(39)m=	46.26	46.01	45.76	44.5	44.25	42.99	42.99	42.74	43.49	44.25	44.75	45.25	

Average = Sum(39)$_{1…12}$ /12= 44.44 (39)

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

(40)m=	0.76	0.75	0.75	0.73	0.73	0.7	0.7	0.7	0.71	0.73	0.73	0.74	

Average = Sum(40)$_{1…12}$ /12= 0.73 (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 2.01 (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 81.93 (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=	90.13	86.85	83.57	80.29	77.02	73.74	73.74	77.02	80.29	83.57	86.85	90.13	

Total = Sum(44)$_{1…12}$ = 983.18 (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=	133.65	116.89	120.62	105.16	100.91	87.07	80.69	92.59	93.7	109.19	119.19	129.44	

Total = Sum(45)$_{1…12}$ = 1289.11 (45)

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

(46)m=	20.05	17.53	18.09	15.77	15.14	13.06	12.1	13.89	14.05	16.38	17.88	19.42	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	24.91	22.5	24.91	24.11	24.91	24.11	24.91	24.91	24.11	24.91	24.11	24.91	(61)

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

(62)m=	158.57	139.4	145.54	129.27	125.82	111.18	105.6	117.5	117.81	134.11	143.3	154.35	(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	14.44	12.66	12.17	9.54	8.45	7.19	6.8	7.71	7.77	10.04	12.46	14.13	(63) (G2)
WWHRS	-29.24	-25.72	-26.26	-21.63	-20.1	-16.59	-14.06	-17.01	-17.5	-21.62	-25.01	-28.26	(63) (G10)

Output from water heater

(64)m=	113.6	99.85	105.82	96.86	95.99	86.17	83.47	91.5	91.29	101.16	104.58	110.68

Output from water heater (annual)$_{1...12}$ | 1180.98 | (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=	50.67	44.49	46.34	40.99	39.78	34.98	33.06	37.01	37.18	42.54	45.66	49.27	(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=	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	100.49	(66)

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

(67)m=	16.51	14.66	11.93	9.03	6.75	5.7	6.16	8	10.74	13.64	15.92	16.97	(67)

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

(68)m=	175.46	177.28	172.69	162.93	150.6	139.01	131.27	129.45	134.03	143.8	156.13	167.72	(68)

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

(69)m=	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	33.05	(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=	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	-80.39	(71)

Water heating gains (Table 5)

(72)m=	68.1	66.21	62.28	56.94	53.47	48.58	44.43	49.75	51.64	57.17	63.42	66.22	(72)

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

(73)m=	316.22	314.3	303.05	285.04	266.96	249.43	238	243.34	252.56	270.76	291.61	307.05	(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)

North	0.9x	0.77	x	1.71	x	10.63	x	0.63	x	0.7	=	11.11	(74)
North	0.9x	0.77	x	4.09	x	10.63	x	0.63	x	0.7	=	13.29	(74)
North	0.9x	0.77	x	1.71	x	20.32	x	0.63	x	0.7	=	21.24	(74)
North	0.9x	0.77	x	4.09	x	20.32	x	0.63	x	0.7	=	25.4	(74)
North	0.9x	0.77	x	1.71	x	34.53	x	0.63	x	0.7	=	36.09	(74)
North	0.9x	0.77	x	4.09	x	34.53	x	0.63	x	0.7	=	43.16	(74)
North	0.9x	0.77	x	1.71	x	55.46	x	0.63	x	0.7	=	57.97	(74)
North	0.9x	0.77	x	4.09	x	55.46	x	0.63	x	0.7	=	69.33	(74)
North	0.9x	0.77	x	1.71	x	74.72	x	0.63	x	0.7	=	78.09	(74)
North	0.9x	0.77	x	4.09	x	74.72	x	0.63	x	0.7	=	93.39	(74)
North	0.9x	0.77	x	1.71	x	79.99	x	0.63	x	0.7	=	83.6	(74)
North	0.9x	0.77	x	4.09	x	79.99	x	0.63	x	0.7	=	99.98	(74)
North	0.9x	0.77	x	1.71	x	74.68	x	0.63	x	0.7	=	78.05	(74)
North	0.9x	0.77	x	4.09	x	74.68	x	0.63	x	0.7	=	93.34	(74)
North	0.9x	0.77	x	1.71	x	59.25	x	0.63	x	0.7	=	61.92	(74)
North	0.9x	0.77	x	4.09	x	59.25	x	0.63	x	0.7	=	74.06	(74)
North	0.9x	0.77	x	1.71	x	41.52	x	0.63	x	0.7	=	43.39	(74)
North	0.9x	0.77	x	4.09	x	41.52	x	0.63	x	0.7	=	51.89	(74)
North	0.9x	0.77	x	1.71	x	24.19	x	0.63	x	0.7	=	25.28	(74)
North	0.9x	0.77	x	4.09	x	24.19	x	0.63	x	0.7	=	30.24	(74)
North	0.9x	0.77	x	1.71	x	13.12	x	0.63	x	0.7	=	13.71	(74)
North	0.9x	0.77	x	4.09	x	13.12	x	0.63	x	0.7	=	16.4	(74)
North	0.9x	0.77	x	1.71	x	8.86	x	0.63	x	0.7	=	9.27	(74)
North	0.9x	0.77	x	4.09	x	8.86	x	0.63	x	0.7	=	11.08	(74)
South	0.9x	0.77	x	1.71	x	46.75	x	0.63	x	0.7	=	24.43	(78)
South	0.9x	0.77	x	1.71	x	76.57	x	0.63	x	0.7	=	40.01	(78)
South	0.9x	0.77	x	1.71	x	97.53	x	0.63	x	0.7	=	50.97	(78)
South	0.9x	0.77	x	1.71	x	110.23	x	0.63	x	0.7	=	57.61	(78)
South	0.9x	0.77	x	1.71	x	114.87	x	0.63	x	0.7	=	60.03	(78)
South	0.9x	0.77	x	1.71	x	110.55	x	0.63	x	0.7	=	57.77	(78)
South	0.9x	0.77	x	1.71	x	108.01	x	0.63	x	0.7	=	56.45	(78)
South	0.9x	0.77	x	1.71	x	104.89	x	0.63	x	0.7	=	54.82	(78)
South	0.9x	0.77	x	1.71	x	101.89	x	0.63	x	0.7	=	53.25	(78)
South	0.9x	0.77	x	1.71	x	82.59	x	0.63	x	0.7	=	43.16	(78)
South	0.9x	0.77	x	1.71	x	55.42	x	0.63	x	0.7	=	28.96	(78)
South	0.9x	0.77	x	1.71	x	40.4	x	0.63	x	0.7	=	21.11	(78)

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

(83)m=	48.84	86.65	130.22	184.91	231.52	241.35	227.84	190.8	148.53	98.68	59.07	41.46	(83)

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

(84)m=	365.06	400.96	433.27	469.95	498.47	490.79	465.84	434.14	401.09	369.43	350.68	348.51	(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

DER WorkSheet: New dwelling design stage

(86)m=	1	0.99	0.98	0.93	0.78	0.56	0.41	0.45	0.72	0.95	0.99	1	(86)

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

(87)m=	20.32	20.43	20.61	20.83	20.96	21	21	21	20.98	20.82	20.54	20.31	(87)

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

(88)m=	20.29	20.29	20.3	20.31	20.32	20.34	20.34	20.34	20.33	20.32	20.31	20.3	(88)

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

(89)m=	1	0.99	0.98	0.91	0.74	0.5	0.34	0.39	0.66	0.94	0.99	1	(89)

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

(90)m=	19.38	19.54	19.79	20.12	20.28	20.33	20.34	20.34	20.32	20.11	19.72	19.38	(90)

fLA = Living area ÷ (4) = 0.43 (91)

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

(92)m=	19.79	19.93	20.14	20.43	20.58	20.62	20.62	20.63	20.61	20.42	20.07	19.78	(92)

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

(93)m=	19.79	19.93	20.14	20.43	20.58	20.62	20.62	20.63	20.61	20.42	20.07	19.78	(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	0.92	0.75	0.53	0.37	0.42	0.69	0.94	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	363.56	397.47	423.1	430.02	376.24	257.91	172.92	180.46	276.54	346.95	347.14	347.43	(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=	716.38	691.29	624.29	513	392.85	258.88	172.98	180.59	282.97	434.46	580.62	705.12	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	262.49	197.45	149.69	59.74	12.36	0	0	0	0	65.11	168.1	266.12	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 1181.05 (98)

Space heating requirement in kWh/m²/year 19.36 (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		93.7	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	262.49	197.45	149.69	59.74	12.36	0	0	0	0	65.11	168.1	266.12	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	280.14	210.73	159.75	63.76	13.19	0	0	0	0	69.48	179.41	284.01	

Total (kWh/year) =Sum(211)$_{1...5,10....12}$= 1260.46 (211)

DER WorkSheet: New dwelling design stage

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)

113.6	99.85	105.82	96.86	95.99	86.17	83.47	91.5	91.29	101.16	104.58	110.68

Efficiency of water heater 87.2 (216)

(217)m=	89.61	89.49	89.22	88.5	87.59	87.2	87.2	87.2	87.2	88.54	89.32	89.64	(217)

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

(219)m=	126.77	111.57	118.61	109.45	109.59	98.82	95.72	104.93	104.69	114.26	117.08	123.47

Total = Sum(219a)$_{1...12}$ = 1334.96 (219)

Annual totals	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		1260.46	
Water heating fuel used		1334.96	
Electricity for pumps, fans and electric keep-hot			
mechanical ventilation - balanced, extract or positive input from outside	97.96		(230a)
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year sum of (230a)…(230g) =		172.96	(231)
Electricity for lighting		291.56	(232)
Electricity generated by PVs		-259.09	(233)
Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =		2800.85	(338)

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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	=	272.26	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	288.35	(264)
Space and water heating	(261) + (262) + (263) + (264) =			560.61	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	89.76	(267)
Electricity for lighting	(232) x	0.519	=	151.32	(268)
Energy saving/generation technologies Item 1		0.519	=	-134.47	(269)
Total CO2, kg/year		sum of (265)…(271) =		667.23	(272)
Dwelling CO2 Emission Rate		(272) ÷ (4) =		10.94	(273)
EI rating (section 14)				92	(274)

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 15 July 2021

Property Details: Unit 7 - 2B 3P - Be Green

Dwelling type:	Flat
Located in:	England
Region:	South East England
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	East
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	None
Ventilation rate during hot weather (ach):	3 (Windows open half the time)

Overheating Details:

Summer ventilation heat loss coefficient:	163.05	**(P1)**
Transmission heat loss coefficient:	27.7	
Summer heat loss coefficient:	190.8	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
South (South Window)	0	1
North (North Window)	0	1
North (North Window 2)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
South (South Window)	1	0.9	1	0.9	**(P8)**
North (North Window)	1	0.9	1	0.9	**(P8)**
North (North Window 2)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
South (South Window)	0.9 x	1.71	118.4	0.63	0.7	0.9	72.32	
North (North Window)	0.9 x	3.42	86.66	0.63	0.7	0.9	105.87	
North (North Window 2)	0.9 x	4.09	86.66	0.63	0.7	0.9	126.61	
						Total	304.8	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	359.56	345.01	352.22	
Total summer gains	686.23	649.8	609.44	**(P5)**
Summer gain/loss ratio	3.6	3.41	3.19	**(P6)**
Mean summer external temperature (South East England)	15.4	17.4	17.5	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	19.25	21.06	20.94	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Slight**	**Slight**	

Assessment of likelihood of high internal temperature: Slight

Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.41
Printed on 15 July 2021 at 16:05:43

Project Information:

Assessed By: ()

Building Type: Flat

Dwelling Details:

NEW DWELLING DESIGN STAGE

Total Floor Area: 117.6m²

Site Reference : 106 Bexley Road

Plot Reference: Unit 14 - 3B 6P - Be Green

Address : 106 Bexley Road , Erith , DA8 3SP

Client Details:

Name: Kang

Address : Upna Ltd , 106 Bexley Road , Erith , DA8 3SP

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

1a TER and DER

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

Target Carbon Dioxide Emission Rate (TER)	16.92 kg/m²	
Dwelling Carbon Dioxide Emission Rate (DER)	11.09 kg/m²	OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	53.1 kWh/m²	
Dwelling Fabric Energy Efficiency (DFEE)	42.4 kWh/m²	
		OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.16 (max. 0.30)	0.16 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.18 (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	4.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main Heating system: Database: (rev 479, product index 017513):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Worcester
Model: Greenstar
Model qualifier: 32CDi Compact ErP
(Combi)
Efficiency 89.8 % SEDBUK2009
Minimum 88.0 % **OK**

Secondary heating system: None

Regulations Compliance Report

5 Cylinder insulation			
Hot water Storage:	No cylinder		
6 Controls			
Space heating controls	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			
Continuous supply and extract system			
Specific fan power:		0.46	
Maximum		1.5	**OK**
MVHR efficiency:		92%	
Minimum		70%	**OK**
9 Summertime temperature			
Overheating risk (South East England):		Slight	**OK**
Based on:			
Overshading:		Average or unknown	
Windows facing: West		1.28m²	
Windows facing: North		3.84m²	
Windows facing: North		4.09m²	
Windows facing: East		6.14m²	
Ventilation rate:		3.00	
Blinds/curtains:		None	
10 Key features			
Thermal bridging		0.028 W/m²K	
Doors U-value		1 W/m²K	
Roofs U-value		0.11 W/m²K	
Party Walls U-value		0 W/m²K	
Photovoltaic array			

SAP Input

Property Details: Unit 14 - 3B 6P - Be Green

Address:	106 Bexley Road , Erith , DA8 3SP
Located in:	England
Region:	South East England
UPRN:	
Date of assessment:	13 July 2021
Date of certificate:	15 July 2021
Assessment type:	New dwelling design stage
Transaction type:	New dwelling
Tenure type:	Unknown
Related party disclosure:	No related party
Thermal Mass Parameter:	Indicative Value Medium
Water use <= 125 litres/person/day:	True
PCDF Version:	479

Property description:

Dwelling type:	Flat
Detachment:	
Year Completed:	2021

Floor Location:	Floor area:	Storey height:
Floor 0	117.6 m²	2.7 m

Living area:	36.5 m² (fraction 0.31)
Front of dwelling faces:	South

Opening types:

Name:	Source:	Type:	Glazing:	Argon:	Frame:
Front Door	Manufacturer	Solid			Wood
West Window	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
North Window	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
North Window 2	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U
East Window	SAP 2012	Windows	low-E, En = 0.05, soft coat	Yes	PVC-U

Name:	**Gap:**	**Frame Factor:**	**g-value:**	**U-value:**	**Area:**	**No. of Openings:**
Front Door	mm	0.7	0	1	1.91	1
West Window	16mm or more	0.7	0.63	1.2	1.28	1
North Window	16mm or more	0.7	0.63	1.2	1.28	3
North Window 2	16mm or more	0.7	0.63	1.2	4.09	1
East Window	16mm or more	0.7	0.63	1.2	6.14	1

Name:	Type-Name:	Location:	Orient:	Width:	Height:
Front Door		External Wall	South	0.91	2.1
West Window		External Wall	West	0.9	1.425
North Window		External Wall	North	0.9	1.425
North Window 2		External Wall	North	1.475	2.775
East Window		External Wall	East	2.3	2.67

Overshading: Average or unknown

Opaque Elements:

Type:	Gross area:	Openings:	Net area:	U-value:	Ru value:	Curtain wall:	Kappa:
<u>External Elements</u>							
External Wall	92.88	17.26	75.62	0.16	0	False	N/A
Corridor Wall	28.35	0	28.35	0.16	0.4	False	N/A
Flat Roof	117.6	0	117.6	0.11	0		N/A
<u>Internal Elements</u>							

SAP Input

Party Elements

Party Wall	7.02	N/A
Party Floor	117.6	N/A

Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0278

	Length	Psi-value		
[Approved]	8.27	0.3	E2	Other lintels (including other steel lintels)
[Approved]	3.6	0.04	E3	Sill
[Approved]	25.1	0.05	E4	Jamb
[Approved]	34.4	0.07	E7	Party floor between dwellings (in blocks of flats)
[Approved]	9.2	0.02	E9	Balcony between dwellings, wall insulation continuous
[Approved]	2.6	0.06	E18	Party wall between dwellings

Ventilation:

Pressure test:	Yes (As designed)
Ventilation:	Balanced with heat recovery Number of wet rooms: Kitchen + 2 Ductwork: Insulation, rigid Approved Installation Scheme: True
Number of chimneys:	0
Number of open flues:	0
Number of fans:	0
Number of passive stacks:	0
Number of sides sheltered:	1
Pressure test:	4

DRAFT

Main heating system:

Main heating system:

Boiler systems with radiators or underfloor heating
Gas boilers and oil boilers
Fuel: mains gas
Info Source: Boiler Database
Database: (rev 479, product index 017513) Efficiency: Winter 87.2 % Summer: 90.7
Brand name: Worcester
Model: Greenstar
Model qualifier: 32CDi Compact ErP
(Combi boiler)
Systems with radiators
Central heating pump : 2013 or later
Design flow temperature: Design flow temperature >45°C
Unknown
Boiler interlock: Yes
Weather Compensator

Main heating Control:

Main heating Control:

Time and temperature zone control by suitable arrangement of plumbing and electrical services
Control code: 2110

Secondary heating system:

Secondary heating system: None

Water heating:

Water heating:

From main heating system
Water code: 901
Fuel :mains gas
No hot water cylinder
Flue Gas Heat Recovery System:
Database (rev 479, product index 060035)

Brand name: Worcester
Model: Greenstar Xtra
Model qualifier: 2015

Waste Water Heat Recovery System:
Total rooms with shower and/or bath: 2
Product index: 080106, Megaflo SHRU 60 System B
Number of mixer showers in rooms with a bath: 0
Number of mixer showers in rooms without a bath: 2

Solar panel: False

Others:

Electricity tariff:	Standard Tariff
In Smoke Control Area:	Unknown
Conservatory:	No conservatory
Low energy lights:	100%
Terrain type:	Low rise urban / suburban
EPC language:	English
Wind turbine:	No
Photovoltaics:	Photovoltaic 1 Installed Peak power: 0.3 Tilt of collector: 30° Overshading: None or very little Collector Orientation: South
Assess Zero Carbon Home:	No

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User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.5.41

Property Address: Unit 14 - 3B 6P - Be Green

Address : 106 Bexley Road , Erith , DA8 3SP

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	117.6	(1a) x	2.7	(2a) =	317.52	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	117.6	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	317.52	(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							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

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

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

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

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

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.19	(21)

Infiltration rate modified for monthly wind speed

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

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

0.24	0.23	0.23	0.2	0.2	0.18	0.18	0.17	0.19	0.2	0.21	0.22

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0.5 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0.5 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 78.2 (23c)

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

(24a)m=	0.34	0.34	0.34	0.31	0.31	0.28	0.28	0.28	0.29	0.31	0.32	0.33	(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	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.34	0.34	0.34	0.31	0.31	0.28	0.28	0.28	0.29	0.31	0.32	0.33	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.91	x	1	=	1.91			(26)
Windows Type 1			1.28	x1/[1/(1.2)+ 0.04]		=	1.47			(27)
Windows Type 2			1.28	x1/[1/(1.2)+ 0.04]		=	1.47			(27)
Windows Type 3			4.09	x1/[1/(1.2)+ 0.04]		=	4.68			(27)
Windows Type 4			6.14	x1/[1/(1.2)+ 0.04]		=	7.03			(27)
Walls Type1	92.88	17.26	75.62	x	0.16	=	12.1			(29)
Walls Type2	28.35	0	28.35	x	0.15	=	4.26			(29)
Roof	117.6	0	117.6	x	0.11	=	12.94			(30)
Total area of elements, m²			238.83							(31)
Party wall			7.02	x	0	=	0			(32)
Party floor			117.6							(32a)

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

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 48.78 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 13812.5 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 6.63 (36)

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

Total fabric heat loss (33) + (36) = 55.41 (37)

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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=	36.14	35.65	35.17	32.74	32.26	29.84	29.84	29.35	30.81	32.26	33.23	34.2	(38)

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

(39)m=	91.55	91.06	90.58	88.16	87.67	85.25	85.25	84.76	86.22	87.67	88.64	89.61	

Average = $Sum(39)_{1...12}$ /12= 88.04 (39)

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

(40)m=	0.78	0.77	0.77	0.75	0.75	0.72	0.72	0.72	0.73	0.75	0.75	0.76	

Average = $Sum(40)_{1...12}$ /12= 0.75 (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 2.85 (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) + 36 101.97 (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=	112.17	108.09	104.01	99.93	95.85	91.77	91.77	95.85	99.93	104.01	108.09	112.17	

Total = $Sum(44)_{1...12}$ = 1223.66 (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=	166.34	145.48	150.13	130.88	125.59	108.37	100.42	115.24	116.61	135.9	148.35	161.09	

Total = $Sum(45)_{1...12}$ = 1604.41 (45)

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

(46)m=	24.95	21.82	22.52	19.63	18.84	16.26	15.06	17.29	17.49	20.39	22.25	24.16	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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

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

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

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

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

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

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

(61)m=	24.91	22.5	24.91	24.11	24.91	24.11	24.91	24.91	24.11	24.91	24.11	24.91	(61)

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

(62)m=	191.26	167.99	175.04	154.99	150.5	132.48	125.34	140.15	140.72	160.81	172.46	186.01	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	17.76	15.37	15.19	11.87	10.12	8.53	8.11	9.17	9.23	12.58	15.41	17.4	(63) (G2)
WWHRS	-43.72	-38.47	-39.26	-32.3	-29.99	-24.73	-20.93	-25.34	-26.08	-32.25	-37.36	-42.26	(63) (G10)

Output from water heater

(64)m=	128.48	112.98	119.3	109.58	109.1	97.97	95.02	104.35	104.16	114.69	118.43	125.05	

Output from water heater (annual)$_{1...12}$ — 1339.12 (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=	61.54	54	56.15	49.55	47.99	42.06	39.62	44.54	44.8	51.42	55.35	59.79	(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=	171.21	171.21	171.21	171.21	171.21	171.21	171.21	171.21	171.21	171.21	171.21	171.21	(66)

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

(67)m=	68.49	60.83	49.47	37.45	28	23.64	25.54	33.2	44.56	56.57	66.03	70.39	(67)

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

(68)m=	420.98	425.35	414.34	390.9	361.32	333.52	314.94	310.57	321.58	345.02	374.6	402.4	(68)

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

(69)m=	54.97	54.97	54.97	54.97	54.97	54.97	54.97	54.97	54.97	54.97	54.97	54.97	(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=	-114.14	-114.14	-114.14	-114.14	-114.14	-114.14	-114.14	-114.14	-114.14	-114.14	-114.14	-114.14	(71)

Water heating gains (Table 5)

(72)m=	82.71	80.36	75.46	68.81	64.5	58.42	53.25	59.87	62.22	69.11	76.88	80.37	(72)

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

(73)m=	687.22	681.58	654.32	612.21	568.86	530.61	508.78	518.69	543.41	585.74	632.55	668.21	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.28	x	10.63	x	0.63	x	0.7	=	12.48	(74)
North	0.9x	0.77	x	4.09	x	10.63	x	0.63	x	0.7	=	13.29	(74)
North	0.9x	0.77	x	1.28	x	20.32	x	0.63	x	0.7	=	23.85	(74)
North	0.9x	0.77	x	4.09	x	20.32	x	0.63	x	0.7	=	25.4	(74)
North	0.9x	0.77	x	1.28	x	34.53	x	0.63	x	0.7	=	40.52	(74)
North	0.9x	0.77	x	4.09	x	34.53	x	0.63	x	0.7	=	43.16	(74)
North	0.9x	0.77	x	1.28	x	55.46	x	0.63	x	0.7	=	65.09	(74)
North	0.9x	0.77	x	4.09	x	55.46	x	0.63	x	0.7	=	69.33	(74)
North	0.9x	0.77	x	1.28	x	74.72	x	0.63	x	0.7	=	87.68	(74)
North	0.9x	0.77	x	4.09	x	74.72	x	0.63	x	0.7	=	93.39	(74)
North	0.9x	0.77	x	1.28	x	79.99	x	0.63	x	0.7	=	93.87	(74)
North	0.9x	0.77	x	4.09	x	79.99	x	0.63	x	0.7	=	99.98	(74)
North	0.9x	0.77	x	1.28	x	74.68	x	0.63	x	0.7	=	87.64	(74)
North	0.9x	0.77	x	4.09	x	74.68	x	0.63	x	0.7	=	93.34	(74)
North	0.9x	0.77	x	1.28	x	59.25	x	0.63	x	0.7	=	69.53	(74)
North	0.9x	0.77	x	4.09	x	59.25	x	0.63	x	0.7	=	74.06	(74)
North	0.9x	0.77	x	1.28	x	41.52	x	0.63	x	0.7	=	48.72	(74)
North	0.9x	0.77	x	4.09	x	41.52	x	0.63	x	0.7	=	51.89	(74)
North	0.9x	0.77	x	1.28	x	24.19	x	0.63	x	0.7	=	28.39	(74)
North	0.9x	0.77	x	4.09	x	24.19	x	0.63	x	0.7	=	30.24	(74)
North	0.9x	0.77	x	1.28	x	13.12	x	0.63	x	0.7	=	15.39	(74)
North	0.9x	0.77	x	4.09	x	13.12	x	0.63	x	0.7	=	16.4	(74)
North	0.9x	0.77	x	1.28	x	8.86	x	0.63	x	0.7	=	10.4	(74)
North	0.9x	0.77	x	4.09	x	8.86	x	0.63	x	0.7	=	11.08	(74)
East	0.9x	0.77	x	6.14	x	19.64	x	0.63	x	0.7	=	36.85	(76)
East	0.9x	0.77	x	6.14	x	38.42	x	0.63	x	0.7	=	72.09	(76)
East	0.9x	0.77	x	6.14	x	63.27	x	0.63	x	0.7	=	118.73	(76)
East	0.9x	0.77	x	6.14	x	92.28	x	0.63	x	0.7	=	173.16	(76)
East	0.9x	0.77	x	6.14	x	113.09	x	0.63	x	0.7	=	212.21	(76)
East	0.9x	0.77	x	6.14	x	115.77	x	0.63	x	0.7	=	217.24	(76)
East	0.9x	0.77	x	6.14	x	110.22	x	0.63	x	0.7	=	206.82	(76)
East	0.9x	0.77	x	6.14	x	94.68	x	0.63	x	0.7	=	177.66	(76)
East	0.9x	0.77	x	6.14	x	73.59	x	0.63	x	0.7	=	138.09	(76)
East	0.9x	0.77	x	6.14	x	45.59	x	0.63	x	0.7	=	85.55	(76)
East	0.9x	0.77	x	6.14	x	24.49	x	0.63	x	0.7	=	45.95	(76)
East	0.9x	0.77	x	6.14	x	16.15	x	0.63	x	0.7	=	30.31	(76)
West	0.9x	0.77	x	1.28	x	19.64	x	0.63	x	0.7	=	7.68	(80)
West	0.9x	0.77	x	1.28	x	38.42	x	0.63	x	0.7	=	15.03	(80)
West	0.9x	0.77	x	1.28	x	63.27	x	0.63	x	0.7	=	24.75	(80)

West	0.9x	0.77	x	1.28	x	92.28	x	0.63	x	0.7	=	36.1	(80)
West	0.9x	0.77	x	1.28	x	113.09	x	0.63	x	0.7	=	44.24	(80)
West	0.9x	0.77	x	1.28	x	115.77	x	0.63	x	0.7	=	45.29	(80)
West	0.9x	0.77	x	1.28	x	110.22	x	0.63	x	0.7	=	43.12	(80)
West	0.9x	0.77	x	1.28	x	94.68	x	0.63	x	0.7	=	37.04	(80)
West	0.9x	0.77	x	1.28	x	73.59	x	0.63	x	0.7	=	28.79	(80)
West	0.9x	0.77	x	1.28	x	45.59	x	0.63	x	0.7	=	17.83	(80)
West	0.9x	0.77	x	1.28	x	24.49	x	0.63	x	0.7	=	9.58	(80)
West	0.9x	0.77	x	1.28	x	16.15	x	0.63	x	0.7	=	6.32	(80)

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

(83)m=	70.31	136.37	227.17	343.68	437.53	456.37	430.92	358.28	267.49	162	87.32	58.11	(83)

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

(84)m=	757.53	817.95	881.48	955.89	1006.39	986.99	939.69	876.96	810.9	747.75	719.88	726.31	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.98	0.92	0.77	0.55	0.4	0.44	0.71	0.95	0.99	1	(86)

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

(87)m=	20.34	20.44	20.61	20.84	20.96	21	21	21	20.98	20.82	20.55	20.33	(87)

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

(88)m=	20.27	20.28	20.28	20.3	20.3	20.32	20.32	20.32	20.31	20.3	20.29	20.29	(88)

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

(89)m=	0.99	0.99	0.97	0.9	0.72	0.49	0.34	0.38	0.65	0.93	0.99	1	(89)

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

(90)m=	19.38	19.53	19.79	20.11	20.27	20.32	20.32	20.32	20.3	20.1	19.72	19.38	(90)

fLA = Living area ÷ (4) = 0.31 (91)

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

(92)m=	19.68	19.82	20.04	20.34	20.48	20.53	20.53	20.53	20.51	20.33	19.98	19.68	(92)

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

(93)m=	19.68	19.82	20.04	20.34	20.48	20.53	20.53	20.53	20.51	20.33	19.98	19.68	(93)

8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.99	0.97	0.9	0.74	0.51	0.36	0.4	0.67	0.93	0.99	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	752.78	808.33	855.18	860.13	740.58	503.62	334.94	350.06	541.74	693.64	709.75	722.74	(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=	1407.95	1358.24	1226.85	1008.37	770.12	505.38	335.04	350.29	552.89	852.71	1141.32	1386.84	(97)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(98)m=	487.45	369.54	276.52	106.73	21.98	0	0	0	0	118.35	310.73	494.09		
									Total per year (kWh/year) = Sum(98)1...5,9...12 =				2185.4	(98)

Space heating requirement in kWh/m²/year	18.58	(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		93.7	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	487.45	369.54	276.52	106.73	21.98	0	0	0	0	118.35	310.73	494.09		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	520.22	394.39	295.11	113.91	23.46	0	0	0	0	126.3	331.62	527.31		(211)
Total (kWh/year) =Sum(211)1...5,10...12=													2332.33	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)1...5,10...12=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Output from water heater (calculated above)	128.48	112.98	119.3	109.58	109.1	97.97	95.02	104.35	104.16	114.69	118.43	125.05		
Efficiency of water heater													87.2	(216)
(217)m=	89.95	89.86	89.62	88.89	87.77	87.2	87.2	87.2	87.2	88.94	89.71	89.97		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	142.84	125.73	133.12	123.27	124.31	112.35	108.96	119.67	119.45	128.95	132.02	138.99		
Total = Sum(219a)1...12 =													1509.68	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2332.33	
Water heating fuel used			1509.68	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		222.74		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		297.74	(231)
Electricity for lighting			483.8	(232)
Electricity generated by PVs			-259.09	(233)

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Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) =	4364.47	(338)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	Fuel Price (Table 12)		Fuel Cost £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	81.17	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	52.54	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	39.27	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	63.81	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	0	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			356.79	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.92	(257)
SAP rating (Section 12)		87.14	(258)

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	=	503.78	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	326.09	(264)
Space and water heating	(261) + (262) + (263) + (264) =			829.87	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	154.53	(267)
Electricity for lighting	(232) x	0.519	=	251.09	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-134.47	(269)
Total CO2, kg/year		sum of (265)…(271) =		1101.03	(272)
CO2 emissions per m²		(272) ÷ (4) =		9.36	(273)
EI rating (section 14)				91	(274)

13a. Primary Energy

	Energy kWh/year	Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211) x	1.22	=	2845.45	(261)

Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	1841.81	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4687.25	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	914.06	(267)
Electricity for lighting	(232)	x	0	=	1485.28	(268)
Energy saving/generation technologies Item 1			3.07	=	-795.39	(269)
'Total Primary Energy		sum of (265)…(271) =			6291.2	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =			53.5	(273)

DER WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.5.41

Property Address: Unit 14 - 3B 6P - Be Green

Address : 106 Bexley Road , Erith , DA8 3SP

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Ground floor	117.6	(1a)	x	2.7	(2a)	=	317.52	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	117.6	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	317.52	(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							0	x 10 =	0	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0	÷ (5) =	0	(8)

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

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.2	(18)

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

Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.92	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.19	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

Wind Factor (22a)m = (22)m ÷ 4

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(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

0.24	0.23	0.23	0.2	0.2	0.18	0.18	0.17	0.19	0.2	0.21	0.22

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0.5	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	78.2	(23c)

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

(24a)m=	0.34	0.34	0.34	0.31	0.31	0.28	0.28	0.28	0.29	0.31	0.32	0.33	(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	0	0	0	0	0	0	0	0	0	0	0	(24d)

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

(25)m=	0.34	0.34	0.34	0.31	0.31	0.28	0.28	0.28	0.29	0.31	0.32	0.33	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			1.91	x	1	=	1.91			(26)
Windows Type 1			1.28	x1/[1/(1.2)+ 0.04]		=	1.47			(27)
Windows Type 2			1.28	x1/[1/(1.2)+ 0.04]		=	1.47			(27)
Windows Type 3			4.09	x1/[1/(1.2)+ 0.04]		=	4.68			(27)
Windows Type 4			6.14	x1/[1/(1.2)+ 0.04]		=	7.03			(27)
Walls Type1	92.88	17.26	75.62	x	0.16	=	12.1			(29)
Walls Type2	28.35	0	28.35	x	0.15	=	4.26			(29)
Roof	117.6	0	117.6	x	0.11	=	12.94			(30)
Total area of elements, m²			238.83							(31)
Party wall			7.02	x	0	=	0			(32)
Party floor			117.6							(32a)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	48.78	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	13812.5	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

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

Thermal bridges : S (L x Y) calculated using Appendix K		6.63	(36)

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

Total fabric heat loss	(33) + (36) =	55.41	(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=	36.14	35.65	35.17	32.74	32.26	29.84	29.84	29.35	30.81	32.26	33.23	34.2	(38)

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

(39)m=	91.55	91.06	90.58	88.16	87.67	85.25	85.25	84.76	86.22	87.67	88.64	89.61	

Average = $Sum(39)_{1…12}$ /12= 88.04 (39)

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

(40)m=	0.78	0.77	0.77	0.75	0.75	0.72	0.72	0.72	0.73	0.75	0.75	0.76	

Average = $Sum(40)_{1…12}$ /12= 0.75 (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 2.85 (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) + 36 101.97 (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=	112.17	108.09	104.01	99.93	95.85	91.77	91.77	95.85	99.93	104.01	108.09	112.17	

Total = $Sum(44)_{1…12}$ = 1223.66 (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=	166.34	145.48	150.13	130.88	125.59	108.37	100.42	115.24	116.61	135.9	148.35	161.09	

Total = $Sum(45)_{1…12}$ = 1604.41 (45)

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

(46)m=	24.95	21.82	22.52	19.63	18.84	16.26	15.06	17.29	17.49	20.39	22.25	24.16	(46)

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

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

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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=	24.91	22.5	24.91	24.11	24.91	24.11	24.91	24.91	24.11	24.91	24.11	24.91	(61)

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

(62)m=	191.26	167.99	175.04	154.99	150.5	132.48	125.34	140.15	140.72	160.81	172.46	186.01	(62)

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

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

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
FHRS	18.71	16.18	15.99	13.31	10.64	8.53	8.11	9.17	9.23	14.09	16.23	18.34	(63) (G2)
WWHRS	-43.72	-38.47	-39.26	-32.3	-29.99	-24.73	-20.93	-25.34	-26.08	-32.25	-37.36	-42.26	(63) (G10)

Output from water heater

(64)m=	127.53	112.17	118.49	108.14	108.58	97.97	95.02	104.35	104.16	113.19	117.61	124.12	

Output from water heater (annual)$_{1...12}$ — 1331.34 (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=	61.54	54	56.15	49.55	47.99	42.06	39.62	44.54	44.8	51.42	55.35	59.79	(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=	142.68	142.68	142.68	142.68	142.68	142.68	142.68	142.68	142.68	142.68	142.68	142.68	(66)

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

(67)m=	27.39	24.33	19.79	14.98	11.2	9.45	10.22	13.28	17.82	22.63	26.41	28.16	(67)

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

(68)m=	282.05	284.98	277.61	261.9	242.08	223.46	211.01	208.08	215.46	231.16	250.98	269.61	(68)

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

(69)m=	37.27	37.27	37.27	37.27	37.27	37.27	37.27	37.27	37.27	37.27	37.27	37.27	(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=	-114.14	-114.14	-114.14	-114.14	-114.14	-114.14	-114.14	-114.14	-114.14	-114.14	-114.14	-114.14	(71)

Water heating gains (Table 5)

(72)m=	82.71	80.36	75.46	68.81	64.5	58.42	53.25	59.87	62.22	69.11	76.88	80.37	(72)

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

(73)m=	460.96	458.47	441.66	414.5	386.58	360.13	343.28	350.04	364.31	391.7	423.08	446.94	(73)

6. Solar gains:

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

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.28	x	10.63	x	0.63	x	0.7	=	12.48	(74)
North	0.9x	0.77	x	4.09	x	10.63	x	0.63	x	0.7	=	13.29	(74)
North	0.9x	0.77	x	1.28	x	20.32	x	0.63	x	0.7	=	23.85	(74)
North	0.9x	0.77	x	4.09	x	20.32	x	0.63	x	0.7	=	25.4	(74)
North	0.9x	0.77	x	1.28	x	34.53	x	0.63	x	0.7	=	40.52	(74)
North	0.9x	0.77	x	4.09	x	34.53	x	0.63	x	0.7	=	43.16	(74)
North	0.9x	0.77	x	1.28	x	55.46	x	0.63	x	0.7	=	65.09	(74)
North	0.9x	0.77	x	4.09	x	55.46	x	0.63	x	0.7	=	69.33	(74)
North	0.9x	0.77	x	1.28	x	74.72	x	0.63	x	0.7	=	87.68	(74)
North	0.9x	0.77	x	4.09	x	74.72	x	0.63	x	0.7	=	93.39	(74)
North	0.9x	0.77	x	1.28	x	79.99	x	0.63	x	0.7	=	93.87	(74)
North	0.9x	0.77	x	4.09	x	79.99	x	0.63	x	0.7	=	99.98	(74)
North	0.9x	0.77	x	1.28	x	74.68	x	0.63	x	0.7	=	87.64	(74)
North	0.9x	0.77	x	4.09	x	74.68	x	0.63	x	0.7	=	93.34	(74)
North	0.9x	0.77	x	1.28	x	59.25	x	0.63	x	0.7	=	69.53	(74)
North	0.9x	0.77	x	4.09	x	59.25	x	0.63	x	0.7	=	74.06	(74)
North	0.9x	0.77	x	1.28	x	41.52	x	0.63	x	0.7	=	48.72	(74)
North	0.9x	0.77	x	4.09	x	41.52	x	0.63	x	0.7	=	51.89	(74)
North	0.9x	0.77	x	1.28	x	24.19	x	0.63	x	0.7	=	28.39	(74)
North	0.9x	0.77	x	4.09	x	24.19	x	0.63	x	0.7	=	30.24	(74)
North	0.9x	0.77	x	1.28	x	13.12	x	0.63	x	0.7	=	15.39	(74)
North	0.9x	0.77	x	4.09	x	13.12	x	0.63	x	0.7	=	16.4	(74)
North	0.9x	0.77	x	1.28	x	8.86	x	0.63	x	0.7	=	10.4	(74)
North	0.9x	0.77	x	4.09	x	8.86	x	0.63	x	0.7	=	11.08	(74)
East	0.9x	0.77	x	6.14	x	19.64	x	0.63	x	0.7	=	36.85	(76)
East	0.9x	0.77	x	6.14	x	38.42	x	0.63	x	0.7	=	72.09	(76)
East	0.9x	0.77	x	6.14	x	63.27	x	0.63	x	0.7	=	118.73	(76)
East	0.9x	0.77	x	6.14	x	92.28	x	0.63	x	0.7	=	173.16	(76)
East	0.9x	0.77	x	6.14	x	113.09	x	0.63	x	0.7	=	212.21	(76)
East	0.9x	0.77	x	6.14	x	115.77	x	0.63	x	0.7	=	217.24	(76)
East	0.9x	0.77	x	6.14	x	110.22	x	0.63	x	0.7	=	206.82	(76)
East	0.9x	0.77	x	6.14	x	94.68	x	0.63	x	0.7	=	177.66	(76)
East	0.9x	0.77	x	6.14	x	73.59	x	0.63	x	0.7	=	138.09	(76)
East	0.9x	0.77	x	6.14	x	45.59	x	0.63	x	0.7	=	85.55	(76)
East	0.9x	0.77	x	6.14	x	24.49	x	0.63	x	0.7	=	45.95	(76)
East	0.9x	0.77	x	6.14	x	16.15	x	0.63	x	0.7	=	30.31	(76)
West	0.9x	0.77	x	1.28	x	19.64	x	0.63	x	0.7	=	7.68	(80)
West	0.9x	0.77	x	1.28	x	38.42	x	0.63	x	0.7	=	15.03	(80)
West	0.9x	0.77	x	1.28	x	63.27	x	0.63	x	0.7	=	24.75	(80)

West	0.9x	0.77	x	1.28	x	92.28	x	0.63	x	0.7	=	36.1	(80)
West	0.9x	0.77	x	1.28	x	113.09	x	0.63	x	0.7	=	44.24	(80)
West	0.9x	0.77	x	1.28	x	115.77	x	0.63	x	0.7	=	45.29	(80)
West	0.9x	0.77	x	1.28	x	110.22	x	0.63	x	0.7	=	43.12	(80)
West	0.9x	0.77	x	1.28	x	94.68	x	0.63	x	0.7	=	37.04	(80)
West	0.9x	0.77	x	1.28	x	73.59	x	0.63	x	0.7	=	28.79	(80)
West	0.9x	0.77	x	1.28	x	45.59	x	0.63	x	0.7	=	17.83	(80)
West	0.9x	0.77	x	1.28	x	24.49	x	0.63	x	0.7	=	9.58	(80)
West	0.9x	0.77	x	1.28	x	16.15	x	0.63	x	0.7	=	6.32	(80)

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

(83)m=	70.31	136.37	227.17	343.68	437.53	456.37	430.92	358.28	267.49	162	87.32	58.11	(83)

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

(84)m=	531.27	594.85	668.83	758.18	824.11	816.5	774.2	708.31	631.8	553.7	510.4	505.04	(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	1	1	0.97	0.87	0.66	0.48	0.55	0.85	0.99	1	1	(86)

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

(87)m=	20.15	20.25	20.44	20.72	20.92	20.99	21	21	20.95	20.69	20.38	20.14	(87)

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

(88)m=	20.27	20.28	20.28	20.3	20.3	20.32	20.32	20.32	20.31	20.3	20.29	20.29	(88)

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

(89)m=	1	1	0.99	0.96	0.84	0.59	0.41	0.47	0.8	0.98	1	1	(89)

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

(90)m=	19.1	19.26	19.55	19.95	20.22	20.31	20.32	20.32	20.27	19.91	19.46	19.11	(90)

fLA = Living area ÷ (4) = 0.31 (91)

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

(92)m=	19.43	19.57	19.83	20.19	20.44	20.52	20.53	20.53	20.48	20.15	19.75	19.43	(92)

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

(93)m=	19.43	19.57	19.83	20.19	20.44	20.52	20.53	20.53	20.48	20.15	19.75	19.43	(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	1	0.99	0.96	0.84	0.61	0.43	0.49	0.81	0.98	1	1	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	530.85	593.68	664.03	729.43	695.29	499.36	334.62	349.27	512.39	543.89	509.39	504.76	(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=	1384.86	1335.95	1206.99	995.21	765.86	505	335.01	350.22	550.21	837.63	1120.98	1364.59	(97)

DER WorkSheet: New dwelling design stage

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m=	635.39	498.81	403.96	191.36	52.5	0	0	0	0	218.54	440.35	639.71	

Total per year (kWh/year) = Sum(98)1...5,9...12 = 3080.61 (98)

Space heating requirement in kWh/m²/year 26.2 (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		93.7	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	635.39	498.81	403.96	191.36	52.5	0	0	0	0	218.54	440.35	639.71		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	678.11	532.35	431.12	204.23	56.03	0	0	0	0	233.24	469.95	682.73		
Total (kWh/year) =Sum(211)1...5,10...12 =													3287.74	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)1...5,10...12 =													0	(215)
Water heating														
Output from water heater (calculated above)														
	127.53	112.17	118.49	108.14	108.58	97.97	95.02	104.35	104.16	113.19	117.61	124.12		
Efficiency of water heater													87.2	(216)
(217)m=	90.1	90.04	89.88	89.4	88.31	87.2	87.2	87.2	87.2	89.47	89.94	90.11		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	141.55	124.58	131.83	120.96	122.96	112.35	108.96	119.67	119.45	126.51	130.77	137.74		
Total = Sum(219a)1...12 =													1497.33	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3287.74	
Water heating fuel used			1497.33	
Electricity for pumps, fans and electric keep-hot				
mechanical ventilation - balanced, extract or positive input from outside		222.74		(230a)
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		297.74	(231)
Electricity for lighting			483.8	(232)
Electricity generated by PVs			-259.09	(233)

DER WorkSheet: New dwelling design stage

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 5307.53 (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	=	710.15	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	323.42	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1033.57	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	154.53	(267)
Electricity for lighting	(232)	x	0.519	=	251.09	(268)
Energy saving/generation technologies Item 1			0.519	=	-134.47	(269)
Total CO2, kg/year			sum of (265)…(271) =		1304.73	(272)
Dwelling CO2 Emission Rate			(272) ÷ (4) =		11.09	(273)
EI rating (section 14)					89	(274)

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 15 July 2021

Property Details: Unit 14 - 3B 6P - Be Green

Dwelling type:	Flat
Located in:	England
Region:	South East England
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	South
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	None
Ventilation rate during hot weather (ach):	3 (Windows open half the time)

Overheating Details:

Summer ventilation heat loss coefficient:	314.34	**(P1)**
Transmission heat loss coefficient:	55.4	
Summer heat loss coefficient:	369.76	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
West (West Window)	0	1
North (North Window)	0	1
North (North Window 2)	0	1
East (East Window)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
West (West Window)	1	0.9	1	0.9	**(P8)**
North (North Window)	1	0.9	1	0.9	**(P8)**
North (North Window 2)	1	0.9	1	0.9	**(P8)**
East (East Window)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
West (West Window)	0.9 x	1.28	124.8	0.63	0.7	0.9	57.06	
North (North Window)	0.9 x	3.84	86.66	0.63	0.7	0.9	118.87	
North (North Window 2)	0.9 x	4.09	86.66	0.63	0.7	0.9	126.61	
East (East Window)	0.9 x	6.14	124.8	0.63	0.7	0.9	273.71	
						Total	576.25	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	527.61	505.78	515.69	
Total summer gains	1144.62	1082.03	1000.58	**(P5)**
Summer gain/loss ratio	3.1	2.93	2.71	**(P6)**
Mean summer external temperature (South East England)	15.4	17.4	17.5	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	18.75	20.58	20.46	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Slight**	**Not significant**	

SAP 2012 Overheating Assessment

Assessment of likelihood of high internal temperature: Slight