Energy and Sustainability Statement

17 North End, NW3 7HR

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1.1	29/09/2021	Updated SuDS & PV sections	L Davies	
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About *MES Building Solutions*

MES Building Solutions **is an established consultancy practice specialising in providing building solutions throughout the UK.**

We offer a full range of services for both residential and commercial buildings from small individual properties through to highly complex mixed use developments.

We are an industry leader in delivering a professional, accredited and certified service to a wide range of clients including architects, developers, builders, housing associations, the public sector and private householders.

Employing highly qualified staff, our team comes from a variety of backgrounds within the construction industry with combined knowledge of building design, engineering, assessment, construction, development, research and surveying.

We are renowned for our creative thinking and provide a high quality, honest and diligent service.

MES Building Solutions maintains its position at the forefront of changes in planning, building regulations and neighbourly matters, as well as technological advances. Our clients, large or small are therefore assured of a cost effective, cohesive and fully integrated professional service.

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Section 1: Introduction

1.1 Executive Summary

This report is produced in support of a planning application to London Borough of Camden for the development at 17 North End, NW3 7HR.

The application is for the construction of a new dwelling, consisting of one 3-bed detached house. This proposal is to be considered a minor development.

For this development the recommended strategy is the implementation of a 'fabric first' holistic approach; that is based on ensuring the building fabric and core services are designed and installed correctly and implementation of LZC technology in the form of an Air Source Heat Pump (ASHP). This has allowed the proposed dwellings to achieve a compliant Fabric Energy Efficiency specification and achieves a 55% reduction in energy consumption & 56% reduction in carbon emissions from LZC technology, exceeding the 19% reduction target from London Borough of Camden.

Table 1a shows the reduction in kWh and tonnes of CO_2 per year through the fabric improvements, energy efficiency system measures and implementation of an ASHP, which ensure the development, will meet and exceed current building regulations.

Total reduction in regulated emissions & energy use – Part L 2013		
	kWh/year	**Tonnes CO_2/year**
Baseline	13,558.07	2.86
Be Lean & Be Clean	11,844.30	2.53
Reduction over Baseline	**12.64%**	**11.72%**
Be Green	5,896.70	1.28
Reduction over Baseline	**56.51%**	**55.34%**

1.2 Introduction

MES Building Solutions has been retained to provide an energy statement in order to address the energy and carbon reduction policies of the London Borough of Camden. The purpose of this statement is to establish the predicted energy requirements for the proposed development and show how energy efficiency measures in conjunction with renewable generation can be used to reduce the predicted energy consumption and associated carbon dioxide emissions. This is in line with the requirements of Camden's Local Plan policy CC1.

This is achieved by following the energy hierarchy which includes:

- Calculation of baseline energy consumption & CO_2 emissions using indicative SAP calculations
- Implementation of the energy hierarchy (be lean, be clean, be green)
- Calculation of energy consumption & CO_2 emissions at each stage of energy hierarchy
- Calculation of final energy consumption & CO_2 emissions
- Calculation of reduction in emissions achieved
- Calculation of contribution from renewable generation

1.3 Planning Policy

National Policy

In February 2019, the Government published the National Planning Policy Framework (NPPF) which superseded a number of planning policies including the Planning Policy Statement (PPS) suite.

The NPPF outlines the Government's planning policies for England. It provides a framework within which local people and accountable councils can produce their own distinctive local plan which reflect the needs and priorities of their neighbourhoods and communities. The purpose of the NPPF is to contribute to the achievement of sustainable development.

The NPPF aims to strengthen local decision making as a way to foster the delivery of sustainable developments. However, the NPPF also outlines that sustainable developments require careful attention to viability and costs in plan-making and decision-taking processes. Over everything else, plans should be deliverable. Therefore, the size and scale of development within the plan should not be subjected to large scale obligations and burdens, so that their ability to be developed viably is threatened.

The NPPF guidance promotes planning for climate change. Chapter 14 of the NPPF, Meeting the Challenge of Climate Change, Flooding and Coastal Change (paragraphs 149 to 154) state that:

Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure.

- New development should be planned for in ways that:

    - Avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and
    - Can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

- To help increase the use and supply of renewable and low carbon energy and heat, plans should:
    - Provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);
    - Consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
    - Identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

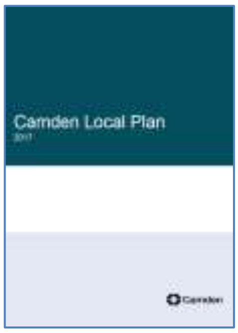
- Local planning authorities should support community-led initiatives for renewable and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning.

- In determining planning applications, local planning authorities should expect new development to:
    - Comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
    - Take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

- When determining planning applications for renewable and low carbon development, local planning authorities should:
    - Not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and
    - Approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.

Camden Local Plan 2017

Policy CC1 Climate change mitigation



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

The main policy in London Borough of Camden's Local Plan that relates to energy and carbon dioxide emissions is CC1. This has been reproduced below.

Policy CC1 Climate change mitigation

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

We will:

a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;
b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;
c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;
d. support and encourage sensitive energy efficiency improvements to existing buildings;
e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and
f. expect all developments to optimise resource efficiency.

For decentralised energy networks, we will promote decentralised energy by:

g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;
h. protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and
i. requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

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

The energy hierarchy

8.6 The Council's Sustainability Plan 'Green Action for Change' commits the Council to seek low and where possible zero carbon buildings. New developments in Camden will be expected to be designed to minimise energy use and CO2 emissions in operation through the application of the energy hierarchy. It is understood that some sustainable design measures may be challenging for listed buildings and some conservation areas and we would advise developers to engage early with the Council to develop innovative solutions.

8.7 The energy hierarchy is a sequence of steps that minimise the energy consumption of a building. Buildings designed in line with the energy hierarchy prioritise lower cost passive design measures, such as improved fabric performance over higher cost active systems such as renewable energy technologies. The following diagram shows a simplified schematic of the energy hierarchy, which is explained further in supplementary planning document Camden Planning Guidance on sustainability.

8.8 All developments involving five or more dwellings and/or more than 500 sqm of (gross internal) any floorspace will be required to submit an energy statement demonstrating how the energy hierarchy has been applied to make the fullest contribution to CO2 reduction. All new residential development will also be

required to demonstrate a 19% CO2 reduction below Part L 2013 Building Regulations (in addition to any requirements for renewable energy). This can be demonstrated through an energy statement or sustainability statement.

The combination of Policy CC1 and the above extract from London Borough of Camden's Local Plan gives a requirement that the development reduce its carbon emissions by a minimum of 19%. It is encouraged that developments go beyond this, so this report will demonstrate a larger improvement than this. This improvement does not have to be down to renewable technologies, but can be the result of any combination of fabric improvements, efficient building services, and decentralised energy or LZC technologies.

Policy CC2 Adapting to climate change

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

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

a. the protection of existing green spaces and promoting new appropriate green infrastructure;

b. not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;

c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and

d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

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

Sustainable design and construction measures

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

e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;

f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;

g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and

h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.

The New London Plan (adopted March 2021)

Policy SI 2 Minimising greenhouse gas emissions

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

1) be lean: use less energy and manage demand during operation
2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
3) be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site
4) be seen: monitor, verify and report on energy performance.

B Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

C A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

1) through a cash in lieu contribution to the borough's carbon offset fund, or
2) off-site provided that an alternative proposal is identified and delivery is certain.

D Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.

E Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.
F Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.

Policy SI 3 Energy infrastructure

A Boroughs and developers should engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from large-scale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.

B Energy masterplans should be developed for large-scale development locations (such as those outlined in Part A and other opportunities) which establish the most effective energy supply options. Energy masterplans should identify:

1) major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)

2) heat loads from existing buildings that can be connected to future phases of a heat network
3) major heat supply plant including opportunities to utilise heat from energy from waste plants
4) secondary heat sources, including both environmental and waste heat
5) opportunities for low and ambient temperature heat networks
6) possible land for energy centres and/or energy storage
7) possible heating and cooling network routes
8) opportunities for futureproofing utility infrastructure networks to minimise the impact from road works
9) infrastructure and land requirements for electricity and gas supplies
10) implementation options for delivering feasible projects, considering issues of procurement, funding and risk, and the role of the public sector
11) opportunities to maximise renewable electricity generation and incorporate demand-side response measures.

C Development Plans should:
1) identify the need for, and suitable sites for, any necessary energy infrastructure requirements including energy centres, energy storage and upgrades to existing infrastructure
2) identify existing heating and cooling networks, identify proposed locations for future heating and cooling networks and identify opportunities for expanding and inter-connecting existing networks as well as establishing new networks.
D Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system:
1) the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

a) connect to local existing or planned heat networks
b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
c) use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)
d) use ultra-low NOx gas boilers

2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements in Part B of Policy SI 1 Improving air quality 3) where a heat network is planned but not yet in existence the development should be designed to allow for the cost-effective connection at a later date.

E) Heat networks should achieve good practice design and specification standards for primary, secondary and tertiary systems comparable to those set out in the CIBSE/ADE Code of Practice CP1 or equivalent.

Policy SI 4 Managing heat risk

A Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

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

1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
2) minimise internal heat generation through energy efficient design
3) manage the heat within the building through exposed internal thermal mass and high ceilings
4) provide passive ventilation
5) provide mechanical ventilation
6) provide active cooling systems.

Policy SI 12 Flood risk management

A Current and expected flood risk from all sources (as defined in paragraph 9.12.2) across London should be managed in a sustainable and cost-effective way in collaboration with the Environment Agency, the Lead Local Flood Authorities, developers and infrastructure providers.
B Development Plans should use the Mayor's Regional Flood Risk Appraisal and their Strategic Flood Risk Assessment as well as Local Flood Risk Management Strategies, where necessary, to identify areas where particular and cumulative flood risk issues exist and develop actions and policy approaches aimed at reducing these risks. Boroughs should co-operate and jointly address cross-boundary flood risk issues including with authorities outside London.

C Development proposals should ensure that flood risk is minimised and mitigated, and that residual risk is addressed. This should include, where possible, making space for water and aiming for development to be set back from the banks of watercourses.

D Developments Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan. The Mayor will work with the Environment Agency and relevant local planning authorities, including authorities outside London, to safeguard an appropriate location for a new Thames Barrier.

E Development proposals for utility services should be designed to remain operational under flood conditions and buildings should be designed for quick recovery following a flood.

F Development proposals adjacent to flood defences will be required to protect the integrity of flood defences and allow access for future maintenance and upgrading. Unless exceptional circumstances are demonstrated for not doing so, development proposals should be set back from flood defences to allow for any foreseeable future maintenance and upgrades in a sustainable and cost-effective way.

G Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat.

Section 2: Description of development

2.1 Location

This report is produced in support of a planning application to the London Borough of Camden for a development of a single new dwelling at 17 North End, NW3 7HR.

The site is approximately 0.6 miles away from Golders Green tube station, with the site also in close proximity to bus stops along North End Way. The site location can be found in the aerial photo below;

Figure 2.1 – Aerial photograph of site location

Figure 2.2: Site location (Studio RO\ST)

2.2 Details of development

The application is for the construction of a new dwelling, consisting of one 3-bed detached house. This proposal is to be considered a minor development.

It is proposed a fabric first holistic approach is to be taken to ensure sustainability for now and the future, while implementing LZC technology in the form of an Air Source Heat Pump to further reduce energy demand and CO_2 emissions. Dedicated bicycle storage will be provided (see image 2.4) to promote active and sustainable travel.

Figures 2.3 & 2.4, below, show the ground and first floor layouts of the proposed dwelling.

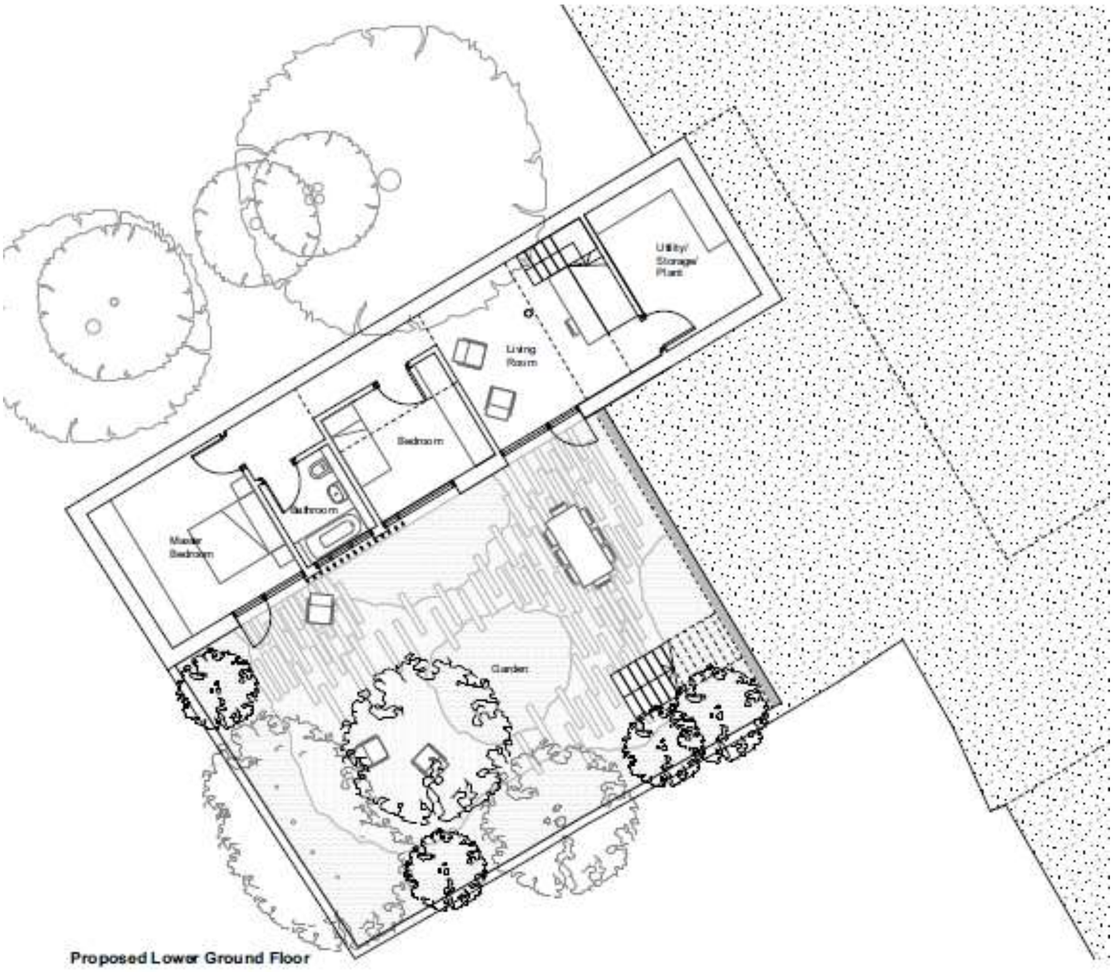
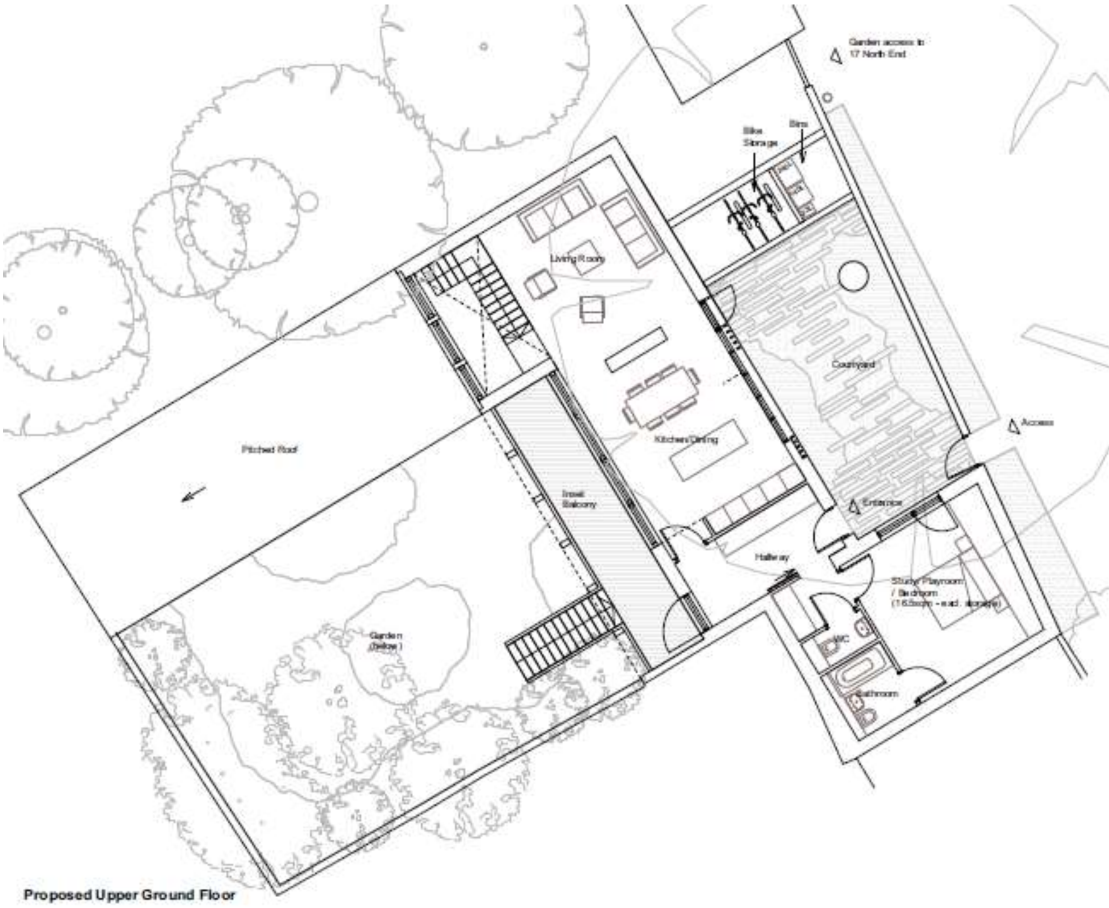


Figure 2.3: Proposed Ground Floor plan (Studio RO\ST))



Proposed Upper Ground Floor

Figure 2.4: Proposed First Floor (Studio RO\ST)

Section 3: Energy

3.1 The Energy Hierarchy

In order to address energy efficiency and in particular the 19% reduction in CO_2 emissions that is being targeted the design team have adopted the energy hierarchy. The energy hierarchy is generally accepted as the most effective way of reducing a buildings' carbon emissions.

1. Be lean: use less energy
2. Be clean: supply energy efficiently
3. Be green: use renewable energy
4. Be seen: monitor, verify and report on energy performance

Development proposals should:

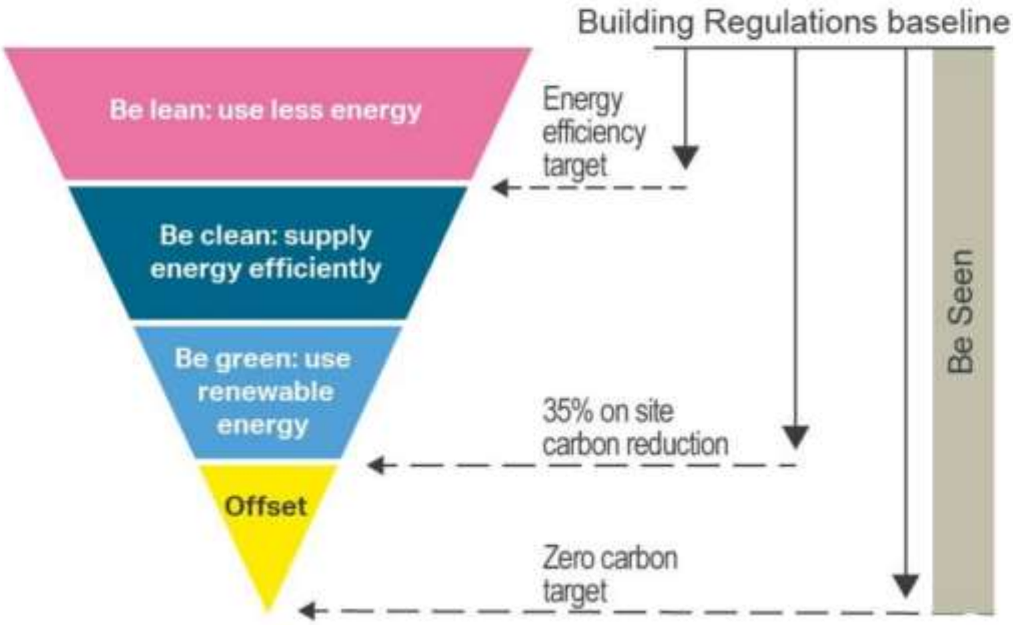


Figure 3.1: The Energy Hierarchy

- ***Reducing energy demand***

  The first step in the process of reducing the overall energy used and CO_2 produced by the building is to minimise the energy required to heat it. A well-insulated building envelope and passive design will reduce the energy requirement for heating and ventilating the building.

- ***Energy efficient systems***

  The second step is to specify services and controls, lighting and appliances that are energy efficient and which result in further reduction in energy requirements.

- ***Making use of Low or zero-carbon (LZC) technologies***
When the energy demand has been reduced by implementing the processes of improving the fabric and energy efficiency, then LZC technologies can be employed to reduce the environmental impact of the remaining energy consumption.

- ***Monitoring and reporting***
Ensure comprehensive monitoring and reporting of energy demand and carbon emissions. Major developments are required to undertake this process for at least five years.

3.2 Calculating Baseline Energy Demand

The first step is to calculate a Building Regulations Part L1 2013 compliant specification in order to establish notional baseline emissions for the development. Calculated data using the government's approved methodology (SAP 2012 and NCM) has been used to establish baseline energy requirements which comply with the 2013 edition of Part L minimum elemental standards.

Full SAP calculations have been used at each stage of the energy hierarchy as the basis for both energy consumption and CO_2 emissions.

The baseline emissions and energy consumption figures – based on the TER for each unit – produced by the calculations taken from the software modelling are shown in table 3a below:

3a: Total Annual Part L Notional Baseline Regulated Emissions & Fabric Energy Efficiency	
Emissions	**2.86 Tonnes CO_2/yr**
Energy	**13,558.07 kWh/yr**

3.3 Emission Reduction Targets (Be Lean and Be Clean)

The first two steps of the energy hierarchy look at reducing energy consumption in the building through improvements to its fabric and by increasing the efficiency of the building services. This reduces the energy required to run the building and thus the emissions associated with that energy use.

The current 2013 Part L is already stringent in terms of fabric performance targets. The fabric specification used in the 'notional building' (used to calculate the target/building emission rate) can be difficult to achieve in reality and further opportunities for improvement to the building fabric and services beyond those which meet the current 2013 Building Regulations requirements can be very limited when compared with those which may be expected from buildings constructed to earlier versions of the Regulations, but further improvements are possible by considering the following steps:

- Reduce elemental U-Values
- Reducing heat loss through uncontrolled ventilation (air leakage)
- Increased control of necessary ventilation
- Improving mechanical & electrical system efficiency
- Increasing control over mechanical & electrical systems.

The full specification proposed for the 'Be Lean & Be Clean' stages can be found in Table 3b, below.

Element	Be Lean and Be Clean Proposed Specification
Walls	0.23W/m²K
Flat Roof	0.14W/m²K
Sloped Roof	0.14W/m²K
Ground Floor	0.10W/m²K
Glazed Openings	1.20W/m²K
Doors	1.40W/m²K
Air Permeability	4.00m³/m²/hr
Thermal Bridging	Calculated
Ventilation	Mechanical Ventilation with Heat Recovery
Lighting	100% low energy lamps
Space Heating	Gas Combi Boiler
Controls	At least two heating zones, each with their own time and temperature control
DHW	Via main heating
LZC Generation	none

Table 3b: 'Be Lean and Be Clean' Proposed specification

The performance of this specification – relating to both energy consumption and carbon dioxide emissions – can be found in Table 3d, below.

3d: Total reduction in regulated emissions & energy use – Part L 2013		
	kWh/year	**Tonnes CO_2/year**
Baseline	13,558.07	2.86
Be Lean & Be Clean	11,844.30	2.53
Reduction over Baseline	**12.64%**	**11.72%**

3.4 District Heating and CHP

District heating

We have investigated the feasibility of connecting to a district heating network. Unfortunately it appears that the nearest proposed network(s) are approximately 5km away – see the extract from the Mayor of London's Heat Map in Figure 3a, below.

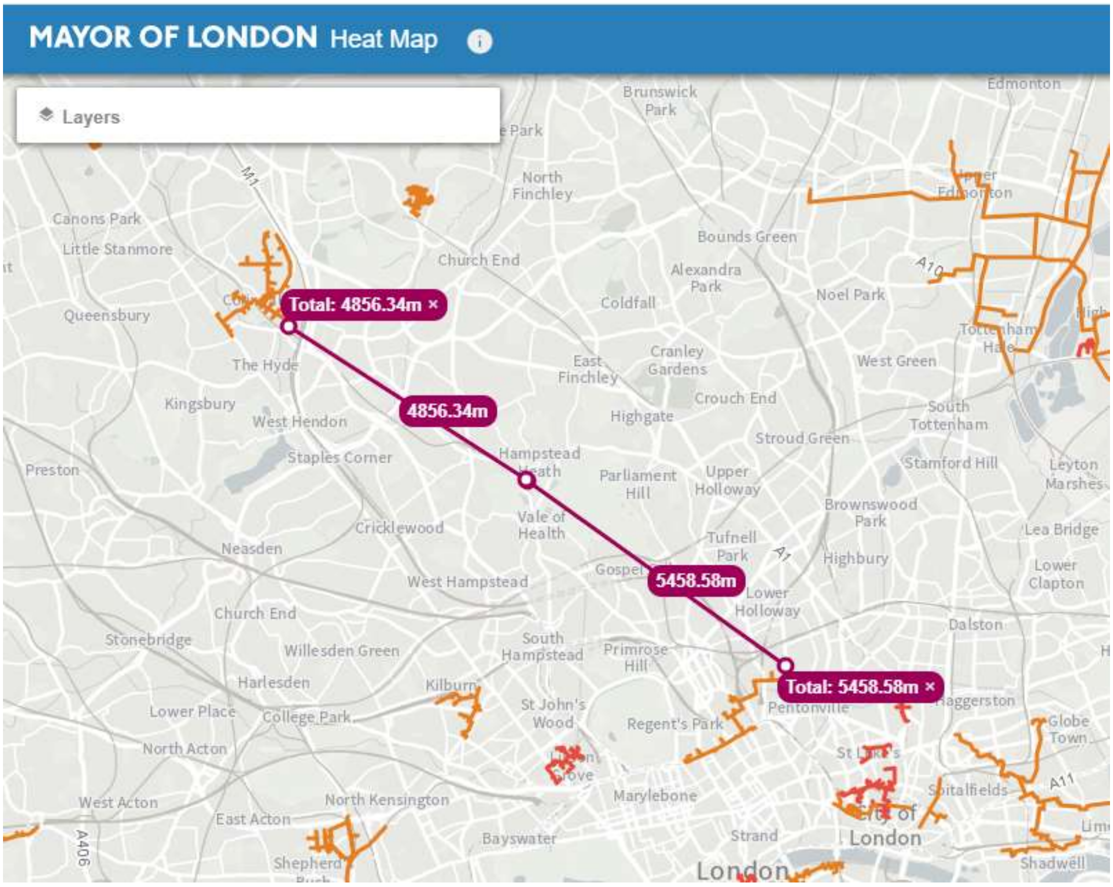


Figure 3a: Heat map showing site proximity to proposed heat networks

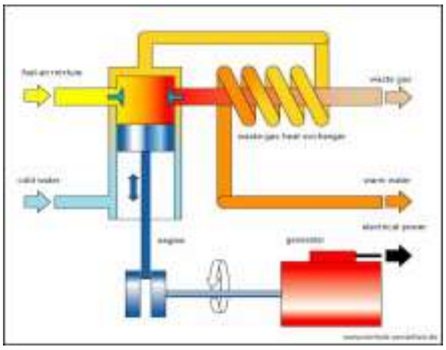
As such, connection to a district heating network is not a viable option on this occasion.

Communal heating scheme

The benefit of communal heating systems becomes questionable for small scale residential installation when compared to more traditional self-contained individual boilers. Additional space is required for centralised plant rooms and ducting/pipework. The increased cost and complexity of such systems is not offset by the minimal performance improvement that may be achieved and given this; communal heating is not proposed for the development.

Combined heat & power (CHP)

Combined heat and power uses an electricity generator, generally a gas powered internal combustion engine, with heat recovery on the exhaust used to heat water for heating and domestic hot water supply.



The proportions of heat and electricity produced are normally in the region of 65:35. This requires a constant heat load throughout the year for the system to perform efficiently.

For CHP to be viable on residential developments a minimum of 100 units is usually required in order to generate sufficient heating baseload. As this is not the case on this occasion CHP is not viable for consideration.

3.5 'Be Green' - CO_2 reduction through the use of renewable or low carbon technology

Energy resources accepted as renewable or low carbon technologies are defined by the Department of Energy & Climate Change Low Carbon Buildings Program as:

- Solar photovoltaics
- Wind turbines
- Small hydro
- Solar thermal hot water
- Ground source heat pumps
- Air source heat pumps
- Bio-energy

- Renewable CHP
- Micro CHP (Combined heat and power)

Given the nature of the site (being overshaded by existing trees) the most appropriate LZC technology for this development would be an air source heat pump. This also has the benefit of being the Government's currently preferred low carbon heat source as per the upcoming Future Homes Standard.

Solar Photovoltaics

Solar panel electricity systems, also known as solar photovoltaics (PV), capture the sun's energy using photovoltaic cells. These cells do not need direct sunlight to work – they can still generate some electricity on a cloudy day. The cells convert the sunlight into electricity, which can be used to run household appliances and lighting.

This technology is still under consideration by the client, but currently not included due to considerations surrounding the green roof(s) proposed.

Wind Turbines

Wind turbines harness the power of the wind and use it to generate electricity. Forty percent of all the wind energy in Europe blows over the UK, making it an ideal country for domestic turbines. Urban sites such as the location of this development are generally unsuitable for wind turbine installations due to the interrupted turbulent wind flows caused by surrounding buildings and large obstacles. There are also possible issues with noise and 'flicker' for the neighbouring buildings.

The NOABL wind resource database for the site location records average wind speeds as shown in Table 3g below. The British Wind Energy Association (BWEA) generally recommends an average wind speed of at least 7m/s for viable system performance.

Table 3h: Average wind speeds for the site	
45m above ground level	6.9m/s
25m above ground level	6.5m/s
10m above ground level	5.5m/s

The urban nature of the site, lack of space and low average wind speeds mean that a wind turbine cannot be recommended as a viable option for this development. There are also general issues surrounding the use of building mounted turbines with the potential for excessive noise and vibration within the building.

Small Hydro Generation

Hydroelectricity generation uses running water to generate electricity, whether it is a small stream or a larger river. All streams and rivers flow downhill. Before the water flows down the hill, it has potential energy because of its height. Hydro power systems convert this potential energy into kinetic energy in a turbine, which drives a generator to produce electricity. Small, or 'micro' hydro generation requires a reliable source of flowing water with a reasonably constant flow velocity. Systems of this nature are normally installed in locations with a natural moving water source such as a river, stream or spring where part of the flow can be diverted through a generator.

There is no such source of flowing water in this case and small hydro generation is not an option for this development.

Solar Water heating

Solar water heating systems use free heat from the sun to warm domestic hot water. Solar hot water heating can generate a large proportion of a dwelling's annual DHW requirement. The displaced fuel would be mains gas meaning that the CO_2 savings of this type of system would be relatively low due to the low carbon intensity of the displaced fuel.

Consequently, solar thermal is not considered to be a suitable system for this development and the roof space would be better used for PV as it offsets electricity meaning the CO_2 saving is considerably more than solar thermal, although SAP 10 emission factors will alter this going forward.

Heat Pumps

Heat pumps use similar technology as refrigerators but reversed. A refrigerant liquid is used as a medium to extract heat from a source and convert it into useful heat energy. The heat source used can be generally one of three types; the ground, the air or a body of water. Both ground and water sourced heat pumps use a long circuitous pipe through which a refrigerant is pumped. In ground sourced heat pumps this can be either a coiled pipe or 'slinky' that is buried in a series of horizontal trenches or a loop inside a vertical bore hole to depths that can be up to 200m or deeper. Water sourced heat pumps generally use a similar system to the 'slinky' used for ground sourced systems but either floated on or submerged in a body of water (either a large pool or running water source). Air source heat pumps have a refrigerant coil mounted outside the building through which is passed air so that heat can be extracted. All three types of heat pump generally use the collected heat from the source to heat water. The heated water can then be used for space heating and DHW. Heat pumps require an input of energy to drive pumps, this is usually electricity and so they cannot be considered to be zero carbon unless the supplied electricity is from renewable sources; they do however have very good efficiencies; energy produced by heat pumps is typically in the region of 2.5 times that which is required to run them, giving efficiencies of 250%.

Due to its efficiency and low carbon fuel source of mains electricity an air source heat pump is considered to be the most appropriate LZC technology for this development.

Bio Energy

The Low Carbon Buildings Program (LCBP) defines biomass as follows:

"Biomass is often called 'bioenergy' or 'biofuels'. These biofuels are produced from organic materials, either directly from plants or indirectly from industrial, commercial, domestic or agricultural products. Biofuels fall into two main categories:

- *Woody biomass includes forest products, untreated wood products, energy crops, short rotation coppice (SRC), e.g. willow.*
- *Non-woody biomass includes animal waste, industrial and biodegradable municipal products from food processing and high energy crops, e.g. rape, sugar cane, maize."*

For small-scale domestic [and small scale commercial] applications of biomass the fuel usually takes the form of wood pellets, wood chips and logs. The LCBP goes on to state:

"There are two main ways of using biomass to heat a domestic property:

- *Stand-alone stoves providing space heating for a single room. These can be fuelled by logs or pellets but only pellets are suitable for automatic feed. Generally they are 5-11 kW in output, and some models can be fitted with a back boiler to provide water heating.*
- *Boilers connected to central heating and hot water systems. These are suitable for pellets, logs or chips, and are generally larger than 15 kW"*

This technology is dismissed as the space requirements needed for the boiler and pellet store make this impractical along with complying with the clean air zone requirements.

The full specification for the 'Be Green' stage, including an ASHP as man heating and hot water source can be found in Table 3e, below.

Element	Be Lean and Be Clean Proposed Specification
Walls	0.23W/m^{2}K
Flat Roof	0.14W/m^{2}K

Sloped Roof	0.14W/m²K
Ground Floor	0.10W/m²K
Windows	1.20W/m²K
Doors	1.40W/m²K
Air Permeability	4.00m³/m²/hr
Thermal Bridging	Calculated
Ventilation	Mechanical Ventilation with Heat Recovery
Lighting	100% low energy lamps
Space Heating	Air Source Heat Pump (ASHP) – Flow temperature <=35°C
Controls	At least two heating zones, each with their own time and temperature control
DHW	250l cylinder heat from ASHP (supplementary immersion for DHW only)
LZC Generation	none

Table 3e: 'Be Lean, Be Clean & Be Green' Proposed specification

Table 3f, below, shows the overall performance of this specification broken down by step of the energy hierarchy.

Total reduction in regulated emissions & energy use – Part L 2013		
	kWh/year	**Tonnes CO_2/year**
Baseline	13,558.07	2.86
Be Lean & Be Clean	11,844.30	2.53
Reduction over Baseline	**12.64%**	**11.72%**
Be Green	5,896.70	1.28
Reduction over Baseline	**56.51%**	**55.34%**

Section 4: Sustainability

4.1 SI5 Water Infrastructure

Policy SI5 of the London Plan 2021 states that developments should;

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

Water calculations have been undertaken and can be found in detail in Appendix C to this report. However, the summary rates can be found below;

Taps (other than kitchen taps)		6.00(litres/min)
Kitchen and Utility Taps		8.00(litres/min)
Showers		8.00(litres/min)
Baths (with shower over)		180(litres to overflow)
WCs (Flush Volume)	Full Flush:	4.00(litres)
	Part Flush:	2.60(litres)
Washing Machine		8.17(litres/kg dry load)
Dishwasher		1.25(litres/place setting)

The resulting estimated consumption of wholesome water (excluding external use) has been calculated as 104.6 litres per person per day. Including external use this is 109.6l/s.

4.2 SI12 Flood risk management

The development's location can be found marked on the Environment Agency's flood risk maps in Figures 4.1 and 4.2, below. This shows that the development location is not located in an area that benefits from any flood defences. However, it is also not in an area at risk of flooding from rivers or seas. The risk map in Figure 4.2, for surface water flooding, does show that some of the wider area surrounding the site is at risk – but the site itself is, in the main, not at risk. There is one small area (that is in the location of the rear garden of the proposed development) that shows a low risk, but this is very small and localised on the site. As such, it would appear that the proposed development is not at significant risk of flooding.

Figure 4.1: Flood risk map (rivers & sea) for 17 North End

Figure 4.2: Flood risk map (surface water) for 17 North End

4.3 SI13 Sustainable drainage

Policy SI13 of the London Plan 2021 states that developments should;

> Aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:
>
> 1. Rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)
> 2. Rainwater infiltration to ground or close to source
> 3. Rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)
> 4. Rainwater discharge direct to a watercourse (unless not appropriate)
> 5. Controlled rainwater discharge to a surface water sewer or drain
> 6. Controlled rainwater discharge to a combined sewer

This is broadly the same as Camden Council's policy CC2.

It is assumed that the development will connect into existing public sewer(s) running in Wildwood Terrace to the north-east of the site. This is also the highest point of the site, with the land falling away to the south-west.

Table 4a, below, shows the change in impermeable area that will result from the development.

Total Site Area	383m^2
Impermeable area (as a percentage of the total area of the proposed development footprint of 383m^2)	
Pre-development	Post-development
32m^2	150m^2
Impermeable Land Use: existing buildings	Impermeable Lane use: building footprint, storage areas and hard landscaping

Table 4.a: Change in impermeable area of the proposed development site.

This is based on the existing site being domestic garden with one outbuilding. For the post-development site the proposed garden area and the green roof have been taken as permeable, with all other parts of the site (dwelling & stores) being impermeable.

An increase in impermeable area on site will result in greater rainfall runoff. Reduction in runoff will help mitigate flood risk both on and off site. As such it is proposed to limit the discharge rate of surface water from the site to the greenfield run off rate for the 1 in 100 year rainfall event. Initial calculations of this can be found in Appendix D.

To mitigate against an increase of surface water flooding, an area of green roof will be located on the roof of the lower volume (adjacent to the garden). This can be considered to be a permeable area, as can the main garden to the rear of the property and the upper courtyard. The remaining pitched roofs will, where possible, feed into the green roof and also into planters in the courtyard and rear garden, which will be designed as raingardens. Rainwater butts will be incorporated to absorb some of the water from the roofs, to be used for gardening. This is subject to detailed design demonstrating that there is sufficient infiltration capacity in the garden area. The roof over the stores, sloped roof pitches facing the courtyard and the courtyard itself may be able to drain to permeable paving in this area. However, due to the slope of the site and the location of the lower ground floor this will not be possible if it would cause issues with water levels and ingress into the lower level walls. As such it is assumed that these areas may need to discharge via storage below the courtyard in order to limit the run off rate to the greenfield rate. Initial calculations showing the amount of storage required to limit the development run off rate to the greenfield rate can also be found in Appendix D to this report.

The above approach following the SI3 hierarchy in the following way;

1. Use of rainwater as a resource – drainage into planters in the courtyard and rear garden using rainwater at source.
2. Infiltration – through the rear garden
3. Attenuation – via the green roof
4. Discharge via hydrobrake (or other suitable device) to the public sewer at a rate no greater than the greenfield

It should be noted that the above is not a detailed design proposal and is based on limited information on the detailed site conditions and locations of existing drainage. A detailed design should be commissioned for the full drainage package (surface water, SUDS and foul water) prior to site commencement.

Section 5: Summary

For this development the recommended strategy is; the implementation of a 'fabric first' holistic approach that is based on ensuring the building fabric and core services are designed and installed correctly, and implementation of an Air Source Heat pump to reduce energy demand and CO2 emissions, This has allowed the proposed dwellings to achieve a compliant Fabric Energy Efficiency specification and achieves a 56% reduction in energy consumption and 55% reduction in carbon emissions, exceeding the 19% reduction target from London Borough of Camden.

Table 5a below shows the reduction in kWh and tonnes of CO_2 per year through the fabric improvements and energy efficiency system measures which ensure the development will meet and exceed current building regulations.

5.a: Total reduction in regulated emissions & energy use – Part L 2013		
	kWh/year	**Tonnes CO_2/year**
Baseline	13,558.07	2.86
Be Lean & Be Clean	11,844.30	2.53
Reduction over Baseline	**12.64%**	**11.72%**
Be Green	5,896.70	1.28
Reduction over Baseline	**56.51%**	**55.34%**

The development will also be specified with water use fittings that limit the use of potable water to below 110l/person/day (including allowance for external water use). It has also been shown that the proposed SUDs strategy has the ability to reduce rainwater run off to the same rate as the greenfield rate for the site pre-development.

Appendix A

SAP Calculations for 'Be Lean, Be Clean'

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Property Reference	0001-Artefact-S-17-North-End	**Issued on Date**	07/09/2021
Assessment Reference	Be lean & Be Clean	**Prop Type Ref**	17 North End
Property	17, North End, NW3 7HR		

SAP Rating	82 B	**DER**	18.02	**TER**	18.19
Environmental	82 B	**% DER<TER**	0.96		
CO_2 Emissions (t/year)	2.65	**DFEE**	57.58	**TFEE**	72.35
General Requirements Compliance	Pass	**% DFEE<TFEE**	20.41		

Assessor Details	Miss Lorelei Davies, Lorelei Davies, Tel: 01636 653055, Lorelei.Davies@mesbuildingsolutions.co.uk	**Assessor ID**	W996-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Detached House, total floor area 170 m²

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:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.19 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.02 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)72.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)57.6 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.23 (max. 0.30)        0.23 (max. 0.70)          OK
Floor           0.10 (max. 0.25)        0.10 (max. 0.70)          OK
Roof            0.14 (max. 0.20)        0.14 (max. 0.35)          OK
Openings        1.20 (max. 2.00)        1.20 (max. 3.30)          OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.041
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         4.00 (design value)
Maximum                                 10.0                                              OK
----------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc
Combi boiler
Efficiency: 89.0% SEDBUK2009
Minimum: 88.0%                                    OK

Secondary heating system:               None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       No cylinder
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Time and temperature zone control                 OK


Hot water controls:                     No cylinder


Boiler interlock                        Yes                                               OK
----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                 75%                                               OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                     1.50
Maximum                                 1.5                                               OK
MVHR efficiency:                        84%
Minimum:                                70%                                               OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Slight                                            OK
Based on:
Overshading:                            Average
Windows facing North East:              9.88 m², No overhang
Windows facing South East:              16.47 m², No overhang
Windows facing South West:              19.44 m², No overhang
Windows facing North West:              4.41 m², No overhang
Air change rate:                        8.00 ach
Blinds/curtains:                        None
----------------------------------------------------------------------------------------------------
10 Key features
Floor U-value                           0.10 W/m²K



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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)			Storey height (m)		Volume (m3)	
Ground floor	72.5400	(1b)	x	2.8500	(2b) =	206.7390	(1b) - (3b)
First floor	97.5500	(1c)	x	2.8400	(2c) =	277.0420	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 170.0900							(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	483.7810	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1850	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2359	0.2313	0.2266	0.2035	0.1989	0.1758	0.1758	0.1711	0.1850	0.1989	0.2081	0.2174	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	71.4000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3789	0.3743	0.3696	0.3465	0.3419	0.3188	0.3188	0.3141	0.3280	0.3419	0.3511	0.3604	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows/Glazed Doors (Uw = 1.20)			50.2000	1.1450	57.4809			(27)
Roof Lights (Uw = 1.20)			12.3600	1.1450	14.1527			(27a)
Ground Floor			149.0800	0.1000	14.9080	75.0000	11181.0000	(28a)
External Wall	249.1000	50.2000	198.9000	0.2300	45.7470	60.0000	11934.0000	(29a)
Wall below Ground	20.8300		20.8300	0.2300	4.7909	9.0000	187.4700	(29a)
External Sloped Roof	127.0300	12.3600	114.6700	0.1400	16.0538	9.0000	1032.0300	(30)
External Flat Roof	29.9900		29.9900	0.1400	4.1986	9.0000	269.9100	(30)
Total net area of external elements Aum(A, m2)			576.0300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	157.3319			(33)
Internal Stud Wall 1			197.0500			9.0000	1773.4500	(32c)
Internal Floor 1			21.0100			18.0000	378.1800	(32d)
Internal Ceiling 1			21.0100			18.0000	378.1800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	27134.2200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.5286	(35)
Thermal bridges (User defined value 0.041 * total exposed area)		23.6172	(36)
Total fabric heat loss	(33) + (36) =	180.9491	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	60.4865	59.7482	59.0098	55.3179	54.5796	50.8877	50.8877	50.1493	52.3645	54.5796	56.0563	57.5331	(38)
Heat transfer coeff	241.4357	240.6973	239.9589	236.2671	235.5287	231.8368	231.8368	231.0985	233.3136	235.5287	237.0054	238.4822	(39)
Average = Sum(39)m / 12 =												236.0825	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4195	1.4151	1.4108	1.3891	1.3847	1.3630	1.3630	1.3587	1.3717	1.3847	1.3934	1.4021	(40)
HLP (average)												1.3880	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9627	(42)
Average daily hot water use (litres/day)	104.5640	(43)

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Daily hot water use	115.0204	110.8378	106.6553	102.4727	98.2901	94.1076	94.1076	98.2901	102.4727	106.6553	110.8378	115.0204	(44)
Energy conte	170.5719	149.1833	153.9438	134.2119	128.7795	111.1269	102.9754	118.1658	119.5771	139.3556	152.1175	165.1898	(45)
Energy content (annual)											Total = Sum(45)m =	1645.1986	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5858	22.3775	23.0916	20.1318	19.3169	16.6690	15.4463	17.7249	17.9366	20.9033	22.8176	24.7785	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.0876	46.4092	47.9562	50.0876	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	221.5308	195.2107	204.9027	183.5270	178.8671	157.5362	150.9316	168.2534	168.8922	190.3145	201.4326	216.1487	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	221.5308	195.2107	204.9027	183.5270	178.8671	157.5362	150.9316	168.2534	168.8922	190.3145	201.4326	216.1487	(64)
								Total per year (kWh/year) = Sum(64)m =				2237.5473	(64)
Heat gains from water heating, kWh/month	69.4549	61.1103	63.9260	56.9542	55.3411	48.5520	46.2284	51.8120	52.0882	59.0755	62.9078	67.6653	(65)

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	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.4576	27.0522	22.0003	16.6556	12.4503	10.5111	11.3576	14.7630	19.8149	25.1595	29.3649	31.3041	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	341.6415	345.1867	336.2529	317.2341	293.2263	270.6623	255.5882	252.0430	260.9767	279.9955	304.0034	326.5674	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	(71)
Water heating gains (Table 5)	93.3533	90.9379	85.9221	79.1031	74.3832	67.4333	62.1349	69.6398	72.3447	79.4025	87.3720	90.9480	(72)
Total internal gains	535.8928	533.6171	514.6157	483.4333	450.5002	419.0471	399.5211	406.8862	423.5766	454.9979	491.1806	519.2599	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	9.8800	11.2829	0.6300	0.8000	0.7700	38.9353	(75)
Southeast	16.4700	36.7938	0.6300	0.8000	0.7700	211.6569	(77)
Southwest	19.4400	36.7938	0.6300	0.8000	0.7700	249.8245	(79)
Northwest	4.4100	11.2829	0.6300	0.8000	0.7700	17.3790	(81)
Northeast	12.3600	22.3677	0.6300	0.7000	1.0000	109.7287	(82)

Solar gains	627.5244	1131.7622	1705.5581	2360.2640	2857.4019	2927.6086	2784.9421	2402.2355	1931.5141	1294.1369	763.3169	529.3373	(83)
Total gains	1163.4172	1665.3794	2220.1739	2843.6972	3307.9021	3346.6557	3184.4632	2809.1217	2355.0907	1749.1349	1254.4975	1048.5972	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.2186	31.3144	31.4107	31.9015	32.0016	32.5112	32.5112	32.6150	32.3054	32.0016	31.8022	31.6052	
alpha	3.0812	3.0876	3.0940	3.1268	3.1334	3.1674	3.1674	3.1743	3.1537	3.1334	3.1201	3.1070	
util living area	0.9845	0.9566	0.8928	0.7597	0.5870	0.4239	0.3144	0.3675	0.6015	0.8675	0.9690	0.9885	(86)
MIT	19.3459	19.6729	20.0987	20.5320	20.7780	20.8792	20.9045	20.8982	20.8085	20.4040	19.7784	19.2947	(87)
Th 2	19.7484	19.7518	19.7551	19.7717	19.7751	19.7918	19.7918	19.7952	19.7851	19.7751	19.7684	19.7617	(88)
util rest of house	0.9808	0.9472	0.8711	0.7179	0.5269	0.3505	0.2306	0.2758	0.5189	0.8314	0.9607	0.9858	(89)
MIT 2	17.5627	18.0346	18.6346	19.2234	19.5219	19.6426	19.6627	19.6629	19.5761	19.0827	18.2043	17.4975	(90)
Living area fraction									fLA = Living area / (4) =			0.1540	(91)
MIT	17.8373	18.2870	18.8601	19.4250	19.7154	19.8330	19.8540	19.8532	19.7659	19.2862	18.4468	17.7743	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.6873	18.1370	18.7101	19.2750	19.5654	19.6830	19.7040	19.7032	19.6159	19.1362	18.2968	17.6243	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9721	0.9307	0.8487	0.6988	0.5160	0.3437	0.2244	0.2686	0.5063	0.8080	0.9467	0.9788	(94)
Useful gains	1130.9548	1549.9978	1884.3113	1987.2015	1706.7472	1150.0816	714.6054	754.4288	1192.4674	1413.3036	1187.5784	1026.3825	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	3232.1809	3186.1035	2929.9334	2451.2635	1852.5199	1178.4372	719.6267	763.3563	1286.9398	2010.5154	2653.6970	3201.4648	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1563.3123	1099.4631	777.9429	334.1246	108.4549	0.0000	0.0000	0.0000	0.0000	444.3256	1055.6054	1618.2613	(98)
Space heating												7001.4900	(98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2	(98) / (4) =	41.1634	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.8000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	7544.7091	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1563.3123	1099.4631	777.9429	334.1246	108.4549	0.0000	0.0000	0.0000	0.0000	444.3256	1055.6054	1618.2613	(98)
Space heating efficiency (main heating system 1)	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000	(210)
Space heating fuel (main heating system)	1684.6037	1184.7662	838.3005	360.0481	116.8695	0.0000	0.0000	0.0000	0.0000	478.7992	1137.5059	1743.8160	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	221.5308	195.2107	204.9027	183.5270	178.8671	157.5362	150.9316	168.2534	168.8922	190.3145	201.4326	216.1487	(64)
Efficiency of water heater												80.5000	(216)
(217)m	88.5306	88.2625	87.6880	86.2666	83.7749	80.5000	80.5000	80.5000	80.5000	86.7931	88.1678	88.5940	(217)
Fuel for water heating, kWh/month	250.2309	221.1705	233.6724	212.7439	213.5091	195.6971	187.4927	209.0104	209.8039	219.2737	228.4651	243.9767	(219)
Water heating fuel used												2625.0464	(219)

Annual totals kWh/year		
Space heating fuel - main system	7544.7091	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 1.8750)		
mechanical ventilation fans (SFP = 1.8750)	1106.6490	(230a)
central heating pump	30.0000	(230c)
Total electricity for the above, kWh/year	1136.6490	(231)
Electricity for lighting (calculated in Appendix L)	537.8905	(232)
Total delivered energy for all uses	11844.2951	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7544.7091	0.2160	1629.6572	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2625.0464	0.2160	567.0100	(264)
Space and water heating			2196.6672	(265)
Pumps and fans	1136.6490	0.5190	589.9209	(267)
Energy for lighting	537.8905	0.5190	279.1652	(268)
Total CO2, kg/year			3065.7532	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.0200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		18.0200	ZC1
Total Floor Area	TFA	170.0900	
Assumed number of occupants	N	2.9627	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		11.9025	ZC2
CO2 emissions from cooking, equation (L16)		1.1177	ZC3
Total CO2 emissions		31.0402	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		31.0402	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)			Storey height (m)			Volume (m3)	
Ground floor	72.5400	(1b)	x	2.8500	(2b)	=	206.7390	(1b) - (3b)
First floor	97.5500	(1c)	x	2.8400	(2c)	=	277.0420	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 170.0900								(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =			483.7810	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0827	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3327	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3077	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3924	0.3847	0.3770	0.3385	0.3308	0.2923	0.2923	0.2847	0.3077	0.3308	0.3462	0.3616	(22b)
Effective ac	0.5770	0.5740	0.5711	0.5573	0.5547	0.5427	0.5427	0.5405	0.5473	0.5547	0.5599	0.5654	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			34.1200	1.3258	45.2348			(27)
TER Room Window (Uw = 1.70)			8.4000	1.5918	13.3708			(27a)
Ground Floor			149.0800	0.1300	19.3804			(28a)
External Wall	249.1000	34.1200	214.9800	0.1800	38.6964			(29a)
Wall below Ground	20.8300		20.8300	0.1800	3.7494			(29a)
External Sloped Roof	127.0300	8.4000	118.6300	0.1300	15.4219			(30)
External Flat Roof	29.9900		29.9900	0.1300	3.8987			(30)
Total net area of external elements Aum(A, m2)			576.0300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		139.7524			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		30.4297	(36)
Total fabric heat loss	(33) + (36) =	170.1821	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	92.1123	91.6351	91.1674	88.9705	88.5594	86.6460	86.6460	86.2917	87.3830	88.5594	89.3910	90.2603	(38)
Heat transfer coeff	262.2944	261.8172	261.3495	259.1526	258.7416	256.8282	256.8282	256.4738	257.5652	258.7416	259.5731	260.4424	(39)
Average = Sum(39)m / 12 =												259.1506	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5421	1.5393	1.5365	1.5236	1.5212	1.5100	1.5100	1.5079	1.5143	1.5212	1.5261	1.5312	(40)
HLP (average)												1.5236	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9627	(42)
Average daily hot water use (litres/day)	104.5640	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.0204	110.8378	106.6553	102.4727	98.2901	94.1076	94.1076	98.2901	102.4727	106.6553	110.8378	115.0204	(44)
Energy conte	170.5719	149.1833	153.9438	134.2119	128.7795	111.1269	102.9754	118.1658	119.5771	139.3556	152.1175	165.1898	(45)
Energy content (annual)										Total = Sum(45)m =		1645.1986	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5858	22.3775	23.0916	20.1318	19.3169	16.6690	15.4463	17.7249	17.9366	20.9033	22.8176	24.7785	(46)

Water storage loss:
Total storage loss

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.0876	46.4092	47.9562	50.0876	49.3151	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	221.5308	195.2107	204.9027	183.5270	178.8671	157.5362	150.9316	168.2534	168.8922	190.3145	201.4326	216.1487	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	221.5308	195.2107	204.9027	183.5270	178.8671	157.5362	150.9316	168.2534	168.8922	190.3145	201.4326	216.1487	(64)
Total per year (kWh/year) = Sum(64)m =												2237.5473	(64)
Heat gains from water heating, kWh/month													
	69.4549	61.1103	63.9260	56.9542	55.3411	48.5520	46.2284	51.8120	52.0882	59.0755	62.9078	67.6653	(65)

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	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	30.4576	27.0522	22.0003	16.6556	12.4503	10.5111	11.3576	14.7630	19.8149	25.1595	29.3649	31.3041	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	341.6415	345.1867	336.2529	317.2341	293.2263	270.6623	255.5882	252.0430	260.9767	279.9955	304.0034	326.5674	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	(71)
Water heating gains (Table 5)													
	93.3533	90.9379	85.9221	79.1031	74.3832	67.4333	62.1349	69.6398	72.3447	79.4025	87.3720	90.9480	(72)
Total internal gains													
	535.8928	533.6171	514.6157	483.4333	450.5002	419.0471	399.5211	406.8862	423.5766	454.9979	491.1806	519.2599	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.7100	11.2829	0.6300	0.7000	0.7700	23.1375	(75)
Southeast	11.2000	36.7938	0.6300	0.7000	0.7700	125.9403	(77)
Southwest	13.2100	36.7938	0.6300	0.7000	0.7700	148.5421	(79)
Northwest	3.0000	11.2829	0.6300	0.7000	0.7700	10.3446	(81)
Northeast	8.4000	22.3677	0.6300	0.7000	1.0000	74.5729	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	382.5376	692.7298	1050.3178	1462.1721	1776.5290	1822.5945	1732.8159	1490.6937	1192.4886	793.9008	465.8449	322.3318	(83)
Total gains	918.4304	1226.3469	1564.9335	1945.6054	2227.0292	2241.6416	2132.3370	1897.5799	1616.0653	1248.8987	957.0256	841.5917	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	45.0326	45.1147	45.1954	45.5786	45.6510	45.9911	45.9911	46.0546	45.8595	45.6510	45.5047	45.3529	
alpha	4.0022	4.0076	4.0130	4.0386	4.0434	4.0661	4.0661	4.0703	4.0573	4.0434	4.0336	4.0235	
util living area													
	0.9985	0.9950	0.9829	0.9393	0.8315	0.6633	0.5103	0.5844	0.8384	0.9754	0.9965	0.9989	(86)
MIT	19.2152	19.4557	19.8387	20.3237	20.7132	20.9188	20.9783	20.9633	20.7814	20.2383	19.6283	19.1750	(87)
Th 2	19.6561	19.6582	19.6602	19.6698	19.6716	19.6800	19.6800	19.6816	19.6768	19.6716	19.6680	19.6642	(88)
util rest of house													
	0.9979	0.9931	0.9764	0.9158	0.7698	0.5532	0.3668	0.4344	0.7524	0.9619	0.9950	0.9985	(89)
MIT 2	17.3077	17.6600	18.2161	18.9056	19.4079	19.6311	19.6733	19.6684	19.5096	18.8037	17.9196	17.2540	(90)
Living area fraction										fLA = Living area / (4) =		0.1540	(91)
MIT	17.6015	17.9366	18.4661	19.1241	19.6090	19.8294	19.8743	19.8678	19.7055	19.0246	18.1828	17.5499	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6015	17.9366	18.4661	19.1241	19.6090	19.8294	19.8743	19.8678	19.7055	19.0246	18.1828	17.5499	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9965	0.9893	0.9680	0.9033	0.7664	0.5668	0.3889	0.4571	0.7547	0.9522	0.9921	0.9975	(94)
Useful gains	915.1863	1213.2772	1514.7910	1757.3827	1706.8912	1270.5854	829.2472	867.3159	1219.5840	1189.2022	949.4581	839.4722	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	3488.9045	3413.2001	3127.3229	2649.5928	2046.3826	1343.0613	840.9371	889.4125	1443.7806	2179.8064	2876.7879	3476.8868	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	1914.8463	1478.3482	1199.7237	642.3912	252.5816	0.0000	0.0000	0.0000	0.0000	737.0095	1387.6774	1962.2365	(98)
Space heating												9574.8146	(98)
Space heating per m2											(98) / (4) =	56.2926	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	10251.4075	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1914.8463	1478.3482	1199.7237	642.3912	252.5816	0.0000	0.0000	0.0000	0.0000	737.0095	1387.6774	1962.2365	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	2050.1567	1582.8139	1284.5008	687.7851	270.4300	0.0000	0.0000	0.0000	0.0000	789.0894	1485.7360	2100.8956	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	221.5308	195.2107	204.9027	183.5270	178.8671	157.5362	150.9316	168.2534	168.8922	190.3145	201.4326	216.1487	(64)
Efficiency of water heater												80.3000	(216)
(217)m	89.2361	89.0929	88.7712	87.9421	85.9198	80.3000	80.3000	80.3000	80.3000	88.1252	88.9813	89.2857	(217)
Fuel for water heating, kWh/month	248.2523	219.1091	230.8211	208.6907	208.1792	196.1845	187.9597	209.5310	210.3265	215.9593	226.3762	242.0866	(219)

Water heating fuel used	2603.4763	(219)
Annual totals kWh/year		
Space heating fuel - main system	10251.4075	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	537.8905	(232)
Total delivered energy for all uses	13467.7742	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	10251.4075	0.2160	2214.3040	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2603.4763	0.2160	562.3509	(264)
Space and water heating			2776.6549	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	537.8905	0.5190	279.1652	(268)
Total CO2, kg/m2/year			3094.7451	(272)
Emissions per m2 for space and water heating			16.3246	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.6413	(272b)
Emissions per m2 for pumps and fans			0.2288	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3246 * 1.00) + 1.6413 + 0.2288, rounded to 2 d.p.			18.1900	(273)

Appendix B

SAP Calculations for 'Be Lean, Be Clean & Be Green'

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

Property Reference	0001-Artefact-S-17-North-End	**Issued on Date**	07/09/2021
Assessment Reference	Be Green	**Prop Type Ref**	17 North End
Property	17, North End, NW3 7HR		

SAP Rating	80 C	**DER**	17.88	**TER**	26.95
Environmental	82 B	**% DER<TER**	33.65		
CO_2 Emissions (t/year)	2.67	**DFEE**	57.58	**TFEE**	72.35
General Requirements Compliance	Pass	**% DFEE<TFEE**	20.41		

Assessor Details	Miss Lorelei Davies, Lorelei Davies, Tel: 01636 653055, Lorelei.Davies@mesbuildingsolutions.co.uk	**Assessor ID**	W996-0001
Client			

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.14r10

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

DWELLING AS DESIGNED

Detached House, total floor area 170 m²

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:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 26.95 kgCO_2/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.88 kgCO_2/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 72.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 57.6 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Floor	0.10 (max. 0.25)	0.10 (max. 0.70)	OK
Roof	0.14 (max. 0.20)	0.14 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.041

3 Air permeability

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

4 Heating efficiency

Main heating system:	Heat pump with radiators or underfloor - Electric
Air-to-water heat pump	
Secondary heating system:	None

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 2.56 kWh/day	
Permitted by DBSCG 2.56	OK	
Primary pipework insulated:	Yes	OK

6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK

7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%		
Minimum	75%	OK

8 Mechanical ventilation

Continuous supply and extract system		
Specific fan power:	1.50	
Maximum	1.5	OK
MVHR efficiency:	84%	
Minimum:	70%	OK

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing North East:	9.88 m², No overhang	
Windows facing South East:	16.47 m², No overhang	
Windows facing South West:	19.44 m², No overhang	
Windows facing North West:	4.41 m², No overhang	
Air change rate:	8.00 ach	
Blinds/curtains:	None	

10 Key features

Floor U-value	0.10 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)			Storey height (m)			Volume (m3)	
Ground floor	72.5400	(1b)	x	2.8500	(2b)	=	206.7390	(1b) - (3b)
First floor	97.5500	(1c)	x	2.8400	(2c)	=	277.0420	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 170.0900								(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	483.7810	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							0 * 10 =	0.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1850	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2359	0.2313	0.2266	0.2035	0.1989	0.1758	0.1758	0.1711	0.1850	0.1989	0.2081	0.2174	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	71.4000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3789	0.3743	0.3696	0.3465	0.3419	0.3188	0.3188	0.3141	0.3280	0.3419	0.3511	0.3604	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows/Glazed Doors (Uw = 1.20)			50.2000	1.1450	57.4809			(27)
Roof Lights (Uw = 1.20)			12.3600	1.1450	14.1527			(27a)
Ground Floor			149.0800	0.1000	14.9080	75.0000	11181.0000	(28a)
External Wall	249.1000	50.2000	198.9000	0.2300	45.7470	60.0000	11934.0000	(29a)
Wall below Ground	20.8300		20.8300	0.2300	4.7909	9.0000	187.4700	(29a)
External Sloped Roof	127.0300	12.3600	114.6700	0.1400	16.0538	9.0000	1032.0300	(30)
External Flat Roof	29.9900		29.9900	0.1400	4.1986	9.0000	269.9100	(30)
Total net area of external elements Aum(A, m2)			576.0300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	157.3319			(33)
Internal Stud Wall 1			197.0500			9.0000	1773.4500	(32c)
Internal Floor 1			21.0100			18.0000	378.1800	(32d)
Internal Ceiling 1			21.0100			18.0000	378.1800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	27134.2200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.5286	(35)
Thermal bridges (User defined value 0.041 * total exposed area)		23.6172	(36)
Total fabric heat loss	(33) + (36) =	180.9491	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	60.4865	59.7482	59.0098	55.3179	54.5796	50.8877	50.8877	50.1493	52.3645	54.5796	56.0563	57.5331	(38)
Heat transfer coeff	241.4357	240.6973	239.9589	236.2671	235.5287	231.8368	231.8368	231.0985	233.3136	235.5287	237.0054	238.4822	(39)
Average = Sum(39)m / 12 =												236.0825	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4195	1.4151	1.4108	1.3891	1.3847	1.3630	1.3630	1.3587	1.3717	1.3847	1.3934	1.4021	(40)
HLP (average)												1.3880	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9627	(42)
Average daily hot water use (litres/day)	104.5640	(43)

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.0204	110.8378	106.6553	102.4727	98.2901	94.1076	94.1076	98.2901	102.4727	106.6553	110.8378	115.0204	(44)
Energy conte	170.5719	149.1833	153.9438	134.2119	128.7795	111.1269	102.9754	118.1658	119.5771	139.3556	152.1175	165.1898	(45)

Energy content (annual) Total = Sum(45)m = 1645.1986 (45)

Distribution loss (46)m = 0.15 x (45)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	25.5858	22.3775	23.0916	20.1318	19.3169	16.6690	15.4463	17.7249	17.9366	20.9033	22.8176	24.7785	(46)

Water storage loss:

Store volume	250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	2.5600	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	1.3824	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	42.8544	38.7072	42.8544	41.4720	42.8544	41.4720	42.8544	42.8544	41.4720	42.8544	41.4720	42.8544	(56)
If cylinder contains dedicated solar storage	42.8544	38.7072	42.8544	41.4720	42.8544	41.4720	42.8544	42.8544	41.4720	42.8544	41.4720	42.8544	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	236.6887	208.9017	220.0606	198.1959	194.8963	175.1109	169.0922	184.2826	183.5611	205.4724	216.1015	231.3066	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Output from w/h	236.6887	208.9017	220.0606	198.1959	194.8963	175.1109	169.0922	184.2826	183.5611	205.4724	216.1015	231.3066	(64)

Total per year (kWh/year) = Sum(64)m = 2423.6706 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	109.6086	97.3782	104.0797	95.8127	95.7126	88.1369	87.1328	92.1836	90.9466	99.2292	101.7663	107.8190	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.4576	27.0522	22.0003	16.6556	12.4503	10.5111	11.3576	14.7630	19.8149	25.1595	29.3649	31.3041	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	341.6415	345.1867	336.2529	317.2341	293.2263	270.6623	255.5882	252.0430	260.9767	279.9955	304.0034	326.5674	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	(71)
Water heating gains (Table 5)	147.3234	144.9080	139.8921	133.0731	128.6460	122.4124	117.1139	123.9027	126.3147	133.3725	141.3420	144.9181	(72)
Total internal gains	589.8629	587.5872	568.5858	537.4033	504.7630	474.0261	454.5001	461.1491	477.5467	508.9680	545.1507	573.2299	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	9.8800	11.2829	0.6300	0.8000	0.7700	38.9353	(75)
Southeast	16.4700	36.7938	0.6300	0.8000	0.7700	211.6569	(77)
Southwest	19.4400	36.7938	0.6300	0.8000	0.7700	249.8245	(79)
Northwest	4.4100	11.2829	0.6300	0.8000	0.7700	17.3790	(81)
Northeast	12.3600	22.3677	0.6300	0.7000	1.0000	109.7287	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	627.5244	1131.7622	1705.5581	2360.2640	2857.4019	2927.6086	2784.9421	2402.2355	1931.5141	1294.1369	763.3169	529.3373	(83)
Total gains	1217.3873	1719.3494	2274.1439	2897.6673	3362.1649	3401.6347	3239.4422	2863.3846	2409.0607	1803.1049	1308.4676	1102.5673	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.2186	31.3144	31.4107	31.9015	32.0016	32.5112	32.5112	32.6150	32.3054	32.0016	31.8022	31.6052	
alpha	3.0812	3.0876	3.0940	3.1268	3.1334	3.1674	3.1674	3.1743	3.1537	3.1334	3.1201	3.1070	
util living area	0.9824	0.9531	0.8873	0.7525	0.5800	0.4178	0.3093	0.3610	0.5917	0.8593	0.9654	0.9868	(86)
MIT	19.3734	19.6976	20.1181	20.5431	20.7826	20.8806	20.9050	20.8990	20.8134	20.4215	19.8044	19.3227	(87)
Th 2	19.7484	19.7518	19.7551	19.7717	19.7751	19.7918	19.7918	19.7952	19.7851	19.7751	19.7684	19.7617	(88)
util rest of house	0.9784	0.9430	0.8648	0.7103	0.5201	0.3452	0.2268	0.2707	0.5095	0.8218	0.9563	0.9837	(89)
MIT 2	17.6024	18.0696	18.6607	19.2368	19.5265	19.6436	19.6630	19.6633	19.5803	19.1047	18.2412	17.5381	(90)

Living area fraction fLA = Living area / (4) = 0.1540 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	17.8752	18.3204	18.8852	19.4380	19.7200	19.8342	19.8543	19.8536	19.7703	19.3075	18.4820	17.8130	(92)

Temperature adjustment 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
adjusted MIT	17.8752	18.3204	18.8852	19.4380	19.7200	19.8342	19.8543	19.8536	19.7703	19.3075	18.4820	17.8130	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9697	0.9278	0.8459	0.6975	0.5173	0.3478	0.2311	0.2752	0.5084	0.8044	0.9432	0.9767	(94)
Useful gains	1180.5593	1595.1683	1923.6692	2021.0854	1739.2092	1183.2387	748.7200	788.1065	1224.7201	1450.4999	1234.2079	1076.8533	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	3277.5301	3230.2424	2971.9288	2489.7793	1888.9295	1213.4704	754.4618	798.1327	1322.9530	2050.8742	2697.5961	3246.4657	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1560.1463	1098.7698	779.9051	337.4596	111.3919	0.0000	0.0000	0.0000	0.0000	446.6784	1053.6395	1614.1916	(98)

Space heating		7002.1822	(98)
Space heating per m2	(98) / (4) =	41.1675	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	249.9000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2801.9937	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1560.1463	1098.7698	779.9051	337.4596	111.3919	0.0000	0.0000	0.0000	0.0000	446.6784	1053.6395	1614.1916	(98)
Space heating efficiency (main heating system 1)	249.9000	249.9000	249.9000	249.9000	249.9000	0.0000	0.0000	0.0000	0.0000	249.9000	249.9000	249.9000	(210)
Space heating fuel (main heating system)	624.3082	439.6838	312.0869	135.0378	44.5746	0.0000	0.0000	0.0000	0.0000	178.7429	421.6245	645.9350	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	236.6887	208.9017	220.0606	198.1959	194.8963	175.1109	169.0922	184.2826	183.5611	205.4724	216.1015	231.3066	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	135.1734	119.3042	125.6771	113.1901	111.3057	100.0062	96.5690	105.2442	104.8322	117.3457	123.4161	132.0997	(219)
Water heating fuel used												1384.1637	(219)

Annual totals kWh/year		
Space heating fuel - main system	2801.9937	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 1.8750)		
mechanical ventilation fans (SFP = 1.8750)	1106.6490	(230a)
central heating pump	30.0000	(230c)
Total electricity for the above, kWh/year	1136.6490	(231)
Electricity for lighting (calculated in Appendix L)	537.8905	(232)
Total delivered energy for all uses	5860.6969	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2801.9937	0.5190	1454.2347	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1384.1637	0.5190	718.3809	(264)
Space and water heating			2172.6157	(265)
Pumps and fans	1136.6490	0.5190	589.9209	(267)
Energy for lighting	537.8905	0.5190	279.1652	(268)
Total CO2, kg/year			3041.7017	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.8800	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		17.8800	ZC1
Total Floor Area	TFA	170.0900	
Assumed number of occupants	N	2.9627	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		11.9025	ZC2
CO2 emissions from cooking, equation (L16)		1.1177	ZC3
Total CO2 emissions		30.9002	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		30.9002	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)
Ground floor		72.5400 (1b)	x	2.8500 (2b)	=	206.7390 (1b) - (3b)
First floor		97.5500 (1c)	x	2.8400 (2c)	=	277.0420 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	170.0900					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	483.7810 (5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0827	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3327	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3077	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3924	0.3847	0.3770	0.3385	0.3308	0.2923	0.2923	0.2847	0.3077	0.3308	0.3462	0.3616	(22b)
Effective ac	0.5770	0.5740	0.5711	0.5573	0.5547	0.5427	0.5427	0.5405	0.5473	0.5547	0.5599	0.5654	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.40)			34.1200	1.3258	45.2348			(27)
TER Room Window (Uw = 1.70)			8.4000	1.5918	13.3708			(27a)
Ground Floor			149.0800	0.1300	19.3804			(28a)
External Wall	249.1000	34.1200	214.9800	0.1800	38.6964			(29a)
Wall below Ground	20.8300		20.8300	0.1800	3.7494			(29a)
External Sloped Roof	127.0300	8.4000	118.6300	0.1300	15.4219			(30)
External Flat Roof	29.9900		29.9900	0.1300	3.8987			(30)
Total net area of external elements Aum(A, m2)			576.0300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	139.7524			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		30.4297	(36)
Total fabric heat loss	(33) + (36) =	170.1821	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	92.1123	91.6351	91.1674	88.9705	88.5594	86.6460	86.6460	86.2917	87.3830	88.5594	89.3910	90.2603	(38)
Heat transfer coeff	262.2944	261.8172	261.3495	259.1526	258.7416	256.8282	256.8282	256.4738	257.5652	258.7416	259.5731	260.4424	(39)
Average = Sum(39)m / 12 =												259.1506	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5421	1.5393	1.5365	1.5236	1.5212	1.5100	1.5100	1.5079	1.5143	1.5212	1.5261	1.5312	(40)
HLP (average)												1.5236	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9627	(42)
Average daily hot water use (litres/day)	104.5640	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.0204	110.8378	106.6553	102.4727	98.2901	94.1076	94.1076	98.2901	102.4727	106.6553	110.8378	115.0204	(44)
Energy conte	170.5719	149.1833	153.9438	134.2119	128.7795	111.1269	102.9754	118.1658	119.5771	139.3556	152.1175	165.1898	(45)
Energy content (annual)										Total = Sum(45)m =		1645.1986	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5858	22.3775	23.0916	20.1318	19.3169	16.6690	15.4463	17.7249	17.9366	20.9033	22.8176	24.7785	(46)
Water storage loss:													
Store volume												250.0000	(47)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

a) If manufacturer declared loss factor is known (kWh/day):	1.8903	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	1.0208	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(56)
If cylinder contains dedicated solar storage	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	225.4787	198.7765	208.8506	187.3475	183.6863	164.2625	157.8822	173.0726	172.7127	194.2624	205.2531	220.0966	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	225.4787	198.7765	208.8506	187.3475	183.6863	164.2625	157.8822	173.0726	172.7127	194.2624	205.2531	220.0966	(64)
Total per year (kWh/year) = Sum(64)m =												2291.6817	(64)
Heat gains from water heating, kWh/month	100.6406	89.2780	95.1117	87.1339	86.7446	79.4582	78.1648	83.2156	82.2679	90.2612	93.0876	98.8510	(65)

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	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	148.1347	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.4576	27.0522	22.0003	16.6556	12.4503	10.5111	11.3576	14.7630	19.8149	25.1595	29.3649	31.3041	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	341.6415	345.1867	336.2529	317.2341	293.2263	270.6623	255.5882	252.0430	260.9767	279.9955	304.0034	326.5674	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	37.8135	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	-118.5078	(71)
Water heating gains (Table 5)	135.2696	132.8542	127.8384	121.0194	116.5922	110.3586	105.0602	111.8489	114.2609	121.3188	129.2883	132.8643	(72)
Total internal gains	577.8091	575.5334	556.5320	525.3495	492.7092	461.9724	442.4463	449.0953	465.4929	496.9142	533.0969	561.1761	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.7100	11.2829	0.6300	0.7000	0.7700	23.1375	(75)
Southeast	11.2000	36.7938	0.6300	0.7000	0.7700	125.9403	(77)
Southwest	13.2100	36.7938	0.6300	0.7000	0.7700	148.5421	(79)
Northwest	3.0000	11.2829	0.6300	0.7000	0.7700	10.3446	(81)
Northeast	8.4000	22.3677	0.6300	0.7000	1.0000	74.5729	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	382.5376	692.7298	1050.3178	1462.1721	1776.5290	1822.5945	1732.8159	1490.6937	1192.4886	793.9008	465.8449	322.3318	(83)
Total gains	960.3466	1268.2632	1606.8498	1987.5216	2269.2382	2284.5669	2175.2622	1939.7890	1657.9815	1290.8150	998.9418	883.5080	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000	(85)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	45.0326	45.1147	45.1954	45.5786	45.6510	45.9911	45.9911	46.0546	45.8595	45.6510	45.5047	45.3529	
alpha	4.0022	4.0076	4.0130	4.0386	4.0434	4.0661	4.0661	4.0703	4.0573	4.0434	4.0336	4.0235	
util living area	0.9982	0.9943	0.9813	0.9354	0.8245	0.6543	0.5014	0.5740	0.8291	0.9726	0.9959	0.9987	(86)
MIT	19.2366	19.4768	19.8586	20.3401	20.7231	20.9228	20.9796	20.9656	20.7915	20.2576	19.6496	19.1965	(87)
Th 2	19.6561	19.6582	19.6602	19.6698	19.6716	19.6800	19.6800	19.6816	19.6768	19.6716	19.6680	19.6642	(88)
util rest of house	0.9975	0.9922	0.9743	0.9108	0.7617	0.5444	0.3598	0.4256	0.7410	0.9578	0.9941	0.9983	(89)
MIT 2	17.3390	17.6906	18.2445	18.9272	19.4186	19.6338	19.6738	19.6693	19.5191	18.8302	17.9505	17.2855	(90)
Living area fraction									fLA = Living area / (4) =			0.1540	(91)
MIT	17.6313	17.9657	18.4931	19.1448	19.6195	19.8324	19.8749	19.8690	19.7151	19.0501	18.2122	17.5799	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6313	17.9657	18.4931	19.1448	19.6195	19.8324	19.8749	19.8690	19.7151	19.0501	18.2122	17.5799	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9959	0.9881	0.9654	0.8983	0.7589	0.5582	0.3816	0.4481	0.7440	0.9477	0.9909	0.9970	(94)
Useful gains	956.3884	1253.1943	1551.2798	1785.3390	1722.0284	1275.1864	830.1709	869.1344	1233.5972	1223.2965	989.8339	880.8666	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	3496.7160	3420.8278	3134.3922	2654.9766	2049.1118	1343.8151	841.0887	889.7082	1446.2628	2186.3812	2884.4300	3484.6808	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1890.0038	1456.6497	1177.8356	626.1391	243.3501	0.0000	0.0000	0.0000	0.0000	716.5350	1364.1092	1937.2378	(98)
Space heating												9411.8603	(98)
Space heating per m2											(98) / (4) =	55.3346	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	10066.1608	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1890.0038	1456.6497	1177.8356	626.1391	243.3501	0.0000	0.0000	0.0000	0.0000	716.5350	1364.1092	1937.2378	(98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)	2021.3944	1557.9142	1259.7172	669.6675	260.2675	0.0000	0.0000	0.0000	0.0000	766.3476	1458.9403	2071.9121	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	225.4787	198.7765	208.8506	187.3475	183.6863	164.2625	157.8822	173.0726	172.7127	194.2624	205.2531	220.0966	(64)
Efficiency of water heater												79.8000	(216)
(217)m	89.2248	89.0660	88.7086	87.7891	85.5650	79.8000	79.8000	79.8000	79.8000	87.9838	88.9403	89.2787	(217)
Fuel for water heating, kWh/month	252.7084	223.1789	235.4345	213.4064	214.6746	205.8428	197.8474	216.8830	216.4320	220.7934	230.7763	246.5275	(219)
Water heating fuel used												2674.5053	(219)

Annual totals kWh/year		
Space heating fuel - main system	10066.1608	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	75.0000	(231)
Electricity for lighting (calculated in Appendix L)	537.8905	(232)
Total delivered energy for all uses	13353.5566	(238)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	10066.1608	0.2160	2174.2907	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2674.5053	0.2160	577.6931	(264)
Space and water heating			2751.9839	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	537.8905	0.5190	279.1652	(268)
Total CO2, kg/m2/year			3070.0740	(272)
Emissions per m2 for space and water heating			16.1796	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.6413	(272b)
Emissions per m2 for pumps and fans			0.2288	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.1796 * 1.55) + 1.6413 + 0.2288, rounded to 2 d.p.			26.9500	(273)

Appendix C

Water Use Calculations

breglobal

Job no:	
Date:	
Assessor name:	Tom Reynolds
Registration no:	
Development name:	17 North End
Issue Date:	

Rainwater | Greywater | Results

WATER EFFICIENCY CALCULATOR FOR NEW DWELLINGS

(for use with the Code for Sustainable Homes issues Wat 1 for the May 2009 and subsequent versions)

Dwelling Description n/a

1st step - Select from options below:

Is a Rain and/or Greywater system specified?	**No**
Is a shower AND bath present?	**Yes**
Has a washing machine been specified?	**No**
Has a dishwasher been specified?	**No**

2nd step - Build spreadsheet (click button below)

BUILD SPREADSHEET

As soon as this button is pressed the spreadsheet will change according to the options selected previously in the 1st step. Scroll down to see the changes.

3rd step - Enter consumption details for the specified fittings

TAPS (excluding kitchen taps)	Fitting type	Flow rate (litres/min)	Number of fittings
1	Basin Taps	6.00	3
2			
3			
4			
		Proportionate flow rate (litres/min)	4.20

	Consumption / person / day (Litres)	**11.06**

BATHS		Fitting type	Capacity to overflow (litres)	Number of fittings
	1	Baths	180.00	2
	2			
	3			
	4			
		Proportionate capacity to overflow (litres)		126.00
		Consumption / person / day (Litres)		19.80

SHOWERS		Fitting type	Flow rate (litres/min)	Number of fittings
	1	Showers	8.00	2
	2			
	3			
	4			
		Proportionate flow rate (litres/min)		5.60
		Consumption / person / day (Litres)		34.96

DISHWASHER	
Where no dishwasher is specified, a default consumption figure of 1.25 litres per place setting is used.	
Consumption / person / day (Litres)	4.50

WASHING MACHINES				Number of fittings
Where no washing machine is specified, a default consumption figure of 8.17 litres per kilogram of dry load is used.				
Where no washing machines have been specified but plumbing for future supply of grey/rainwater was installed, please enter details:				
			Consumption / person / day (Litres)	17.16

WC's	Fitting Type	Flush Type	Volume**	Number of fittings
1	WCs	Full Flush	4.00	3
		Part Flush	2.60	
2		Full Flush		
		Part Flush		
3		Full Flush		
		Part Flush		
4		Full Flush		
		Part Flush		
			Average effective flushing volume (litres)	3.06
			Consumption / person / day (Litres)	13.53

KITCHEN SINK TAPS	Fitting Type	Flow rate (litres/minute)	Number of fittings
1	Kitchen and Utility Taps	8.00	2
2			
3			
4			
	Proportionate flow rate (litres/min)		5.60
	Consumption / person / day (Litres)		13.88

WASTE DISPOSAL UNIT	
Is a waste disposal unit specified for the dwelling?	No
Consumption / person / day (Litres)	0.00

WATER SOFTENER	
Water Softener in use?	No
Total capacity used per regeneration (%)	
Water consumed per regeneration (litres)	
Average number of regeneration cycles per day (No.)	
Number of occupants served by the system (No.)	
Water consumed beyond 4% person / day (Litres)	0.00

4th step - Analyse Results	Go to Start

INTERNAL WATER CONSUMPTION

NET INTERNAL WATER CONSUMPTION	(litres/person/day)	114.89
RAINWATER ONLY COLLECTION SAVING	(litres/person/day)	0.00
GREYWATER ONLY RECYCLING SAVING	(litres/person/day)	0.00
RAIN/GREYWATER COLLECTION SAVING (combined system)	(litres/person/day)	0.00
NORMALISATION FACTOR	(litres/person/day)	0.91
TOTAL WATER CONSUMPTION	(litres/person/day)	104.6
CSH CREDITS ACHIEVED		3
CSH MANDATORY LEVEL:		Level 3/4

17. K COMPLIANCE

EXTERNAL WATER USE	(litres / person / day)	5.00
TOTAL WATER CONSUMPTION	(litres / person / day)	109.6
17. K COMPLIANCE?		Yes

PRINTING: before printing please make sure that in "Page Setup" you have selected the page to be as "Landscape" and that the Scale has been set up to 75% (maximum)

Appendix D

Run Off Rate Calculations

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Tom Reynolds
Site name:	17 North End
Site location:	London

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.56810° N
Longitude:	0.18155° W
Reference:	3675823271
Date:	Sep 07 2021 15:38

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.1

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	670	670
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	0.46	0.46
1 in 1 year (l/s):	0.39	0.39
1 in 30 years (l/s):	1.05	1.05
1 in 100 year (l/s):	1.46	1.46
1 in 200 years (l/s):	1.72	1.72

HR Wallingford *Working with water*

Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	Tom Reynolds
Site name:	17 North End
Site location:	London

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site Details

Latitude:	51.56812° N
Longitude:	0.18153° W
Reference:	3463685277
Date:	Sep 07 2021 15:57

Site characteristics

Total site area (ha):	0.037
Significant public open space (ha):	0
Area positively drained (ha):	0.037
Impermeable area (ha):	0.025889
Percentage of drained area that is impermeable (%):	70
Impervious area drained via infiltration (ha):	0.017815
Return period for infiltration system design (year):	10
Impervious area drained to rainwater harvesting (ha):	0
Return period for rainwater harvesting system (year):	10
Compliance factor for rainwater harvesting system (%):	66
Net site area for storage volume design (ha):	0.03
Net impermable area for storage volume design (ha):	0.02
Pervious area contribution to runoff (%):	30

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the 'net site area' and the estimates of Q_{BAR} and other flow rates will have been reduced accordingly.

Design criteria

Climate change allowance factor:	1.4
Urban creep allowance factor:	1.1
Volume control approach	Flow control to max of 2 l/s/ha or Qbar
Interception rainfall depth (mm):	5
Minimum flow rate (l/s):	2

Methodology

esti	IH124
Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
SPR:	0.47	0.47

Hydrological characteristics

	Default	Edited
Rainfall 100 yrs 6 hrs:	--	63
Rainfall 100 yrs 12 hrs:	--	98.56
FEH / FSR conversion factor:	1.28	1.28
SAAR (mm):	670	670
M5-60 Rainfall Depth (mm):	20	20
'r' Ratio M5-60/M5-2 day:	0.4	0.4
Hydological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 10 year:	1.62	1.62
Growth curve factor 30 year:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Q_{BAR} for total site area (l/s):	0.17	0.17
Q_{BAR} for net site area (l/s):	0.15	0.15

Site discharge rates

	Default	Edited
1 in 1 year (l/s):	2	2
1 in 30 years (l/s):	2	2
1 in 100 year (l/s):	2	2

Estimated storage volumes

	Default	Edited
Attenuation storage 1/100 years (m³):	3	3
Long term storage 1/100 years (m³):	0	0
Total storage 1/100 years (m³):	3	3