# 150 HAVERSTOCK STREET, NW3 2AY
# SUSTAINABILITY STATEMENT

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Date: 23/04/16

# CONTENTS

# EXECUTIVE SUMMARY

The proposed development is located on Haverstock Hill within the Belsize Park Conservation Area and falls under the local authority of London Borough of Camden (LBC).

Promoting a sustainable Camden is an integral element of Camden's Local Development Framework strategy. The Core Strategy policy CS13 – Tackling climate change through promoting higher environmental standards sets out the overall approach to tackling climate change, which includes promoting higher environmental standards in design and construction.

Policy DP22 states applicants are strongly encouraged to meet the standards established in the Code for Sustainable Homes (CfSH) and BREEAM methodologies. However, in March 2015 The Government announced that it will not no longer support the CfSH standard and stated its intention to incorporate many of the performance criterial in Building Regulations. The Mayors Draft MALP 2015 London Plan duly removes requirements for the Code for Sustainable Homes but continues to require developments to demonstrate that sustainable design standards are integral to the design, construction and operation. This sustainability statement sets out how the scheme complies with the various policy requirements.

Reducing Energy and carbon is a key opportunity for the development to make it a high quality and sustainable building. Development of the design has led to a number of considerations by the design team these can be summarised:

The proposed building is a compact contemporary design close to good public transport services. The site layout and the design of the building have been considered to ensure that the room layouts are positioned to take maximum benefit from natural daylight. The use of low energy lighting combined with roof lighting will enable diffuse light into this narrow deep plan site and thereby reducing the need for artificial lighting in use. The open plan layout of the design will facilitate a natural ventilation strategy which will further reduce energy loads and improve carbon performance.

The sites adjoins buildings on three sides creating a relatively sheltered location. The proposed building design sets the façade back from the street behind a low planted wall which both screens the development and provides valuable waste and bicycle storage facilities.

The partial demolition of the old shop and erection of a new front to form the new dwelling will enable a new thermally efficient building to be constructed. Using materials with good U values and detailing design to reduce thermal bridging and reduce unintended infiltration will be the key to achieving a low carbon building by reducing heating requirements of the building.

Assessment of the design using SAP methodology and comparison of the data with the requirements of Part L Building Regulations 2013 illustrates the proposed building can achieve a 20% improvement over a notional building when energy efficient design measures and renewable energy in the form of PV panels are provided. The modelling shows that the building can achieve a target emission figure of 933kg$CO_2$/$m^2$ compared to the notional building of 1,204kg$CO_2$/$m^2$. This can be achieved with good practice building improvement measures and gives confidence that the target level can be readily achieved provided detailed designs fully exploits the measures recommended in this report.

The provision of a 1.25 kWp roof-mounted PV array in addition to the energy saving measures detailed in this report will be sufficient to reduce the Target Emission Rate from 1,204kg$CO_2$ down to 933 kg$CO_2$, this equates to a 21.6% improvement in carbon emissions performance.

The development will incorporate modern water efficient fittings. Specific details will need to be confirmed at detailed design however if the recommendations given in this assessment are achieved these would be consistent with Code 4 requirements.

The use of green roof and green walls within the development will help enhance the building in a number of areas namely by making the building climate adapted to the effects of heat, increased rainfall and air pollution it will also improve thermal performance of the roof element. The green walls and roof will also help to improve the streetscape by blending the new dwelling into the historic street and conservation area.

The development will partly demolish the existing shop and therefore it will incorporate some recycled materials into the building fabric. Additional new materials will be specified and sourced with reference to the Green Guide to Specification selecting A rated materials when possible

The development will additionally incorporate sufficient space for storing recyclable waste, which is in accordance with the requirements of the Council polices and those of Part H Building Regulations and the measures set out in the Code.

In summary the development can be shown to support the sustainability policies relevant for an application of this type and scale and on this basis planning permission should be granted.

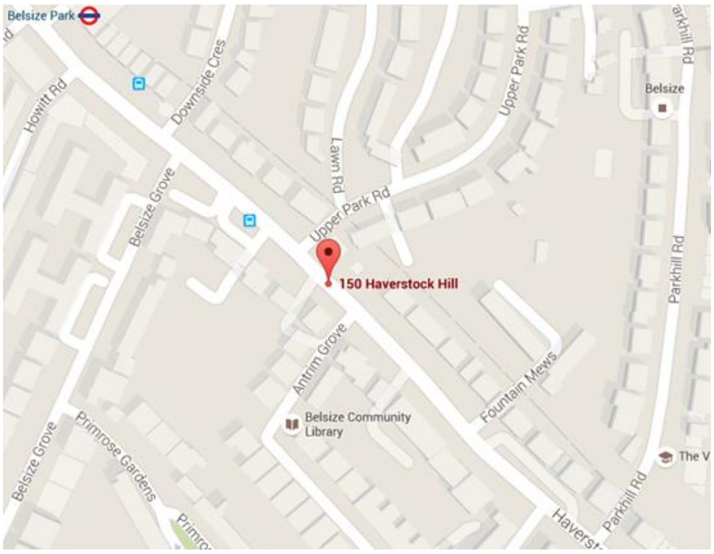
# 1 OVERVIEW OF THE SCHEME

## Existing Situation

1.1 The proposed development is located on Haverstock Hill within the Belsize Park Conservation Area. Its general location and site boundary is given in figure 1 below.

1.2 The development site falls under the local authority of London Borough of Camden (LBC).

**Figure 1 – General Site location**




1.3 The Core Strategy sets out the Councils core planning policy for this period 2010 to 2025. The policy comprises 19 core strategies which seek to address sustainable development within the Borough. Of particular note in respect of sustainability, energy and climate change are the following Strategic Policies:

- CS6 - Providing quality homes
- CS11 - Promoting sustainable and efficient travel
- CS13 - Tackling climate change through promoting higher environmental standards
- CS14 - Promoting high quality places and conserving our heritage
- CS18 - Dealing with our waste and encouraging recycling

1.2 These Core Strategies are support by two Development Policies which together from the local authorities Local Development Framework.

- DP22 - Promoting sustainable design and construction
- DP23 – Water

1.4 These policies are supported by the flowing SPG planning guidance:

- CPG1 Design
- CPG2 Housing
- CPG3 Sustainability

1.5 Policy DP22 entitled Promoting Sustainable Design and Construction states applicants are strongly encouraged to meet the standards established in the Code for Sustainable Homes (CfSH) and BREEAM methodologies. In the context of this residential development the CfSH standard is encouraged by the Council and developments are expected to achieve Code Level 4.

1.6 However, in March 2015 The Government announced that it will not no longer support the CfSH standard and stated its intention to incorporate many of the performance criterial in Building Regulations. This has not yet happened leaving councils and developers needing to negotiate appropriate mitigations formally addressed by the standards. Accordingly, the Mayor has published a transitional statement which sets out how existing London standards should be applied from October 2015 until a time that the Minor Alterations to the London Plan (MALP) are adopted. Draft MALP 2015 London Plan policy 5.3 'Sustainable design and construction' removes requirements for the Code for Sustainable Homes but continues to require development to demonstrate that sustainable design standards are integral to the proposal, including its construction and operation.

1.7 Camden have stated it will continue to require the submission of a Sustainability Statement with applications for new residential development demonstrating how the development mitigates against the causes of climate change and adapts to the effects of climate change in line with existing policies contained in Camden's Core Strategy CS13 Tackling climate change through promoting higher environmental standards and Development Policies document DP22 Sustainable design and construction.

1.8 Therefore this report seeks to assess the scheme against the planning policy requirements and the principles of the CfSH standard but not to formerly apply for BRE certification process.

## Proposed Development

1.9 The proposed development will involves extending and converting the existing single storey hairdressing salon into a house arranged over two floors with reception, kitchen/dining at ground level, and two bedrooms and a roof terrace at first floor level.

1.10 The building presently comprises a floor area of 42m$^2$ (GIA). An area of 4.2m$^2$ at the front of the site is to be demolished and a first floor extension amounting to 28.4m$^2$ added. A roof terrace of 8.2m$^2$ is to be added to the rear of the extension, enclosed by 1.6m high opaque glass screens. The existing walls and floor structure will be largely retained but extended upwards and set back from the pavement.

1.11 The building is an adaption of the existing structure, but set back behind a boundary wall. This will allow some views of the listed 19th century house adjoining the site that are presently obstructed by the existing building. No car parking spaces will be provided because the site is well served by public transport.

1.12 The London Underground station at Belsize Park on the Northern line is nearby, and bus routes: 168, C11 and N5 have stops on Haverstock Hill close to the site. Spaces for secure bicycle parking will be provided at the front of the house behind the new boundary wall. The entrance is accessed via a small terrace that affords a buffer area from the pavement and provides space for bicycle parking, re-cycling and non-recyclable rubbish. A new front boundary wall also provides a planting channel which will enable a living wall screening the development from inside the house as well as the street.

# 2 POLICY

2.1 Section 38(6) of the Planning and Compulsory Purchase Act (2004) requires that proposals shall be determined in accordance with the development plan unless material considerations indicate otherwise. In this case the development plan for the application site comprises the London Borough of Camden Core Strategy and Development Policies adopted in November 2010. Camden Development Policies forms part of the Council's Local Development Framework (LDF). The lead Local Development Framework document is the Core Strategy, which sets out the key elements of the Council's planning vision and strategy for the borough and contains its strategic policies.

2.2 Camden's Core Strategy is supported by Development Policies which must be in general conformity with the London Plan. The Mayor of London's London Plan (2008) sets a social, economic and environmental framework for the future development of the capital, providing the London-wide context for the borough's planning policies. All of the planning documents must also be consistent with national policy prepared by the government in Planning Policy Statements/Guidance (PPS/PPG), unless there is strong evidence that an alternative approach is more appropriate.

2.3 The NPPF, which abolished regional spatial strategies does contain some important policy principles which require consideration specifically with regards Sustainable Development.

## National Planning Policy Framework

2.4 The National Planning Policy Framework was published on 27 March 2012 and was intended to simplify the planning system and place sustainability considerations at the centre of planning policy development and planning approvals. At the heart of the NPPF is a presumption in favour of sustainable development. When considering development proposals local authorities should approve those that accord with the development plan without delay; and where a development plan is absent, silent or relevant policies are out-of-date, granting permission unless any adverse impacts of doing so would significantly and demonstrable outweigh the benefits, when assessed against the policies in the NPPF taken as a whole.

2.5 Addressing climate change is one of the core land use planning principles within the National Planning Policy Framework and underpins both plan-making and decision-taking. The NPPF specifically states that planning plays a key role in helping shape places to secure radical reductions in greenhouse gas emissions, minimising vulnerability and providing resilience to the impacts of climate change, and supporting the delivery of renewable and low carbon energy and associated infrastructure. This is considered to be central to the economic, social and environmental dimensions of sustainable development.

2.6 In determining planning applications, local planning authorities should expect new development to:

- *have a positive strategy to promote energy from renewable and low carbon sources*

- *comply with adopted Local Plan policies on local requirements for decentralised energy supply unless it can be demonstrated 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.*

### National Planning Practice Guidance

2.7 Within the Governments planning guidance series there are two primary areas which need to be considered in relation to the proposed development, these are climate change and renewable and low carbon energy. Within these guides the Government requires policy makers, decision makers and applicants to consider a range of interrelated areas these include:

- *Providing opportunities for renewable and low carbon energy technologies;*
- *Providing opportunities for decentralised energy and heating;*
- *Promoting low carbon design approaches to reduce energy consumption in buildings, such as passive solar design;*
- *Considering future climate risks when allocating development sites to ensure risks are understood over the development's lifetime;*
- *Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality; and*
- *Promoting adaptation approaches in design policies for developments and the public realm.*

## Camden Core Strategy and Development Polices

2.8 Camden policies for promoting a sustainable and attractive Camden, tackling climate change and improving and protecting Camden's environment and quality of life core strategies and development policies are summarised between those of CS13 and CS14 as detailed:

| Core Strategy | Related Development Policies |
|---|---|
| CS13. Tackling climate change through promoting higher environmental standards | DP22. Promoting sustainable design and construction<br><br>DP23. Water |
| CS14. Promoting high quality places and conserving our heritage | DP24. Securing high quality design<br><br>DP25. Conserving Camden's heritage<br><br>DP26. Managing the impact of development on occupiers and neighbours<br><br>DP27. Basements and light wells<br><br>DP28. Noise and vibration<br><br>DP29. Improving access<br><br>DP30. Shopfronts |

2.9 Core Strategy 13 states:

*The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all development to meet the highest feasible environmental standards that are financially viable during construction and occupation by:*

- *ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;*
- *promoting the efficient use of land and buildings;*
- *minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy: - ensuring developments use less energy, - making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralised energy networks; - generating renewable energy on-site; and*
- *ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change.*

2.10 Camden policy 13 also seeks to make the borough water efficient by minimising the potential for surface water flooding by:

- *protecting our existing drinking water and foul water infrastructure, including Barrow Hill Reservoir, Hampstead Heath Reservoir, Highgate Reservoir and Kidderpore Reservoir;*
- *making sure development incorporates efficient water and foul water infrastructure; requiring development to avoid harm to the water environment, water quality or drainage systems and prevents or mitigates local surface water and down-stream flooding, especially Camden Core Strategy 2010 84 in areas up-hill from, and in, areas known to be at risk from surface water flooding such as South and West Hampstead, Gospel Oak and King's Cross*

2.11 To enable buildings to last longer the Council require the design of and build quality of buildings to be to a high standard and to accommodate the changing requirements of occupants over time. Buildings should be designed to be adaptable in the future if consideration is given to:

- *the design of the structure, to enable expansion;*
- *the layout of the internal space;*
- *mechanical services, to allow for expansion or changing expectations and technologies; and*
- *enabling 'retro-fitting', for example for renewable energy generation.*

2.12 The Council require developments to achieve Code Level 4 equivalent in carbon dioxide emissions reduction and 20% below part L Building Regulations 2013. Reductions should include contributions from on-site renewable energy generation (which can include sources of site-related decentralised renewable energy) unless it can be demonstrated that such provision is not feasible. However, policy requirements acknowledge

*Camden's existing dense built form with many conservation areas and other heritage assets means that there are often limits to the contribution that orientation, height and footprint can make towards the energy efficiency of a building. This dense character, along with the varying heights of buildings in central London, can also make the installation of various technologies, including renewable energy technologies more difficult. Camden therefore expect high quality and innovative design to help combat these constraints.*

2.13 Furthermore LBC state that energy efficiency measures relating to heritage assets will be welcomed provided that they do not cause harm to the significance of the heritage asset and its setting.

2.14 Camden Core Strategy acknowledges it is likely to experience the effects of climate change giving rise to more intense rainfall and local flooding, more days with especially poor air quality, increased demand for its open spaces and outdoor pools and increased summer demand for electricity for cooling. To minimise the future need for summer cooling the Council expect the design of developments to consider anticipated changes to the climate. Details of expected adaption measures are contained in the LBC policy DP22 - Promoting sustainable design and construction in Camden Development Policies.

2.15 To promote responsible consumption, the Council requires all new developments to install water efficient devices through the requirements in the Code for Sustainable Homes and BREEAM assessments.

2.16 Although Camden has very low risk from flooding from waterways, the North London Strategic Flood Risk Assessment identified several areas in the borough, in particular West Hampstead, that have experienced surface water flooding when existing water infrastructure has not been able to cope with surface and foul water at the same time as the result of heavy rain. The Council therefore requires developments to manage the increases in surface water or sewage discharge and take account of known sewer flooding problems by including appropriate mitigation measures to avoid increased drainage problems and flood risk downstream.

2.17 When determining applications for planning permission Camden policy require applicants to ensure that development contributes towards a sustainable and attractive Camden. In particular, it supports the Core Strategy by focussing on:

- promoting sustainable design and construction;
- reducing our water consumption and the risk of surface water flooding;
- securing high quality design and conserving our heritage;
- managing the impact of development and noise and vibration;
- providing and improving open space, sport and recreation; and
- basements and lightwells, improving access, shopfront design and air quality and Camden's Clear Zone.

2.18 DP 22 sets out the main requirements for achieving compliance with the policy and Core Strategy. The Council requires all schemes to consider sustainable development principles, along with the detailed elements identified in the table below, from the start of the design process.

| Design | Fabric/Services |
|---|---|
| •the layout of uses<br>•floorplates size/depth<br><br>•floor to ceiling heights<br>•location, size and depth of windows | •level of insulation<br>•choice of materials, including-responsible sourcing, re-use and recycled content<br>•airtightness<br>•efficient heating, cooling and lighting |
| •limiting excessive solar gain | •effective building management system |
| •reducing the need for artificial lighting | •the source of energy used |
| •shading methods, both on or around the building | •metering |
| •optimising natural ventilation | •counter acting the heat expelled from plant |
| •design for and inclusion of renewable energy | •enhancement of/ provision for biodiversity |
| •impact on existing renewable and low carbon technologies in the area | •efficient water use |
| •sustainable urban drainage, including provision of a green or brown roof | •re-use of water |
| •adequate storage space for recyclable meters material, composting where possible | •educational elements, for example visible energy technology |
| •bicycle storage | •on-going management and review |
| •Measures to adapt to climate change<br>•impact on microclimate | |

2.19 Green and brown roofs are encouraged by LBC and detailed in DP22. Green walls play important roles in achieving a sustainable development as they retain rainfall and slow its movement, provide additional insulation, provide valuable habitat to promote biodiversity, provide opportunities for growing food, reduce the heating up of buildings and the wider city and provide valuable enhancement to amenity space. DP22 states they should be designed to enable the benefits that are most suitable for each site.

2.20 The use of BREEAM and Code for Sustainable Homes standards is supported by the Council within it policies. DP22 states that a minimum standard of Level 4 for the Code for Sustainable Homes should be achieved. DP22 additionally states LBC will encourage improvements in environmental sustainability performance in line with the government's timetable towards zero carbon housing.

2.21 DP 23 requires developments to reduce their water consumption, the pressure on the combined sewer network and the risk of flooding by:

- incorporating water efficient features and equipment and capturing, retaining and re-using surface water and grey water on-site;

- limiting the amount and rate of run-off and waste water entering the combined storm water and sewer network and using sustainable urban drainage methods to reduce the risk of flooding;
- reducing the pressure placed on the combined storm water and sewer network from foul water and surface water run-off and ensuring developments in the areas identified by the North London Strategic Flood Risk Assessment are designed to cope with the potential flooding;
- ensuring that developments are assessed for upstream and downstream groundwater flood risks in areas where historic underground streams are known to have been present; and
- encouraging the provision of attractive and efficient water features.

2.22 Developments must be designed to be water efficient to minimise the need for further water infrastructure. This can be through the installation of water efficient appliances and by capturing and re-using rain water and grey water on-site.

2.23 Core Strategy policy CS14 – Promoting high quality places and conserving heritage and sets out the Council's overall strategy on promoting high quality places, seeking to ensure that Camden's places and buildings are attractive, safe, healthy and easy to use and requiring development to be of the highest standard of design that respects local context and character.

2.24 The Council requires all developments, including alterations and extensions to existing buildings, to be of the highest standard of design DP24 requires developments to consider:

- character, setting, context and the form and scale of neighbouring buildings;
- the character and proportions of the existing building, where alterations and extensions are proposed;
- the quality of materials to be used;
- the provision of visually interesting frontages at street level;
- the appropriate location for building services equipment;
- existing natural features, such as topography and trees;
- the provision of appropriate hard and soft landscaping including boundary treatments;
- the provision of appropriate amenity space; and
- accessibility.

# 3 SUSTAINABILITY STATEMENT

## Scope

3.1 In accordance with the adopted policy of CS 13, CS14 and relevant development planning policies requirements for promoting Sustainable Design this Statement covers each of the main policy areas of concern. The issues discussed and considered to be relevant to the planning application are as follows:

- Sustainable Design and Construction;
- Climate Change and Flood Risk;
- Reducing Energy and Carbon;
- Water Efficiency; and
- Materials, Waste and Recycling

## Sustainable Design and Construction

3.2 Core Strategy CP13 and Development Policy DP22 requires developments to achieve a range of sustainable design and construction standards. The policy requires applicants to show how sustainable design principles have been achieved. Assessment of the proposals will be via BREEAM and the Code for Sustainable Homes (CfSH) standard.

3.3 Under Core Strategy 13 and DP22 new developments are expected to achieve Code Level 4. However, in March 2015 the Government announced it was scrapping the Code in order to reduce red tape for house building. Currently, it is expected that elements of the Code will now be incorporated into Building Regulations, which will be retitled as “the new national technical standards” and set at the equivalent of a Code level 4. Until formerly incorporated into new Building Regulations it will be necessary to interpret both the policy and future Building Regulations requirements and mutually agree an appropriate approach required for the development. Accordingly, The Mayor has published a transitional statement which sets out how existing London standards should be applied from October 2015 until a time that the Minor Alterations to the London Plan (MALP) are adopted.

3.4 The Draft MALP 2015 London Plan policy 5.3 ‘Sustainable design and construction’ removes requirements for the Code for Sustainable Homes but continues to require development to demonstrate that sustainable design standards are integral to the proposal, including its construction and operation. Further guidance on achieving a sustainable design is provided in Supplementary Planning Document CPG3 - Sustainability which provides details of the Councils expectations together with suggested design considerations. The following sections therefore select key elements of the SPD and the principles from the CfSH specifically energy, water materials and waste , to demonstrate how the scheme complies with the general spirit and requirements of each .

## Climate Change and Flood Risk

3.5 Core Strategy 13 and development policies DP22 and DP 23 cover climate change and flood risk. These policies are further supported by Camden Planning Guidance documents CPG3. The following text details how these policies can be complied with by the applicant scheme.

3.6 The site is located in the Haverstock Hill which is not within a flood risk zone (see figure below). Additionally the site is not within an area identified by the strategic flood risk management strategy as being at direct risk from surface water flooding. Locally two major events have occurred when the volume and intensity of a rainfall event exceeded the capacity of the drainage system which happened in 1975 and 2002.

3.7 Details of known surface water flooding are illustrated in the diagram below:

**Figure 2 Camden Strategic Flood Risk Map**


3.8 Although the applicant scheme site is between areas where surface water flooding has occurred in the past and therefore need not directly incorporate design measures to secure the development from flooding, nevertheless the development of the site can still contribute to the policy by minimising potable water use (see later section) and thereby not over burdening the local infrastructure network for those residents downstream of the site. The development can also further reduce water entering the local drainage network by capturing and retaining rainwater.

3.9 The design of the development also incorporates a green sedum roof which will help with manging rainwater flow being discharged from the development site into existing over stretched infrastructure. In addition the development will benefit from a rear first floor garden terrace which will be planted to provide the residents with private amenity space. In order to reduce the need for potable water consumption the development will be able to harvest some of the rainfall for watering planters of the rear terrace by provision of a water butt.

## Reducing Energy & Carbon

3.10 The policies relevant in context of energy and low carbon design are outlined in DP22and DP24. The following design measures detailed below illustrate how these policies have been considered and addressed by the scheme.

3.11 The approach to the development's energy strategy has been based upon the energy hierarchy. This requires developments to first limit energy use, before applying energy efficiency measures and renewable energy. The approach has been to make savings 'higher up' the energy hierarchy, thus reducing the demand for energy in the first place.

3.12 The site layout and the design of the building have been considered to ensure that the room layouts are positioned to take maximum benefit from natural daylight. The development has therefore placed the living room at the front of the building which faces south west with the kitchen to the rear of the development plot. In addition generous floor to ceiling heights in relation to window sizes have been considered to improve/ maximise daylight penetration into the habitable rooms.

3.13 A detailed energy assessment has been prepared to accompany the planning application (Appendix A). The assessment includes details on the measures proposed, including supporting calculations to comply with Part L Building Regulations 2013.

3.14 The front façade to Street will be in line with the existing streetscape and conservation area setting. The facade of the development will be slightly set back from the street behind a low level wall, this allows for a large floor to ceiling three paned triple glazed window to be used to allow daylighting to enter the living room without compromising on privacy of the occupants. The depth of the living /reception room is approximately 7 metres, together with the large SW facing window this will allow good levels of daylight penetration to the living area. This is expected to achieve the minimum Average Daylight Factor of at least 1.5%. The site also benefits from being south west facing which will ensure that the front façade will receive good levels of natural daylighting throughout the year even during winter months when the sun angle is lower in the sky.

3.15 The kitchen is located at the rear of the property and will not receive much natural daylight from the front façade due to the narrow plan and depth of the development site. In order to overcome this challenge the development will incorporate a ceiling roof light across the full width of the rear ground floor. The glazed roof light will form part of the rear terrace area and will therefore be constructed of toughened glass capable of being walked on. These features will introduce diffuse light into the kitchen and therefore it is expected that the room will achieve a minimum Average Daylight Factor of at least 2%.

3.16 The first floor of the development will comprise two bedrooms, one double and one single together with a shared bathroom. Daylighting will again be provided by windows to the south west and north east elevations. On the south west elevation, the double bedroom window will be standard dimensions to ensure privacy is maintained to the street. The rear second bedroom will benefit from a floor to ceiling sliding window to enable access to the rear first floor terrace. Between both rooms the stair well, which is in the centre of the building, will have a plateau roof light. This allow diffuse light to enter the centre of the building to both the ground and first floors to further reducing the need for artificial lighting.

3.17 The development is planned to be naturally ventilated. The locations of rooms, the open plan configuration will coupled with the general north east south west orientation will enable windows and doors to be opened as required to create a natural stack effect to cool the development during hot summer days to remove stale air. The use of the central skylight may also permit this to be used for ventilation purposes as well as daylight penetration. It should be noted however, the location of the site on the busy street of Haverstock Hill means the area is within the London Borough Air Quality Management Area (AQMA) where levels of NOx, PM10 and ground Ozone regularly exceed WHO standards. Natural ventilation opportunities will therefore need be considered in relation to maintaining a healthy internal environment and therefore mechanical ventilation may be required. If required heat recovery could be incorporated on stale air rejected from the building.

3.18 The orientation of the building toward the south west together with large floor to ceiling triple glazing provides increased levels of natural daylight to the living room however during summer months this orientation can be vulnerable to excessive heat gain due to sun angles and the hot air being trapped by surrounding streetscape. The set back from the street with the proposed low level planter may therefore be used, with appropriate plant selection, to provide some level of solar shading by means of greenwall. The use of native deciduous climbing species in the planters will enable daylight levels to be maintained during the winter months when solar gain is an advantage, it will also provide a contribution to local urban biodiversity. In addition by selecting appropriate plants for the living wall these may be used to trap some air pollutants from the road. Combined these measures also assist the development comply with DP28 reducing the effect of noise nuisance in properties located on busy roads.

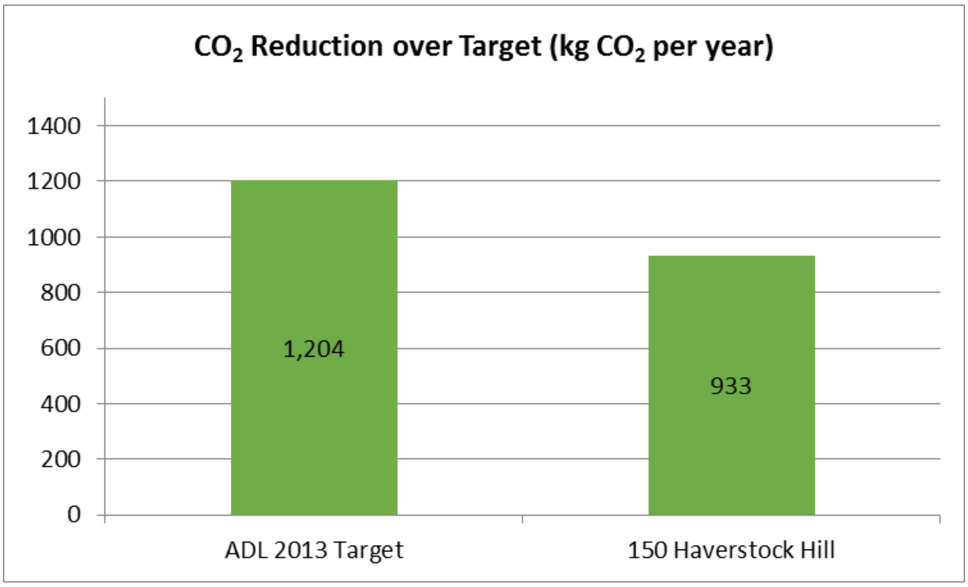
3.19 New lighting within the development will be energy efficient, with 100% of the fittings being low energy specification. Lighting design in all rooms will provide low energy fitting with mix of up, down and task lighting to ensure energy demand is kept low whilst maintaining lighting quality.

3.20 Modelling of the development has been undertaken using approved SAP modelling software to determine how the scheme complies with Part L of the Building Regulations 2013. Details of the performance parameters are detailed in Appendix A. Consideration has been given to U values and unintended heat losses as a result of cold bridging and air leakage rates. The simple block from of the development will assist in achieving minimal heat losses. Good detailed designing and good construction practices will ensure minimum heat loses are minimised. In addition the location of adjacent and adjoining properties further reduce building exposure and this will assist in creating a building with an efficient thermal envelope.

3.21 Camden Policy requires that residential developments achieve 20% carbon reduction through the incorporation of on-site renewable energy where this can be achieved whilst having regard to urban setting and conservation restrictions. Consideration has been given to accommodate the PV panels at roof level as the most viable source of renewable energy which can be readily incorporated into the development. Only 5 panels ($8m^2$) will be required which can be incorporated on the roof along with the sedum green roof.

3.22 Modelling of the energy load for the scheme and assessment of the available roof scape has enabled an assessment of the potential to install renewable energy on the project. It has been determined that provision of a 1.25 kWp roof-mounted PV array in addition to the energy saving measures detailed above and within Appendix A will be sufficient to reduce the Target Emission Rate from 1,204kg$CO_2$ down to 933 kg$CO_2$, this equates to a 21.6% improvement in carbon emissions performance.

**Figure 3 Summary of SAP modelling**




## Water Efficiency

3.23 Camden CS13 Policy requires the '*promotion of the efficient use and conservation of water resources'.* The following measures detail how this policy will be addressed by the development.

3.24 Consideration has been given to rainwater harvesting in the context of providing a source of water for the courtyard garden, however it is not considered practical to fit rainwater harvesting into the apartment buildings because of internal space constraints and very limited payback.

3.25 Water in the home is covered under CfSH assessment which is no longer required by Government policy. Measures detailed in the CfSH vary according to target level, Camden require new dwellings post 2015 to achieve an equivalent of a Code 4. To achieve this requires a 50% reduction in total water consumption this equates to a target of 105 litres/person would be required within the development. In the context of this small development such a level can be achieved through the following commonplace design measures:

- Low flush WCs designed to reduce the volume of water consumed during flushing. There are various systems that can be specified to achieve a reduction in flush volume, such as low single flush cisterns, dual-flush cisterns which provide a part flush for liquids and a full flush for solids. To comply with Code 3 standard WC's will need to be 4/2.6 Litre dual flush units.
- Delayed inlet valves prevent water entering the WC cistern until it has completely emptied, enabling a precise volume of water to be discharged independent of water pressure.
- Flow restrictors contain precision-made holes or filters to restrict water flow and reduce the outlet flow and pressure. Flow rate of water at the mains fed Kitchen sink should not exceed 4Litres/min. At bathrooms this would need to be restricted to 1.7 litres/minute and be from spray taps.
- Flow rate of each shower at the outlet using cold water should not exceed 8.0 litres/min.
- Baths will need to be 160Litre maximum capacity units.
- A rated appliances including washing machines and dishwashers.

## Materials, Waste and Recycling

3.26 Core Strategy CS13 and CS18 together with Development Policies DP22 and DP26 set out the requirements for sustainable material use and waste management to be promoted in all new developments. These policies are supported by SPD CPG1 & 3 Design and Sustainability respectively. These require materials to be selected from sustainable sources and for new development to address waste in accordance with the UK waste hierarchy. The following measures detail how this policy will be addressed by the development.

3.27 Policy guide CPG3 entitled Sustainability requires all developments to be constructed using materials which are responsibly sourced, from sustainable sources and have a minimum environmental impact. This policy also requires that materials are used with a recycled content and are capable of being readily recycled at the end of the buildings life. At the detailed design stage the applicants design team will detail the building design by selecting, as far as possible, materials with an A rating from BRE Green Guide to Specification.

3.28 Camden policy states sustainable waste management is a consideration for both design and construction works and for the operation of the residential units. All developments are required to aim for at least 10% of the total value of materials used to be derived from recycled and reused sources. As the site is to be only partially demolished and with a new development being built on the footprint of the former shop building some reuse of material within the fabric will be inherent in the scheme. The applicant will ensure that materials derived from the demolition process are appropriately disposed of via suitable facilities which will recover recyclable materials such as brick, concrete, timber and metal waste. In addition materials that can be segregated and or retained onsite and incorporated into the new development will be considered.

3.29 In terms of operational waste management, occupants will be able to recycle waste streams by through the provision of appropriate waste storage. Waste storage space will be provided in accordance with the design requirements of Part H of the Building Regulations and in general accordance with CfSH Level 4 requirements. The set back of the building off the street pavement line behind planted wall enables the development to discretely store waste and recycling materials in suitable containers. This additionally makes collection of wastes from the premises easy and will avoid spoiling the character of this conservation area and or creating nuisance for neighbouring properties.

3.30 The requirements under the CfSH are not strictly required however the general principles can be applied as representing best practice. Under the Code a system is to provide 60Litres waste storage per bedroom and a further 60 Litres storage for dry recyclables per bedroom externally is required. Additionally, the standard requires 30 litres storage internally within the Kitchen area.

# 4 CONCLUSION

4.1 Envision has been appointed by Cunnane Town Planning LLP to prepare a Sustainability Statement in support of a planning application for the insertion of a new dwelling on the site of 150 Haverstock Hill which currently occupied by a commercial premises.

4.2 The provision of well-designed compact new residential building will enhance the street by providing a contemporary sustainable home on a site where the present building is redundant.

4.3 The architectural proposals for the building provide a high quality design in accordance with Camden's stated policy aims. Whilst this development is not required to be assessed formally under the Code for Sustainable Homes Assessment, the key areas of Climate Change, energy efficiency, renewable energy, sustainable design water conservation, sustainable and responsible materials use and waste management have all been considered within the scheme. Assessment of design measures illustrates that the Code 4 standards can still be obtained for these assessment areas and it can therefore be concluded that the development complies with the spirit of the Camden policies.

4.4 Assessment of the energy and carbon using SAP methodology and comparison of the data with the requirements of Part L Building Regulations 2013 illustrates the proposed building can achieve a 20% improvement over a notional building when energy efficient design measures and renewable energy in the form of PV panels are provided. The modelling shows that the building can achieve a target emission figure of 933kg$CO_2$/m$^2$ compared to the notional building of 1,204kg$CO_2$/m$^2$. This can be achieved with good practice building improvement measures and gives confidence that the target level can be readily achieved provided detailed designs fully exploits the measures recommended. It will also be important to give attention to good quality construction practice to ensure that insulation levels, cold bridging issues and uncontrolled air leakage are avoided.

4.5 It has been established that the provision of a 1.25 kWp roof-mounted PV array would be sufficient to achieve reduce the carbon emissions from the building by 21.6%.

4.6 The development will incorporate modern water efficient fittings. Specific details will need to be confirmed at detailed design however if the recommendations given in this assessment are achieved these would be consistent with Code 4 requirements.

4.7 The use of green roof and green walls within the development will help enhance the building in a number of areas namely by making the building climate adapted to the effects of heat, increased rainfall and air pollution. The green walls and roof will also help to improve the streetscape by blending the new dwelling into the historic street and conservation area.

4.8 The development will partly demolish the existing shop and therefore it will incorporate recycle some materials into the building fabric. Additional new materials will be specified and sourced with reference to the Green Guide to Specification. The development will additionally incorporate sufficient space for storing recyclable waste, which is in accordance with the requirements of the Council polices and those of Part H Building Regulations and the measures set out in the Code.

4.9 In summary the development can be shown to support the sustainability policies relevant for an application of this type and scale and on this basis planning permission should be granted.

# APPENDIX A

## Energy Assessment

# Outline Energy Note

**150 Haverstock Hill, London, NW3 2AY**

**25th April 2016**

| Revision | Date | Author | Approved |
|---|---|---|---|
| First Issue | 25/04/2016 | Sam Wallis | Matthew Brundle |

## Policy Outline

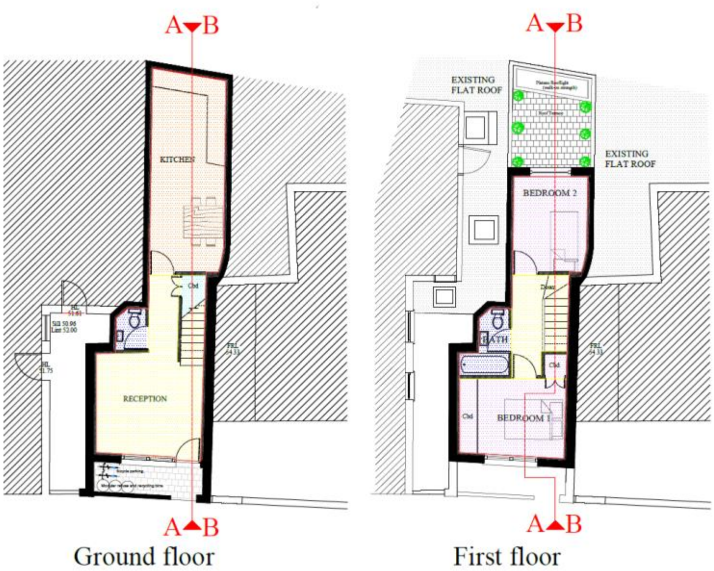
1.1 The proposed residential development at Haverstock Hill is under the planning authority of the London Borough of Camden who will require the development to meet with the following requirements.

- 20% reduction in $CO_2$ emissions over ADL1A 2013.

## Energy Modelling

1.2 The development consists of a narrow mid-terrace two-storey dwelling with partial party-walls at ground and first floors.

**Fig 1.1 Dwelling Layout**




1.3 Energy modelling was undertaken using Stroma FSAP 2012 V 1.0.3.4, which is a DCLG approved methodology and software for conducting domestic energy assessments.

## Achieving the $CO_2$ Reduction Target

1.4 Energy Modelling has been undertaken on the Development with the following assumptions used;

**Fig 1.2 Summary of U-Values**

| Element | U-Value | Comment |
|---|---|---|
| **External Wall** | 0.15 | - Wall assumed to be a cavity wall with AAC blocks. |
| **Party Wall** | 0 | -Party wall assumed to be fully filled cavity with effective sealing at all exposed edges and in line with insulation layers in abutting elements. |
| **External Roof** | 0.11 | |
| **Window Units (including roof-lights)** | 1.2 | - Window specified as triple glazed, argon-filled with low emissivity. |
| **Ground Floor** | 0.13 | |

1.5 Ventilation

- The designed Air Permeability Rate (APR) has been set at $3m^3/h.m^2$ @ 50Pa.
- The dwelling will be naturally ventilated with a basic extract fans to all WC's and kitchen hood.

1.6 Space Heating

- Space heating has been assumed as a gas-fired combi boiler with an 89.1% efficiency with a delayed start thermostat and boiler interlock.
- Heating outlets are assumed as radiator outlets.

1.7 Water Heating

- The instant hot water supply is assumed to be provided from the primary heating system.

1.8 Low & Zero-Carbon (LZC) Technologies

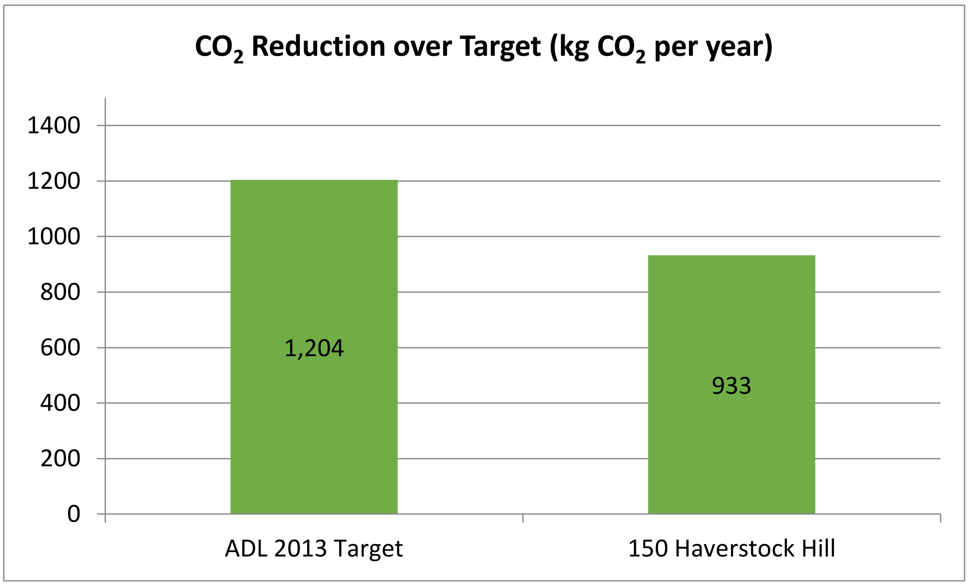
- At this stage of design development, a LZC technology will be required to meet with the $CO_2$ reduction targets.
- For this development, a Photovoltaic Array (PV) array is considered a suitable choice. The following output was included;
    - A south-facing PV array (significantly over-shaded) with an Installed Peak Power of 1.25[1] kWp has been assumed.

1.9 Additional

- All light outlets to be "Low-Energy".

## Summary of Results

Fig 1.2 $CO_2$ reduction over ADL 2013 Target Baseline




1.10 Design and specification actions as taken in this Technical Note will result in a **21.6%** reduction in $CO_2$ emissions over 2013 Building Regulations for the dwelling, as detailed in the chart above. This complies with the carbon requirements of Camden's Energy & Sustainability policies.

[1] Based on 5 no. 250 Watt PV Panels with an approximate area of $8m^2$

# SAP WorkSheet: New dwelling design stage

User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | | **Stroma Number:** | |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.3.4 |

Property Address: 150 Haverstock Hill

**Address :** The Hairdressers, 150 Haverstock Hill, LONDON, NW3 2AY

## 1. Overall dwelling dimensions:

| | Area(m²) | | | Av. Height(m) | | | Volume(m³) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 34.6 | (1a) | x | 2.55 | (2a) | = | 88.23 | (3a) |
| First floor | 26.2 | (1b) | x | 2.3 | (2b) | = | 60.26 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 60.8 | (4) | | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) | | = | 148.49 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 | x 40 = | 0 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 | x 20 = | 0 | (6b) |
| Number of intermittent fans | | | | | | | 3 | x 10 = | 30 | (7a) |
| Number of passive vents | | | | | | | 0 | x 10 = | 0 | (7b) |
| Number of flueless gas fires | | | | | | | 0 | x 40 = | 0 | (7c) |

| | | | | Air changes per hour | |
|---|---|---|---|---|---|
| Infiltration due to chimneys, flues and fans = | (6a)+(6b)+(7a)+(7b)+(7c) = | 30 | ÷ (5) = | 0.2 | (8) |

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

| | | | |
|---|---|---|---|
| Number of storeys in the dwelling (ns) | | 0 | (9) |
| Additional infiltration | [(9)-1]x0.1 = | 0 | (10) |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction | | 0 | (11) |
| *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35* | | | |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 | | 0 | (12) |
| If no draught lobby, enter 0.05, else enter 0 | | 0 | (13) |
| Percentage of windows and doors draught stripped | | 0 | (14) |
| Window infiltration | 0.25 - [0.2 x (14) ÷ 100] = | 0 | (15) |
| Infiltration rate | (8) + (10) + (11) + (12) + (13) + (15) = | 0 | (16) |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area | | 3 | (17) |
| If based on air permeability value, then | (18) = [(17) ÷ 20]+(8), otherwise (18) = (16) | 0.35 | (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.78 | (20) |
| Infiltration rate incorporating shelter factor | (21) = (18) x (20) = | 0.27 | (21) |

Infiltration rate modified for monthly wind speed

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monthly average wind speed from Table 7 | | | | | | | | | | | | |
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |

Wind Factor (22a)m = (22)m ÷ 4

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.35 | 0.34 | 0.33 | 0.3 | 0.29 | 0.26 | 0.26 | 0.25 | 0.27 | 0.29 | 0.31 | 0.32 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24a) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24b) |

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (24c) |

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.56 | 0.56 | 0.56 | 0.55 | 0.54 | 0.53 | 0.53 | 0.53 | 0.54 | 0.54 | 0.55 | 0.55 | (24d) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.56 | 0.56 | 0.56 | 0.55 | 0.54 | 0.53 | 0.53 | 0.53 | 0.54 | 0.54 | 0.55 | 0.55 | (25) |

## 3. Heat losses and heat loss parameter:

| **ELEMENT** | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 1.7 | x | 1.3 | = | 2.21 | | | (26) |
| Windows Type 1 | | | 6.66 | x1/[1/( 1.2 )+ 0.04] | | = | 7.63 | | | (27) |
| Windows Type 2 | | | 3.14 | x1/[1/( 1.2 )+ 0.04] | | = | 3.6 | | | (27) |
| Rooflights | | | 3.09 | x1/[1/(1.2) + 0.04] | | = | 3.708 | | | (27b) |
| Floor | | | 34.6 | x | 0.14 | = | 4.844 | 110 | 3806 | (28) |
| Walls | 105.24 | 11.5 | 93.74 | x | 0.14 | = | 13.12 | 60 | 5624.58 | (29) |
| Roof | 34.6 | 3.09 | 31.51 | x | 0.11 | = | 3.47 | 9 | 283.59 | (30) |
| Total area of elements, m² | | | 174.44 | | | | | | | (31) |
| Party wall | | | 66.72 | x | 0 | = | 0 | 70 | 4670.533 | (32) |
| Internal wall ** | | | 85.37 | | | | | 9 | 768.366 | (32c) |

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

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 38.4 (33)

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 15153.07 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K = (34) ÷ (4) = 249.23 (35)

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

Thermal bridges : S (L x Y) calculated using Appendix K 26.17 (36)

# SAP WorkSheet: New dwelling design stage

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

Total fabric heat loss (33) + (36) = 64.57 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 27.47 | 27.35 | 27.24 | 26.71 | 26.61 | 26.15 | 26.15 | 26.06 | 26.32 | 26.61 | 26.81 | 27.02 | (38) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 92.04 | 91.92 | 91.81 | 91.28 | 91.18 | 90.72 | 90.72 | 90.63 | 90.89 | 91.18 | 91.38 | 91.59 | |

Average = $Sum(39)_{1...12}$ /12= 91.28 (39)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.51 | 1.51 | 1.51 | 1.5 | 1.5 | 1.49 | 1.49 | 1.49 | 1.49 | 1.5 | 1.5 | 1.51 | |

Average = $Sum(40)_{1...12}$ /12= 1.5 (40)

Number of days in month (Table 1a)

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

## 4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2 (42)

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

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 81.8 (43)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (44)m= | 89.98 | 86.71 | 83.43 | 80.16 | 76.89 | 73.62 | 73.62 | 76.89 | 80.16 | 83.43 | 86.71 | 89.98 | |

Total = $Sum(44)_{1...12}$ = 981.59 (44)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 133.44 | 116.7 | 120.43 | 104.99 | 100.74 | 86.93 | 80.56 | 92.44 | 93.54 | 109.02 | 119 | 129.23 | |

Total = $Sum(45)_{1...12}$ = 1287.01 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 20.02 | 17.51 | 18.06 | 15.75 | 15.11 | 13.04 | 12.08 | 13.87 | 14.03 | 16.35 | 17.85 | 19.38 | (46) |

Water storage loss:

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

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

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

Water storage loss:

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

Temperature factor from Table 2b 0 (49)

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

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

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

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (56) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (57) |

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

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (59) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 50.96 | 46.03 | 50.96 | 49.32 | 50.96 | 49.32 | 50.96 | 50.96 | 49.32 | 50.96 | 49.32 | 50.96 | (61) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 184.39 | 162.73 | 171.39 | 154.31 | 151.7 | 136.25 | 131.52 | 143.4 | 142.86 | 159.97 | 168.31 | 180.18 | (62) |

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (63) |

Output from water heater

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (64)m= | 184.39 | 162.73 | 171.39 | 154.31 | 151.7 | 136.25 | 131.52 | 143.4 | 142.86 | 159.97 | 168.31 | 180.18 |

Output from water heater (annual)$_{1...12}$ — 1887.01 (64)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 57.11 | 50.31 | 52.78 | 47.24 | 46.24 | 41.23 | 39.52 | 43.48 | 43.43 | 48.99 | 51.9 | 55.71 | (65) |

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

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 120.25 | 120.25 | 120.25 | 120.25 | 120.25 | 120.25 | 120.25 | 120.25 | 120.25 | 120.25 | 120.25 | 120.25 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 39 | 34.64 | 28.17 | 21.33 | 15.94 | 13.46 | 14.54 | 18.9 | 25.37 | 32.21 | 37.6 | 40.08 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 261.13 | 263.84 | 257.02 | 242.48 | 224.13 | 206.88 | 195.36 | 192.65 | 199.48 | 214.02 | 232.37 | 249.61 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 49.03 | 49.03 | 49.03 | 49.03 | 49.03 | 49.03 | 49.03 | 49.03 | 49.03 | 49.03 | 49.03 | 49.03 | (69) |

Pumps and fans gains (Table 5a)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | (70) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (71)m= | -80.17 | -80.17 | -80.17 | -80.17 | -80.17 | -80.17 | -80.17 | -80.17 | -80.17 | -80.17 | -80.17 | -80.17 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 76.76 | 74.87 | 70.94 | 65.61 | 62.15 | 57.27 | 53.12 | 58.44 | 60.32 | 65.84 | 72.08 | 74.88 | (72) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 469 | 465.46 | 448.24 | 421.53 | 394.33 | 369.72 | 355.14 | 362.1 | 377.28 | 404.18 | 434.15 | 456.68 | (73) |

## 6. Solar gains:

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

| Orientation: | Access Factor Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest 0.9x | 0.77 | x | 6.66 | x | 36.79 | | 0.63 | x | 0.8 | = | 85.59 | (79) |
| Southwest 0.9x | 0.77 | x | 3.14 | x | 36.79 | | 0.63 | x | 0.8 | = | 40.35 | (79) |
| Southwest 0.9x | 0.77 | x | 6.66 | x | 62.67 | | 0.63 | x | 0.8 | = | 145.79 | (79) |
| Southwest 0.9x | 0.77 | x | 3.14 | x | 62.67 | | 0.63 | x | 0.8 | = | 68.73 | (79) |
| Southwest 0.9x | 0.77 | x | 6.66 | x | 85.75 | | 0.63 | x | 0.8 | = | 199.47 | (79) |
| Southwest 0.9x | 0.77 | x | 3.14 | x | 85.75 | | 0.63 | x | 0.8 | = | 94.05 | (79) |
| Southwest 0.9x | 0.77 | x | 6.66 | x | 106.25 | | 0.63 | x | 0.8 | = | 247.16 | (79) |
| Southwest 0.9x | 0.77 | x | 3.14 | x | 106.25 | | 0.63 | x | 0.8 | = | 116.53 | (79) |
| Southwest 0.9x | 0.77 | x | 6.66 | x | 119.01 | | 0.63 | x | 0.8 | = | 276.84 | (79) |
| Southwest 0.9x | 0.77 | x | 3.14 | x | 119.01 | | 0.63 | x | 0.8 | = | 130.52 | (79) |
| Southwest 0.9x | 0.77 | x | 6.66 | x | 118.15 | | 0.63 | x | 0.8 | = | 274.83 | (79) |
| Southwest 0.9x | 0.77 | x | 3.14 | x | 118.15 | | 0.63 | x | 0.8 | = | 129.58 | (79) |
| Southwest 0.9x | 0.77 | x | 6.66 | x | 113.91 | | 0.63 | x | 0.8 | = | 264.97 | (79) |
| Southwest 0.9x | 0.77 | x | 3.14 | x | 113.91 | | 0.63 | x | 0.8 | = | 124.93 | (79) |
| Southwest 0.9x | 0.77 | x | 6.66 | x | 104.39 | | 0.63 | x | 0.8 | = | 242.83 | (79) |
| Southwest 0.9x | 0.77 | x | 3.14 | x | 104.39 | | 0.63 | x | 0.8 | = | 114.49 | (79) |
| Southwest 0.9x | 0.77 | x | 6.66 | x | 92.85 | | 0.63 | x | 0.8 | = | 215.99 | (79) |
| Southwest 0.9x | 0.77 | x | 3.14 | x | 92.85 | | 0.63 | x | 0.8 | = | 101.83 | (79) |
| Southwest 0.9x | 0.77 | x | 6.66 | x | 69.27 | | 0.63 | x | 0.8 | = | 161.13 | (79) |
| Southwest 0.9x | 0.77 | x | 3.14 | x | 69.27 | | 0.63 | x | 0.8 | = | 75.97 | (79) |
| Southwest 0.9x | 0.77 | x | 6.66 | x | 44.07 | | 0.63 | x | 0.8 | = | 102.51 | (79) |
| Southwest 0.9x | 0.77 | x | 3.14 | x | 44.07 | | 0.63 | x | 0.8 | = | 48.33 | (79) |
| Southwest 0.9x | 0.77 | x | 6.66 | x | 31.49 | | 0.63 | x | 0.8 | = | 73.25 | (79) |
| Southwest 0.9x | 0.77 | x | 3.14 | x | 31.49 | | 0.63 | x | 0.8 | = | 34.53 | (79) |
| Rooflights 0.9x | 1 | x | 3.09 | x | 26 | x | 0.63 | x | 0.8 | = | 36.44 | (82) |
| Rooflights 0.9x | 1 | x | 3.09 | x | 54 | x | 0.63 | x | 0.8 | = | 75.69 | (82) |
| Rooflights 0.9x | 1 | x | 3.09 | x | 96 | x | 0.63 | x | 0.8 | = | 134.56 | (82) |
| Rooflights 0.9x | 1 | x | 3.09 | x | 150 | x | 0.63 | x | 0.8 | = | 210.24 | (82) |
| Rooflights 0.9x | 1 | x | 3.09 | x | 192 | x | 0.63 | x | 0.8 | = | 269.11 | (82) |
| Rooflights 0.9x | 1 | x | 3.09 | x | 200 | x | 0.63 | x | 0.8 | = | 280.32 | (82) |
| Rooflights 0.9x | 1 | x | 3.09 | x | 189 | x | 0.63 | x | 0.8 | = | 264.91 | (82) |
| Rooflights 0.9x | 1 | x | 3.09 | x | 157 | x | 0.63 | x | 0.8 | = | 220.05 | (82) |
| Rooflights 0.9x | 1 | x | 3.09 | x | 115 | x | 0.63 | x | 0.8 | = | 161.19 | (82) |
| Rooflights 0.9x | 1 | x | 3.09 | x | 66 | x | 0.63 | x | 0.8 | = | 92.51 | (82) |
| Rooflights 0.9x | 1 | x | 3.09 | x | 33 | x | 0.63 | x | 0.8 | = | 46.25 | (82) |
| Rooflights 0.9x | 1 | x | 3.09 | x | 21 | x | 0.63 | x | 0.8 | = | 29.43 | (82) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 162.38 | 290.21 | 428.08 | 573.93 | 676.47 | 684.74 | 654.8 | 577.37 | 479.01 | 329.6 | 197.1 | 137.21 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 631.38 | 755.67 | 876.32 | 995.45 | 1070.8 | 1054.46 | 1009.94 | 939.47 | 856.29 | 733.78 | 631.25 | 593.89 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.98 | 0.97 | 0.93 | 0.84 | 0.7 | 0.53 | 0.39 | 0.43 | 0.66 | 0.89 | 0.97 | 0.99 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.67 | 19.91 | 20.25 | 20.61 | 20.86 | 20.97 | 20.99 | 20.99 | 20.91 | 20.57 | 20.04 | 19.62 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 19.68 | 19.68 | 19.68 | 19.69 | 19.69 | 19.69 | 19.69 | 19.69 | 19.69 | 19.69 | 19.69 | 19.68 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.98 | 0.96 | 0.91 | 0.8 | 0.63 | 0.43 | 0.28 | 0.32 | 0.56 | 0.85 | 0.96 | 0.98 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.98 | 18.33 | 18.8 | 19.28 | 19.57 | 19.67 | 19.69 | 19.69 | 19.64 | 19.25 | 18.52 | 17.91 | (90) |

fLA = Living area ÷ (4) = | 0.26 | (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 18.43 | 18.74 | 19.18 | 19.63 | 19.91 | 20.01 | 20.03 | 20.03 | 19.97 | 19.6 | 18.92 | 18.36 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 18.28 | 18.59 | 19.03 | 19.48 | 19.76 | 19.86 | 19.88 | 19.88 | 19.82 | 19.45 | 18.77 | 18.21 | (93) |

## 8. Space heating requirement

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation factor for gains, hm: | | | | | | | | | | | | | |
| (94)m= | 0.97 | 0.95 | 0.89 | 0.79 | 0.63 | 0.44 | 0.29 | 0.33 | 0.57 | 0.84 | 0.95 | 0.98 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 612.85 | 714.34 | 783.67 | 787.07 | 676.41 | 467.14 | 296.45 | 313.16 | 491.17 | 615.73 | 598.52 | 579.65 | (95) |
| Monthly average external temperature from Table 8 | | | | | | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
| Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m ] | | | | | | | | | | | | | |
| (97)m= | 1286.27 | 1258.72 | 1150.26 | 965.94 | 734.62 | 477.53 | 297.87 | 315.57 | 520.06 | 806.64 | 1066.77 | 1282.78 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 501.02 | 365.82 | 272.74 | 128.79 | 43.31 | 0 | 0 | 0 | 0 | 142.03 | 337.14 | 523.13 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 2313.99 | (98)

Space heating requirement in kWh/m²/year | 38.06 | (99)

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

**Space heating:**

| | | | |
|---|---|---|---|
| Fraction of space heat from secondary/supplementary system | | 0 | (201) |
| Fraction of space heat from main system(s) | (202) = 1 – (201) = | 1 | (202) |
| Fraction of total heating from main system 1 | (204) = (202) × [1 – (203)] = | 1 | (204) |
| Efficiency of main space heating system 1 | | 93 | (206) |
| Efficiency of secondary/supplementary heating system, % | | 0 | (208) |

# SAP WorkSheet: New dwelling design stage

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement (calculated above) | | | | | | | | | | | | | | |
| | 501.02 | 365.82 | 272.74 | 128.79 | 43.31 | 0 | 0 | 0 | 0 | 142.03 | 337.14 | 523.13 | | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | | (211) |
| | 538.74 | 393.36 | 293.27 | 138.48 | 46.57 | 0 | 0 | 0 | 0 | 152.73 | 362.52 | 562.5 | | |
| Total (kWh/year) =Sum(211)$_{1...5,10...12}$= | | | | | | | | | | | | | 2488.16 | (211) |
| Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) | | | | | | | | | | | | | | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total (kWh/year) =Sum(215)$_{1...5,10...12}$= | | | | | | | | | | | | | 0 | (215) |

**Water heating**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from water heater (calculated above) | 184.39 | 162.73 | 171.39 | 154.31 | 151.7 | 136.25 | 131.52 | 143.4 | 142.86 | 159.97 | 168.31 | 180.18 | | |
| Efficiency of water heater | | | | | | | | | | | | | 79.9 | (216) |
| (217)m= | 87.04 | 86.63 | 85.81 | 84.2 | 81.94 | 79.9 | 79.9 | 79.9 | 79.9 | 84.35 | 86.36 | 87.18 | | (217) |
| Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m | | | | | | | | | | | | | | |
| (219)m= | 211.85 | 187.85 | 199.72 | 183.27 | 185.13 | 170.52 | 164.6 | 179.47 | 178.8 | 189.65 | 194.89 | 206.69 | | |
| Total = Sum(219a)$_{1...12}$ = | | | | | | | | | | | | | 2252.44 | (219) |

**Annual totals**

| | | kWh/year | kWh/year | |
|---|---|---|---|---|
| Space heating fuel used, main system 1 | | | 2488.16 | |
| Water heating fuel used | | | 2252.44 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 | | (230e) |
| Total electricity for the above, kWh/year | sum of (230a)…(230g) = | | 75 | (231) |
| Electricity for lighting | | | 275.48 | (232) |
| Electricity generated by PVs | | | -701.69 | (233) |

## 10a. Fuel costs - individual heating systems:

| | Fuel kWh/year | Fuel Price (Table 12) | | Fuel Cost £/year | |
|---|---|---|---|---|---|
| Space heating - main system 1 | (211) x | 3.48 | x 0.01 = | 86.59 | (240) |
| Space heating - main system 2 | (213) x | 0 | x 0.01 = | 0 | (241) |
| Space heating - secondary | (215) x | 13.19 | x 0.01 = | 0 | (242) |
| Water heating cost (other fuel) | (219) | 3.48 | x 0.01 = | 78.38 | (247) |
| Pumps, fans and electric keep-hot | (231) | 13.19 | x 0.01 = | 9.89 | (249) |
| (if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a | | | | | |
| Energy for lighting | (232) | 13.19 | x 0.01 = | 36.34 | (250) |
| Additional standing charges (Table 12) | | | | 120 | (251) |
| | one of (233) to (235) x) | 13.19 | x 0.01 = | -92.55 | (252) |

# SAP WorkSheet: New dwelling design stage

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

| | | | |
|---|---|---|---|
| **Total energy cost** | (245)...(247) + (250)…(254) = | 238.65 | (255) |

## 11a. SAP rating - individual heating systems

| | | | |
|---|---|---|---|
| Energy cost deflator (Table 12) | | 0.42 | (256) |
| Energy cost factor (ECF) | [(255) x (256)] ÷ [(4) + 45.0] = | 0.95 | (257) |
| **SAP rating (Section 12)** | | 86.78 | (258) |

## 12a. $CO_2$ emissions – Individual heating systems including micro-CHP

| | **Energy** kWh/year | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 0.216 | = | 537.44 | (261) |
| Space heating (secondary) | (215) x | 0.519 | = | 0 | (263) |
| Water heating | (219) x | 0.216 | = | 486.53 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 1023.97 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) x | 0.519 | = | 142.97 | (268) |
| Energy saving/generation technologies<br>Item 1 | | 0.519 | = | -364.18 | (269) |
| Total CO2, kg/year | | sum of (265)…(271) = | | 841.69 | (272) |
| **CO2 emissions per m²** | | (272) ÷ (4) = | | 13.84 | (273) |
| EI rating (section 14) | | | | 89 | (274) |

## 13a. Primary Energy

| | **Energy** kWh/year | **Primary** factor | | **P. Energy** kWh/year | |
|---|---|---|---|---|---|
| Space heating (main system 1) | (211) x | 1.22 | = | 3035.55 | (261) |
| Space heating (secondary) | (215) x | 3.07 | = | 0 | (263) |
| Energy for water heating | (219) x | 1.22 | = | 2747.97 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | 5783.53 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) x | 3.07 | = | 230.25 | (267) |
| Electricity for lighting | (232) x | 0 | = | 845.71 | (268) |
| Energy saving/generation technologies<br>Item 1 | | 3.07 | = | -2154.19 | (269) |
| ‘Total Primary Energy | | sum of (265)…(271) = | | 4705.3 | (272) |
| **Primary energy kWh/m²/year** | | (272) ÷ (4) = | | 77.39 | (273) |