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Part of the FOCUS consultancy group

Energy and Sustainability Statement
154 Royal College Street, NW1 0TA

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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

To ensure compliance with London Borough of Camden Core Strategy and Local Plan a number of sustainable construction strategies will be incorporated in the design and construction of the development. These will include, amongst others, minimum standards relating to energy and water use which will reduce the developments environmental impact over its lifetime, which assists in ensuring a sustainable development for both current and future users.

To ensure compliance with London Borough of Camden Local Plan (2017), Camden Planning Guidance- Energy Efficiency and Adaptation (March 2019) and the London Plan the energy strategy proposed for the development at 154 Royal College Street, NW1 is the specification of an air source heat pump and solar PV.

This approach results in an overall reduction in emissions of 35.77% and if SAP10 emission factors are used it is increased to 68.72% which complies with both the London Plan and the Camden Local Plan.

Table 1a shows the reduction in tonnes of CO_2 and kWh per year through the recommended fabric improvements, energy efficiency measures and LZC technologies.

1a: Improvement over Part L and SAP 10		
	Part L	**SAP 10**
Total Baseline Emissions (Tonnes CO_2/yr)	7.38	6.81
Total Be Lean & Be Clean Emissions (Tonnes CO_2/yr)	5.21	2.34
Total Be Lean, Be Clean & Be Green Emissions (Tonnes CO_2/yr)	4.74	2.13
Contribution from PV (Tonnes CO_2/yr)	-0.47	-0.21
Total improvement over baseline (%)	**35.77%**	**68.72%**

1.2 Introduction

MES Building Solutions has been to provide an energy statement in order to address the requirements of requirements of Camden Council. The purpose of this Energy and Sustainability Statement is to establish the predicted energy requirements for the proposed development illustrating 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 achieved by following the energy hierarchy which includes:

- Calculation of baseline energy consumption & CO_2 emissions using SBEM 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

The report also addresses wider sustainability principles, looking at the following areas:

- Energy use
- Water conservation
- Materials selection
- Flood risk & surface water management
- Waste management
- Pollution mitigation
- Health & Wellbeing
- Construction & building management
- Site ecology

1.2 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:
    - o 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.

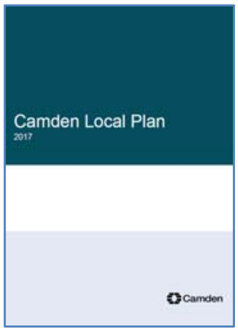
- In determining planning applications, local planning authorities should expect new development to:
    - Comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved 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.

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.

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.

London Plan (2016)

Policy 5.2 Minimising Carbon Dioxide Emissions
Planning decisions

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

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

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

Residential buildings:

Year	**Improvement on 2010 Building Regulations**
2010 – 2013	25 per cent (Code for Sustainable Homes level 4)
2013 - 2016	40 per cent
2016 - 2031	Zero Carbon

Non-domestic buildings:

Year	**Improvement on 2010 Building Regulations**
2010 – 2013	25 per cent
2013 - 2016	40 per cent
2016 - 2019	As per building regulations requirements
2019 - 2031	Zero Carbon

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

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

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

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

Policy 5.3 Sustainable Design and Construction

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

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

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

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

LDF preparation
D Within LDFs boroughs should consider the need to develop more detailed policies and proposals based on the sustainable design principles outlined above and those which are outlined in the Mayor's supplementary planning guidance that are specific to their local circumstances.

Policy 5.6 Decentralised Energy in Development Proposals

Planning decisions
A Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

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

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

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

Policy 5.7 Renewable Energy

Strategic

A The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London.

Planning decisions

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

LDF preparation

C Within LDFs boroughs should, and other agencies may wish to, develop more detailed policies and proposals to support the development of renewable energy in London – in particular, to identify broad areas where specific renewable energy technologies, including large scale systems and the large scale deployment of small scale systems, are appropriate. The identification of areas should be consistent with any guidelines and criteria outlined by the Mayor.

D All renewable energy systems should be located and designed to minimise any potential adverse impacts on biodiversity, the natural environment and historical assets, and to avoid any adverse impacts on air quality.

London Plan (December 2019) - Intend to publish version

A draft new London Plan was published by the Mayor for consultation in December 2017, although the current 2016 Plan is still the adopted Development Plan, the proposed document is given significant weight.

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 Regulations156 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.

1.3 SAP 10

The following guidance was issued by the GLA, in October 2018, for all new developments.

'Grid electricity has been significantly decarbonised since the last update of Part L in April 2014 and in July 2018 the Government published updated carbon emission factors (SAP 10) demonstrating this. These new emission factors will however not be incorporated into Part L of the Building Regulations until the Government has consulted on new Building Regulations.

The impact of these new emission factors is significant in that technologies generating on-site electricity (such as gas-engine CHP and solar PV) will not achieve the carbon savings they have to date. It is therefore anticipated that developments will need to utilise alternative or additional technologies to meet the 35 per cent on-site carbon reduction target, including using zero emission or local secondary heat sources.

The GLA has decided that from January 2019 and until central Government updates Part L with the latest carbon emission factors, planning applicants are encouraged to use the SAP 10 emission factors for referable applications when estimating CO_2 emission performance against London Plan policies. This will ensure that the assessment of new developments better reflects the actual carbon emissions associated with their expected operation'.

As a result of the above guidance, MES have based the reduction targets on the proposed SAP 10 emission factors, as these are considered more accurate although it is acknowledged that the EPC certificates are currently assessed against SAP 2012.

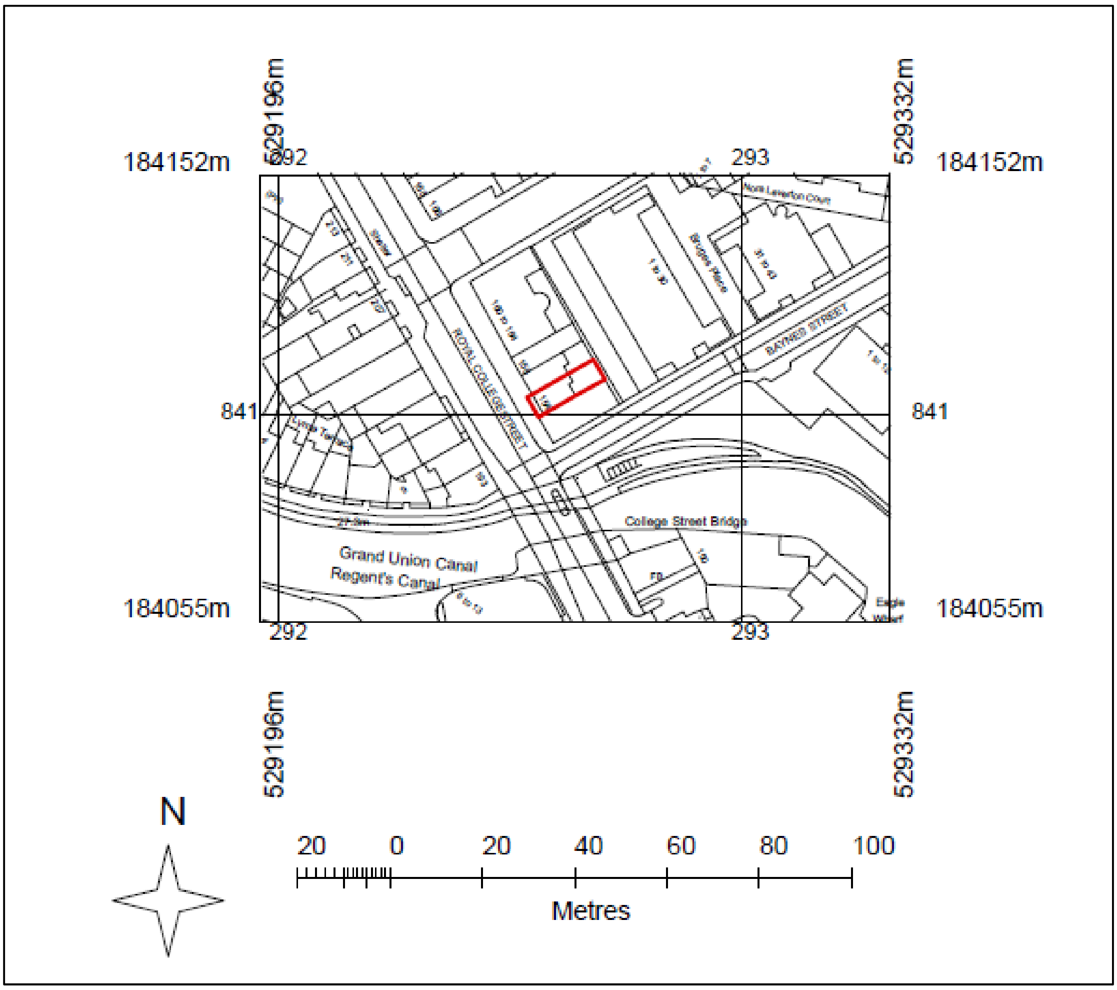
	Emissions kg CO_2 per kWh	
	SAP 2012	**SAP 10**
Mains Gas	0.216	0.210
Electricity	0.519	0.233

1c: SAP 2012 and SAP 10 emission factors

Section 2: Description of development

2.1 Location

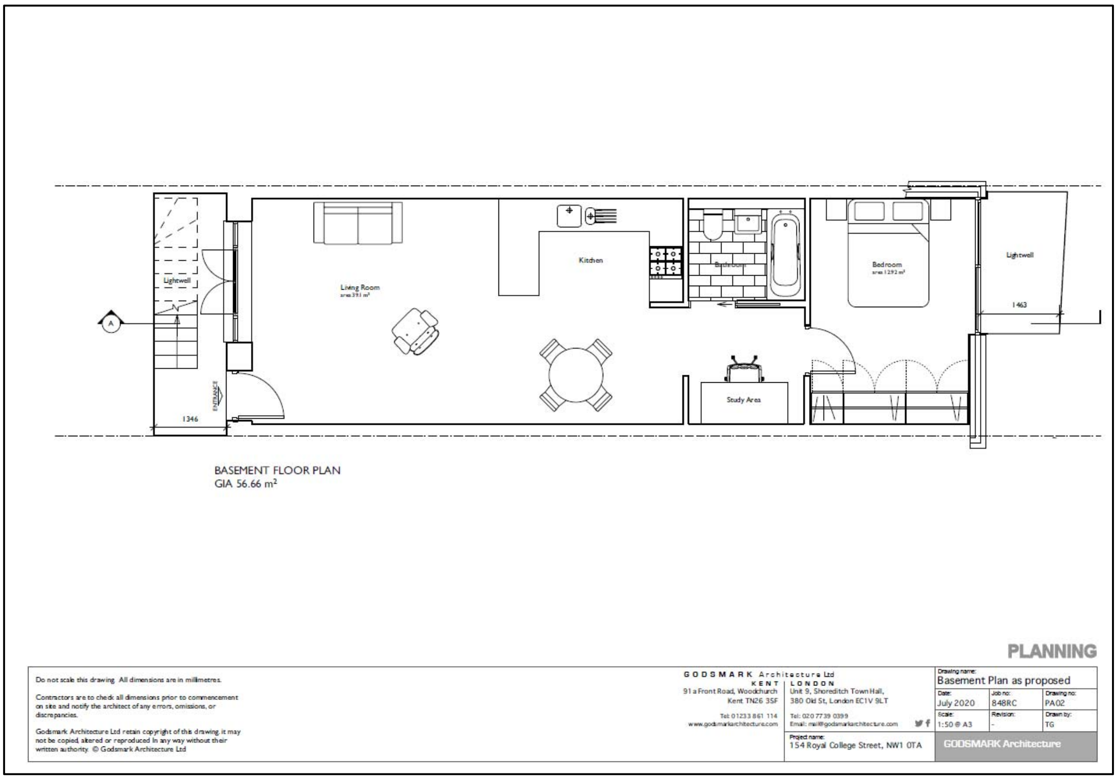
The development site is located at 154 Royal College Street, NW1 0TA, which is an established residential street containing predominately two and three storey terraced dwellings, with an element of ground floor retail.



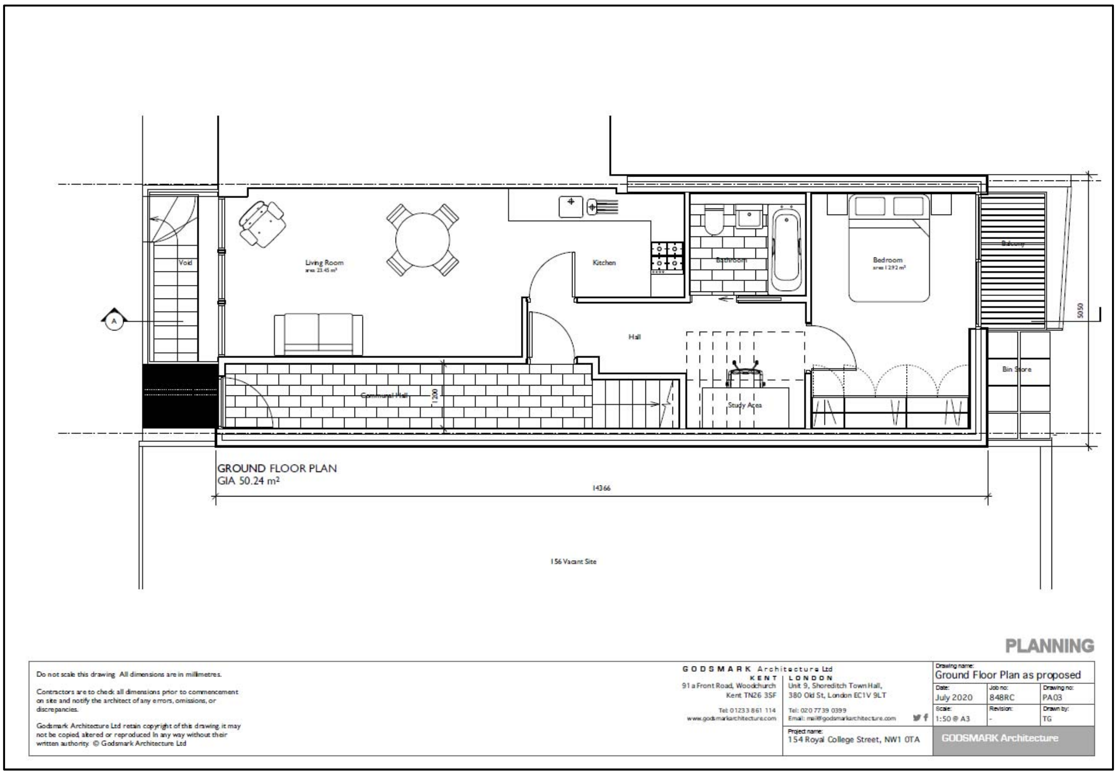
Site Location Plan (Godsmark Architects Ltd)

2.2 Details of development

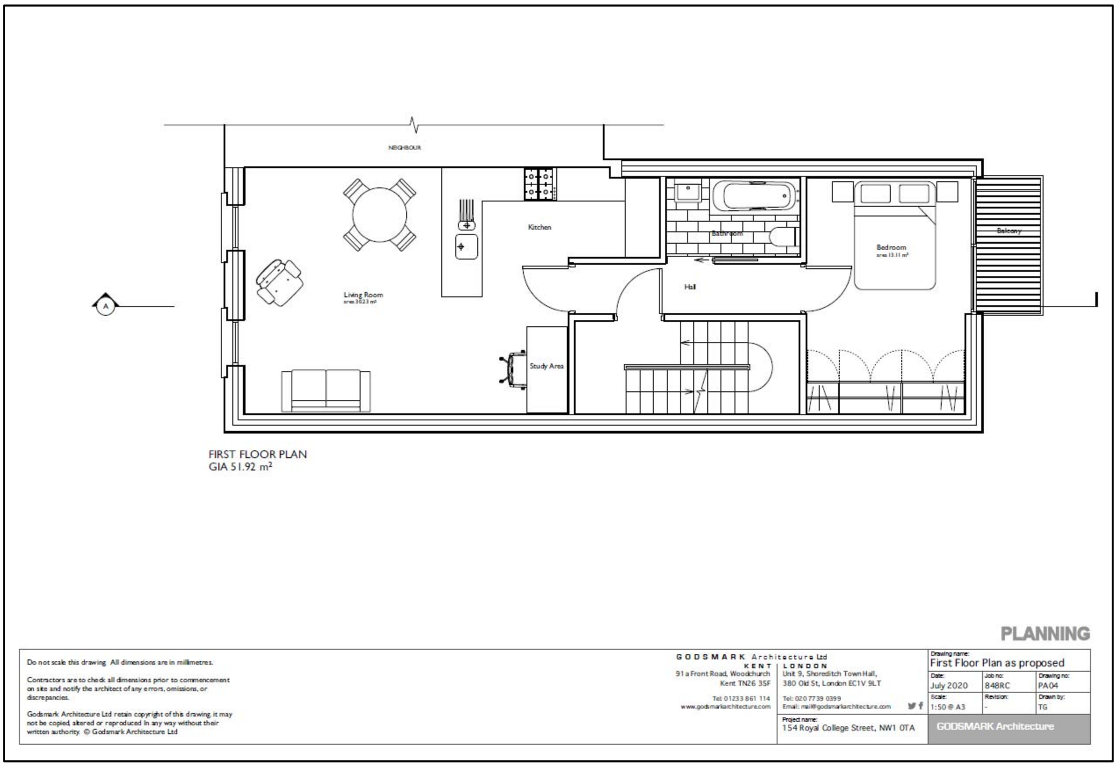
The application is for the construction of four flats on the existing site, which will be demolished and rebuilt. In line with London Borough of Camden planning policy this is to be considered a minor development.



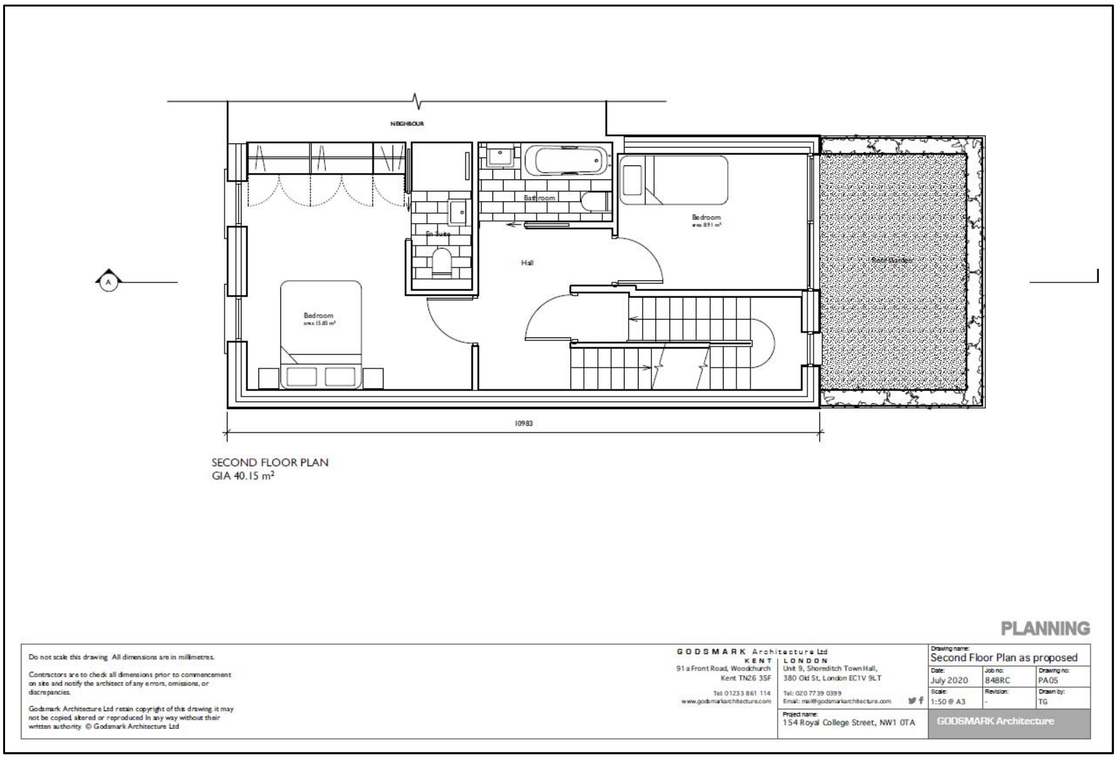
Proposed Basement Floor Plan (Godsmark Architecture Ltd)



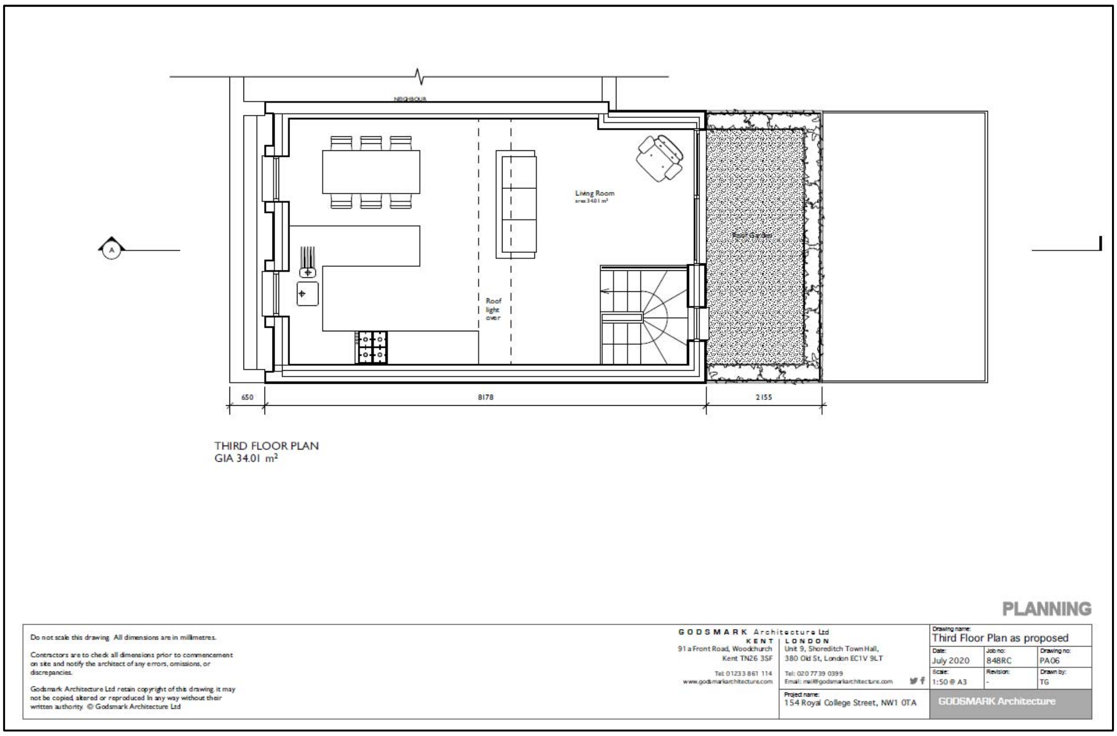
Proposed Ground Floor Plan (Godsmark Architecture Ltd)



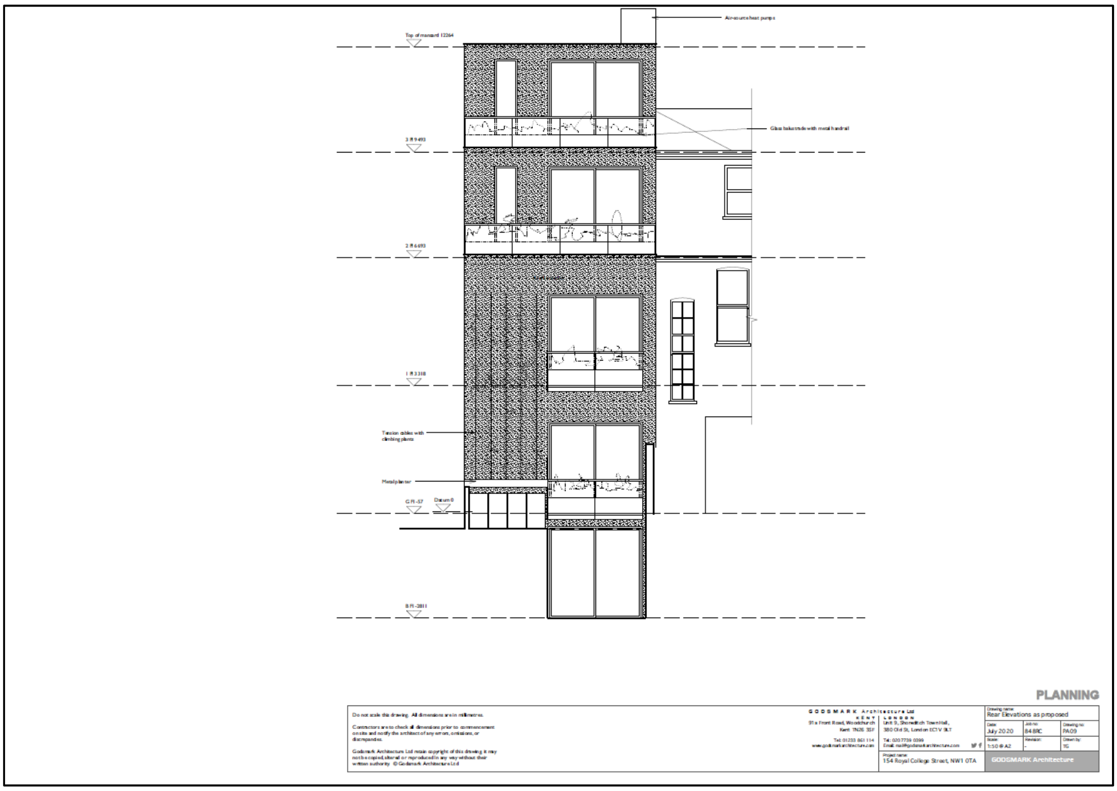
Proposed First Floor Plan (Godsmark Architecture Ltd)



Proposed Second Floor Plan (Godsmark Architecture Ltd)



Proposed Third Floor Plan (Godsmark Architecture Ltd)



Proposed Elevations (Godsmark Architecture Ltd)

Section 3: Energy

3.1 The Energy Hierarchy

The energy hierarchy is generally accepted as the most effective way of reducing building 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:

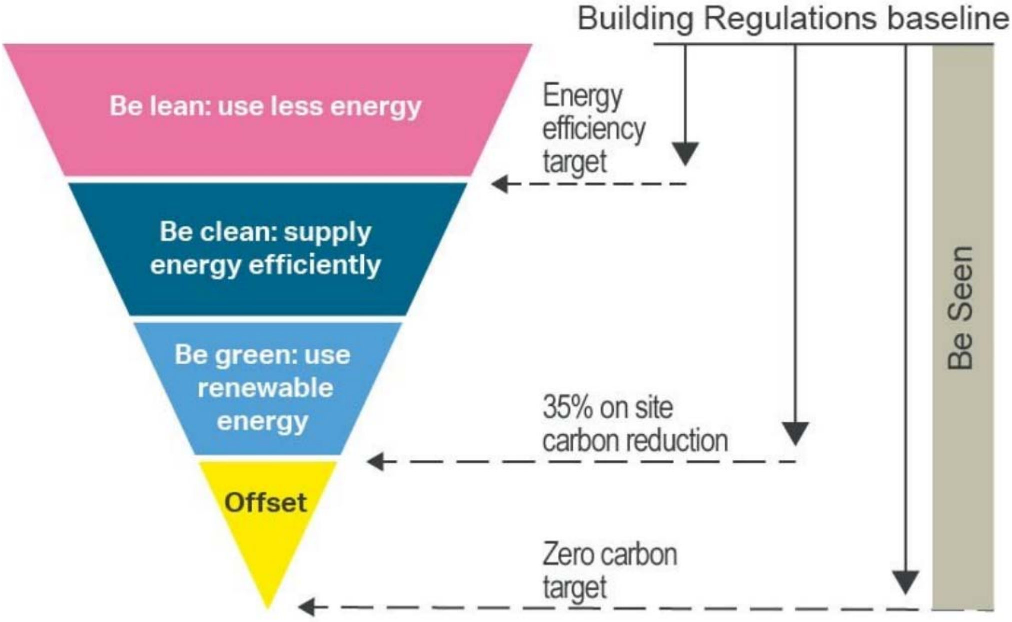


Figure 3.1: The Energy Hierarchy

- ***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

Energy used in a building is divided between that which is regulated (Heating, Cooling, Hot water, Ventilation & Lighting) and that which is said to be associated with the building in use (Equipment and Appliances).

3a: Unregulated Energy Use and Emissions		
	Part L	SAP 10
Emissions (Tonnes CO_2 per year)	4.61	10,672
Energy (kWh per year)	19,940	10,672

The first step is to calculate a Building Regulations Part L1A 2013 compliant specification in order to establish baseline emissions for the development. In order to comply with Camden's planning requirements, the development must achieve targets based on a Part L 2010 baseline. However; the development will be required to comply with 2013 Building Regulations and as such baseline figures are calculated using the most appropriate SAP model. Full SAP calculations have been undertaken on the government approved SAP2012 software and the current methodology has been used to establish baseline energy requirements which comply with the 2013 edition of Part L1A, along with applying the conversion factor to the SAP 10 emissions.

House Type	Part L Carbon Emissions (tonnes CO_2 per year)								Total Emissions (tonnes CO_2 per year)
	Space Heating (Gas)	Space Heating (Electricity)	Secondary Heating	Water Heating (Gas)	Water Heating (Electricity)	Pumps & Fans	Lighting	Additional Allowable Generation	
Flat 1	0.77	0.00	0.00	0.72	0.00	0.04	0.13	0.00	1.66
Flat 2	0.78	0.00	0.00	0.70	0.00	0.04	0.12	0.00	1.64
Flat 3	0.93	0.00	0.00	0.70	0.00	0.04	0.12	0.00	1.79
Flat 4	1.29	0.00	0.00	0.79	0.00	0.04	0.17	0.00	2.28
Total:	**3.76**	**0.00**	**0.00**	**2.91**	**0.00**	**0.16**	**0.55**	**0.00**	**7.38**
								Total:	**7.38**

Table 3.b: Part L Baseline carbon dioxide (CO_2) emissions. (Tonnes CO_2 per year)

House Type	SAP 10 Carbon Emissions (tonnes CO_2 per year)								Total Emissions (tonnes CO_2 per year)
	Space Heating (Gas)	Space Heating (Electricity)	Secondary Heating	Water Heating (Gas)	Water Heating (Electricity)	Pumps & Fans	Lighting	Additional Allowable Generation	
Flat 1	0.75	0.00	0.00	0.70	0.00	0.02	0.06	0.00	1.53
Flat 2	0.76	0.00	0.00	0.68	0.00	0.02	0.05	0.00	1.51
Flat 3	0.90	0.00	0.00	0.68	0.00	0.02	0.06	0.00	1.65
Flat 4	1.25	0.00	0.00	0.77	0.00	0.02	0.08	0.00	2.11
Total:	**3.66**	**0.00**	**0.00**	**2.83**	**0.00**	**0.07**	**0.25**	**0.00**	**6.81**
								Total:	**6.81**

Table 3c: SAP 10 'Baseline' carbon dioxide (CO_2) emissions. (Tonnes CO_2 per year)

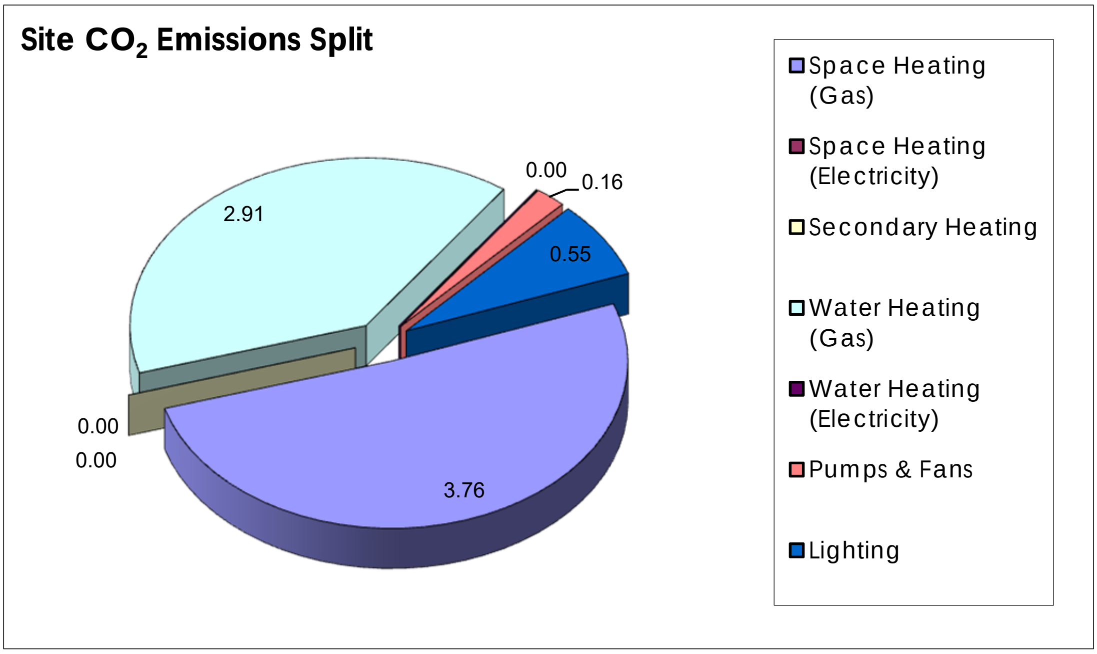


Figure 3.2: Part L Baseline carbon dioxide emissions (tonnes CO_2 per year) split.

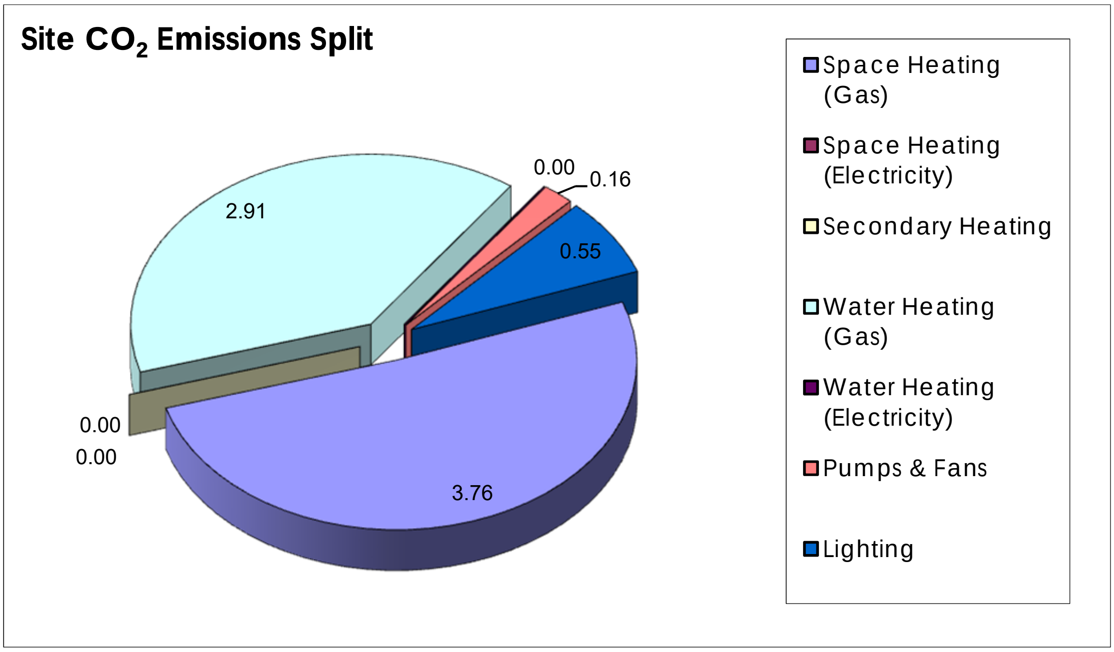


Figure 3.3: SAP 10 Baseline CO_2 emissions split

Figures 3.2 and 3.3 show how the CO_2 emissions are split between individual energy end uses.

3.3 Emission reduction targets

London Borough of Camden requires this minor development to achieve a 35% reduction over 2013 Part L minimum standards. We are aiming to accomplish this through a holistic, fabric first approach that will only require a limited amount of additional renewable technology. The TER accounts for REGULATED energy only and as such the emissions for appliances & cooking are discounted when calculating the planning target.

3.4 Energy Efficiency Measures (Be lean & be clean)

The first two steps of the Mayor's energy hierarchy require the reduction of 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. As the new 2013 Part L1A is already very stringent in terms of fabric performance targets, the reduction possible from further improvement to the building fabric and services is limited when compared those which may be expected from buildings constructed to earlier versions of Building Regulations.

The increase in Building Regulation targets has meant that we have had to combine stages one and two of the hierarchy to try and achieve a Part L compliant specification. A summary of the specification as used in the compliant model is shown in table 3d, below.

3d: Building Regulations Specification (Lean & Clean)	
Element	**Specification**
External Walls	0.11-0.23W/m²K
Corridor Walls	0.44/m²K
Flat Roof	0.24/m²K
Floor	0.12-0.26W/m²K
Solid Doors	1.40W/m²K
Windows/Fully Glazed Doors	1.40W/m²K
Air Permeability	5.1m³/m²/hr
Ventilation	Intermittent extract ventilation
Thermal Bridging	Calculated Y-Value
Lighting	100% low energy lamps
Space Heating	Low temp <=35 degree Air source heat pump
Heating Controls	Time and temperature zone control
DHW	Via main heating
Secondary Heating	None

House Type	Floor Area (m^2)	Part L Carbon Emissions (tonnes CO_2 per year)								Total Emissions (tonnes CO_2 per year)
		Space Heating (Gas)	Space Heating (Electricity)	Secondary Heating	Water Heating (Gas)	Water Heating (Electricity)	Pumps & Fans	Lighting	Additional Allowable Generation	
Flat 1	56	0.00	0.38	0.00	0.00	0.57	0.02	0.13	0.00	1.10
Flat 2	50	0.00	0.54	0.00	0.00	0.55	0.02	0.12	0.00	1.23
Flat 3	51	0.00	0.62	0.00	0.00	0.56	0.02	0.12	0.00	1.32
Flat 4	74	0.00	0.76	0.00	0.00	0.62	0.02	0.17	0.00	1.56
Total:	**231**	**0.00**	**2.30**	**0.00**	**0.00**	**2.30**	**0.06**	**0.55**	**0.00**	**5.21**
									Total:	**5.21**

Table 3.e: Part L ‘Lean & Clean’ carbon dioxide (CO_2) emissions. (Tonnes CO_2 per year)

House Type	Floor Area (m^2)	SAP 10 Carbon Emissions (tonnes CO_2 per year)								Total Emissions (tonnes CO_2 per year)
		Space Heating (Gas)	Space Heating (Electricity)	Secondary Heating	Water Heating (Gas)	Water Heating (Electricity)	Pumps & Fans	Lighting	Additional Allowable Generation	
Flat 1	56	0.00	0.17	0.00	0.00	0.26	0.01	0.06	0.00	0.50
Flat 2	50	0.00	0.24	0.00	0.00	0.25	0.01	0.05	0.00	0.55
Flat 3	51	0.00	0.28	0.00	0.00	0.25	0.01	0.06	0.00	0.59
Flat 4	74	0.00	0.34	0.00	0.00	0.28	0.01	0.08	0.00	0.70
Total:	**231**	**0.00**	**1.03**	**0.00**	**0.00**	**1.03**	**0.03**	**0.25**	**0.00**	**2.34**
									Total:	**2.34**

Table 3f: SAP 10 ‘Lean & Clean’ carbon dioxide (CO_2) emissions. (Tonnes CO_2 per year)

3.5 Be Clean (District Heating & CHP)

District heating

It is a requirement of the London Plan (Policy 5.6) to consider the application of both a district heating scheme and/or CHP technology on all new developments unless it is not possible on the application site.

As can be seen from the London Heat Map extract in Figure 3.4 below, there are no existing, or proposed heating networks within a feasible distance of the site, the closest proposed network being over 800m away. Space would be required for incoming pipework, and may need to be laid during the project for future use, with no guarantee it will be suitable or compatible at such time a connection may be available. Space would also be required for a plant room, to fit the heat exchangers, pump controls and ancillaries as well as riser space for the distribution pipework.

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

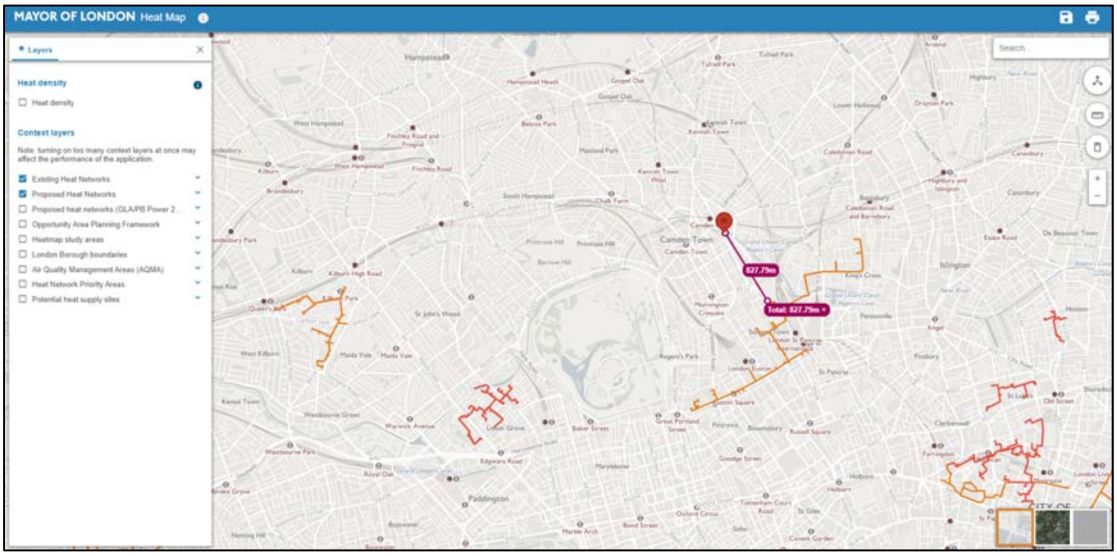
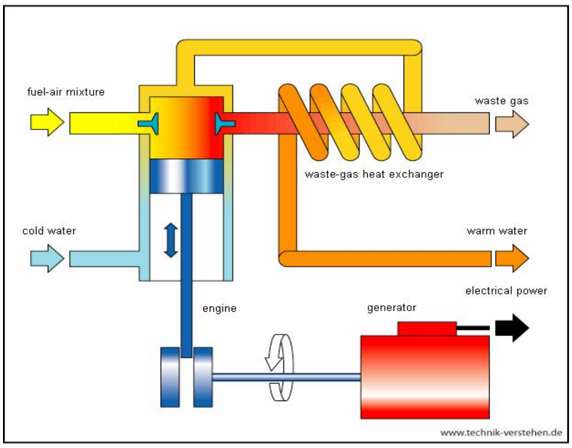


Figure 3.4 London Heat map showing the lack of a potential district heating network within the site boundary.

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.

In this case, CHP is not considered suitable given the lack of a district heating network within feasible reach of the site. The London Heat map indicates that there is currently no potential future district heating network for this site. The red line, indicated above, has been identified as a route that the decentralised energy network may eventually be extended into but the timescale for delivery is as yet unclear and as this is still too far away the use of this technology is discounted for this development.

An evaluation of the potential of renewable technology for this site is discussed in section 3.7 as this development will require a contribution to achieve the 35% reduction target.

3.6 The Cooling Hierarchy

Overheating within dwellings has become a more prevalent issue and steps to mitigate this risk are included within the steps over the cooling hierarchy listed below.

1. Minimising internal heat generation through energy efficient design: For example, heat distribution infrastructure within buildings should be designed to minimise pipe lengths, particularly lateral pipework in corridors of apartment blocks, and adopting pipe configurations which minimise heat loss e.g. twin pipes.
2. Reducing the amount of heat entering the building in summer: For example, through use of carefully designed shading measures, including balconies, louvres, internal or external blinds, shutters, trees and vegetation.
3. Use of thermal mass and high ceilings to manage the heat within the building: Increasing the amount of exposed thermal mass can help to absorb excess heat within the building.
4. Passive ventilation: For example, through the use of openable windows, shallow floorplates, dual aspect units, designing in the 'stack effect'
5. Mechanical ventilation: Mechanical ventilation can be used to make use of 'free cooling' where the outside air temperature is below that in the building during summer months. This will require a by-pass on the heat recovery system for summer mode operation.

For this development the average risk of over overheating has been assessed by the SAP software as being 'slight'. This is a result of the high standard of insulation specification and windows.

3.7 CO_2 reduction through the use of renewable or low carbon technology (Be green)

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, and in attempting to meet the Future Home Standards, solar photovoltaics and air source heat pumps have been specified.

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 will be one of the recommended renewable technologies on the site, with the installation of 4 x 300W panels giving 1.2kW peak.

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 3g: Average wind speeds for the site	
45m above ground level	6.1m/s
25m above ground level	5.6m/s
10m above ground level	4.8m/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%.

The ‘fuel’ for heat pumps is usually grid supplied electricity which does not demonstrate any significant reductions when compared to efficient gas boilers under current Part L, however, this will change with the introduction of SAP 10. This is a chosen 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.

3h: Building Regulations Specification (Lean, Clean & Green)	
Element	**Specification**
External Walls	0.11-0.23W/m²K
Corridor Walls	0.44/m²K
Flat Roof	0.24/m²K
Floor	0.12-0.26W/m²K
Solid Doors	1.40W/m²K
Windows/Fully Glazed Doors	1.40W/m²K
Air Permeability	5.1m³/m²/hr
Ventilation	Intermittent extract ventilation
Thermal Bridging	Calculated Y-Value
Lighting	100% low energy lamps
Space Heating	Low temp <=35 degree Air source heat pump
Heating Controls	Time and temperature zone control
DHW	Via main heating
Secondary Heating	None
Renewable Technology	4 x 300W PV panels

House Type	Part L Carbon Emissions (tonnes CO_2 per year)								Total Emissions (tonnes CO_2 per year)
	Space Heating (Gas)	Space Heating (Electricity)	Secondary Heating	Water Heating (Gas)	Water Heating (Electricity)	Pumps & Fans	Lighting	Additional Allowable Generation	
Flat 1	0.00	0.38	0.00	0.00	0.57	0.02	0.13	-0.12	0.98
Flat 2	0.00	0.54	0.00	0.00	0.55	0.02	0.12	-0.12	1.11
Flat 3	0.00	0.62	0.00	0.00	0.56	0.02	0.12	-0.12	1.20
Flat 4	0.00	0.76	0.00	0.00	0.62	0.02	0.17	-0.12	1.44
Total:	**0.00**	**2.30**	**0.00**	**0.00**	**2.30**	**0.06**	**0.55**	**-0.47**	**4.74**
								Total:	**4.74**

Table 3i: Part L 'Be lean be clean & be green' carbon dioxide (CO_2) emissions. (Tonnes CO_2 per year)

House Type	SAP 10 Carbon Emissions (tonnes CO_2 per year)								Total Emissions (tonnes CO_2 per year)
	Space Heating (Gas)	Space Heating (Electricity)	Secondary Heating	Water Heating (Gas)	Water Heating (Electricity)	Pumps & Fans	Lighting	Additional Allowable Generation	
Flat 1	0.00	0.17	0.00	0.00	0.26	0.01	0.06	-0.05	0.44
Flat 2	0.00	0.24	0.00	0.00	0.25	0.01	0.05	-0.05	0.50
Flat 3	0.00	0.28	0.00	0.00	0.25	0.01	0.06	-0.05	0.54
Flat 4	0.00	0.34	0.00	0.00	0.28	0.01	0.08	-0.05	0.65
Total:	**0.00**	**1.03**	**0.00**	**0.00**	**1.03**	**0.03**	**0.25**	**-0.21**	**2.13**
								Total:	**2.13**

Table 3j: SAP 10 'Be lean be clean & be green' carbon dioxide (CO_2) emissions. (Tonnes CO_2 per year)

House Type	Energy (kWh per year)								Total Energy (kWh per year)
	Space Heating (1) *SAP (261)*	Space Heating (2) *SAP (262)*	Secondary Heating *SAP (263)*	Water Heating *SAP (264)*	Space Cooling *SAP (266)*	Pumps & Fans *SAP (267)*	Lighting *SAP (268)*	Additional Allowable Generation	
Flat 1	0	741	0	0	1,097	30	258	-228	1,898
Flat 2	0	1,041	0	0	1,064	30	234	-228	2,140
Flat 3	0	1,200	0	0	1,070	30	240	-228	2,312
Flat 4	0	1,458	0	0	1,199	30	324	-228	2,783
Total:	**0**	**4,440**	**0**	**0**	**4,429**	**120**	**1,056**	**-913**	**9,132**
								Total:	**9,132**

Table 3k: 'Be lean be clean & be green' Energy demand (kWh per year)

3l: Contribution from renewables & total improvement over Part L		
	Part L	**SAP 10**
Total Baseline Emissions (Tonnes CO_2/yr)	7.38	6.81
Total Be Lean & Be Clean Emissions (Tonnes CO_2/yr)	5.21	2.34
Total compliant Be Green Emissions (Tonnes CO_2/yr)	4.74	2.13
Contribution from PV (Tonnes CO_2/yr)	-0.47	-0.21
Percentage reduction achieved from PV	9.02%	8.97%
Total improvement over baseline (%)	**35.77%**	**68.72%**

Section 4: Sustainability

4.1 Land Use & Ecology

Sustainability Objective:
To protect, maintain and enhance existing biodiversity and habitats. To create new habitats to add value to the landscape in order to improve the urban environment.

This is an urban location with the potential site currently containing an existing building and is assumed to have minimal ecological value. The nature of the development means there may be opportunity to improve the ecology of the site by incorporating areas of planting. Efforts will be made to protect any existing urban habitats while encouraging new ones.

As the current site may have limited ecological value any undertaking to improve upon this will have a positive ecological impact.

4.2 Materials

Sustainability Objective:
To reduce the impact of construction on natural resources by using sustainable, legally sourced product.

Building materials have a significant impact when the embodied energy and resources used in their manufacture, transport and disposal are considered. Responsible sourcing of materials can have a real beneficial effect on the embodied impact of the final development.

All relevant materials in basic and finishing elements will be responsibly and legally sourced from certified suppliers using sustainable raw materials where possible.

Wherever possible reused and recycled materials will be sourced.

All materials will be sourced from local suppliers where possible to reduce transport miles and support the local supply chain.

Materials containing chemicals which are harmful to health or the environment will be avoided wherever possible.

4.3 Pollution

Sustainability Objective: *To reduce the environmental impact of atmospheric, watercourse, noise and sound pollution.*

There are a variety of forms of environmental pollution that can potentially arise from the construction and use of buildings. A significant proportion is airborne in the form of dust, fumes and chemicals. Other forms of pollution include unwanted noise or light.

Best practice will be used during the construction phase to ensure that environmental pollution due to construction work will be minimised. This site, being on a former petrol station forecourt, will have a specific strategy for dealing with the removal of this contaminated material.

Efforts will be made to ensure the environmental impact of the materials used for the build will be reduced through responsible sourcing and reduced wastage.

The use of materials whose manufacture or installation requires the use of harmful global warming chemicals will be avoided.

Any cooling systems will be specified to either contain no potentially damaging chemicals, or where this is unavoidable to minimise the risk of environmental contamination due to accidental spillage.

4.4 Site Management

Sustainability Objective: *To use sustainable construction methods and encourage best practice in building delivery.*

Best practice will be used during construction so as to reduce the impact of works on the surrounding environment.

The construction site will be managed so as to reduce resource use, energy for site operations, water consumption, waste and pollution.

A system of monitoring, target setting and reporting could be put in place to ensure standards are met.

Home and building user guides could be provided to building end users, if requested, to ensure they are provided with adequate information to enable effective use of the building and its systems. These will be tailored to ensure all building users fully understand the buildings operation so as to encourage efficient use.

4.5 Transport

Sustainability Objective:

To reduce pollution and congestion levels. To encourage walking, cycling and the use of public transport.

As around 30% of UK energy use is associated with transport. Developments of this nature that can encourage a reduction in car use have a positive impact on the environment both through a reduced reliance on precious fossil fuel resources and a reduction in harmful emissions.

The location of the development means that it is close to local amenities and has excellent public transport links, with regular bus services on Royal College Street and Camden Road Overground Station within walking distance of approximately 150m away.

4.6 Waste Management

Sustainability Objective:

To reduce waste going to landfill through material efficiency, recycling and sustainable construction methods.

A key part of sustainability is to manage resources efficiently. Reducing the amount of waste created and maximising resource efficiency during demolition, construction and during the building's lifetime is fundamental to providing sustainable developments.

Efforts to reduce construction waste generally will concentrate on reducing site waste together with increasing reuse and recycling of waste that cannot be avoided in an effort to reduce volumes going to landfill. This could be implemented through a Site Waste Management Plan.

Adequate facilities will be provided for the storage and recycling of household waste and this in conjunction with the adoption of the Local Authority collection scheme for waste and recycling will encourage occupants to minimise waste going to landfill.

4.7 Water Use

Sustainability Objective:
Conserve water through efficiency measures and recycling. Mitigating against increases in flood risk due to reduction in permeable areas and climate change.

Water is a precious commodity even in the UK and with ever increasing demand for clean drinking water measures need to be taken to safeguard future supplies.

Approximately 50% of the water consumed in domestic dwellings is not used for consumption, (the percentage is even higher in many commercial buildings) it is for washing and flushing of toilets etc. Measures to reduce the amount of potable water used for these activities reduce the demand for potable water and make better use of this limited resource.

A reduction in water use will be achieved through a combination of efficiency measures, including the specification of efficient fittings, lower capacity baths and dual flush toilets.

Development of previously open land and climate change increases the chance of flash flooding and the management of surface water run-off is to be considered seriously in order to mitigate these effects.

Initial investigations of the Environment Agency Flood Map suggest that the site is in Zone 1 with a low risk of flooding.

As the site currently contains an existing building, if the new proposals are surfaced with impermeable materials, it is not anticipated that redevelopment would cause any significant increase in run-off from the site with correct planning and design. A full SuDS design could be undertaken to further confirm this and influence design choices.

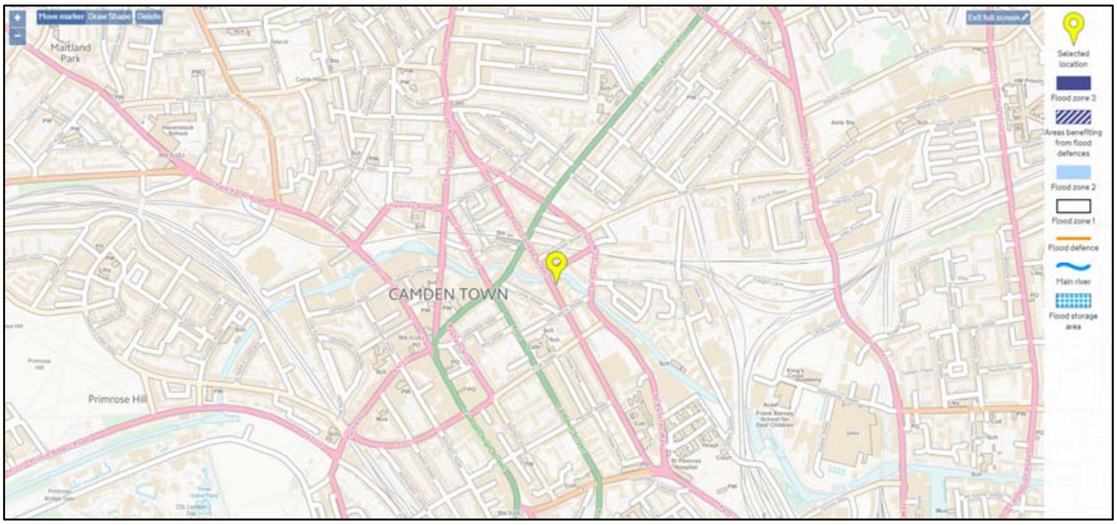


Figure 4.1: Environment Agency Flood Map for the development

4.8 Health & Wellbeing

Sustainability Objective:

To provide comfortable working and living spaces that promotes a healthy environment and which is adaptable to changing needs.

Health and wellbeing considers the environment provided for building users and how this promotes healthy happy lives.

The dwellings are designed and orientated wherever possible in such a way as to provide natural daylight, sunlight and external views to occupied spaces thus adding to the internal environment.

Finishing elements will be chosen which do not contain harmful chemicals.

Every practical effort will be made to minimise sound transmission both from the external environment and between individual dwellings. The measures employed will aim to go beyond current Building Regulation standards for minimising sound transmission.

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. This has allowed the proposed dwelling to achieve a compliant Fabric Energy Efficiency specification and to exceed the 35% requirement required from Camden. The design proposals of high quality building fabric, efficient mechanical services along with the installation of an air source heat pump and solar PV have achieved the Camden Council requirement with a 35.77% reduction over current Part L.

Table 4.a shows the reduction in kWh and tonnes of CO_2 per year through the recommended fabric improvements and energy efficiency system measures which ensure the development will meet and exceed current building regulations.

Table 4a: Total anticipated reduction in regulated emissions & energy use				
	Part L		SAP 10	
	kWh/year	Tonnes CO_2 per year	kWh/year	Tonnes CO_2 per year
Total Part L1A 'Baseline' annual figures	32,259	7.38	40,380	6.81
Total 'be lean, be clean' annual figures	10,045	5.21	39,490	2.34
Total 'be lean, be clean & be green' annual figures	9,132	4.74	36,165	2.13
Contribution from PV	**-913**	**-0.47**	**-4,215**	**-0.21**
Total reduction over Baseline	**71.69%**	**35.77%**	**71.69%**	**68.72%**

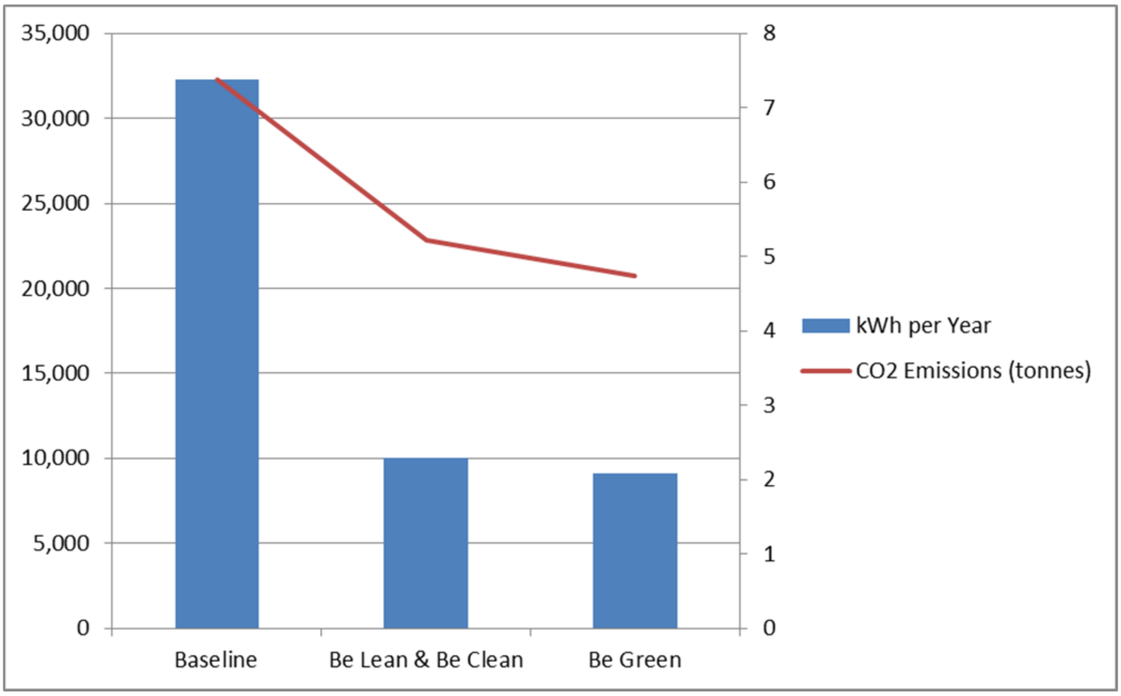


Figure 5.1: Part L Reduction through each stage of the Energy Hierarchy

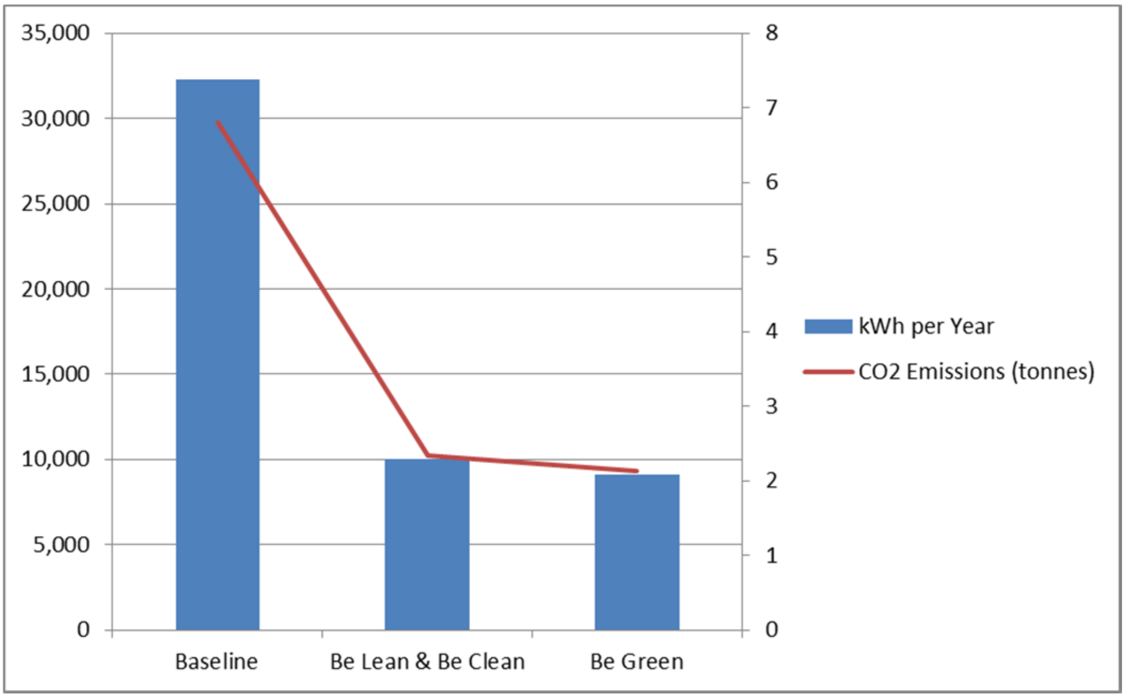


Figure 5.2: SAP 10 Reduction through each stage of the Energy Hierarchy

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

Property Reference	0007-Godsmark-Royal-College-F1	Issued on Date	13/08/2020
Assessment Reference	AD	Prop Type Ref	Flat 1
Property	Flat 1, 154, Royal College Street, London, NW1 0TA		

SAP Rating	87 B	DER	17.66	TER	29.83
Environmental	88 B	% DER<TER	40.80		
CO_2 Emissions (t/year)	0.81	DFEE	42.14	TFEE	54.19
General Requirements Compliance	Pass	% DFEE<TFEE	22.24		

Assessor Details	Mr. Andrew Gwynne, Andrew Gwynne, Tel: 01636 653055, andrew.gwynne@mesenergyservices.co.uk	Assessor ID	P741-0001
Client			

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

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

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DWELLING AS DESIGNED

Basement flat, total floor area 56 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) 29.83 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.66 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)42.1 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.11 (max. 0.30)	0.13 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.20 (max. 0.20)	0.20 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.049

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3 Air permeability

Air permeability at 50 pascals:	5.10 (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: 2.10 kWh/day	
Permitted by DBSCG 2.10	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
Not applicable

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9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing East:	6.10 m², No overhang	
Windows facing West:	4.73 m², No overhang	
Air change rate:	6.00 ach	
Blinds/curtains:	None	

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10 Key features

External wall U-value	0.13 W/m²K
External wall U-value	0.11 W/m²K
Party wall U-value	0.00 W/m²K
Floor U-value	0.12 W/m²K
Photovoltaic array	0.30 kW

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)	
Basement floor	55.7700 (1a)	x	2.4200 (2a)	=	134.9634	(1a) - (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.7700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	134.9634	(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							2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.1482	(8)
Pressure test		Yes	
Measured/design AP50		5.1000	
Infiltration rate		0.4032	(18)
Number of sides sheltered		4	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2822	(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	0.3598	0.3528	0.3457	0.3105	0.3034	0.2681	0.2681	0.2611	0.2822	0.3034	0.3175	0.3316	(22b)
Effective ac	0.5647	0.5622	0.5598	0.5482	0.5460	0.5359	0.5359	0.5341	0.5398	0.5460	0.5504	0.5550	(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	
Door			1.9700	1.4000	2.7580			(26)
Glazed Door (Uw = 1.40)			10.8300	1.3258	14.3580			(27)
Basement			55.7700	0.1200	6.6924	75.0000	4182.7500	(28)
Wall 1 - To Lightwell	16.3000	12.8000	3.5000	0.1300	0.4550	60.0000	210.0000	(29a)
Wall 2 - Basement	50.9000		50.9000	0.1100	5.5990	60.0000	3054.0000	(29a)
Flat Ceiling - To Stairwell	8.2400		8.2400	0.2005	1.6524	9.0000	74.1600	(30)
Total net area of external elements Aum(A, m2)			131.2100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.5148			(33)
Party Wall 1			17.6800	0.0000	0.0000	45.0000	795.6000	(32)
Party Ceilings 1			46.3300			80.0000	3706.4000	(32b)
Stud Wall			48.2500			9.0000	434.2500	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12457.1600	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		223.3667	(35)
Thermal bridges (User defined value 0.049 * total exposed area)		6.4293	(36)
Total fabric heat loss	(33) + (36) =	37.9441	(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	25.1525	25.0406	24.9308	24.4153	24.3188	23.8698	23.8698	23.7867	24.0428	24.3188	24.5140	24.7180	(38)
Heat transfer coeff	63.0966	62.9846	62.8749	62.3593	62.2629	61.8139	61.8139	61.7307	61.9868	62.2629	62.4580	62.6620	(39)
Average = Sum(39)m / 12 =												62.3589	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1314	1.1294	1.1274	1.1182	1.1164	1.1084	1.1084	1.1069	1.1115	1.1164	1.1199	1.1236	(40)
HLP (average)												1.1181	(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	1.8599	(42)
Average daily hot water use (litres/day)	78.3722	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.2094	83.0745	79.9397	76.8048	73.6699	70.5350	70.5350	73.6699	76.8048	79.9397	83.0745	86.2094	(44)
Energy conte	127.8461	111.8150	115.3831	100.5938	96.5221	83.2912	77.1816	88.5670	89.6248	104.4490	114.0143	123.8121	(45)
Energy content (annual)										Total = Sum(45)m =		1233.1001	(45)
Distribution loss (46)m = 0.15 x (45)m	19.1769	16.7723	17.3075	15.0891	14.4783	12.4937	11.5772	13.2850	13.4437	15.6674	17.1021	18.5718	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:

Store volume	180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	2.1000	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	1.1340	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	(56)
If cylinder contains dedicated solar storage	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	(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	186.2625	164.5782	173.7995	157.1258	154.9385	139.8232	135.5980	146.9834	146.1568	162.8654	170.5463	182.2285	(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	186.2625	164.5782	173.7995	157.1258	154.9385	139.8232	135.5980	146.9834	146.1568	162.8654	170.5463	182.2285	(64)

Total per year (kWh/year) = Sum(64)m = 1920.9061 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	89.2419	79.3891	85.0980	78.6730	78.8267	72.9199	72.3960	76.1816	75.0258	81.4624	83.1353	87.9007	(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	92.9941	92.9941	92.9941	92.9941	92.9941	92.9941	92.9941	92.9941	92.9941	92.9941	92.9941	92.9941	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.6080	12.9747	10.5517	7.9883	5.9714	5.0413	5.4473	7.0806	9.5035	12.0669	14.0839	15.0140	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	162.1676	163.8504	159.6099	150.5822	139.1863	128.4758	121.3206	119.6378	123.8783	132.9060	144.3019	155.0124	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.2994	32.2994	32.2994	32.2994	32.2994	32.2994	32.2994	32.2994	32.2994	32.2994	32.2994	32.2994	(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)	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	(71)
Water heating gains (Table 5)	119.9489	118.1385	114.3790	109.2681	105.9499	101.2777	97.3064	102.3947	104.2025	109.4925	115.4658	118.1460	(72)
Total internal gains	350.6227	348.8618	338.4388	321.7368	305.0058	288.6930	277.9725	283.0113	291.4827	308.3637	327.7498	342.0706	(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	
East	6.1000	19.6403	0.7600	0.7000	0.7700	44.1695	(76)
West	4.7300	19.6403	0.7600	0.7000	0.7700	34.2494	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	78.4189	153.4040	252.6345	368.4523	451.5522	462.2440	440.0751	378.0180	293.8244	182.0267	97.7791	64.4879	(83)
Total gains	429.0416	502.2658	591.0733	690.1891	756.5580	750.9370	718.0476	661.0293	585.3070	490.3904	425.5289	406.5585	(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	54.8417	54.9392	55.0351	55.4900	55.5760	55.9797	55.9797	56.0551	55.8235	55.5760	55.4024	55.2220	
alpha	4.6561	4.6626	4.6690	4.6993	4.7051	4.7320	4.7320	4.7370	4.7216	4.7051	4.6935	4.6815	
util living area	0.9909	0.9806	0.9491	0.8592	0.7001	0.5145	0.3764	0.4251	0.6771	0.9175	0.9817	0.9928	(86)
MIT	20.0717	20.2196	20.4561	20.7181	20.8739	20.9298	20.9403	20.9386	20.8989	20.6680	20.3173	20.0422	(87)
Th 2	19.9753	19.9769	19.9785	19.9860	19.9874	19.9940	19.9940	19.9952	19.9915	19.9874	19.9846	19.9816	(88)
util rest of house	0.9883	0.9752	0.9354	0.8252	0.6417	0.4387	0.2916	0.3345	0.5968	0.8886	0.9757	0.9908	(89)
MIT 2	18.7444	18.9591	19.2957	19.6540	19.8409	19.9019	19.9092	19.9097	19.8750	19.6006	19.1083	18.7066	(90)

Living area fraction fLA = Living area / (4) = 0.6005 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	19.5414	19.7160	19.9925	20.2930	20.4612	20.5192	20.5284	20.5275	20.4899	20.2416	19.8343	19.5086	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5414	19.7160	19.9925	20.2930	20.4612	20.5192	20.5284	20.5275	20.4899	20.2416	19.8343	19.5086	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9869	0.9735	0.9356	0.8363	0.6700	0.4788	0.3369	0.3829	0.6380	0.8967	0.9746	0.9896	(94)
Useful gains	423.4398	488.9558	552.9929	577.1758	506.8596	359.5367	241.8754	253.0770	373.3995	439.7431	414.7154	402.3155	(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	961.6824	933.1821	848.3417	710.4586	545.4977	365.8866	242.8278	254.7963	396.0886	600.3120	795.3609	959.2697	(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	400.4525	298.5201	219.7395	95.9637	28.7467	0.0000	0.0000	0.0000	0.0000	119.4633	274.0648	414.3739	(98)

Space heating		1851.3244	(98)
Space heating per m2	(98) / (4) =	33.1957	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 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 %)	249.9000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	740.8261	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	400.4525	298.5201	219.7395	95.9637	28.7467	0.0000	0.0000	0.0000	0.0000	119.4633	274.0648	414.3739	(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)	160.2451	119.4558	87.9310	38.4008	11.5033	0.0000	0.0000	0.0000	0.0000	47.8044	109.6698	165.8159	(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	186.2625	164.5782	173.7995	157.1258	154.9385	139.8232	135.5980	146.9834	146.1568	162.8654	170.5463	182.2285	(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	106.3749	93.9910	99.2573	89.7349	88.4857	79.8534	77.4403	83.9425	83.4705	93.0128	97.3994	104.0711	(219)
Water heating fuel used												1097.0337	(219)

Annual totals kWh/year			
Space heating fuel - main system		740.8261	(211)
Space heating fuel - secondary		0.0000	(215)
Electricity for pumps and fans:			
central heating pump		30.0000	(230c)
Total electricity for the above, kWh/year		30.0000	(231)
Electricity for lighting (calculated in Appendix L)		257.9812	(232)
Energy saving/generation technologies (Appendices M ,N and Q)			
PV Unit 0 (0.80 * 0.30 * 951 * 1.00) =	-228.1478	-228.1478	(233)
Total delivered energy for all uses		1897.6932	(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	740.8261	0.5190	384.4887	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1097.0337	0.5190	569.3605	(264)
Space and water heating			953.8492	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	257.9812	0.5190	133.8923	(268)
Energy saving/generation technologies				
PV Unit	-228.1478	0.5190	-118.4087	(269)
Total CO2, kg/year			984.9028	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.6600	(273)

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

DER		17.6600	ZC1
Total Floor Area	TFA	55.7700	
Assumed number of occupants	N	1.8599	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.2310	ZC2
CO2 emissions from cooking, equation (L16)		2.9341	ZC3
Total CO2 emissions		37.8251	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		37.8251	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)	
Basement floor		55.7700	(1a)	x	2.4200	(2a)	=	134.9634	(1a) - (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.7700								(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	134.9634	(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							2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.1482	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3982	(18)
Number of sides sheltered			4	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.7000	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.2787	(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	0.3554	0.3484	0.3414	0.3066	0.2996	0.2648	0.2648	0.2578	0.2787	0.2996	0.3136	0.3275	(22b)
Effective ac	0.5631	0.5607	0.5583	0.5470	0.5449	0.5351	0.5351	0.5332	0.5388	0.5449	0.5492	0.5536	(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 Opaque door			1.9700	1.0000	1.9700			(26)
TER Opening Type (Uw = 1.40)			10.8300	1.3258	14.3580			(27)
Basement			55.7700	0.1300	7.2501			(28)
Wall 1 - To Lightwell	16.3000	12.8000	3.5000	0.1800	0.6300			(29a)
Wall 2 - Basement	50.9000		50.9000	0.1800	9.1620			(29a)
Flat Ceiling - To Stairwell	8.2400		8.2400	0.1300	1.0712			(30)
Total net area of external elements Aum(A, m2)			131.2100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.4413			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.9177	(36)
Total fabric heat loss	(33) + (36) =	41.3590	(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	25.0815	24.9723	24.8652	24.3624	24.2683	23.8304	23.8304	23.7493	23.9991	24.2683	24.4586	24.6576	(38)
Heat transfer coeff	66.4404	66.3312	66.2242	65.7213	65.6273	65.1893	65.1893	65.1082	65.3580	65.6273	65.8176	66.0165	(39)
Average = Sum(39)m / 12 =												65.7209	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1913	1.1894	1.1875	1.1784	1.1767	1.1689	1.1689	1.1674	1.1719	1.1767	1.1802	1.1837	(40)
HLP (average)												1.1784	(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	1.8599	(42)
Average daily hot water use (litres/day)	78.3722	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.2094	83.0745	79.9397	76.8048	73.6699	70.5350	70.5350	73.6699	76.8048	79.9397	83.0745	86.2094	(44)
Energy conte	127.8461	111.8150	115.3831	100.5938	96.5221	83.2912	77.1816	88.5670	89.6248	104.4490	114.0143	123.8121	(45)
Energy content (annual)										Total = Sum(45)m =		1233.1001	(45)
Distribution loss (46)m = 0.15 x (45)m	19.1769	16.7723	17.3075	15.0891	14.4783	12.4937	11.5772	13.2850	13.4437	15.6674	17.1021	18.5718	(46)

Water storage loss:		
Store volume	180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5520	(48)
Temperature factor from Table 2b	0.5400	(49)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Enter (49) or (54) in (55) 0.8381 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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	177.0888	156.2923	164.6258	148.2480	145.7648	130.9454	126.4243	137.8097	137.2790	153.6917	161.6685	173.0548	(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	177.0888	156.2923	164.6258	148.2480	145.7648	130.9454	126.4243	137.8097	137.2790	153.6917	161.6685	173.0548	(64)

Total per year (kWh/year) = Sum(64)m = 1812.8928 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	81.9030	72.7603	77.7590	71.5708	71.4877	65.8177	65.0570	68.8427	67.9236	74.1234	76.0331	80.5617	(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	92.9941	92.9941	92.9941	92.9941	92.9941	92.9941	92.9941	92.9941	92.9941	92.9941	92.9941	92.9941	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.6080	12.9747	10.5517	7.9883	5.9714	5.0413	5.4473	7.0806	9.5035	12.0669	14.0839	15.0140	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	162.1676	163.8504	159.6099	150.5822	139.1863	128.4758	121.3206	119.6378	123.8783	132.9060	144.3019	155.0124	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.2994	32.2994	32.2994	32.2994	32.2994	32.2994	32.2994	32.2994	32.2994	32.2994	32.2994	32.2994	(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)	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	-74.3953	(71)
Water heating gains (Table 5)	110.0846	108.2742	104.5148	99.4039	96.0857	91.4135	87.4422	92.5305	94.3383	99.6283	105.6015	108.2818	(72)
Total internal gains	340.7585	338.9976	328.5746	311.8726	295.1416	278.8288	268.1083	273.1470	281.6184	298.4995	317.8855	332.2064	(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	
East	6.1000	19.6403	0.6300	0.7000	0.7700	36.6142	(76)
West	4.7300	19.6403	0.6300	0.7000	0.7700	28.3910	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	65.0051	127.1638	209.4207	305.4276	374.3130	383.1759	364.7991	313.3570	243.5649	150.8906	81.0537	53.4571	(83)
Total gains	405.7636	466.1614	537.9953	617.3002	669.4546	662.0047	632.9074	586.5041	525.1834	449.3901	398.9393	385.6635	(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	58.2916	58.3875	58.4819	58.9294	59.0138	59.4103	59.4103	59.4843	59.2569	59.0138	58.8432	58.6658	
alpha	4.8861	4.8925	4.8988	4.9286	4.9343	4.9607	4.9607	4.9656	4.9505	4.9343	4.9229	4.9111	
util living area	0.9953	0.9902	0.9734	0.9174	0.7909	0.6050	0.4483	0.5016	0.7629	0.9526	0.9905	0.9963	(86)
MIT	19.8205	19.9862	20.2698	20.6165	20.8645	20.9720	20.9948	20.9911	20.9156	20.5736	20.1296	19.7869	(87)
Th 2	19.9269	19.9285	19.9301	19.9373	19.9386	19.9450	19.9450	19.9461	19.9425	19.9386	19.9359	19.9330	(88)
util rest of house	0.9938	0.9869	0.9645	0.8908	0.7323	0.5158	0.3434	0.3913	0.6789	0.9314	0.9867	0.9951	(89)
MIT 2	18.3724	18.6140	19.0224	19.5066	19.8148	19.9278	19.9432	19.9428	19.8803	19.4617	18.8291	18.3277	(90)

Living area fraction fLA = Living area / (4) = 0.6005 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	19.2420	19.4380	19.7715	20.1731	20.4451	20.5548	20.5747	20.5723	20.5020	20.1294	19.6100	19.2039	(92)

Temperature adjustment 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
adjusted MIT	19.2420	19.4380	19.7715	20.1731	20.4451	20.5548	20.5747	20.5723	20.5020	20.1294	19.6100	19.2039	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9925	0.9850	0.9629	0.8973	0.7617	0.5685	0.4065	0.4577	0.7258	0.9359	0.9852	0.9940	(94)
Useful gains	402.7176	459.1915	518.0448	553.9331	509.9558	376.3317	257.2737	268.4259	381.1762	420.5738	393.0521	383.3629	(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	992.7529	964.3220	878.8925	740.8821	573.9193	388.1920	259.1053	271.6504	418.4251	625.3893	823.3809	990.5087	(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	438.9862	339.4477	268.4706	134.6033	47.5888	0.0000	0.0000	0.0000	0.0000	152.3827	309.8367	451.7165	(98)

Space heating 2143.0325 (98)

Space heating per m2 (98) / (4) = 38.4263 (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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2292.0134	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	438.9862	339.4477	268.4706	134.6033	47.5888	0.0000	0.0000	0.0000	0.0000	152.3827	309.8367	451.7165	(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)	469.5040	363.0456	287.1344	143.9607	50.8971	0.0000	0.0000	0.0000	0.0000	162.9761	331.3762	483.1192	(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	177.0888	156.2923	164.6258	148.2480	145.7648	130.9454	126.4243	137.8097	137.2790	153.6917	161.6685	173.0548	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.1414	86.8294	86.1111	84.5576	82.1918	79.8000	79.8000	79.8000	79.8000	84.7911	86.5222	87.2592	(217)
Fuel for water heating, kWh/month	203.2201	179.9992	191.1783	175.3219	177.3472	164.0920	158.4264	172.6938	172.0288	181.2593	186.8521	198.3227	(219)

Water heating fuel used	2160.7418	(219)
Annual totals kWh/year		
Space heating fuel - main system	2292.0134	(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)	257.9812	(232)
Total delivered energy for all uses	4785.7364	(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	2292.0134	0.2160	495.0749	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2160.7418	0.2160	466.7202	(264)
Space and water heating			961.7951	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	257.9812	0.5190	133.8923	(268)
Total CO2, kg/m2/year			1134.6124	(272)
Emissions per m2 for space and water heating			17.2457	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.4008	(272b)
Emissions per m2 for pumps and fans			0.6980	(272c)
Target Carbon Dioxide Emission Rate (TER) = (17.2457 * 1.55) + 2.4008 + 0.6980, rounded to 2 d.p.			29.8300	(273)

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

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Property Reference	0007-Godsmark-Royal-College-F2	**Issued on Date**	13/08/2020
Assessment Reference	AD	**Prop Type Ref**	Flat 2
Property	Flat 2, 154, Royal College Street, London, NW1 0TA		

SAP Rating	84 B	**DER**	22.01	**TER**	32.54
Environmental	86 B	**% DER<TER**	32.37		
CO_2 Emissions (t/year)	0.91	**DFEE**	61.74	**TFEE**	60.98
General Requirements Compliance	Fail	**% DFEE<TFEE**	-1.25		

Assessor Details	Mr. Andrew Gwynne, Andrew Gwynne, Tel: 01636 653055, andrew.gwynne@mesenergyservices.co.uk	**Assessor ID**	P741-0001
Client			

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

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

DWELLING AS DESIGNED

Ground-floor flat, total floor area 50 m^2

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) 32.54 $kgCO_2/m^2$
Dwelling Carbon Dioxide Emission Rate (DER) 22.01 $kgCO_2/m^2$OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE) 61.0 $kWh/m^2/yr$
Dwelling Fabric Energy Efficiency (DFEE) 61.7 $kWh/m^2/yr$Fail
Excess energy =0.7 $kWh/m^2/yr$ (1.1%)

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.20 (max. 0.20)	0.21 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.068

3 Air permeability
Air permeability at 50 pascals: 5.10 (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: 2.10 kWh/day
Permitted by DBSCG 2.10 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
Not applicable

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing East:	6.10 m^2, No overhang	
Windows facing West:	7.50 m^2, No overhang	
Air change rate:	6.00 ach	
Blinds/curtains:	None	

10 Key features

External wall U-value	0.13 W/m^2K
Party wall U-value	0.00 W/m^2K
Floor U-value	0.12 W/m^2K
Photovoltaic array	0.30 kW

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		50.4500 (1b)	x	3.0500 (2b)	=	153.8725	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.4500						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	153.8725	(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							2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.1300	(8)
Pressure test		Yes	
Measured/design AP50		5.1000	
Infiltration rate		0.3850	(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) =	0.3561	(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	0.4540	0.4451	0.4362	0.3917	0.3828	0.3383	0.3383	0.3294	0.3561	0.3828	0.4006	0.4184	(22b)
Effective ac	0.6031	0.5991	0.5951	0.5767	0.5733	0.5572	0.5572	0.5543	0.5634	0.5733	0.5802	0.5875	(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	
Window (Uw = 1.40)			7.5000	1.3258	9.9432			(27)
Door			1.9100	1.4000	2.6740			(26)
Glazed Door (Uw = 1.40)			6.1000	1.3258	8.0871			(27)
Ground Floor			4.2500	0.1200	0.5100	75.0000	318.7500	(28a)
Wall 1	61.0600	15.5100	45.5500	0.1300	5.9215	60.0000	2733.0000	(29a)
Wall 3 - Stairwell	30.5300		30.5300	0.4400	13.4332	9.0000	274.7700	(29a)
Flat Ceiling - To Stairwell	5.8000		5.8000	0.2107	1.2220	9.0000	52.2000	(30)
Flat Roof	1.3000		1.3000	0.1400	0.1820	9.0000	11.7000	(30)
Total net area of external elements Aum(A, m2)			102.9400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	41.9730			(33)
Party Wall 1			20.8900	0.0000	0.0000	45.0000	940.0500	(32)
Party Floor 1			46.2400			80.0000	3699.2000	(32d)
Party Ceilings 1			43.3800			80.0000	3470.4000	(32b)
Stud Wall			77.5900			9.0000	698.3100	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12198.3800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		241.7915	(35)
Thermal bridges (User defined value 0.068 * total exposed area)		6.9999	(36)
Total fabric heat loss	(33) + (36) =	48.9730	(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	30.6228	30.4196	30.2203	29.2847	29.1096	28.2946	28.2946	28.1437	28.6085	29.1096	29.4637	29.8340	(38)
Heat transfer coeff	79.5958	79.3925	79.1933	78.2576	78.0826	77.2676	77.2676	77.1167	77.5815	78.0826	78.4367	78.8070	(39)
Average = Sum(39)m / 12 =												78.2568	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5777	1.5737	1.5697	1.5512	1.5477	1.5316	1.5316	1.5286	1.5378	1.5477	1.5547	1.5621	(40)
HLP (average)												1.5512	(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	1.7034	(42)
Average daily hot water use (litres/day)	74.6547	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	82.1202	79.1340	76.1478	73.1616	70.1754	67.1892	67.1892	70.1754	73.1616	76.1478	79.1340	82.1202	(44)
Energy conte	121.7819	106.5112	109.9100	95.8222	91.9437	79.3404	73.5206	84.3659	85.3735	99.4946	108.6061	117.9392	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content (annual)											Total = Sum(45)m =	1174.6093	(45)
Distribution loss (46)m = 0.15 x (45)m	18.2673	15.9767	16.4865	14.3733	13.7916	11.9011	11.0281	12.6549	12.8060	14.9242	16.2909	17.6909	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1340	(55)
Total storage loss	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	(56)
If cylinder contains dedicated solar storage	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	(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	180.1983	159.2744	168.3264	152.3542	150.3601	135.8724	131.9370	142.7823	141.9055	157.9110	165.1381	176.3556	(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	180.1983	159.2744	168.3264	152.3542	150.3601	135.8724	131.9370	142.7823	141.9055	157.9110	165.1381	176.3556	(64)
									Total per year (kWh/year) = Sum(64)m =			1862.4153	(64)
Heat gains from water heating, kWh/month	87.2256	77.6255	83.2782	77.0865	77.3044	71.6063	71.1787	74.7848	73.6123	79.8151	81.3371	85.9479	(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	85.1678	85.1678	85.1678	85.1678	85.1678	85.1678	85.1678	85.1678	85.1678	85.1678	85.1678	85.1678	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.2302	11.7509	9.5565	7.2349	5.4082	4.5658	4.9335	6.4128	8.6072	10.9288	12.7555	13.5979	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	148.4026	149.9426	146.0620	137.8005	127.3720	117.5706	111.0227	109.4827	113.3634	121.6248	132.0533	141.8547	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.5168	31.5168	31.5168	31.5168	31.5168	31.5168	31.5168	31.5168	31.5168	31.5168	31.5168	31.5168	(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)	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	(71)
Water heating gains (Table 5)	117.2387	115.5142	111.9331	107.0646	103.9038	99.4532	95.6703	100.5172	102.2393	107.2783	112.9682	115.5214	(72)
Total internal gains	330.4219	328.7581	319.1019	303.6503	288.2343	273.1399	263.1769	267.9630	275.7602	291.3823	309.3275	322.5244	(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	
West	7.5000	19.6403	0.7600	0.7000	0.7700	54.3067	(80)
East	6.1000	19.6403	0.7600	0.7000	0.7700	44.1695	(76)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	98.4762	192.6403	317.2511	462.6918	567.0461	580.4726	552.6336	474.7041	368.9761	228.5839	122.7882	80.9820	(83)
Total gains	428.8980	521.3983	636.3529	766.3421	855.2804	853.6125	815.8104	742.6671	644.7363	519.9662	432.1157	403.5064	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)													
tau	42.5706	42.6796	42.7869	43.2985	43.3956	43.8533	43.8533	43.9391	43.6759	43.3956	43.1997	42.9967	
alpha	3.8380	3.8453	3.8525	3.8866	3.8930	3.9236	3.9236	3.9293	3.9117	3.8930	3.8800	3.8664	
util living area	0.9911	0.9809	0.9514	0.8700	0.7260	0.5486	0.4088	0.4636	0.7166	0.9285	0.9832	0.9929	(86)
MIT	19.7296	19.9113	20.2083	20.5568	20.7902	20.8960	20.9224	20.9172	20.8329	20.4913	20.0436	19.7013	(87)
Th 2	19.6297	19.6327	19.6356	19.6493	19.6519	19.6639	19.6639	19.6661	19.6593	19.6519	19.6467	19.6413	(88)
util rest of house	0.9882	0.9747	0.9356	0.8307	0.6537	0.4465	0.2886	0.3359	0.6156	0.8971	0.9766	0.9906	(89)
MIT 2	17.9785	18.2430	18.6668	19.1478	19.4294	19.5431	19.5604	19.5607	19.4907	19.0805	18.4475	17.9460	(90)
Living area fraction									fLA = Living area / (4) =			0.4618	(91)
MIT	18.7872	19.0135	19.3787	19.7985	20.0579	20.1679	20.1894	20.1872	20.1106	19.7321	19.1847	18.7567	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7872	19.0135	19.3787	19.7985	20.0579	20.1679	20.1894	20.1872	20.1106	19.7321	19.1847	18.7567	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9858	0.9711	0.9320	0.8356	0.6770	0.4864	0.3367	0.3871	0.6525	0.8993	0.9736	0.9885	(94)
Useful gains	422.7960	506.3157	593.0861	640.3391	579.0652	415.1960	274.6781	287.4811	420.6822	467.6228	420.7098	398.8741	(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	1153.1225	1120.5067	1019.9098	852.8936	652.6042	430.2199	277.3468	292.0541	466.3115	713.0549	947.8821	1147.1697	(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	543.3629	412.7363	317.5569	153.0392	54.7130	0.0000	0.0000	0.0000	0.0000	182.6014	379.5641	556.7319	(98)
Space heating												2600.3057	(98)
Space heating per m2											(98) / (4) =	51.5422	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 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 %)	249.9000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1040.5385	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	543.3629	412.7363	317.5569	153.0392	54.7130	0.0000	0.0000	0.0000	0.0000	182.6014	379.5641	556.7319	(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)	217.4321	165.1606	127.0736	61.2402	21.8940	0.0000	0.0000	0.0000	0.0000	73.0698	151.8864	222.7819	(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	180.1983	159.2744	168.3264	152.3542	150.3601	135.8724	131.9370	142.7823	141.9055	157.9110	165.1381	176.3556	(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	102.9116	90.9620	96.1316	87.0098	85.8710	77.5970	75.3495	81.5433	81.0426	90.1833	94.3108	100.7171	(219)
Water heating fuel used												1063.6295	(219)

Annual totals kWh/year			
Space heating fuel - main system		1040.5385	(211)
Space heating fuel - secondary		0.0000	(215)
Electricity for pumps and fans:			
central heating pump		30.0000	(230c)
Total electricity for the above, kWh/year		30.0000	(231)
Electricity for lighting (calculated in Appendix L)		233.6495	(232)
Energy saving/generation technologies (Appendices M ,N and Q)			
PV Unit 0 (0.80 * 0.30 * 951 * 1.00) =	-228.1478	-228.1478	(233)
Total delivered energy for all uses		2139.6697	(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	1040.5385	0.5190	540.0395	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1063.6295	0.5190	552.0237	(264)
Space and water heating			1092.0632	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	233.6495	0.5190	121.2641	(268)
Energy saving/generation technologies				
PV Unit	-228.1478	0.5190	-118.4087	(269)
Total CO2, kg/year			1110.4886	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			22.0100	(273)

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

DER		22.0100	ZC1
Total Floor Area	TFA	50.4500	
Assumed number of occupants	N	1.7034	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.4312	ZC2
CO2 emissions from cooking, equation (L16)		3.1691	ZC3
Total CO2 emissions		42.6103	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		42.6103	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		50.4500 (1b)	x	3.0500 (2b)	=	153.8725	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.4500						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	153.8725	(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							2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.1300	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3800	(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) =	0.3515	(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	0.4481	0.4393	0.4306	0.3866	0.3778	0.3339	0.3339	0.3251	0.3515	0.3778	0.3954	0.4130	(22b)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5529	0.5618	0.5714	0.5782	0.5853	(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 Opaque door			1.9100	1.0000	1.9100			(26)
TER Opening Type (Uw = 1.40)			10.7000	1.3258	14.1856			(27)
Ground Floor			4.2500	0.1300	0.5525			(28a)
Wall 1	61.0600	12.6100	48.4500	0.1800	8.7210			(29a)
Wall 3 - Stairwell	30.5300		30.5300	0.1800	5.4954			(29a)
Flat Ceiling - To Stairwell	5.8000		5.8000	0.1300	0.7540			(30)
Flat Roof	1.3000		1.3000	0.1300	0.1690			(30)
Total net area of external elements Aum(A, m2)			102.9400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		31.7875			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		5.2488	(36)
Total fabric heat loss	(33) + (36) =	37.0363	(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	30.4877	30.2897	30.0957	29.1841	29.0136	28.2197	28.2197	28.0726	28.5255	29.0136	29.3586	29.7193	(38)
Heat transfer coeff	67.5240	67.3260	67.1320	66.2204	66.0499	65.2560	65.2560	65.1089	65.5618	66.0499	66.3949	66.7556	(39)
Average = Sum(39)m / 12 =												66.2196	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3384	1.3345	1.3307	1.3126	1.3092	1.2935	1.2935	1.2906	1.2995	1.3092	1.3161	1.3232	(40)
HLP (average)												1.3126	(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	1.7034	(42)
Average daily hot water use (litres/day)	74.6547	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	82.1202	79.1340	76.1478	73.1616	70.1754	67.1892	67.1892	70.1754	73.1616	76.1478	79.1340	82.1202	(44)
Energy conte	121.7819	106.5112	109.9100	95.8222	91.9437	79.3404	73.5206	84.3659	85.3735	99.4946	108.6061	117.9392	(45)
Energy content (annual)										Total = Sum(45)m =		1174.6093	(45)
Distribution loss (46)m = 0.15 x (45)m	18.2673	15.9767	16.4865	14.3733	13.7916	11.9011	11.0281	12.6549	12.8060	14.9242	16.2909	17.6909	(46)

Water storage loss:

Store volume	180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5520	(48)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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	171.0245	150.9884	159.1527	143.4764	141.1864	126.9946	122.7632	133.6086	133.0277	148.7373	156.2603	167.1819	(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	171.0245	150.9884	159.1527	143.4764	141.1864	126.9946	122.7632	133.6086	133.0277	148.7373	156.2603	167.1819	(64)
Total per year (kWh/year) = Sum(64)m =												1754.4020	(64)
Heat gains from water heating, kWh/month	79.8866	70.9968	75.9392	69.9842	69.9654	64.5040	63.8397	67.4458	66.5100	72.4761	74.2349	78.6089	(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	85.1678	85.1678	85.1678	85.1678	85.1678	85.1678	85.1678	85.1678	85.1678	85.1678	85.1678	85.1678	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.2578	11.7754	9.5764	7.2500	5.4194	4.5753	4.9438	6.4261	8.6251	10.9516	12.7821	13.6262	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	148.4026	149.9426	146.0620	137.8005	127.3720	117.5706	111.0227	109.4827	113.3634	121.6248	132.0533	141.8547	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.5168	31.5168	31.5168	31.5168	31.5168	31.5168	31.5168	31.5168	31.5168	31.5168	31.5168	31.5168	(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)	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	-68.1342	(71)
Water heating gains (Table 5)	107.3745	105.6500	102.0688	97.2003	94.0395	89.5890	85.8061	90.6530	92.3751	97.4141	103.1040	105.6572	(72)
Total internal gains	320.5852	318.9183	309.2576	293.8012	278.3813	263.2852	253.3229	258.1122	265.9139	281.5408	299.4898	312.6885	(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	
East	4.8000	19.6403	0.6300	0.7000	0.7700	28.8111	(76)
West	5.9000	19.6403	0.6300	0.7000	0.7700	35.4137	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	64.2248	125.6374	206.9069	301.7613	369.8198	378.5764	360.4202	309.5956	240.6412	149.0793	80.0808	52.8154	(83)
Total gains	384.8100	444.5557	516.1644	595.5625	648.2011	641.8616	613.7431	567.7078	506.5552	430.6202	379.5706	365.5038	(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	51.8848	52.0374	52.1878	52.9062	53.0428	53.6882	53.6882	53.8094	53.4377	53.0428	52.7672	52.4821	
alpha	4.4590	4.4692	4.4792	4.5271	4.5362	4.5792	4.5792	4.5873	4.5625	4.5362	4.5178	4.4988	
util living area	0.9945	0.9889	0.9717	0.9169	0.7967	0.6157	0.4600	0.5139	0.7710	0.9515	0.9893	0.9956	(86)
MIT	19.6593	19.8396	20.1496	20.5386	20.8230	20.9593	20.9913	20.9859	20.8879	20.4985	20.0109	19.6328	(87)
Th 2	19.8108	19.8139	19.8169	19.8310	19.8336	19.8459	19.8459	19.8482	19.8412	19.8336	19.8283	19.8227	(88)
util rest of house	0.9927	0.9852	0.9620	0.8889	0.7351	0.5189	0.3434	0.3921	0.6821	0.9291	0.9850	0.9942	(89)
MIT 2	18.0569	18.3206	18.7678	19.3161	19.6728	19.8213	19.8431	19.8431	19.7593	19.2777	18.5812	18.0266	(90)
Living area fraction									fLA = Living area / (4) =			0.4618	(91)
MIT	18.7969	19.0221	19.4060	19.8807	20.2040	20.3469	20.3734	20.3709	20.2805	19.8415	19.2415	18.7684	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7969	19.0221	19.4060	19.8807	20.2040	20.3469	20.3734	20.3709	20.2805	19.8415	19.2415	18.7684	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9905	0.9819	0.9578	0.8903	0.7562	0.5624	0.3975	0.4486	0.7187	0.9292	0.9821	0.9923	(94)
Useful gains	381.1545	436.5109	494.3813	530.2330	490.2007	361.0126	243.9725	254.6778	364.0365	400.1489	372.7804	362.6973	(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	978.8924	950.7855	866.4048	727.1450	561.6866	375.0200	246.2373	258.5414	405.2071	610.4017	806.1348	972.5245	(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	444.7170	345.5926	276.7855	141.7766	53.1855	0.0000	0.0000	0.0000	0.0000	156.4281	312.0151	453.7114	(98)
Space heating												2184.2118	(98)
Space heating per m2											(98) / (4) =	43.2946	(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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2336.0554	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	444.7170	345.5926	276.7855	141.7766	53.1855	0.0000	0.0000	0.0000	0.0000	156.4281	312.0151	453.7114	(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)	475.6331	369.6177	296.0273	151.6327	56.8829	0.0000	0.0000	0.0000	0.0000	167.3028	333.7060	485.2528	(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	171.0245	150.9884	159.1527	143.4764	141.1864	126.9946	122.7632	133.6086	133.0277	148.7373	156.2603	167.1819	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.2506	86.9549	86.2766	84.7821	82.4680	79.8000	79.8000	79.8000	79.8000	84.9484	86.6241	87.3465	(217)
Fuel for water heating, kWh/month	196.0154	173.6399	184.4680	169.2296	171.2015	159.1411	153.8386	167.4293	166.7014	175.0914	180.3889	191.4009	(219)

Water heating fuel used	2088.5459	(219)
Annual totals kWh/year		
Space heating fuel - main system	2336.0554	(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)	234.1364	(232)
Total delivered energy for all uses	4733.7377	(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	2336.0554	0.2160	504.5880	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2088.5459	0.2160	451.1259	(264)
Space and water heating			955.7139	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	234.1364	0.5190	121.5168	(268)
Total CO2, kg/m2/year			1116.1557	(272)
Emissions per m2 for space and water heating			18.9438	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.4087	(272b)
Emissions per m2 for pumps and fans			0.7716	(272c)
Target Carbon Dioxide Emission Rate (TER) = (18.9438 * 1.55) + 2.4087 + 0.7716, rounded to 2 d.p.			32.5400	(273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

Property Reference	0007-Godsmark-Royal-College-F3	**Issued on Date**	13/08/2020
Assessment Reference	AD	**Prop Type Ref**	Flat 3
Property	Flat 3, 154, Royal College Street, London, NW1 0TA		

SAP Rating	83 B	**DER**	23.34	**TER**	34.83
Environmental	85 B	**% DER<TER**	32.99		
CO_2 Emissions (t/year)	0.98	**DFEE**	67.08	**TFEE**	68.49
General Requirements Compliance	Pass	**% DFEE<TFEE**	2.05		

Assessor Details	Mr. Andrew Gwynne, Andrew Gwynne, Tel: 01636 653055, andrew.gwynne@mesenergyservices.co.uk	**Assessor ID**	P741-0001
Client			

Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design System) version 4.12r02

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

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

DWELLING AS DESIGNED

Ground-floor flat, total floor area 51 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) 34.83 kgCO_2/m²
Dwelling Carbon Dioxide Emission Rate (DER) 23.34 kgCO_2/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE) 68.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 67.1 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.44 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.21 (max. 0.25)	0.21 (max. 0.70)	OK
Roof	0.16 (max. 0.20)	0.21 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.067

3 Air permeability

Air permeability at 50 pascals:	5.10 (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: 2.10 kWh/day	
Permitted by DBSCG 2.10	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
Not applicable

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing East:	6.10 m², No overhang	
Windows facing West:	3.83 m², No overhang	
Air change rate:	6.00 ach	
Blinds/curtains:	None	

10 Key features

External wall U-value	0.13 W/m²K
Party wall U-value	0.00 W/m²K
Photovoltaic array	0.30 kW

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		51.3900 (1b)	x	3.0500 (2b)	=	156.7395	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	51.3900						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	156.7395	(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							2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.1276	(8)
Pressure test			Yes	
Measured/design AP50			5.1000	
Infiltration rate			0.3826	(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) =	0.3539	(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	0.4512	0.4424	0.4335	0.3893	0.3804	0.3362	0.3362	0.3274	0.3539	0.3804	0.3981	0.4158	(22b)
Effective ac	0.6018	0.5979	0.5940	0.5758	0.5724	0.5565	0.5565	0.5536	0.5626	0.5724	0.5793	0.5865	(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	
Window (Uw = 1.40)			3.8300	1.3258	5.0777			(27)
Door			1.9100	1.4000	2.6740			(26)
Glazed Door (Uw = 1.40)			6.1000	1.3258	8.0871			(27)
Floor 2 - To Stairwell			8.4600	0.2143	1.8131	20.0000	169.2000	(28b)
Wall 1	75.0300	11.8400	63.1900	0.1300	8.2147	60.0000	3791.4000	(29a)
Wall 3 - Stairwell	28.8300		28.8300	0.4400	12.6852	9.0000	259.4700	(29a)
Flat Ceiling - To Stairwell	5.8000		5.8000	0.2143	1.2430	9.0000	52.2000	(30)
Flat Roof	12.7700		12.7700	0.1400	1.7878	9.0000	114.9300	(30)
Total net area of external elements Aum(A, m2)			130.8900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.5825			(33)
Party Wall 1			20.6800	0.0000	0.0000	45.0000	930.6000	(32)
Party Floor 1			42.9300			80.0000	3434.4000	(32d)
Party Ceilings 1			38.6200			80.0000	3089.6000	(32b)
Stud Wall			50.9400			9.0000	458.4600	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12300.2600	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		239.3512	(35)
Thermal bridges (User defined value 0.067 * total exposed area)		8.7696	(36)
Total fabric heat loss	(33) + (36) =	50.3522	(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	31.1277	30.9233	30.7228	29.7814	29.6053	28.7854	28.7854	28.6335	29.1012	29.6053	29.9616	30.3341	(38)
Heat transfer coeff	81.4799	81.2754	81.0750	80.1336	79.9575	79.1375	79.1375	78.9857	79.4534	79.9575	80.3138	80.6863	(39)
Average = Sum(39)m / 12 =												80.1327	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5855	1.5815	1.5776	1.5593	1.5559	1.5399	1.5399	1.5370	1.5461	1.5559	1.5628	1.5701	(40)
HLP (average)												1.5593	(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	1.7311	(42)
Average daily hot water use (litres/day)	75.3130	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	82.8443	79.8318	76.8193	73.8068	70.7942	67.7817	67.7817	70.7942	73.8068	76.8193	79.8318	82.8443	(44)
Energy conte	122.8557	107.4504	110.8792	96.6672	92.7545	80.0400	74.1689	85.1099	86.1263	100.3719	109.5638	118.9792	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content (annual)										Total = Sum(45)m =		1184.9671	(45)
Distribution loss (46)m = 0.15 x (45)m	18.4284	16.1176	16.6319	14.5001	13.9132	12.0060	11.1253	12.7665	12.9190	15.0558	16.4346	17.8469	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1340	(55)
Total storage loss	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	(56)
If cylinder contains dedicated solar storage	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	(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	181.2721	160.2136	169.2956	153.1992	151.1709	136.5720	132.5853	143.5263	142.6583	158.7883	166.0958	177.3956	(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	181.2721	160.2136	169.2956	153.1992	151.1709	136.5720	132.5853	143.5263	142.6583	158.7883	166.0958	177.3956	(64)
								Total per year (kWh/year) = Sum(64)m =				1872.7731	(64)
Heat gains from water heating, kWh/month	87.5827	77.9378	83.6005	77.3674	77.5740	71.8389	71.3943	75.0321	73.8626	80.1068	81.6556	86.2937	(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	86.5537	86.5537	86.5537	86.5537	86.5537	86.5537	86.5537	86.5537	86.5537	86.5537	86.5537	86.5537	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.5962	12.0760	9.8209	7.4350	5.5578	4.6921	5.0700	6.5902	8.8453	11.2312	13.1084	13.9741	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	150.8432	152.4085	148.4640	140.0667	129.4667	119.5041	112.8485	111.2832	115.2277	123.6250	134.2250	144.1876	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.6554	31.6554	31.6554	31.6554	31.6554	31.6554	31.6554	31.6554	31.6554	31.6554	31.6554	31.6554	(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)	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	(71)
Water heating gains (Table 5)	117.7186	115.9789	112.3662	107.4548	104.2661	99.7763	95.9600	100.8497	102.5870	107.6704	113.4105	115.9862	(72)
Total internal gains	334.1241	332.4295	322.6172	306.9227	291.2567	275.9386	265.8447	270.6892	278.6261	294.4927	312.7101	326.1140	(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	
West	3.8300	19.6403	0.7600	0.7000	0.7700	27.7326	(80)
East	6.1000	19.6403	0.7600	0.7000	0.7700	44.1695	(76)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	71.9021	140.6557	231.6399	337.8330	414.0271	423.8304	403.5038	346.6038	269.4068	166.8999	89.6534	59.1288	(83)
Total gains	406.0262	473.0852	554.2572	644.7557	705.2837	699.7690	669.3485	617.2930	548.0329	461.3925	402.3635	385.2427	(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	41.9335	42.0390	42.1430	42.6380	42.7320	43.1747	43.1747	43.2577	43.0031	42.7320	42.5424	42.3460	
alpha	3.7956	3.8026	3.8095	3.8425	3.8488	3.8783	3.8783	3.8838	3.8669	3.8488	3.8362	3.8231	
util living area	0.9929	0.9866	0.9690	0.9189	0.8142	0.6519	0.4996	0.5552	0.7947	0.9511	0.9872	0.9942	(86)
MIT	19.6736	19.8247	20.0910	20.4330	20.7066	20.8638	20.9120	20.9031	20.7813	20.4123	19.9831	19.6511	(87)
Th 2	19.6240	19.6269	19.6298	19.6433	19.6458	19.6577	19.6577	19.6599	19.6531	19.6458	19.6407	19.6354	(88)
util rest of house	0.9905	0.9821	0.9583	0.8903	0.7504	0.5420	0.3570	0.4089	0.7010	0.9276	0.9820	0.9922	(89)
MIT 2	17.8946	18.1159	18.5005	18.9870	19.3383	19.5149	19.5498	19.5480	19.4404	18.9731	18.3578	17.8701	(90)
Living area fraction									fLA = Living area / (4) =			0.5849	(91)
MIT	18.9352	19.1154	19.4308	19.8328	20.1387	20.3039	20.3466	20.3407	20.2248	19.8150	19.3085	18.9119	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9352	19.1154	19.4308	19.8328	20.1387	20.3039	20.3466	20.3407	20.2248	19.8150	19.3085	18.9119	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9889	0.9799	0.9564	0.8949	0.7758	0.5977	0.4323	0.4861	0.7449	0.9312	0.9804	0.9908	(94)
Useful gains	401.5146	463.5876	530.0871	576.9881	547.1811	418.2268	289.3412	300.0614	408.2185	429.6464	394.4724	381.7045	(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	1192.4760	1155.3657	1048.3665	876.0860	674.7348	451.3951	296.4972	311.2573	486.6332	736.8045	980.5103	1187.0461	(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	588.4752	464.8748	385.5998	215.3505	94.8999	0.0000	0.0000	0.0000	0.0000	228.5256	421.9473	599.1742	(98)
Space heating												2998.8474	(98)
Space heating per m2											(98) / (4) =	58.3547	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 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 %)	249.9000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1200.0190	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	588.4752	464.8748	385.5998	215.3505	94.8999	0.0000	0.0000	0.0000	0.0000	228.5256	421.9473	599.1742	(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)	235.4843	186.0243	154.3017	86.1747	37.9752	0.0000	0.0000	0.0000	0.0000	91.4468	168.8465	239.7656	(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													
Water heating requirement	181.2721	160.2136	169.2956	153.1992	151.1709	136.5720	132.5853	143.5263	142.6583	158.7883	166.0958	177.3956	(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	103.5249	91.4984	96.6851	87.4924	86.3340	77.9966	75.7197	81.9682	81.4725	90.6844	94.8577	101.3110	(219)

Water heating fuel used		1069.5449	(219)
Annual totals kWh/year			
Space heating fuel - main system		1200.0190	(211)
Space heating fuel - secondary		0.0000	(215)
Electricity for pumps and fans:			
central heating pump		30.0000	(230c)
Total electricity for the above, kWh/year		30.0000	(231)
Electricity for lighting (calculated in Appendix L)		240.1133	(232)
Energy saving/generation technologies (Appendices M ,N and Q)			
PV Unit 0 (0.80 * 0.30 * 951 * 1.00) =	-228.1478	-228.1478	(233)
Total delivered energy for all uses		2311.5293	(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	1200.0190	0.5190	622.8098	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1069.5449	0.5190	555.0938	(264)
Space and water heating			1177.9036	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	240.1133	0.5190	124.6188	(268)
Energy saving/generation technologies				
PV Unit	-228.1478	0.5190	-118.4087	(269)
Total CO2, kg/year			1199.6837	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			23.3400	(273)

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

DER		23.3400	ZC1
Total Floor Area	TFA	51.3900	
Assumed number of occupants	N	1.7311	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.3938	ZC2
CO2 emissions from cooking, equation (L16)		3.1241	ZC3
Total CO2 emissions		43.8578	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		43.8578	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	51.3900 (1b)	x	3.0500 (2b)	=	156.7395	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 51.3900						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	156.7395	(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							2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.1276	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3776	(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) =	0.3493	(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	0.4453	0.4366	0.4279	0.3842	0.3755	0.3318	0.3318	0.3231	0.3493	0.3755	0.3929	0.4104	(22b)
Effective ac	0.5992	0.5953	0.5915	0.5738	0.5705	0.5551	0.5551	0.5522	0.5610	0.5705	0.5772	0.5842	(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 Opaque door			1.9100	1.0000	1.9100			(26)
TER Opening Type (Uw = 1.40)			9.9300	1.3258	13.1648			(27)
Floor 2 - To Stairwell			8.4600	0.1300	1.0998			(28b)
Wall 1	75.0300	11.8400	63.1900	0.1800	11.3742			(29a)
Wall 3 - Stairwell	28.8300		28.8300	0.1800	5.1894			(29a)
Flat Ceiling - To Stairwell	5.8000		5.8000	0.1300	0.7540			(30)
Flat Roof	12.7700		12.7700	0.1300	1.6601			(30)
Total net area of external elements Aum(A, m2)			130.8900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		35.1523			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.8558	(36)
Total fabric heat loss	(33) + (36) =	42.0081	(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	30.9910	30.7918	30.5966	29.6797	29.5081	28.7095	28.7095	28.5616	29.0171	29.5081	29.8552	30.2180	(38)
Heat transfer coeff	72.9991	72.7999	72.6047	71.6877	71.5162	70.7176	70.7176	70.5697	71.0252	71.5162	71.8632	72.2261	(39)
Average = Sum(39)m / 12 =												71.6869	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4205	1.4166	1.4128	1.3950	1.3916	1.3761	1.3761	1.3732	1.3821	1.3916	1.3984	1.4054	(40)
HLP (average)												1.3950	(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	1.7311	(42)
Average daily hot water use (litres/day)	75.3130	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	82.8443	79.8318	76.8193	73.8068	70.7942	67.7817	67.7817	70.7942	73.8068	76.8193	79.8318	82.8443	(44)
Energy conte	122.8557	107.4504	110.8792	96.6672	92.7545	80.0400	74.1689	85.1099	86.1263	100.3719	109.5638	118.9792	(45)
Energy content (annual)										Total = Sum(45)m =		1184.9671	(45)
Distribution loss (46)m = 0.15 x (45)m	18.4284	16.1176	16.6319	14.5001	13.9132	12.0060	11.1253	12.7665	12.9190	15.0558	16.4346	17.8469	(46)

Water storage loss:

Store volume	180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5520	(48)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.8381 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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	172.0984	151.9277	160.1219	144.3214	141.9971	127.6942	123.4115	134.3525	133.7805	149.6146	157.2180	168.2219	(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	172.0984	151.9277	160.1219	144.3214	141.9971	127.6942	123.4115	134.3525	133.7805	149.6146	157.2180	168.2219	(64)

Total per year (kWh/year) = Sum(64)m = 1764.7598 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	80.2437	71.3091	76.2615	70.2652	70.2350	64.7367	64.0553	67.6932	66.7604	72.7678	74.5533	78.9547	(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	86.5537	86.5537	86.5537	86.5537	86.5537	86.5537	86.5537	86.5537	86.5537	86.5537	86.5537	86.5537	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.5962	12.0760	9.8209	7.4350	5.5578	4.6921	5.0700	6.5902	8.8453	11.2312	13.1084	13.9741	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	150.8432	152.4085	148.4640	140.0667	129.4667	119.5041	112.8485	111.2832	115.2277	123.6250	134.2250	144.1876	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.6554	31.6554	31.6554	31.6554	31.6554	31.6554	31.6554	31.6554	31.6554	31.6554	31.6554	31.6554	(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)	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	-69.2430	(71)
Water heating gains (Table 5)	107.8544	106.1147	102.5020	97.5905	94.4019	89.9120	86.0958	90.9854	92.7227	97.8062	103.5463	106.1219	(72)
Total internal gains	324.2599	322.5653	312.7530	297.0584	281.3925	266.0744	255.9804	260.8250	268.7619	284.6284	302.8459	316.2497	(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	
East	6.1000	19.6403	0.6300	0.7000	0.7700	36.6142	(76)
West	3.8300	19.6403	0.6300	0.7000	0.7700	22.9889	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	59.6030	116.5962	192.0173	280.0458	343.2066	351.3331	334.4834	287.3163	223.3241	138.3512	74.3180	49.0146	(83)
Total gains	383.8630	439.1615	504.7703	577.1042	624.5991	617.4075	590.4638	548.1413	492.0859	422.9796	377.1638	365.2644	(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	48.8876	49.0214	49.1532	49.7819	49.9013	50.4648	50.4648	50.5706	50.2463	49.9013	49.6603	49.4108	
alpha	4.2592	4.2681	4.2769	4.3188	4.3268	4.3643	4.3643	4.3714	4.3498	4.3268	4.3107	4.2941	
util living area	0.9950	0.9905	0.9771	0.9350	0.8369	0.6708	0.5112	0.5662	0.8114	0.9605	0.9906	0.9960	(86)
MIT	19.5419	19.7153	20.0241	20.4264	20.7507	20.9326	20.9837	20.9750	20.8408	20.4092	19.9068	19.5164	(87)
Th 2	19.7477	19.7506	19.7535	19.7672	19.7698	19.7817	19.7817	19.7839	19.7771	19.7698	19.7646	19.7592	(88)
util rest of house	0.9933	0.9872	0.9689	0.9110	0.7788	0.5672	0.3775	0.4291	0.7245	0.9411	0.9867	0.9946	(89)
MIT 2	17.8437	18.0975	18.5447	19.1182	19.5373	19.7399	19.7764	19.7746	19.6571	19.1090	18.3870	17.8141	(90)

Living area fraction fLA = Living area / (4) = 0.5849 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	18.8370	19.0438	19.4101	19.8834	20.2471	20.4375	20.4826	20.4768	20.3495	19.8695	19.2759	18.8098	(92)

Temperature adjustment 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
adjusted MIT	18.8370	19.0438	19.4101	19.8834	20.2471	20.4375	20.4826	20.4768	20.3495	19.8695	19.2759	18.8098	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9916	0.9847	0.9660	0.9137	0.8034	0.6254	0.4561	0.5095	0.7689	0.9430	0.9847	0.9931	(94)
Useful gains	380.6246	432.4542	487.6102	527.2747	501.7993	386.1238	269.2839	279.2662	378.3746	398.8688	371.3942	362.7452	(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	1061.1910	1029.6699	937.3319	787.3775	611.2553	412.8154	274.5667	287.6953	443.8724	662.9226	875.0031	1055.2087	(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	506.3414	401.3290	334.5930	187.2741	81.4352	0.0000	0.0000	0.0000	0.0000	196.4560	362.5984	515.1928	(98)

Space heating 2585.2198 (98)
Space heating per m2 (98) / (4) = 50.3059 (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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2764.9410	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	506.3414	401.3290	334.5930	187.2741	81.4352	0.0000	0.0000	0.0000	0.0000	196.4560	362.5984	515.1928	(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)	541.5416	429.2288	357.8535	200.2931	87.0965	0.0000	0.0000	0.0000	0.0000	210.1134	387.8058	551.0084	(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	172.0984	151.9277	160.1219	144.3214	141.9971	127.6942	123.4115	134.3525	133.7805	149.6146	157.2180	168.2219	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.5231	87.2861	86.7358	85.5098	83.3936	79.8000	79.8000	79.8000	79.8000	85.5413	86.9729	87.6085	(217)
Fuel for water heating, kWh/month	196.6321	174.0572	184.6088	168.7776	170.2733	160.0178	154.6510	168.3616	167.6448	174.9033	180.7667	192.0155	(219)

Water heating fuel used	2092.7097	(219)
Annual totals kWh/year		
Space heating fuel - main system	2764.9410	(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)	240.1133	(232)
Total delivered energy for all uses	5172.7640	(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	2764.9410	0.2160	597.2273	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2092.7097	0.2160	452.0253	(264)
Space and water heating			1049.2526	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	240.1133	0.5190	124.6188	(268)
Total CO2, kg/m2/year			1212.7964	(272)
Emissions per m2 for space and water heating			20.4174	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.4250	(272b)
Emissions per m2 for pumps and fans			0.7574	(272c)
Target Carbon Dioxide Emission Rate (TER) = (20.4174 * 1.55) + 2.4250 + 0.7574, rounded to 2 d.p.			34.8300	(273)

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

Property Reference	0007-Godsmark-Royal-College-F4	Issued on Date	13/08/2020
Assessment Reference	AD	Prop Type Ref	Flat 4
Property	Flat 4, 154, Royal College Street, London, NW1 0TA		

SAP Rating	83 B	DER	19.56	TER	30.93
Environmental	85 B	% DER<TER	36.75		
CO_2 Emissions (t/year)	1.20	DFEE	58.44	TFEE	65.77
General Requirements Compliance	Pass	% DFEE<TFEE	11.15		

Assessor Details	Mr. Andrew Gwynne, Andrew Gwynne, Tel: 01636 653055, andrew.gwynne@mesenergyservices.co.uk	Assessor ID	P741-0001
Client			

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Top-floor flat, total floor area 74 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) 30.93 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 19.56 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)65.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)58.4 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.19 (max. 0.30)        0.44 (max. 0.70)         OK
Party wall      0.00 (max. 0.20)         -                       OK
Floor           0.21 (max. 0.25)        0.21 (max. 0.70)         OK
Roof            0.14 (max. 0.20)        0.16 (max. 0.35)         OK
Openings        1.42 (max. 2.00)        1.60 (max. 3.30)         OK
----------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.068
----------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         5.10 (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: 2.10 kWh/day
Permitted by DBSCG 2.10                           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
Not applicable
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Slight                                            OK
Based on:
Overshading:                            Average
Windows facing East:                    15.10 m², No overhang
Windows facing West:                    4.60 m², No overhang
Air change rate:                        6.00 ach
Blinds/curtains:                        None
----------------------------------------------------------------------------------------------------
10 Key features
External wall U-value                   0.13 W/m²K
Party wall U-value                      0.00 W/m²K
Photovoltaic array                      0.30 kW



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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	39.8300	(1b)	x	3.0500	(2b)	=	121.4815	(1b) - (3b)
First floor	34.0100	(1c)	x	2.7600	(2c)	=	93.8676	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 73.8400								(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	215.3491	(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							3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.1393	(8)
Pressure test		Yes	
Measured/design AP50		5.1000	
Infiltration rate		0.3943	(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) =	0.3647	(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	0.4650	0.4559	0.4468	0.4012	0.3921	0.3465	0.3465	0.3374	0.3647	0.3921	0.4103	0.4286	(22b)
Effective ac	0.6081	0.6039	0.5998	0.5805	0.5769	0.5600	0.5600	0.5569	0.5665	0.5769	0.5842	0.5918	(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	
Window (Uw = 1.40)			7.5000	1.3258	9.9432			(27)
Door			1.9100	1.4000	2.6740			(26)
Glazed Door (Uw = 1.40)			12.2000	1.3258	16.1742			(27)
Roof Light (Uw = 1.60)			2.7400	1.5038	4.1203			(27a)
Floor 2 - To Stairwell			1.2900	0.2143	0.2765	20.0000	25.8000	(28b)
Wall 1	105.8900	19.3100	86.5800	0.1300	11.2554	60.0000	5194.8000	(29a)
Wall 3 - Stairwell	18.9400		18.9400	0.4400	8.3336	9.0000	170.4600	(29a)
Wall 4 - Dormer Cheeks	2.7600	2.3000	0.4600	0.1600	0.0736	9.0000	4.1400	(29a)
Wall 5 - Mansard	4.6800		4.6800	0.2300	1.0764	9.0000	42.1200	(29a)
Flat Roof	38.9400	2.7400	36.2000	0.1400	5.0680	9.0000	325.8000	(30)
Flat Roof - Dormer	0.6800		0.6800	0.1600	0.1088	9.0000	6.1200	(30)
Total net area of external elements Aum(A, m2)			173.1800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		59.1040			(33)
Party Wall 1			16.6100	0.0000	0.0000	45.0000	747.4500	(32)
Party Floor 1			38.5400			80.0000	3083.2000	(32d)
Stud Wall			82.9600			9.0000	746.6400	(32c)
Internal Floor 1			32.3600			18.0000	582.4800	(32d)
Internal Ceiling 1			32.2600			18.0000	580.6800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	11509.6900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		155.8734	(35)
Thermal bridges (User defined value 0.068 * total exposed area)		11.7762	(36)
Total fabric heat loss	(33) + (36) =	70.8802	(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	43.2169	42.9185	42.6260	41.2522	40.9952	39.7987	39.7987	39.5771	40.2596	40.9952	41.5152	42.0588	(38)
Heat transfer coeff	114.0971	113.7987	113.5062	112.1325	111.8754	110.6789	110.6789	110.4573	111.1398	111.8754	112.3954	112.9390	(39)
Average = Sum(39)m / 12 =												112.1312	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5452	1.5412	1.5372	1.5186	1.5151	1.4989	1.4989	1.4959	1.5051	1.5151	1.5221	1.5295	(40)
HLP (average)												1.5186	(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	2.3356	(42)
Average daily hot water use (litres/day)	89.6712	(43)

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	98.6383	95.0515	91.4646	87.8778	84.2910	80.7041	80.7041	84.2910	87.8778	91.4646	95.0515	98.6383	(44)
Energy conte	146.2778	127.9355	132.0180	115.0965	110.4378	95.2994	88.3089	101.3358	102.5461	119.5076	130.4518	141.6623	(45)
Energy content (annual)										Total = Sum(45)m =		1410.8775	(45)
Distribution loss (46)m = 0.15 x (45)m	21.9417	19.1903	19.8027	17.2645	16.5657	14.2949	13.2463	15.2004	15.3819	17.9261	19.5678	21.2493	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1340	(55)
Total storage loss	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	(56)
If cylinder contains dedicated solar storage	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	(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	204.6942	180.6987	190.4344	171.6285	168.8542	151.8314	146.7253	159.7522	159.0781	177.9240	186.9838	200.0787	(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	204.6942	180.6987	190.4344	171.6285	168.8542	151.8314	146.7253	159.7522	159.0781	177.9240	186.9838	200.0787	(64)
									Total per year (kWh/year) = Sum(64)m =			2098.6835	(64)
Heat gains from water heating, kWh/month	95.3705	84.7491	90.6291	83.4952	83.4537	76.9127	76.0958	80.4273	79.3222	86.4694	88.6008	93.8358	(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	116.7815	116.7815	116.7815	116.7815	116.7815	116.7815	116.7815	116.7815	116.7815	116.7815	116.7815	116.7815	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.3729	16.3187	13.2712	10.0472	7.5104	6.3406	6.8512	8.9055	11.9529	15.1770	17.7138	18.8836	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	206.0886	208.2271	202.8380	191.3653	176.8830	163.2718	154.1786	152.0400	157.4291	168.9018	183.3841	196.9954	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.6782	34.6782	34.6782	34.6782	34.6782	34.6782	34.6782	34.6782	34.6782	34.6782	34.6782	34.6782	(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)	-93.4252	-93.4252	-93.4252	-93.4252	-93.4252	-93.4252	-93.4252	-93.4252	-93.4252	-93.4252	-93.4252	-93.4252	(71)
Water heating gains (Table 5)	128.1861	126.1148	121.8133	115.9655	112.1689	106.8231	102.2794	108.1012	110.1697	116.2223	123.0567	126.1234	(72)
Total internal gains	413.6821	411.6950	398.9570	378.4125	357.5968	337.4699	324.3436	330.0811	340.5862	361.3356	385.1891	403.0368	(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	
East	2.9000	19.6403	0.7600	0.7000	0.7700	20.9986	(76)
West	4.6000	19.6403	0.7600	0.7000	0.7700	33.3081	(80)
East	12.2000	19.6403	0.7600	0.7000	0.7700	88.3389	(76)
Horizontal	2.7400	26.0000	0.7600	0.7000	1.0000	34.1097	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	176.7553	349.8883	585.4910	867.0094	1073.2701	1103.2140	1048.4574	893.5930	685.3426	417.6967	221.1554	144.8550	(83)
Total gains	590.4374	761.5833	984.4481	1245.4219	1430.8669	1440.6840	1372.8010	1223.6741	1025.9288	779.0323	606.3445	547.8918	(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	28.0212	28.0947	28.1671	28.5121	28.5776	28.8866	28.8866	28.9445	28.7668	28.5776	28.4454	28.3085	
alpha	2.8681	2.8730	2.8778	2.9008	2.9052	2.9258	2.9258	2.9296	2.9178	2.9052	2.8964	2.8872	
util living area	0.9758	0.9515	0.8940	0.7746	0.6167	0.4583	0.3435	0.3961	0.6288	0.8698	0.9595	0.9801	(86)
MIT	19.2687	19.5408	19.9615	20.4212	20.7114	20.8482	20.8889	20.8791	20.7564	20.3046	19.6927	19.2249	(87)
Th 2	19.6538	19.6568	19.6597	19.6736	19.6762	19.6883	19.6883	19.6906	19.6836	19.6762	19.6709	19.6654	(88)
util rest of house	0.9703	0.9409	0.8719	0.7322	0.5529	0.3753	0.2458	0.2910	0.5408	0.8328	0.9489	0.9756	(89)
MIT 2	17.3893	17.7810	18.3743	19.0001	19.3568	19.5126	19.5457	19.5427	19.4290	18.8744	18.0155	17.3339	(90)
Living area fraction									fLA = Living area / (4) =			0.4606	(91)
MIT	18.2550	18.5915	19.1053	19.6547	19.9807	20.1278	20.1644	20.1582	20.0404	19.5331	18.7880	18.2049	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2550	18.5915	19.1053	19.6547	19.9807	20.1278	20.1644	20.1582	20.0404	19.5331	18.7880	18.2049	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9626	0.9303	0.8610	0.7315	0.5684	0.4040	0.2820	0.3297	0.5664	0.8281	0.9397	0.9689	(94)
Useful gains	568.3699	708.4680	847.6475	911.0859	813.3294	582.0514	387.1253	403.4024	581.1108	645.0956	569.7646	530.8408	(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													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	1592.2221	1558.0792	1430.7834	1205.9480	926.4068	611.8095	394.4990	415.1256	660.2128	999.3998	1313.6793	1581.6954	(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													
	761.7461	570.9387	433.8531	212.3007	84.1296	0.0000	0.0000	0.0000	0.0000	263.6023	535.6185	781.8359	(98)
Space heating												3644.0249	(98)
Space heating per m2											(98) / (4) =	49.3503	(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	1458.1932	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	761.7461	570.9387	433.8531	212.3007	84.1296	0.0000	0.0000	0.0000	0.0000	263.6023	535.6185	781.8359	(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)													
	304.8204	228.4669	173.6107	84.9543	33.6653	0.0000	0.0000	0.0000	0.0000	105.4831	214.3331	312.8595	(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													
Water heating requirement													
	204.6942	180.6987	190.4344	171.6285	168.8542	151.8314	146.7253	159.7522	159.0781	177.9240	186.9838	200.0787	(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													
	116.9013	103.1974	108.7575	98.0174	96.4330	86.7113	83.7952	91.2348	90.8498	101.6128	106.7869	114.2654	(219)
Water heating fuel used												1198.5628	(219)
Annual totals kWh/year													
Space heating fuel - main system												1458.1932	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:			
central heating pump		30.0000	(230c)
Total electricity for the above, kWh/year		30.0000	(231)
Electricity for lighting (calculated in Appendix L)		324.4720	(232)
Energy saving/generation technologies (Appendices M ,N and Q)			
PV Unit 0 (0.80 * 0.30 * 951 * 1.00) =	-228.1478	-228.1478	(233)
Total delivered energy for all uses		2783.0802	(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	1458.1932	0.5190	756.8023	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1198.5628	0.5190	622.0541	(264)
Space and water heating			1378.8564	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	324.4720	0.5190	168.4009	(268)
Energy saving/generation technologies				
PV Unit	-228.1478	0.5190	-118.4087	(269)
Total CO2, kg/year			1444.4186	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			19.5600	(273)

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

DER		19.5600	ZC1
Total Floor Area	TFA	73.8400	
Assumed number of occupants	N	2.3356	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.5390	ZC2
CO2 emissions from cooking, equation (L16)		2.3707	ZC3
Total CO2 emissions		38.4697	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		38.4697	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	39.8300 (1b)	x	3.0500 (2b)	=	121.4815 (1b) - (3b)
First floor	34.0100 (1c)	x	2.7600 (2c)	=	93.8676 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 73.8400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	215.3491 (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							3 * 10 =	30.0000 (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) =	30.0000 / (5) =	0.1393 (8)
Pressure test		Yes
Measured/design AP50		5.0000
Infiltration rate		0.3893 (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) =	0.3601 (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	0.4591	0.4501	0.4411	0.3961	0.3871	0.3421	0.3421	0.3331	0.3601	0.3871	0.4051	0.4231	(22b)
Effective ac	0.6054	0.6013	0.5973	0.5785	0.5749	0.5585	0.5585	0.5555	0.5648	0.5749	0.5821	0.5895	(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 Opaque door			1.9100	1.0000	1.9100			(26)
TER Opening Type (Uw = 1.40)			14.5400	1.3258	19.2765			(27)
TER Room Window (Uw = 1.70)			2.0200	1.5918	3.2154			(27a)
Floor 2 - To Stairwell			1.2900	0.1300	0.1677			(28b)
Wall 1	105.8900	14.7500	91.1400	0.1800	16.4052			(29a)
Wall 3 - Stairwell	18.9400		18.9400	0.1800	3.4092			(29a)
Wall 4 - Dormer Cheeks	2.7600	1.7000	1.0600	0.1800	0.1908			(29a)
Wall 5 - Mansard	4.6800		4.6800	0.1800	0.8424			(29a)
Flat Roof	38.9400	2.0200	36.9200	0.1300	4.7996			(30)
Flat Roof - Dormer	0.6800		0.6800	0.1300	0.0884			(30)
Total net area of external elements Aum(A, m2)			173.1800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		50.3052			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		11.0469 (36)
Total fabric heat loss	(33) + (36) =	61.3521 (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	43.0232	42.7324	42.4473	41.1081	40.8576	39.6912	39.6912	39.4752	40.1405	40.8576	41.3644	41.8943	(38)
Heat transfer coeff	104.3753	104.0844	103.7993	102.4602	102.2096	101.0433	101.0433	100.8273	101.4925	102.2096	102.7165	103.2464	(39)
Average = Sum(39)m / 12 =												102.4590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4135	1.4096	1.4057	1.3876	1.3842	1.3684	1.3684	1.3655	1.3745	1.3842	1.3911	1.3982	(40)
HLP (average)												1.3876	(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	2.3356 (42)
Average daily hot water use (litres/day)	89.6712 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.6383	95.0515	91.4646	87.8778	84.2910	80.7041	80.7041	84.2910	87.8778	91.4646	95.0515	98.6383	(44)
Energy conte	146.2778	127.9355	132.0180	115.0965	110.4378	95.2994	88.3089	101.3358	102.5461	119.5076	130.4518	141.6623	(45)
Energy content (annual)										Total = Sum(45)m =		1410.8775	(45)

Distribution loss (46)m = 0.15 x (45)m

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                21.9417    19.1903    19.8027    17.2645    16.5657    14.2949    13.2463    15.2004    15.3819    17.9261    19.5678    21.2493 (46)
Water storage loss:
Store volume                                                                                                                          180.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                           1.5520 (48)
  Temperature factor from Table 2b                                                                                                      0.5400 (49)
Enter (49) or (54) in (55)                                                                                                              0.8381 (55)
Total storage loss
                25.9803    23.4661    25.9803    25.1422    25.9803    25.1422    25.9803    25.9803    25.1422    25.9803    25.1422    25.9803 (56)
If cylinder contains dedicated solar storage
                25.9803    23.4661    25.9803    25.1422    25.9803    25.1422    25.9803    25.9803    25.1422    25.9803    25.1422    25.9803 (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
               195.5205   172.4128   181.2607   162.7507   159.6805   142.9536   137.5516   150.5785   150.2003   168.7502   178.1060   190.9049 (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
               195.5205   172.4128   181.2607   162.7507   159.6805   142.9536   137.5516   150.5785   150.2003   168.7502   178.1060   190.9049 (64)
                                                                                            Total per year (kWh/year) = Sum(64)m =   1990.6703 (64)
Heat gains from water heating, kWh/month
                88.0315    78.1204    83.2901    76.3929    76.1147    69.8104    68.7569    73.0883    72.2199    79.1304    81.4986    86.4968 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          116.7815   116.7815   116.7815   116.7815   116.7815   116.7815   116.7815   116.7815   116.7815   116.7815   116.7815   116.7815 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                18.3729    16.3187    13.2712    10.0472     7.5104     6.3406     6.8512     8.9055    11.9529    15.1770    17.7138    18.8836 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               206.0886   208.2271   202.8380   191.3653   176.8830   163.2718   154.1786   152.0400   157.4291   168.9018   183.3841   196.9954 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                34.6782    34.6782    34.6782    34.6782    34.6782    34.6782    34.6782    34.6782    34.6782    34.6782    34.6782    34.6782 (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)
               -93.4252   -93.4252   -93.4252   -93.4252   -93.4252   -93.4252   -93.4252   -93.4252   -93.4252   -93.4252   -93.4252   -93.4252 (71)
Water heating gains (Table 5)
               118.3219   116.2505   111.9491   106.1013   102.3047    96.9589    92.4151    98.2369   100.3055   106.3581   113.1925   116.2592 (72)
Total internal gains
               403.8179   401.8308   389.0928   368.5482   347.7326   327.6057   314.4794   320.2169   330.7219   351.4713   375.3248   393.1726 (73)


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6. Solar gains
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[Jan]                                        Area          Solar flux              g                FF              Access              Gains
                                               m2            Table 6a      Specific data    Specific data          factor                  W
                                                                 W/m2        or Table 6b      or Table 6c        Table 6d
-----------------------------------------------------------------------------------------------------
East                                      11.1400             19.6403             0.6300             0.7000             0.7700             66.8658 (76)
West                                       3.4000             19.6403             0.6300             0.7000             0.7700             20.4079 (80)
Horizontal                                 2.0200             26.0000             0.6300             0.7000             1.0000             20.8452 (82)
-----------------------------------------------------------------------------------------------------

Solar gains    108.1189   214.0198   358.1281   530.3177   656.4739   674.7869   641.2957   546.5757   419.2021   255.4954   135.2774    88.6062 (83)
Total gains    511.9368   615.8506   747.2210   898.8659  1004.2065  1002.3927   955.7751   866.7926   749.9240   606.9668   510.6023   481.7788 (84)


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7. Mean internal temperature (heating season)
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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             49.1283    49.2656    49.4009    50.0465    50.1692    50.7483    50.7483    50.8571    50.5237    50.1692    49.9217    49.6654
alpha            4.2752     4.2844     4.2934     4.3364     4.3446     4.3832     4.3832     4.3905     4.3682     4.3446     4.3281     4.3110
util living area
                 0.9962     0.9913     0.9745     0.9169     0.7899     0.6081     0.4563     0.5185     0.7848     0.9604     0.9925     0.9971 (86)

MIT             19.5035    19.7063    20.0558    20.4933    20.8081    20.9546    20.9897    20.9825    20.8635    20.4144    19.8779    19.4739 (87)
Th 2            19.7530    19.7560    19.7589    19.7729    19.7755    19.7876    19.7876    19.7899    19.7829    19.7755    19.7702    19.7647 (88)
util rest of house
                 0.9949     0.9883     0.9654     0.8883     0.7258     0.5079     0.3351     0.3903     0.6945     0.9409     0.9893     0.9961 (89)
MIT 2           17.7913    18.0881    18.5933    19.2094    19.6030    19.7607    19.7844    19.7836    19.6828    19.1203    18.3492    17.7559 (90)
Living area fraction                                                                                      fLA = Living area / (4) =     0.4606 (91)
MIT             18.5800    18.8334    19.2669    19.8007    20.1580    20.3106    20.3395    20.3358    20.2266    19.7164    19.0533    18.5472 (92)
Temperature adjustment                                                                                                                   0.0000
adjusted MIT    18.5800    18.8334    19.2669    19.8007    20.1580    20.3106    20.3395    20.3358    20.2266    19.7164    19.0533    18.5472 (93)


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8. Space heating requirement
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                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9932     0.9852     0.9608     0.8891     0.7475     0.5528     0.3912     0.4497     0.7306     0.9398     0.9868     0.9947 (94)
Useful gains   508.4385   606.7203   717.9665   799.1509   750.6315   554.0864   373.9165   389.7629   547.9114   570.4014   503.8499   479.2071 (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
              1490.4752  1450.2519  1325.1963  1116.8919   864.4936   577.0169   377.8538   396.8347   621.8026   931.7803  1227.8007  1481.2936 (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
               730.6353   566.8532   451.7790   228.7735    84.7134     0.0000     0.0000     0.0000     0.0000   268.8659   521.2446   745.5524 (98)
Space heating                                                                                                                         3598.4173 (98)
Space heating per m2                                                                                                (98) / (4) =      48.7326 (99)
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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	3848.5746	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	730.6353	566.8532	451.7790	228.7735	84.7134	0.0000	0.0000	0.0000	0.0000	268.8659	521.2446	745.5524	(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)	781.4281	606.2601	483.1860	244.6776	90.6025	0.0000	0.0000	0.0000	0.0000	287.5572	557.4809	797.3822	(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	195.5205	172.4128	181.2607	162.7507	159.6805	142.9536	137.5516	150.5785	150.2003	168.7502	178.1060	190.9049	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.0088	87.7557	87.1539	85.7221	83.2101	79.8000	79.8000	79.8000	79.8000	86.0508	87.5117	88.0921	(217)
Fuel for water heating, kWh/month	222.1603	196.4689	207.9777	189.8585	191.9003	179.1399	172.3704	188.6948	188.2209	196.1055	203.5226	216.7107	(219)

Water heating fuel used	2353.1305	(219)
Annual totals kWh/year		
Space heating fuel - main system	3848.5746	(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)	324.4720	(232)
Total delivered energy for all uses	6601.1771	(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	3848.5746	0.2160	831.2921	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2353.1305	0.2160	508.2762	(264)
Space and water heating			1339.5683	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	324.4720	0.5190	168.4009	(268)
Total CO2, kg/m2/year			1546.8943	(272)
Emissions per m2 for space and water heating			18.1415	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.2806	(272b)
Emissions per m2 for pumps and fans			0.5272	(272c)
Target Carbon Dioxide Emission Rate (TER) = (18.1415 * 1.55) + 2.2806 + 0.5272, rounded to 2 d.p.			30.9300	(273)