

ENERGY & SUSTAINABILITY STATEMENT

115 Chatham Street Reading

Produced by XCO₂ for Archel Homes Limited.

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EXECUTIVE SUMMARY

The sustainability and energy strategy for the Chatham Street development has been developed to comply with the relevant policies of the Reading Council Local Plan and Sustainable Design and Construction Guidance.

The proposals incorporate a range of sustainable design and construction measures, primarily addressing the sustainable management of resources, the protection and enhancement of the environment and the effective adaptation and mitigation of the development to climate change.

This report presents the sustainability strategy and assesses the predicted energy performance and carbon dioxide emissions of the proposed development at Chatham Street, located in Reading, Berkshire.

The proposed development comprises a five-storey residential scheme comprising a total of 54 units.

This document is divided into three parts:

- Planning policies;
- Proposed sustainability measures; and,
- Energy Strategy.

The Planning Policy section provides an overview of the site and planning policies applicable to this development in accordance with the Borough of Reading Local Plan (2019) and the Borough of Reading Supplementary Design and Construction Guidance (2019).

The second section on proposed sustainability measures outlines the sustainability measures that have been adopted in the team's aim to maximise sustainability within the site.

The third section describes the predicted energy performance and carbon dioxide emissions of the proposed development at 115 Chatham Street Reading. The development will be compared to a notional building constructed to Part L1A standards.

Key sustainability features of the proposals include:

- The re-use of previously developed land;
- Effective site layout in response to the neighbouring context;
- Efficient design of the proposed massing, openings and internal layouts so that habitable spaces across the site benefit from abundant daylight and sunlight levels, whilst impacts to neighbouring buildings are kept to a minimum;
- The specification of water efficient fittings to limit water consumption to less than 110 litres per person per day for domestic uses, and;
- Effective pollution management and control: the development is not expected to have any significant adverse effects to air, noise or land.

The energy strategy for the scheme focuses on the efficiency of the fabric and building services, so that the energy demand is reduced to the extent feasible. Energy efficiency is primarily achieved through a highly insulated building envelope, mechanical ventilation with heat recovery (MVHR), a good air permeability rate and a thermal bridging ψ -value in line with the Accredited Construction Details. Highly efficient lighting, space conditioning and hot water systems, as well as appropriate controls further reduce the regulated energy demand and consumption of the development. The proposals also incorporate a communal ASHP servicing strategy.

In total, the development is expected to achieve regulated CO₂ savings of 40.8% compared to a notional development that meets the minimum Part L 2013 Regulations standards of performance. The SAP10 carbon factors have been used to calculate the regulated carbon reductions proposed on-site.

ENERGY & SUSTAINABILITY STATEMENT

The proposed energy strategy is seen to exceed the 35% reduction in regulated carbon emissions as specified by Reading Borough Council.

To achieve 'zero carbon' for the residential portion of the scheme, 21.7 tonnes per annum of regulated CO₂, equivalent to 651.7 tonnes over 30 years, from the new-build domestic portion should be offset offsite. Any carbon offset contributions will be subject to viability discussions and detailed design stage calculations.

INTRODUCTION

The proposed residential development is located in Reading, Berkshire. This section presents the description of the site and of the development proposal.

SITE & PROPOSAL

The scheme is a five-storey residential building comprising 54 units and is located on Chatham Street in Reading, Berkshire.

The proposal includes demolition of existing buildings and the redevelopment of the site to provide 54 new

homes together with car and cycle parking and private and communal amenity space.

The location of the development site is shown in Figure 1 below.



Figure 1: Location of the application site.

PLANNING POLICIES

The proposal will seek to respond to the energy and sustainability policies of the Borough of Reading Local Plan as well as the Borough of Reading Sustainable Design and Construction Guidance (2019).

The most relevant applicable energy policies in the context of the proposed development are presented below.

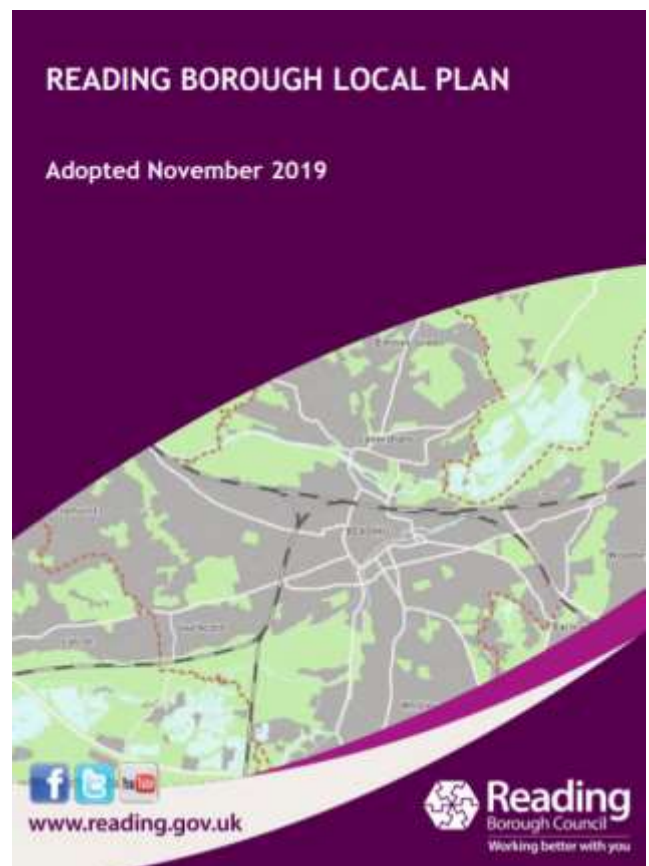
READING BOROUGH LOCAL PLAN (NOVEMBER 2019)

CC2: SUSTAINABLE DESIGN AND CONSTRUCTION

Proposals for new development, including the construction of new buildings and the redevelopment and refurbishment of existing building stock, will be acceptable where the design of buildings and site layouts use energy, water, minerals, materials and other natural resources appropriately, efficiently and with care and take account of the effects of climate change.

To meet these requirements:

- All major non-residential developments or conversions to residential are required to meet the most up to date BREEAM 'Excellent' standards, where possible;
- All minor non-residential developments or conversions to residential are required to meet the most up to date BREEAM 'Very Good' standard as a minimum;
- All non-residential development or conversions to residential should incorporate water conservation measures so that predicted per capita consumption does not exceed the appropriate levels set out in the applicable BREEAM standard. Both residential and non-residential development should include recycling greywater and rainwater harvesting where systems are energy and cost effective.



CC3: ADAPTATION TO CLIMATE CHANGE

All developments will demonstrate how they have been designed to incorporate measures to adapt to climate change. The following measures shall be incorporated into development:

- Wherever possible, new buildings shall be orientated to maximise the opportunities for both natural heating and ventilation and reducing exposure to wind and other elements;
- Proposals involving both new and existing buildings shall demonstrate how they have

been designed to maximise resistance and resilience to climate change for example by including measures such as solar shading, thermal mass, heating and ventilation of the building and appropriately coloured materials in areas exposed to direct sunlight, green and brown roofs, green walls, etc;

- Use of trees and other planting, where appropriate as part of a landscape scheme, to provide shading of amenity areas, buildings and streets and to help to connect habitat, designed with native plants that are carefully selected, managed and adaptable to meet the predicted changed climatic conditions; and
- All development shall minimise the impact of surface water runoff from the development in the design of the drainage system, and where possible incorporate mitigation and resilience measures for any increases in river flooding levels as a result of climate change.

CC4: DECENTRALISED ENERGY

In meeting the sustainability requirements of this plan, developments of the sizes set out below shall demonstrate how consideration has been given to securing energy for the development from a decentralised energy source.

Any development of more than 20 dwellings and/ or non-residential development of over 1,000 sq m shall consider the inclusion of decentralised energy provision, within the site, unless it can be demonstrated that the scheme is not suitable, feasible or viable for this form of energy provision.

Where there is existing decentralised energy provision present within the vicinity of an application site, further developments of 10 dwellings or more or non-residential development of 1,000 sq m or more will be expected to link into the existing decentralised energy network or demonstrate why this is not feasible.

CC5: WASTE MINIMISATION AND STORAGE

Development should demonstrate measures to minimise the generation of waste in the construction, use and life of buildings and promote more sustainable approaches to waste management, including the reuse and recycling of construction waste and the promotion of layouts and designs that provide adequate, well-designed space to facilitate waste storage, reuse, recycling and composting.

EN12: BIODIVERSITY AND THE GREEN NETWORK

The identified Green Network, the key elements of which are shown on the Proposals Map, shall be maintained, protected, consolidated, extended and enhanced. Permission will not be granted for development that negatively affects the sites with identified interest or fragments the overall network. The Green Network comprises:

- Sites with identified biodiversity interest - Local Wildlife Sites, Local Nature Reserves, Biodiversity Opportunity Areas, protected and priority species and their habitats, Priority and Biodiversity Action Plan habitats, and the River Thames and all its tributaries (including the River Kennet and the Kennet & Avon Canal); and
- Areas with potential for biodiversity value and which stitch the Green Network together – designated Local Green Space and open green spaces, and existing and potential Green Links.

New development shall demonstrate how the location and type of green space, landscaping and water features provided within a scheme have been arranged such that they maintain or link into the existing Green Network and contribute to its consolidation. Such features should be designed to maximise the opportunities for enhancing this network. All new development should maximise opportunities to create new assets and links into areas where opportunities are as yet unidentified on the Proposals Map.

On all sites, development should not result in a net loss of biodiversity and geodiversity, and should provide a net gain for biodiversity wherever possible.

Development should:

- Protect and wherever possible enhance features of biodiversity interest on and adjacent to the application site, incorporating and integrating them into development proposals wherever practicable; and
- Provide new tree planting, wildlife friendly landscaping and ecological enhancements (such as wildlife ponds, bird and bat boxes) wherever practicable. In exceptional circumstances where the need for development clearly outweighs the need to protect the value of the site, and it is

demonstrated that the impacts cannot be: 1) avoided; 2) mitigated or; 3) compensated for on-site; then new development will provide off-site compensation to ensure that there is “no net loss” of biodiversity. Provision of off-site compensation shall be calculated in accordance with nationally or locally recognised guidance and metrics. It should not replace existing alternative habitats, and should be provided prior to development.

EN15: AIR QUALITY

Development should have regard to the need to improve air quality and reduce the effects of poor air quality.

i. Development that would detrimentally affect air quality will not be permitted unless the effect is to be mitigated. The following criteria should be taken into account:

- Whether the proposal, including when combined with the cumulative effect of other developments already permitted, would worsen air quality;
- Whether the development is within, or accessed via, an Air Quality Management Area; and
- Whether it can be demonstrated that a local worsening in air quality that would not detrimentally affect human health or the environment would be offset by an overall improvement in air quality, for instance through reduction in the need to travel.

ii. Where a development would introduce sensitive uses (such as residential, schools and nurseries, hospitals, care facilities) into, or intensify such uses within, an Air Quality Management Area, detrimental effects on that use will be mitigated. Mitigation measures should be detailed in any planning application. If there are significant detrimental effects that cannot be mitigated, the application should be refused.

iii. Where required, planning obligations will be used to secure contributions to measures to tackle poor air quality or for air quality monitoring.

EN16: POLLUTION AND WATER RESOURCES

Development will only be permitted where it would not be damaging to the environment and sensitive

receptors through land, noise or light pollution; where it would result in no deterioration in, or ideally enhance, ground and surface water quality; and where adequate water resources, sewerage and wastewater treatment infrastructure will be in place to support the proposed development prior to occupation.

Proposals for development that are sensitive to the effects of noise or light pollution will only be permitted in areas where they will not be subject to high levels of such pollution unless adequate mitigation measures are provided to minimise the impact of such pollution.

Development will only be permitted on land affected by contamination where it is demonstrated that the contamination and land gas can be satisfactorily managed or remediated so that it is suitable for the proposed end use and will not impact on the groundwater environment, human health, buildings and the wider environment, during demolition and construction phases as well as during the future use of the site.

EN18: FLOODING AND SUSTAINABLE DRAINAGE SYSTEMS

Development will be directed to areas at lowest risk of flooding in the first instance, following the Sequential and Exceptions Test set out in the NPPF, and taking into account the effects of climate change. It will consider flooding from all sources, including fluvial, surface water, groundwater and sewer flooding. Where development in areas at risk of flooding is necessary, it will not reduce the capacity of the flood plain to store floodwater, impede the flow of floodwater or in any way increase the risks to life and property arising from flooding. Wherever possible, development should be designed to reduce flood risk, both on- and off-site.

All major developments⁶³ must incorporate sustainable drainage systems (SuDS) as appropriate and in line with the Government's Technical Standards⁶⁴. Smaller schemes are encouraged to incorporate SuDS, where possible. Runoff rates should aim to reflect greenfield conditions and, in any case, must be no greater than the existing conditions of the site. Schemes should ensure that the movement of water through vertical infiltration as well as horizontal run-off does not worsen contamination effects. Wherever possible, SuDS provision should maximise ecological benefits, link into the existing Green Network, incorporate tree planting and landscaping and avoid damage to existing significant trees, including through changes to the site hydrology. All

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new developments in areas of flood risk should give priority to SuDS.

H5: STANDARDS FOR NEW HOUSING

New build housing should be built to the following standards, unless it can be clearly demonstrated that this would render a development unviable:

- a. All new build housing outside the Central Area as defined on the Proposals Map will comply with the nationally described space standard.
- b. All new build housing will be built to the higher water efficiency standard under Regulation 36(3) of the Building Regulations
- c. All major new-build residential development should be designed to achieve zero carbon homes.
- d. All other new build housing will achieve at a minimum a 19% improvement in the dwelling emission rate over the target emission rate, as defined in the 2013 Building Regulations.
- e. All new build housing will be accessible and adaptable in line with M4(2) of the Building Regulations, unless it is built in line with M4(3) (see below).
- f. On developments of 20 or more new build dwellings, at least 5% of dwellings will be wheelchair user dwellings in line with M4(3) of the Building Regulations. Any market homes provided to meet this requirement will be 'wheelchair adaptable' as defined in part M, whilst homes where the Council is responsible for allocating or nominating an individual may be 'wheelchair accessible'.

READING BOROUGH SUSTAINABLE DESIGN AND CONSTRUCTION (SUPPLEMENTARY PLANNING GUIDANCE) (DECEMBER 2019)

Energy Efficiency

- Fabric improvements are much more likely to ensure long-term carbon reductions and are generally achieved at lower cost than on-site generation. Therefore, applicants should seek to improve fabric efficiency in the first instance.

- Maximising natural ventilation is appropriate in most circumstances and is usually a more sustainable option than air conditioning systems, albeit that a building should be able to be made airtight to reduce energy demand for heating or cooling in extreme weather. The simplest method is to create opportunities for cross ventilation. Openings on opposing (or even adjacent) walls can draw air through a space. Windows should be openable if possible, and trickle vents or other such devices should be installed to provide controllable background ventilation. Mechanical ventilation may be required to supplement natural ventilation but this should be very energy efficient, requiring only small levels of energy to run, yet achieve significant benefits in a development. Natural ventilation can also be achieved through the use of 'passive stack effect' and pressure differentials to bring cool fresh air from outside the building without the use of mechanical systems. Design should ensure that cool air is introduced in summer and warm air in winter in order to reduce heating and cooling loads.
- To maximise energy efficiency the heat losses from the building envelope must be kept to a minimum with high levels of airtightness. Heat loss can be prevented by applying high levels of insulation to the roof, walls and floors. Heat loss from windows can be further reduced through double or triple glazing, however, adequate ventilation is always a requirement, and avoids condensation problems.
- Appliances provide heat, light and other essential services and are major consumers of energy. The careful choice of appliances can reduce energy demand, and therefore costs, significantly. Domestic properties should as far as possible use the most energy efficient appliances, in particular energy and water efficient white goods.

Water Management

- The Government has set a small number of 'optional' national standards over and above the Building Regulations minima, which include water efficiency. Local Planning authorities can choose to apply the higher 'optional' standard in their area through incorporating a policy in a Local Plan. RBC has chosen to include the optional water

efficiency standard in policy H5. For clarity, the higher water efficiency standard set out in the Building Regulations is 110 litres per person per day.

- Implementation of the SuDS approach, as opposed to conventional drainage systems, provides several benefits, and is a requirement for major development. Appropriately designed, constructed and maintained SuDS can improve the sustainable management of water for a site by reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream, improve water quality by removing pollutants from diffuse sources and reducing potable water demand through rainwater harvesting.

Decentralised Energy and District Heating

- Policy CC4 of the Local Plan deals with decentralised energy and expects developments of more than 20 dwellings and/or non-residential development of over 1,000 sq m to consider the inclusion of decentralised energy provision, within the site, unless it can be demonstrated that the scheme is not suitable, feasible or viable for this form of energy provision. It also expects developments of over 10 dwellings or more or non-residential development of 1,000 sq m or more to link into an existing district energy network, where one is present within the vicinity of an application site or demonstrate why this is not feasible.
- There are particular issues worthy of further guidance in terms of District Heating (DH). The supporting text to the policy in particular (paragraph 4.1.15) states that air-source or ground source heat pumps should be considered in the first instance, as these methods are less carbon intensive than CHP.

PROPOSED SUSTAINABILITY MEASURES

The proposals incorporate a range of sustainable design and construction measures, primarily addressing the sustainable management of resources, the protection and enhancement of the environment and the effective adaptation and mitigation of the development to climate change.

The following subsections detail the sustainability measures that will be incorporated into the design of the proposed dwellings.

ENERGY

DWELLING EMISSION RATE AND FABRIC ENERGY EFFICIENCY

The methodology set out by the Department of Energy and Climate Change (DECC) for assessing the energy use of dwellings is the Standard Assessment Procedure (SAP). The current version is SAP 2012, the calculations presented within this report have utilised the SAP10 carbon factors.

Preliminary SAP calculations were carried out to assess the potential CO₂ savings achieved through

- Energy efficiency measures
- The efficient supply of energy and
- Renewable systems

The preliminary calculations showed an improvement over Part L Building Regulations 2013, amounting to a 40.8% reduction in regulated CO₂ emissions for the scheme.

The energy demand of the scheme will be reduced through the adoption of high levels of insulation, accredited thermal bridging details and good levels of air tightness to improve the building's fabric efficiency. SAP calculations were based on a building fabric with low U-values and an air permeability rate of 3m³/m².h at 50 Pa.

ENERGY LABELLED WHITE GOODS

The dwellings will be supplied with an EU Energy Efficiency Labelling Scheme Leaflet to help the tenants

choose energy efficient white goods or energy efficient white goods where dwellings have been fitted out.

EXTERNAL LIGHTING

Energy efficient light fittings will be installed throughout the development where appropriate. In addition, external lights will be fitted with controls to reduce the energy consumption of the building during periods of infrequent use:

- External space lighting will include energy efficient fittings
- Security lighting will include daylight cut-off devices, with a maximum wattage of 150W and PIR.

LOW OR ZERO CARBON TECHNOLOGIES

A feasibility study was carried out to determine the energy strategy for the proposed development. The proposed strategy has surpassed Part L Building Regulations due to the reduction in the demand by a highly efficient shell. A communal ASHP strategy was identified as suitable for the development.

CYCLE STORAGE

Cycle storage spaces will be provided in a cycle storage area on the ground floor for use by the occupants to reduce the frequency of short car journeys. The cycle storage will be adequately sized and secure, providing 32 storage spaces.

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WATER

INDOOR WATER USE

The development at 115 Chatham Street Reading aims to reduce water consumption in the dwellings to below 110 litres per person per day through the use of water efficient fittings, and these are listed below.

Table 1: Recommended specification for sanitary fittings.

Fitting	Consumption per use
WC (full flush)	6 litres per flush
WC (half flush)	3 litres per flush
Kitchen sink tap	6 litres per min
Wash basin tap	3 litres per min
Bath	180 litres to overflow
Shower	8 litres per min
Washing machine	8.17 litres per kilogram
Dishwasher	1.25 litres per place setting

MATERIALS

Embodied energy is the energy that is used in the manufacture, processing and the transportation of the materials to site.

The construction build-ups for each of the main building elements are rated from A+ to E. Each element to be used in the building has been rated according to the BRE Green Guide to Specification whereby:

- A+ rated elements are least likely to affect the environment
- E rated elements are most likely to affect the environment

It is assumed that most of the main building elements within this development will achieve between an A+ to C rating where possible.

All timber used during site preparation and construction to be FSC certified, and all non-timber materials to be certified with Environmental Management Systems (ISO 14001 OR BES 6001) where possible.

WASTE

HOUSEHOLD WASTE

Dedicated external waste storage for the dwellings will be provided to meet the Local Authority requirements.

Adequate internal storage for recyclable waste will be provided to all dwellings in a dedicated position. The Local Authority provides recyclable household waste collection and sorting.

CONSTRUCTION SITE WASTE MANAGEMENT

The development will minimise the impact of construction waste on the environment through a Resource Management Plan or Strategy. This plan will include information such as:

- Benchmarks for resource efficiency
- Procedures and commitments to reduce hazardous and non-hazardous waste
- Monitoring hazardous and non-hazardous waste

POLLUTION

GLOBAL WARMING POTENTIAL (GWP) OF INSULANTS

Global warming potential (GWP) is a measure of how effective a gas is at preventing the passage of infrared radiation. Blowing agents, used in the production of insulation, are a common source of gases with high GWPs.

The development will aim to specify insulation materials that have a low Global Warming Potential (GWP).

NO_x EMISSIONS

Space heating and hot water requirements are to be met through high efficiency ASHP which eliminates NO_x emissions.

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HEALTH AND WELLBEING

DAYLIGHTING

The dwellings have been designed with daylight in mind and measures have been taken to maximise daylight where possible.

SOUND INSULATION

The development proposes that airborne sound insulation will comply or exceed current Building Regulations Part E standards.

PRIVATE SPACE

Private external spaces will be provided in the form of winter gardens and balconies for the majority of flats in this development with the aim of improving the quality of life of the occupants.

SURFACE WATER RUN-OFF

The Environment Agency flood map shows the proposed development to be located within an area at low risk of flooding.

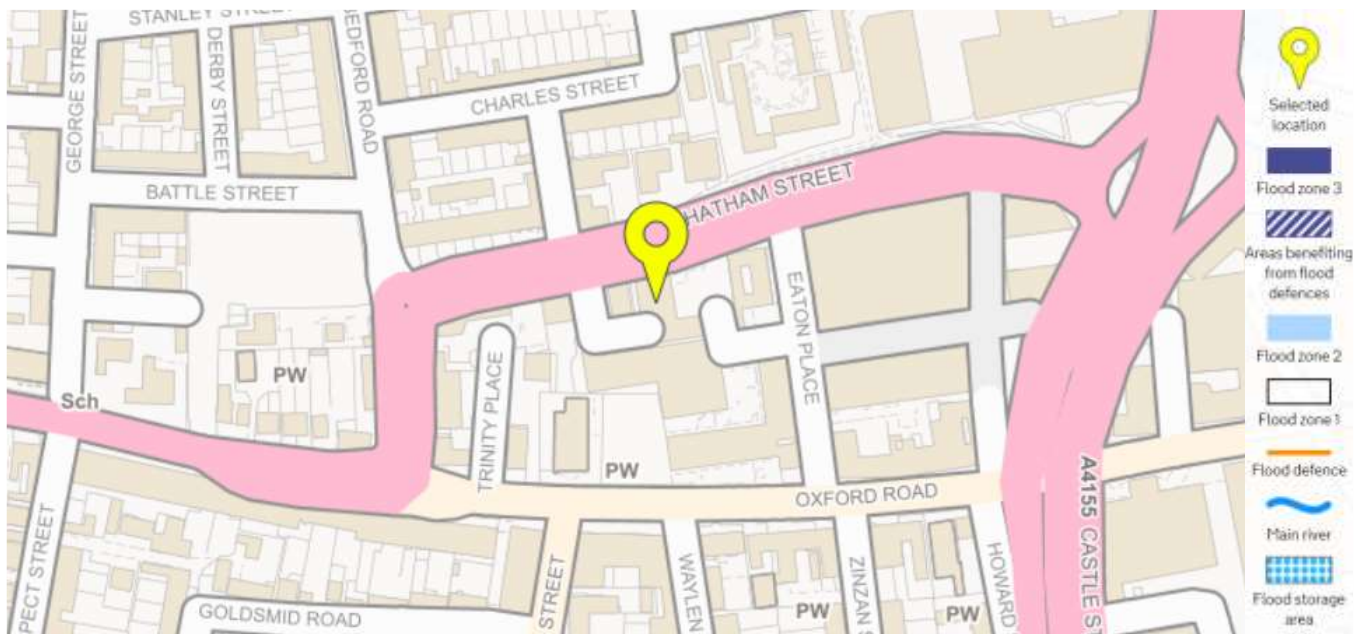


Figure 2: Environment Agency Flood Risk Map for Planning illustrating the site location in flood zone 1.

MANAGEMENT

CONSTRUCTION SITE IMPACTS

To minimise the construction impacts of the site, the contractor will strive to monitor, report and set targets for:

- The production of CO₂ arising from site activities, and;
- Water consumption from site activities.

In addition, contractors will strive to adopt best practice policies for air (dust) and water (ground and surface) pollution occurring on site. All timber will be sourced following the Government's Timber Procurement Policy.

ECOLOGY

ECOLOGICAL VALUE OF SITE & PROTECTION OF ECOLOGICAL FEATURES

Due to its urban location, previous use as a car park there is a significant absence of ecological features on the existing site, the site is considered to be of low ecological value.

ECOLOGICAL MITIGATION AND ENHANCEMENT

Where feasible, the landscape architects will provide recommendations for the planting in order to enhance the existing biodiversity on site. The development will introduce landscaped areas and private gardens to increase the biodiversity of the post-developed site where possible.

BUILDING FOOTPRINT

The proposed development will increase the density of the site. This will ensure that the land is used efficiently whilst maximising the building area.

ENERGY STRATEGY

This section describes the predicted energy performance and carbon dioxide emissions of the proposed 115 Chatham Street Reading development based on the information provided by the design team.

The overall regulated CO₂ savings *on site* against a Part L 2013 compliant scheme are estimated at 40.8% for the site as whole using the SAP10 carbon factors.

METHODOLOGY

The methodology used to determine CO₂ emissions is in accordance with a three-step Energy Hierarchy.

- Step 1 – Use Less Energy;
- Step 2 – Supply Energy Efficiently, and;
- Step 3 – Use Renewable Energy.

The development is compared to a Building Regulations Part L 2013 compliant scheme. The reductions made through each step are outlined below.

STEP 1 – USE LESS ENERGY

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water, ventilation and lighting. Measures will also be put in place to reduce the risk of overheating.

PASSIVE DESIGN MEASURES

ENHANCED U-VALUES

The heat loss of different building fabric elements is dependent upon their U-value, which is a measure of the thermal transmittance through the element. An element with low U-value provides better levels of insulation and reduced heating demand.

The proposed development will incorporate high levels of insulation and high-performance glazing beyond Part L 2013 targets and notional building specifications, in order to reduce the demand for space conditioning.

The table below demonstrates the improved performance of the proposed building fabric beyond the Building Regulations requirements.

AIR TIGHTNESS IMPROVEMENT

Heat loss may also occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing and the use of best practice construction techniques can minimise the amount of air infiltration.

The proposed development will aim to improve upon the Part L 2013 minimum standards for air tightness by targeting air permeability rates of 3m³/m² at 50Pa for all new build residential units.

Table 2: Thermal Envelope U-values.

Domestic (U-values in W/m ² .K)			
Element	Building Regulations	Proposed	Improvement
Walls	0.30	0.15	50%
Floor	0.25	0.10	60%
Roof	0.20	0.10	50%
Windows	2.00	1.30	35%

REDUCING THE NEED FOR ARTIFICIAL LIGHTING

The design of the development incorporates large areas of glazing across all building elevations, to optimise daylight in occupied spaces. Good internal daylight levels will translate to less dependency on artificial lighting and will indirectly deliver energy and

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carbon savings, together with pleasant, healthy spaces for occupants.

ACTIVE DESIGN MEASURES

HIGH EFFICACY LIGHTING

The development intends to incorporate low energy lighting fittings throughout the development. All light fittings will be specified as low energy lighting and will primarily accommodate LEDs.

HEAT RECOVERY VENTILATION

Mechanical ventilation heat recovery (MVHR) is proposed for all of the residential dwellings of the development.

The mechanical ventilation system will include heat recovery in order to achieve ventilation in the most energy-efficient way.

CONTROLS

Advanced lighting and space conditioning controls will be incorporated, specifically:

- For the communal areas of infrequent use, occupant sensors will be fitted for lighting, whereas day lit areas will incorporate daylight sensors where appropriate;
- Heating controls in dwellings will comprise programmer and room thermostats, and;

MONITORING

Apart from the above design measures, the development will incorporate monitoring equipment and systems to enable occupiers to monitor and reduce their energy use.

Smart meters will be installed to monitor the heat and electricity consumption of each dwelling; the display board will demonstrate real-time and historical energy use data and will be installed at an accessible location within the dwellings.

MINIMISING INTERNAL HEAT GENERATION THROUGH ENERGY EFFICIENT DESIGN

The development will be served by a communal ASHP system and therefore heat distribution pipework will be held at a minimum. Heat sources and pipework will be sufficiently insulated to reduce heat dissipation in occupied spaces.

Efficient lighting will be used to further minimise internal heat gains and reduce energy expenditure.

REDUCING THE AMOUNT OF HEAT ENTERING THE BUILDING IN SUMMER

The openings across the development have been appropriately designed to offer satisfactory daylight and views to occupied spaces, without disproportionately increasing solar gains and overheating risks. The development also incorporates balconies, which apart from offering private amenity space for occupants, will also serve as shading elements for the openings of the floor below, obstructing direct solar gains during the peak hours of the summer.

MECHANICAL VENTILATION

The primary strategy for fresh air supply will be through an MVHR system, with a by-pass 'summer mode' activated to allow for free cooling of occupied spaces through the incoming outdoor air and the dissipation of built-up heat. The dwellings have allowed for passive ventilation as a secondary strategy for fresh air supply and as a primary strategy for dissipating heat during peak summer conditions. The passive ventilation strategy includes single-sided ventilation, cross ventilation and night purge ventilation through openable windows and doors, operated by the occupants.

PART L OVERHEATING RISK ASSESSMENT

The potential risk of overheating was assessed via the Part L Building Regulation compliance tool SAP. A 'medium' / 'slight' overheating risk was found for all representative dwelling types modelled in SAP. The SAP overheating risk assessment outputs for a sample of the dwelling types modelled can be found in Appendix A – SAP Results.

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ENERGY USE

The table below shows a breakdown of carbon dioxide emissions associated with the proposed development's fossil fuel and electricity consumption for the different uses. The site-wide data are presented. The figures provide a comparison between the baseline condition and the proposed development

once energy efficiency measures (step 1) have been applied.

This table demonstrates the energy savings achieved through energy efficiency measures (step 1 of the methodology).

Table 3: Breakdown of energy consumption and CO₂ emissions for the baseline and the proposed schemes after 'Step 1 – Use Less Energy' measures are implemented.

	Baseline			Step 1 – Use Less Energy		
	Energy (kWh/yr.)	kgCO ₂ /yr.	kgCO ₂ /m ²	Energy (kWh/yr.)	kgCO ₂ /yr.	kgCO ₂ /m ²
Hot Water	85,230	17,899	7.4	86,150	18,091	7.5
Space Heating	72,580	15,242	6.3	49,510	10,397	4.3
Cooling				0	0	0.0
Auxiliary	3,080	716	0.3	8,580	2,000	0.8
Lighting	12,060	2,810	1.2	11,750	2,739	1.1
Equipment	93,650	21,820	9.1	93,650	21,820	9.1
Total Part L	172,950	36,668	15.2	155,990	33,226	13.8
Total (incl. equipment)	266,600	58,489	24.3	249,640	55,046	22.9

STEP 1 – CO₂ EMISSIONS & SAVINGS

By means of energy efficiency measures alone, regulated CO₂ emissions are shown to reduce by 9.4% (3.4 tonnes per annum) using the SAP10 carbon factors across the whole site.

STEP 2 – SUPPLY ENERGY EFFICIENTLY

The proposed development site is located within an area where there is no existing district heat network within close proximity and an on-site wide CHP network is unlikely to be viable in light of the new carbon factors. A site-wide heat network incorporating low carbon heat generation is proposed for the development. No regulated carbon savings are achieved for this step of the Energy Hierarchy.

ENERGY SYSTEM HIERARCHY

The energy system for the development has been selected in accordance a decentralised energy hierarchy. The hierarchy states that energy systems should consider:

- Connection to existing heating and cooling networks;
- Site wide CHP network; and,
- Communal heating and cooling.

Local heat and power sources minimise distribution losses and achieve greater efficiencies when compared to separate energy systems, thus reducing CO₂ emissions.

In a communal energy system, energy in the form of heat, cooling, and/or electricity is generated from a central source and distributed via a network of insulated pipes to surrounding residences.

CONNECTION TO AN EXISTING NETWORK

The location of the site in the Borough of Reading is not identified to be in close proximity to any of the core or first four phases of the energy clusters identified in the City centre by Element Energy, please see figure 3 overleaf. The site is located the east of the Station Hill and Old Civic Centre areas.

COMMUNAL HEATING AND COOLING

The development will be served by highly efficient ASHPs. A communal system will be implemented to serve the site as a whole.

CO₂ EMISSIONS AFTER STEP 2

Given that it has not been found feasible or viable for the proposed development to incorporate the supply of low carbon heating, no carbon savings are achieved for this step of the Energy Hierarchy.

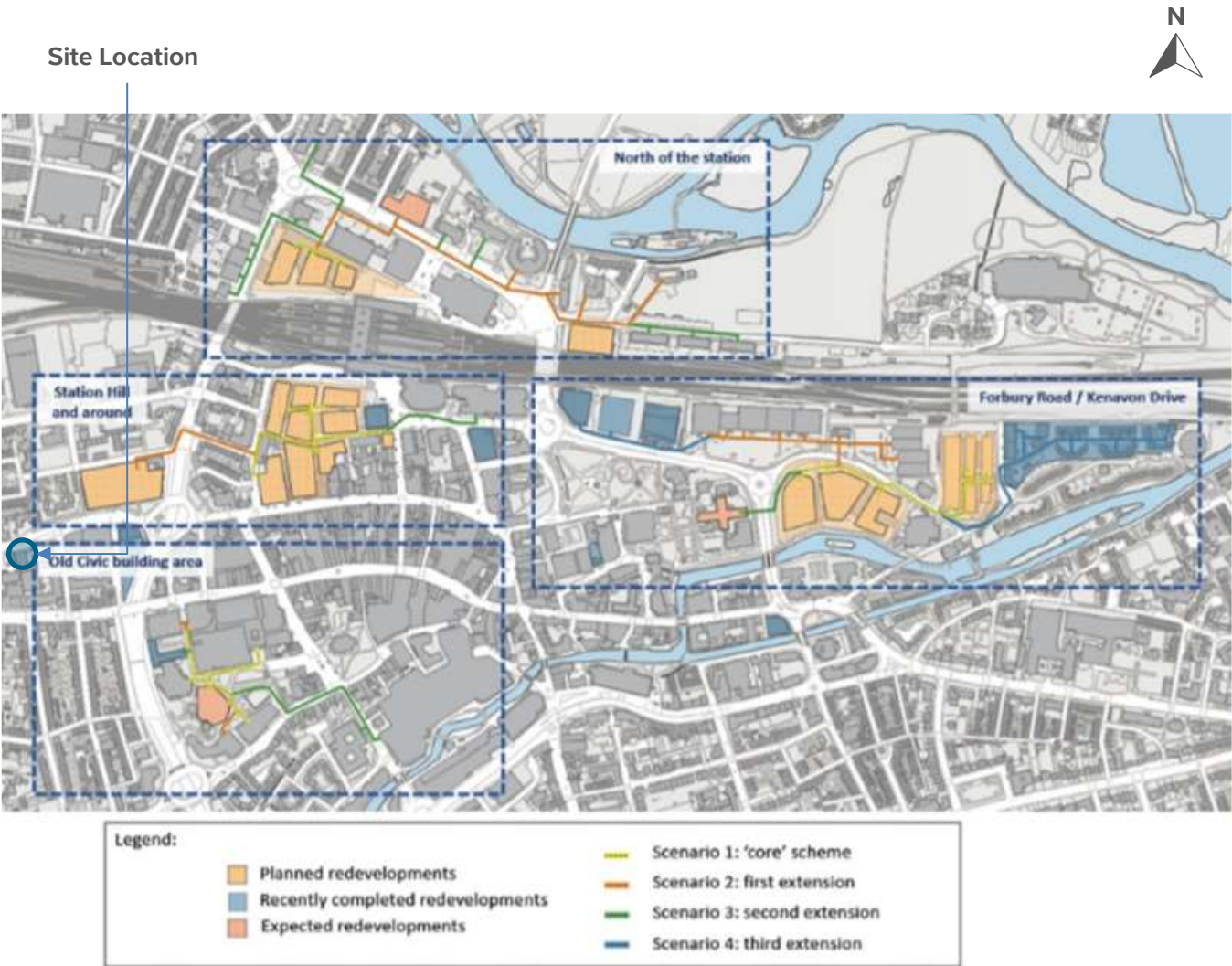


Figure 3: The four identified clusters of the proposed heat network scheme in Reading City centre (Element Energy).

STEP 3 – USE RENEWABLE ENERGY

The renewable technologies feasibility study carried out for the development identified air source heat pumps as suitable technologies for the development. The regulated carbon saving achieved in this step of the Energy Hierarchy is 31.4% over the site wide baseline level in line with the SAP10 carbon factors.

RENEWABLE TECHNOLOGIES FEASIBILITY STUDY

Methods of generating on-site renewable energy (Green) were assessed, once Step 1 – Use Less Energy and Step 2 – Supply Energy Efficiently measures were taken into account.

The development of Chatham Street will benefit from an energy efficient building fabric which will reduce the energy consumption of the proposed development in the first instance. A range of renewable technologies were subsequently considered including:

- Biomass;
- Ground/water source heat pumps;
- Air source heat pump;
- Wind energy;
- Photovoltaic panels, and,
- Solar thermal panels.

In determining the appropriate renewable technology for the site, the following factors were considered:

- CO₂ savings achieved;
- Site constraints;
- Any potential visual impacts, and,
- Compatibility with the Step 2 – Supply Energy Efficiently stage proposals where applicable.

RENEWABLE ENERGY APPRAISAL SUMMARY

The table overleaf summarises the factors taken into account in determining the appropriate renewable technologies for this project. This includes estimated capital cost, lifetime, level of maintenance and level of impact on external appearance. The final column indicates the feasibility of the technology in relation to the site conditions (10 being the most feasible and 0 being infeasible). It is important to note that the information provided is indicative and based upon early project stage estimates.

The feasibility study demonstrates that ASHPs would be the most feasible renewable technologies for the proposed Chatham Street development. Detailed assessments for the proposed technologies can be found in the following sections.

ENERGY & SUSTAINABILITY STATEMENT

Table 4: Summary of renewable technologies feasibility study.

		Comments	Lifetime	Maintenance	Impact on external appearance	Site feasibility
Biomass		Not adopted – Burning of wood pellets releases high NOx emissions and there are limitations for their storage and delivery within an urban location.	20 yrs.	High	High	3
PV		Not adopted – The available roof space is minimised due to the implementation of a communal ASHP strategy.	25 yrs.	Low	Med	5
Solar thermal		Not adopted – The available roof space is minimised due to the implementation of a communal ASHP strategy.	25 yrs.	Low	Med	4
GSHP		Not adopted – The installation of ground loops requires significant space, additional time at the beginning of the construction process and very high capital costs.	20 yrs.	Med	Low	4
ASHP		Adopted	20 yrs.	Med	Med	9
Wind		Not adopted – Wind turbines located at the site will have a significant visual impact on the existing building and urban context.	25 yrs.	Med	High	2

DETAILED ASSESSMENT OF AIR SOURCE HEAT PUMPS

Air source heat pumps (ASHPs) employ the same technology as ground source heat pump (GSHPs). However, instead of using heat exchangers buried in the ground, heat is extracted from the external ambient air.

The efficiency of heat pumps is very much dependent on the temperature difference between the heat source and the space required to be heated. As a result, ASHPs tend to have a lower COP than GSHPs. This is due to the varying levels of air temperature throughout the year when compared to the relatively stable ground temperature. The lower the difference between internal and external air temperature, the more efficient the system.

ASHPs are considered a suitable technology for the development for the following reasons:

- It is a high efficiency system that can cater for the space heating and cooling of the most energy-intensive areas of the proposed development;
- Requires less capital cost than GSHP and other renewable technologies;
- It can be integrated with the proposed ventilation strategy, and;
- It is simple to install when compared to other renewable technologies.

The table below summarises the technical data for the proposed ASHP and estimated CO₂ savings from the application of this technology. In total the ASHP technology would produce regulated CO₂ savings of 31.4% for the development.

Table 5: Summary of technical/operational data and estimated CO₂ savings for ASHPs.

ASHP for domestic spaces		
COP heating	2.0	
Carbon intensity of electricity	0.233	kgCO ₂ /kWh
Proportion of domestic space heating and hot water met by ASHP	100	%
Energy met by ASHP	145,342	kWh/yr.
Energy used by ASHP	76,372	kWh/yr.
Total CO ₂ savings	11.5	t/yr.
Regulated baseline CO ₂ emissions	36.7	t/yr.
Total baseline CO ₂ emissions	58.5	t/yr.
% Regulated CO ₂ reduction*	31.4%	%
% Total CO ₂ reduction*	19.7%	%

* % reduction from site baseline



Figure 4: Outdoor unit of an ASHP.

STEP 3 – CO₂ EMISSIONS & SAVINGS

The incorporation of renewable technologies will further reduce CO₂ emissions by a further 31.4% (11.5 tonnes per annum) across the whole site.

CONCLUSIONS

The sustainability and energy strategy for the Chatham Street development has been developed to comply with the relevant policies of the Reading Council Local Plan and Supplementary Design and Construction Guidance.

The proposals incorporate a range of sustainable design and construction measures, primarily addressing the sustainable management of resources, the protection and enhancement of the environment and the effective adaptation and mitigation of the development to climate change.

SUSTAINABILITY

The proposed Chatham Street development will meet the targets set out by the Borough of Reading.

Key sustainability features of the proposals include:

- The re-use of previously developed land;
- Effective site layout in response to the neighbouring context;
- Efficient design of the proposed massing, openings and internal layouts so that habitable spaces across the site benefit from abundant daylight and sunlight levels, whilst impacts to neighbouring buildings are kept to a minimum;
- The specification of water efficient fittings to limit water consumption to less than 110 litres per person per day for domestic uses, and;
- Effective pollution management and control: the development is not expected to have any significant adverse effects to air, noise or land.

The sustainability measures incorporated reflect the client and design team's aspirations in integrating sustainability measures and demonstrates that the project is designed to exceed the planning policy sustainability requirements.

ENERGY STRATEGY

By implementing the three step Energy Hierarchy as detailed in the previous sections, the Regulated CO₂ emissions for the development have been reduced against a Part L 2013 compliant scheme through on-site measures alone by 40.8% (14.9 tonnes per annum) across the whole site in line with the SAP10 carbon factors. This is seen to satisfy the Reading Borough Council target of a 35% reduction in regulated carbon emissions.

To achieve 'zero carbon' for the residential portion of the scheme, 21.7 tonnes per annum of regulated CO₂, equivalent to 651.7 tonnes over 30 years, from the site should be offset offsite.

Any carbon offset contributions will be subject to viability discussions and detailed design stage calculations.

The table on the following page summarises the implementation of the Energy Hierarchy for the proposed scheme and detail the CO₂ emissions and savings against the baseline scheme for each step of the hierarchy; as well as the savings achieved through carbon offset.

SITE-WIDE CUMULATIVE SAVINGS

Table 6: Site wide regulated CO₂ emissions and savings.

	Total regulated emissions (tonnes CO ₂ /year)	Regulated CO ₂ savings (tonnes CO ₂ /year)	Percentage saving (%)
Baseline	36.7	-	-
Step 1 – Use Less Energy	33.2	3.4	9.4%
Step 2 – Supply Energy Efficiently	33.2	0.0	0.0%
Step 3 – Use Renewable Energy	21.7	11.5	31.4%
Total	-	14.9	40.8%
Offset to zero carbon for domestic		651.7 tonnes over 30 years	

APPENDIX A – SAP RESULTS

SAP WorkSheet: New dwelling as built

User Details:

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.5.33

Property Address: 001

Address : 114-116 CHATHAM STREET, READING, READING, RG1 7HT

1. Overall dwelling dimensions:

	Area(m ²)	Av. Height(m)	Volume(m ³)
Basement	54.2 (1a)	2.5 (2a)	135.5 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	54.2 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	135.5 (5)

2. Ventilation rate:

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				0	0 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				0	0 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)					
Number of storeys in the dwelling (ns)					0 (9)
Additional infiltration					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)					0.15 (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used					
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor				(21) = (18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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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
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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SAP WorkSheet: New dwelling as built

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

0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0.5 (23a)

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

0.5 (23b)

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

78.2 (23c)

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

(24a)m= 0.27 0.27 0.27 0.25 0.25 0.23 0.23 0.23 0.24 0.25 0.25 0.26 (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 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24d)

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

(25)m= 0.27 0.27 0.27 0.25 0.25 0.23 0.23 0.23 0.24 0.25 0.25 0.26 (25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			2.12	1.3	2.756		
Windows Type 1			1.8	$\times 1/[1/(1.3) + 0.04]$	2.22		
Windows Type 2			2.66	$\times 1/[1/(1.3) + 0.04]$	3.29		
Windows Type 3			0.95	$\times 1/[1/(1.3) + 0.04]$	1.17		
Floor			54.2	0.1	5.42		
Walls Type1	26.8	5.41	21.39	0.15	3.21		
Walls Type2	8.5	2.12	6.38	0.3	1.91		
Total area of elements, m²			89.5				
Party wall			44.9	0	0		
Party ceiling			54.2				

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ 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) = 19.98 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 1084 (34)

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

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

Thermal bridges : S (L x Y) calculated using Appendix K 13.43 (36)

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

Total fabric heat loss (33) + (36) = 33.41 (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
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SAP WorkSheet: New dwelling as built

(38)m=

12.14	12	11.86	11.15	11	10.29	10.29	10.15	10.58	11	11.29	11.57
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 (38)

Heat transfer coefficient, W/K

(39)m = (37) + (38)m

(39)m=

45.55	45.41	45.27	44.55	44.41	43.7	43.7	43.56	43.98	44.41	44.7	44.98
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Average = Sum(39)_{1...12} /12=

44.52 (39)

Heat loss parameter (HLP), W/m²K

(40)m = (39)m ÷ (4)

(40)m=

0.84	0.84	0.84	0.82	0.82	0.81	0.81	0.8	0.81	0.82	0.82	0.83
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Average = Sum(40)_{1...12} /12=

0.82 (40)

Number of days in month (Table 1a)

(41)m=

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
31	28	31	30	31	30	31	31	30	31	30	31

 (41)

4. Water heating energy requirement:

kWh/year:

Assumed occupancy, N

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

1.81 (42)

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

77.28 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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)

(44)m=

85.01	81.92	78.83	75.73	72.64	69.55	69.55	72.64	75.73	78.83	81.92	85.01
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Total = Sum(44)_{1...12} =

927.36 (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=

126.06	110.26	113.77	99.19	95.18	82.13	76.11	87.33	88.38	102.99	112.42	122.09
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Total = Sum(45)_{1...12} =

1215.91 (45)

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

(46)m=

18.91	16.54	17.07	14.88	14.28	12.32	11.42	13.1	13.26	15.45	16.86	18.31
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 (46)

Water storage loss:

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

2.5 (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) =

110 (50)

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

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

0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a

1.03 (52)

Temperature factor from Table 2b

0.6 (53)

Energy lost from water storage, kWh/year

(47) x (51) x (52) x (53) =

1.03 (54)

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

1.03 (55)

Water storage loss calculated for each month

((56)m = (55) x (41)m

(56)m=

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01
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 (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=

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01
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 (57)

SAP WorkSheet: New dwelling as built

Primary circuit loss (annual) from Table 3

0

(58)

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

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

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
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(59)

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

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(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=	181.34	160.18	169.05	152.69	150.45	135.62	131.38	142.61	141.87	158.27	165.92	177.36
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(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
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(63)

Output from water heater

(64)m=	181.34	160.18	169.05	152.69	150.45	135.62	131.38	142.61	141.87	158.27	165.92	177.36
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Output from water heater (annual)_{1...12}

1866.75

(64)

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

(65)m=	86.14	76.6	82.05	75.78	75.87	70.1	69.53	73.26	72.18	78.47	80.18	84.82
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(65)

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

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	108.83	108.83	108.83	108.83	108.83	108.83	108.83	108.83	108.83	108.83	108.83	108.83

(66)

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

(67)m=	39.56	35.13	28.57	21.63	16.17	13.65	14.75	19.17	25.73	32.68	38.14	40.66
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(67)

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

(68)m=	236	238.45	232.28	219.14	202.56	186.97	176.56	174.11	180.28	193.42	210	225.59
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(68)

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

(69)m=	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7
--------	------	------	------	------	------	------	------	------	------	------	------	------

(69)

Pumps and fans gains (Table 5a)

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

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

(71)m=	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56	-72.56
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(71)

Water heating gains (Table 5)

(72)m=	115.78	113.99	110.28	105.24	101.97	97.37	93.45	98.47	100.25	105.47	111.36	114
--------	--------	--------	--------	--------	--------	-------	-------	-------	--------	--------	--------	-----

(72)

Total internal gains =

(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	475.31	471.55	455.11	429.99	404.67	381.96	368.73	375.72	390.24	415.53	443.47	464.22
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(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 m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.8	x	10.63	x	0.63	x	0.8	=	6.69
North	0.9x	0.77	x	2.66	x	10.63	x	0.63	x	0.8	=	9.88

(74)

(74)

SAP WorkSheet: New dwelling as built

North	0.9x	0.77	x	0.95	x	10.63	x	0.63	x	0.8	=	3.53	(74)
North	0.9x	0.77	x	1.8	x	20.32	x	0.63	x	0.8	=	12.78	(74)
North	0.9x	0.77	x	2.66	x	20.32	x	0.63	x	0.8	=	18.88	(74)
North	0.9x	0.77	x	0.95	x	20.32	x	0.63	x	0.8	=	6.74	(74)
North	0.9x	0.77	x	1.8	x	34.53	x	0.63	x	0.8	=	21.71	(74)
North	0.9x	0.77	x	2.66	x	34.53	x	0.63	x	0.8	=	32.08	(74)
North	0.9x	0.77	x	0.95	x	34.53	x	0.63	x	0.8	=	11.46	(74)
North	0.9x	0.77	x	1.8	x	55.46	x	0.63	x	0.8	=	34.87	(74)
North	0.9x	0.77	x	2.66	x	55.46	x	0.63	x	0.8	=	51.53	(74)
North	0.9x	0.77	x	0.95	x	55.46	x	0.63	x	0.8	=	18.4	(74)
North	0.9x	0.77	x	1.8	x	74.72	x	0.63	x	0.8	=	46.97	(74)
North	0.9x	0.77	x	2.66	x	74.72	x	0.63	x	0.8	=	69.42	(74)
North	0.9x	0.77	x	0.95	x	74.72	x	0.63	x	0.8	=	24.79	(74)
North	0.9x	0.77	x	1.8	x	79.99	x	0.63	x	0.8	=	50.29	(74)
North	0.9x	0.77	x	2.66	x	79.99	x	0.63	x	0.8	=	74.31	(74)
North	0.9x	0.77	x	0.95	x	79.99	x	0.63	x	0.8	=	26.54	(74)
North	0.9x	0.77	x	1.8	x	74.68	x	0.63	x	0.8	=	46.95	(74)
North	0.9x	0.77	x	2.66	x	74.68	x	0.63	x	0.8	=	69.38	(74)
North	0.9x	0.77	x	0.95	x	74.68	x	0.63	x	0.8	=	24.78	(74)
North	0.9x	0.77	x	1.8	x	59.25	x	0.63	x	0.8	=	37.25	(74)
North	0.9x	0.77	x	2.66	x	59.25	x	0.63	x	0.8	=	55.04	(74)
North	0.9x	0.77	x	0.95	x	59.25	x	0.63	x	0.8	=	19.66	(74)
North	0.9x	0.77	x	1.8	x	41.52	x	0.63	x	0.8	=	26.1	(74)
North	0.9x	0.77	x	2.66	x	41.52	x	0.63	x	0.8	=	38.57	(74)
North	0.9x	0.77	x	0.95	x	41.52	x	0.63	x	0.8	=	13.78	(74)
North	0.9x	0.77	x	1.8	x	24.19	x	0.63	x	0.8	=	15.21	(74)
North	0.9x	0.77	x	2.66	x	24.19	x	0.63	x	0.8	=	22.47	(74)
North	0.9x	0.77	x	0.95	x	24.19	x	0.63	x	0.8	=	8.03	(74)
North	0.9x	0.77	x	1.8	x	13.12	x	0.63	x	0.8	=	8.25	(74)
North	0.9x	0.77	x	2.66	x	13.12	x	0.63	x	0.8	=	12.19	(74)
North	0.9x	0.77	x	0.95	x	13.12	x	0.63	x	0.8	=	4.35	(74)
North	0.9x	0.77	x	1.8	x	8.86	x	0.63	x	0.8	=	5.57	(74)
North	0.9x	0.77	x	2.66	x	8.86	x	0.63	x	0.8	=	8.24	(74)
North	0.9x	0.77	x	0.95	x	8.86	x	0.63	x	0.8	=	2.94	(74)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m= 20.09 38.4 65.25 104.8 141.18 151.14 141.11 111.95 78.45 45.71 24.79 16.75 (83)

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

(84)m= 495.4 509.95 520.36 534.8 545.85 533.1 509.84 487.67 468.69 461.24 468.26 480.97 (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
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SAP WorkSheet: New dwelling as built

(86)m=	0.98	0.97	0.95	0.87	0.72	0.52	0.38	0.41	0.63	0.87	0.96	0.98	(86)
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Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.49	20.56	20.7	20.87	20.97	21	21	21	20.99	20.89	20.68	20.48	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20.22	20.22	20.22	20.23	20.24	20.25	20.25	20.24	20.24	20.23	20.23	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.96	0.93	0.84	0.67	0.46	0.31	0.34	0.57	0.83	0.94	0.98	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	19.77	19.84	19.97	20.13	20.22	20.25	20.25	20.25	20.24	20.16	19.97	19.76	(90)
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fLA = Living area ÷ (4) =	0.51	(91)
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Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	20.14	20.21	20.34	20.51	20.6	20.63	20.63	20.63	20.62	20.53	20.33	20.13	(92)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	------

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

(93)m=	20.14	20.21	20.34	20.51	20.6	20.63	20.63	20.63	20.62	20.53	20.33	20.13	(93)
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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
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Utilisation factor for gains, hm:

(94)m=	0.97	0.96	0.93	0.85	0.7	0.49	0.35	0.38	0.6	0.85	0.95	0.97	(94)
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Useful gains, hmGm, W = (94)m × (84)m

(95)m=	481.11	490.04	485.64	456.68	381.29	262.29	176.05	184.16	282.56	391.57	443.2	468.89	(95)
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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)
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Heat loss rate for mean internal temperature, Lm, W = [(39)m × [(93)m – (96)m]

(97)m=	721.47	695.24	626.55	517.14	395.2	263.44	176.14	184.32	286.79	440.98	591.34	716.45	(97)
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Space heating requirement for each month, kWh/month = 0.024 × [(97)m – (95)m] × (41)m

(98)m=	178.82	137.9	104.83	43.53	10.35	0	0	0	0	36.76	106.66	184.18	(98)
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Total per year (kWh/year) = Sum(98) _{1...5,9...12} =	803.04	(99)
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Space heating requirement in kWh/m²/year

14.82	(99)
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9b. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0	(301)
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Fraction of space heat from community system 1 – (301) =

1	(302)
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The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community heat pump

1	(303a)
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Fraction of total space heat from Community heat pump

(302) × (303a) =	1	(304a)
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Factor for control and charging method (Table 4c(3)) for community heating system

1.05	(305)
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Distribution loss factor (Table 12c) for community heating system

1.2	(306)
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Space heating

Annual space heating requirement

kWh/year

803.04

SAP WorkSheet: New dwelling as built

Space heat from Community heat pump	$(98) \times (304a) \times (305) \times (306) =$	1011.83	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)		0	(308)
Space heating requirement from secondary/supplementary system	$(98) \times (301) \times 100 \div (308) =$	0	(309)

Water heating

Annual water heating requirement		1866.75	
If DHW from community scheme:			
Water heat from Community heat pump	$(64) \times (303a) \times (305) \times (306) =$	2240.1	(310a)
Electricity used for heat distribution	$0.01 \times [(307a)...(307e) + (310a)...(310e)] =$	32.52	(313)
Cooling System Energy Efficiency Ratio		0	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	$= (107) \div (314) =$	0	(315)
Electricity for pumps and fans within dwelling (Table 4f):			
mechanical ventilation - balanced, extract or positive input from outside		148.78	(330a)
warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	$= (330a) + (330b) + (330g) =$	148.78	(331)
Energy for lighting (calculated in Appendix L)		279.43	(332)
Total delivered energy for all uses (307) + (309) + (310) + (312) + (315) + (331) + (332)...(237b) =		3680.14	(338)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating from CHP	(307a) x	4.24	x 0.01 = 42.9 (340a)
Water heating from CHP	(310a) x	4.24	x 0.01 = 94.98 (342a)
Pumps and fans	(331)	13.19	x 0.01 = 19.62 (349)
Energy for lighting	(332)	13.19	x 0.01 = 36.86 (350)
Additional standing charges (Table 12)			120 (351)
Total energy cost	$= (340a)...(342e) + (345)...(354) =$		314.36 (355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	$[(355) \times (356)] \div [(4) + 45.0] =$	1.33	(357)
SAP rating (section12)		81.43	(358)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		200 (367a)
CO2 associated with heat source 1	$[(307b)+(310b)] \times 100 \div (367b) \times$	0.52	= 843.88 (367)
Electrical energy for heat distribution	$[(313) \times$	0.52	= 16.88 (372)

SAP WorkSheet: New dwelling as built

Total CO2 associated with community systems	(363)...(366) + (368)...(372)	=	860.75	(373)
CO2 associated with space heating (secondary)	(309) x	0	=	0 (374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.52	=	0 (375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =		860.75	(376)
CO2 associated with electricity for pumps and fans within dwelling	(331)) x	0.52	=	77.22 (378)
CO2 associated with electricity for lighting	(332))) x	0.52	=	145.02 (379)
Total CO2, kg/year	sum of (376)...(382) =		1082.99	(383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =		19.98	(384)
EI rating (section 14)			85.37	(385)

13b. Primary Energy – Community heating scheme

	Energy kWh/year	Primary factor	P.Energy kWh/year	
Energy from other sources of space and water heating (not CHP)				
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		200	(367a)
Energy associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	3.07	=	4991.71 (367)
Electrical energy for heat distribution	[(313) x		=	99.83 (372)
Total Energy associated with community systems	(363)...(366) + (368)...(372)		=	5091.55 (373)
<i>if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)</i>				5091.55 (373)
Energy associated with space heating (secondary)	(309) x	0	=	0 (374)
Energy associated with water from immersion heater or instantaneous heater	(312) x	3.07	=	0 (375)
Total Energy associated with space and water heating	(373) + (374) + (375) =		5091.55	(376)
Energy associated with space cooling	(315) x	3.07	=	0 (377)
Energy associated with electricity for pumps and fans within dwelling	(331)) x	3.07	=	456.75 (378)
Energy associated with electricity for lighting	(332))) x	3.07	=	857.85 (379)
Total Primary Energy, kWh/year	sum of (376)...(382) =		6406.15	(383)

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